

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

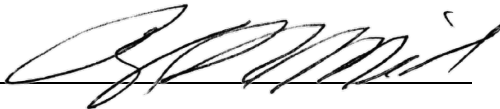
In re Patent of: Andrew William Wright
U.S. Patent No.: 12,236,728 Attorney Docket No.: 36137-0034IP1
Issue Date: February 25, 2025
Appl. Serial No.: 18/676,284
Filing Date: May 28, 2024

Title: METHOD AND SYSTEM FOR LOGGING VEHICLE
BEHAVIOR

DECLARATION OF DR. WILLIAM R. MICHALSON

I hereby declare that all statements made of my own knowledge are true and that all statements made on information and belief are believed to be true. I further declare that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of the Title 18 of the United States Code.

Dated: 31 March 2025

By: 

William R. Michalson, Ph.D.

TABLE OF CONTENTS

I.	ASSIGNMENT.....	5
II.	QUALIFICATIONS	5
III.	SUMMARY OF CONCLUSIONS FORMED.....	10
IV.	LEVEL OF ORDINARY SKILL IN THE ART.....	10
V.	MATERIALS CONSIDERED	12
VI.	TECHNOLOGY OVERVIEW.....	18
A.	Sensors.....	22
1.	Image Sensors	24
2.	Audio Sensors	25
3.	Accelerometers.....	26
4.	Positioning Devices	27
5.	Proximity Sensors	29
6.	Orientation Sensors.....	29
B.	Accident Detection	30
C.	Emergency Response Services.....	31
D.	Mobile Vehicle Monitoring.....	31
E.	Insurance Adjustment.....	31
VII.	OVERVIEW OF THE '728 PATENT	32
A.	Specification.....	32
B.	Claims.....	34
C.	Prosecution History	46
VIII.	CLAIM INTERPRETATION	49
A.	<i>Driving Period</i> (Claims 1, 13, 24, 25)	50
B.	<i>Duration Of A Vehicle Journey</i> (Claims 1, 13, 24).....	53
C.	<i>Duration From A Start To An End Of A Vehicle Journey</i> (Claim 25).....	56
IX.	SUMMARY OF RELEVANT PRIOR ART	58
A.	Callopy	58

B.	Curry	60
C.	Thompson	62
D.	Warren	63
E.	Katayama	66
X.	CALLOPY, CURRY, AND THOMPSON MAKES CLAIMS 1-4 OBVIOUS.....	71
A.	Proposed Combination	71
1.	Callopy and Curry	71
2.	Thompson and Callopy-Curry	77
B.	Analysis of Claims 1-4	84
1.	Claim 1	84
2.	Claim 2	125
3.	Claim 3	127
4.	Claim 4	128
XI.	CALLOPY, CURRY, THOMPSON, AND WARREN MAKES CLAIM 5 OBVIOUS.....	129
A.	Proposed Combination	129
B.	Analysis of Claim 5.....	134
1.	Claim 5	134
XII.	CALLOPY, CURRY, THOMPSON, AND KATAYAMA MAKES CLAIMS 6-28 OBVIOUS	136
A.	Proposed Combination	136
B.	Analysis of Claims 6-28	146
1.	Claim 6	146
2.	Claim 7	150
3.	Claim 8	151
4.	Claim 9	153
5.	Claim 10	153
6.	Claim 11	154
7.	Claim 12	156

8.	Claims 13, 24	157
9.	Claims 14-20, 23, 27, 28.....	161
10.	Claim 21	162
11.	Claim 22	162
12.	Claim 25.....	163
13.	Claim 26.....	172
XIII.	LEGAL PRINCIPLES.....	174
A.	Claim Interpretation	175
B.	Priority.....	175
C.	Anticipation	175
D.	Obviousness.....	176
XIV.	CONCLUSION.....	178

I, William R. Michalson of Worcester, Massachusetts, declare that:

I. ASSIGNMENT

1. I have been retained on behalf of United Services Automobile Association (“USAA”) to offer technical opinions related to U.S. Patent No 12,236,728 (“the ’728 patent”) (USAA-1001). I understand that USAA is requesting that the Patent Trial and Appeal Board (“PTAB” or “Board”) institute an *inter partes* review (“IPR”) proceeding of the ’728 patent.

2. I have been asked to provide my independent analysis of the ’728 patent based on the prior art publications cited in this declaration.

3. I am not and never have been an employee of USAA. I received no compensation for this declaration beyond my normal hourly compensation based on my time actually spent analyzing the ’728 patent, the prior art publications cited below, and issues related thereto, and I will not receive any added compensation based on the outcome of any IPR or other proceeding involving the ’728 patent.

II. QUALIFICATIONS

4. I am over the age of 18 and am competent to write this declaration. I have personal knowledge, or have developed knowledge of these technologies based upon education, training, or experience, of the matters set forth herein.

5. I earned a B.S. in Electrical Engineering from the Syracuse University in 1981, an M.S. and a Ph.D. Electrical Engineering from the Worcester Polytechnic Institute (WPI) in 1985 and 1989, respectively.

6. I am currently a Professor in the Department of Robotics Engineering at WPI. Additionally, I have appointments as a Professor of Computer Science, Electrical and Computer Engineering, and Mechanical Engineering. At WPI, I perform research and teach in the areas of navigation, communications, and computer system design. I have supervised the WPI Center for Advanced Integrated Radio Navigation (CAIRN), which had a focus on the integration of communications, navigation, and information technologies for public safety applications. I currently direct the WPI Robot Communications and Navigation Laboratory. My research focuses on the development, testing, and evaluation of systems for both civilian and military applications with a special emphasis on techniques focused on indoor, underground, or otherwise GPS-deprived situations. My interests in communication, navigation, and computing have led me to play an active role in the development of the Robotics Program at WPI (now the Department of Robotics Engineering), where I teach robotics courses at the graduate and undergraduate level.

7. Prior to joining the faculty of WPI, I worked at the Raytheon Company from 1981-1991, with a leave of absence between 1985-1988 to

complete my Doctoral Degree (Ph.D.) in Electrical Engineering from the Worcester Polytechnic Institute. Prior to my leave of absence, I worked as an Engineer in the Cursive Displays Department and the VLSI Design Department of the Computer and Displays Laboratory within Raytheon's Equipment Division. After receiving my Ph.D., I returned to the Equipment Division of the Raytheon Company where I was promoted to a title of Engineer, Design and Development. I was subsequently selected to sit on the engineering staff of the newly-formed System Engineering Department of the Division's Computer and Displays Laboratory. In this capacity, I acted primarily as a consultant to other departments within the laboratory, and my responsibilities ranged from leading the hardware and software development of supercomputer-class computer systems to performing applied research into the exploitation of new technology.

8. I have more than 40 years of experience in the field of computer technology, specifically in the specialized field of signal and data processing. I have consulted and served, including being qualified by courts, as an expert for numerous patent cases, including in patent cases involving motion sensing, positioning, map navigation technologies, and wireless communications a listing of which is set forth in my current curriculum vitae which is attached to this Declaration as Appendix A. I hold a commercial General Radio Operator's license (with Ship RADAR Endorsement), an Extra Class Amateur Radio operator's

license, and have held a Commercial Radiotelegraph Operators license. I was first licensed as a Radio Amateur in 1974 and have been involved in the design, implementation, and repair of radio systems, including radio controlled systems, since that time.

9. I have been involved with numerous projects involving the tracking and control of remote objects, including flying objects. Starting with my work at Raytheon Company I was involved with the tracking of aircraft in both military and civilian air traffic control systems. I have worked on the guidance and control systems for multiple missile systems as well as the guidance and tracking systems for fire control systems and on spaceborne systems for tracking ballistic missiles. In my work at WPI, I have been involved with numerous projects related to tracking land, sea, and air vehicles using the GPS and/or inertial guidance systems. Some of this work has involved the use and control of rotorcraft for applications, such as firefighting and landmine detection and destruction.

10. I am a named inventor on nine patents, including patents on map navigation devices, geolocation systems, and high resolution and precision location systems. I have authored, or co-authored, over 100 journal papers and conference publications, including papers and publications regarding positioning and navigation systems and methods. I am also the co-author of a chapter entitled "An Approach for Implementing a Reconfigurable Optical Interconnection Network for

Massively Parallel Computers” in Optical Interconnection – Foundations and Approaches by C. Tocci and H. J. Caulfield Eds., Artech House, 1994. I am currently under contract to write a book tentatively entitled “Radionavigation and the Global Positioning System,” which covers the physical principles upon which radionavigation system are based as well as the hardware and software required to perform navigation. At WPI I have taught courses in Sensors, Circuits, and Systems, Digital Circuit Design, Embedded Computing, Computer Architecture, Controls, Engineering Design, and Navigation. In addition, I have advised projects involving computers, navigation, and communications for a large variety of applications in the air, on land, and on the sea.

11. I have received numerous awards and recognition for my work, including becoming an Elected Senior Member of the IEEE. In addition, I was awarded the Joseph Samuel Satin Distinguished Fellowship for the 1994-1995 academic year, and the Aldo Miccioli Fellowship from the Raytheon Company’s Equipment Division. I am also a member of the Institute of Navigation, the Royal Institute of Navigation, the American Society of Engineering Educators, The Society of Automotive Engineers, the National Marine Electronics Association, and the National Academy of Inventors.

12. My *curriculum vitae*, attached as Exhibit A, includes a list of publications on which I am a named author. It contains further details regarding

my experience, education, publications, and other qualifications provide to an expert opinion in connection with this proceeding.

III. SUMMARY OF CONCLUSIONS FORMED

13. This Declaration explains the conclusions that I have formed based on my analysis. To summarize those conclusions:

- Based upon my knowledge and experience and my review of the prior art publications in this declaration, I believe that claims 1-4 of the '728 patent are made obvious by Callopy, Curry, and Thompson;
- Based upon my knowledge and experience and my review of the prior art publications in this declaration, I believe that claim 5 of the '728 patent is made obvious by Callopy, Curry, Thompson, and Warren; and
- Based upon my knowledge and experience and my review of the prior art publications in this declaration, I believe that claims 6-28 of the '728 patent are made obvious by Callopy, Curry, Thompson, and Katayama

IV. LEVEL OF ORDINARY SKILL IN THE ART

14. I have been informed that a person of ordinary skill in the art ("POSITA") is a hypothetical person who is presumed to have the skill and

experience of an ordinary worker in the field at the time of the alleged invention.

The '728 patent was filed May 28, 2024, and claims priority to several applications, including GB Pat. App. No. 1021292.6 filed 12/15/2010 ("Critical Date"). I have applied this Critical Date as the point in time for claim interpretation purposes. My opinion does not change if the invention date is earlier.

15. Based on my knowledge and experience in the field and my review of the '728 patent and file history, I believe that a person of ordinary skill in the art in this matter would have had at least a Bachelor's of Science Degree (or equivalent) in an academic area emphasizing electrical engineering, computer engineering, computer science, or a related technical field, and about 2-3 years of experience in the field of telematics systems (e.g., familiarity with control and diagnostic systems, navigation systems and wireless communication technology). A greater amount of education, i.e., a doctorate in an academic area emphasizing electrical engineering, computer engineering, computer science, or a related technical field, would compensate for fewer years of work experience. Based on my experiences, I have a good understanding of the capabilities of a POSITA. Indeed, I have taught, mentored, advised, and collaborated closely with many such individuals over the course of my career.

V. MATERIALS CONSIDERED

16. My analysis and conclusions set forth in this declaration are based on my educational background and experiences in the field (see Section II). Based on my knowledge and experience, I believe that I am considered to be an expert in the field. Also, based on my knowledge and experience, I understand and know of the capabilities of persons of ordinary skill in the field during the early 2000s–2011s, and I taught, participated in organizations, and worked closely with many such persons in the field during that time frame.

17. As part of my independent analysis for this declaration, I have considered the following: the background knowledge/technologies that were commonly known to persons of ordinary skill in this art during the time before the earliest claimed priority date for the '728 patent; my own knowledge and experiences gained from my work experience in the field of the '728 patent and related disciplines; and my experience in working with others involved in this field and related disciplines.

18. In addition, I have analyzed the following publications and materials:

- U.S. Patent No. 12,236,728 to Wright (“the '728 patent”) (USAA-1001)
- Excerpts from the Prosecution History of the '728 patent (“the Prosecution History”) (USAA-1002)

- Original Complaint for Patent Infringement in Auto Telematics
Ltd. v. United Services Automobile Association, 6:22-cv-00474
(W.D. Tex. May 11, 2022) (USAA-1004)
- International Publication No. WO 2010/062899 (“Callopy”)
(USAA-1004)
- International Publication No. WO 2010/042545 to Curry et. al
(“Curry”) (USAA-1006)
- Thompson et al., “Using Smartphones and Wireless Mobile Sensor
Networks to Detect Car Accidents and Provide Situational
Awareness to Emergency Responders,” Mobilware 2010, LNICST
48, pp. 29–42, 2010 (“Thompson”) (USAA-1007)
- U.S. Pat. Publication No. 2006/0053038 to Warren et al.
(“Warren”) (USAA-1008)
- European Pat. App. Pub. No. EP 1,914,691 to Katayama et al.
(“Katayama”) (USAA-1009)
- U.S. Patent No. 8,682,399 to Rabu (“Rabu”) (USAA-1010)
- U.S. Pat. App. Pub. No. 2002/0105423 to Rast (“Rast”)
(USAA-1021)

- U.S. Pat. App. Pub. No. 2009/0192705 to Golding (“Golding”) (USAA-1022)
- Internet Archive of iPhone User Guide (USAA-1023)
- Internet Archive of iPhone 3G Technical Specification (USAA-1024)
- Internet Archive of iPhone User Guide for iPhone and iPhone 3G (USAA-1025)
- Internet Archive of Instruction Sheet for iPhone 3G (USAA-1026)
- Zhao, Yilin, “Vehicle Location and Navigation Systems,” Artech House, Boston (1997) (“Zhao1997”) (USAA-1027)
- Conover, Gerald D, “ITS Technology in Automotive—Who's on First?” SAE International (2006): 1-11 (“Conover2006”) (USAA-1028)
- Skog, Isaac, et. al, “A versatile PC-based platform for inertial navigation,” Proceedings of the 7th Nordic Signal Processing Symposium-NORSIG 2006. IEEE, 2006 (“Skog2006”) (USAA-1029)
- Cheng et. al, “An Android System Design and Implementation for Telematics Services,” 2010 IEEE International Conference on

Intelligent Computing and Intelligent Systems. Vol. 2. IEEE, 2010
("Cheng2010") (USAA-1030)

- Work, D. B. & Bayen, A. M. B., "Impacts of the mobile internet on transportation cyberphysical systems: traffic monitoring using smartphones," National Workshop for Research on High-Confidence Transportation Cyber-Physical Systems: Automotive, Aviation, & Rail. 2008 ("Work2008") (USAA-1031)
- Flinchbaugh, B., "Smart Camera Systems Technology Roadmap," Real-Time Vision for Human-Computer Interaction (2005), 285-297 ("Flinchbaugh2005") (USAA-1032)
- LeBlanc, David J., "Road departure crash warning system field operational test: methodology and results," Vol. 1: Technical Report, University of Michigan, Ann Arbor, Transportation Research Institute, 2006 ("LeBlanc2006") (USAA-1033)
- Reddy, Sasank et al., "Determining transportation mode on mobile phones," 2008 12th IEEE international symposium on wearable computers. IEEE, 2008 ("Reddy2008") (USAA-1034)
- Zhao, Yilin, "Standardization of mobile phone positioning for 3G systems," IEEE Communications magazine 40.7 (2002): 108-116 ("Zhao2002B") (USAA-1035)

- Strömmer, Esko et al., “Ultra-low power sensors with near field communication for mobile applications,” Wireless Sensor and Actor Networks: IFIP WG 6.8 First International Conference on Wireless Sensor and Actor Networks, WSAN’07, Albacete, Spain, September 24–26, 2007. Springer US, 2007 (“Strömmer2007”) (USAA-1036)
- Schott, Christian, et al., “CMOS single-chip electronic compass with microcontroller,” IEEE Journal of Solid-State Circuits 42.12 (2007): 2923-2933 (“Schott2007”) (USAA-1037)
- Liutkauskas, V. et al., “Location based services,” Elektronika ir elektrotechnika 52.3 (2004) (“Liutkauskas2004”) (USAA-1038)
- Ealey, Lance & Luis Troyano-Bermúdez, “Are automobiles the next commodity?” The McKinsey Quarterly 4 (1996): 62 (“Ealey1996”) (USAA-1039)
- Zhao, Yilin, “Efficient and reliable data transmission for cellular-and-GPS-based mayday systems,” Proceedings of Conference on Intelligent Transportation Systems, IEEE, 1998 (“Zhao1998B”) (USAA-1040)
- Young, Richard A., “Association between embedded cellular phone calls and vehicle crashes involving airbag deployment,”

Proceedings of the First International Driving Symposium on
Human Factors in Driver Assessment, Training and Vehicle
Design ,, Vol. 1. No. 2001, University of Iowa, 2001
("Young2001") (USAA-1041)

- De Fabritiis, Corrado et al., "Traffic estimation and prediction based on real time floating car data," 2008 11th international IEEE conference on intelligent transportation systems, IEEE, 2008 ("DeFabritiis2008") (USAA-1042)
- Schäfer, Ralf-Peter, et al., "A traffic information system by means of real-time floating-car data" (2002) ("Schäfer2002") (USAA-1043)
- Kerner, B. S., et al., "Traffic state detection with floating car data in road networks," Proceedings of the 8th International IEEE Conference on Intelligent Transportation Systems, 2005, ("Kerner2005") (USAA-1044)
- Leduc, Guillaume, "Road traffic data: Collection methods and applications," Working Papers on Energy, Transport and Climate Change 1.55 (2008): 1-55 ("Leduc2008") (USAA-1045)
- Troncoso, Carmela, et al, "Pripayd: privacy friendly pay-as-you-drive insurance," IEEE Transactions on Dependable and Secure

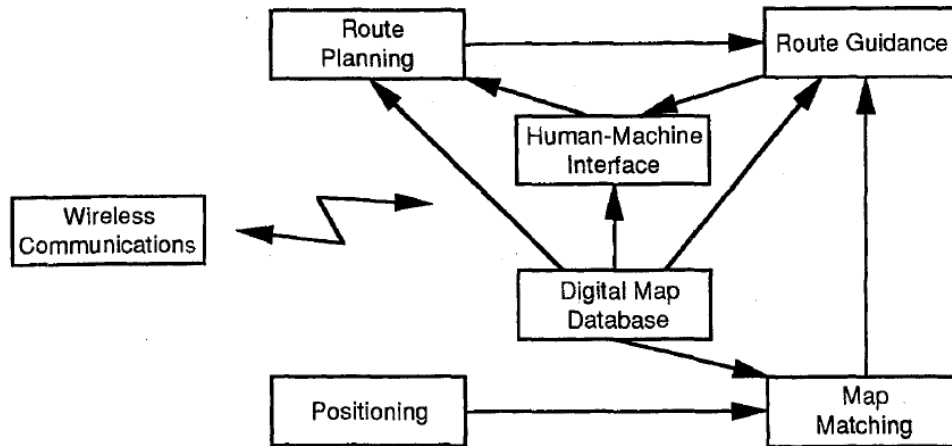
Computing, Vol. 8, No. 5, October 2011 (“Troncoso2011”)
(USAA-1046)

- Excerpts of The New Oxford American Dictionary, Second Edition (2005) (USAA-1048)
- Lee, Suzanne et al., “A Comprehensive Examination of Naturalistic Lane-Changes,” DOT HS 809 702, National Highway Traffic Safety Administration (March 2004) (USAA-1049)
- Turner, S. & Holdener D., “Probe Vehicle Sample Sizes for Real-Time Information: The Houston Experience,” IEEE (1995) (USAA-1050)

19. My analysis and conclusions set forth in this declaration are based on the perspective of a POSITA.

VI. TECHNOLOGY OVERVIEW

20. Techniques for incorporating electronics into vehicles to improve driver experience, including by providing mapping, accident detection and other features, were conventional and well known by the Critical Date. For example, Zhao1997 described the basic modules for performing vehicle location and navigation as early as 1997. USAA-1027 (Zhao1997), 22-25.



USAA-1027 (Zhao1997), 23

Zhao1997 also demonstrates that there was consumer interest in emergency features, such as the “Mayday” functionality, stolen vehicle recovery, navigation, roadside assistance, and other functions. *Id.*, 27.

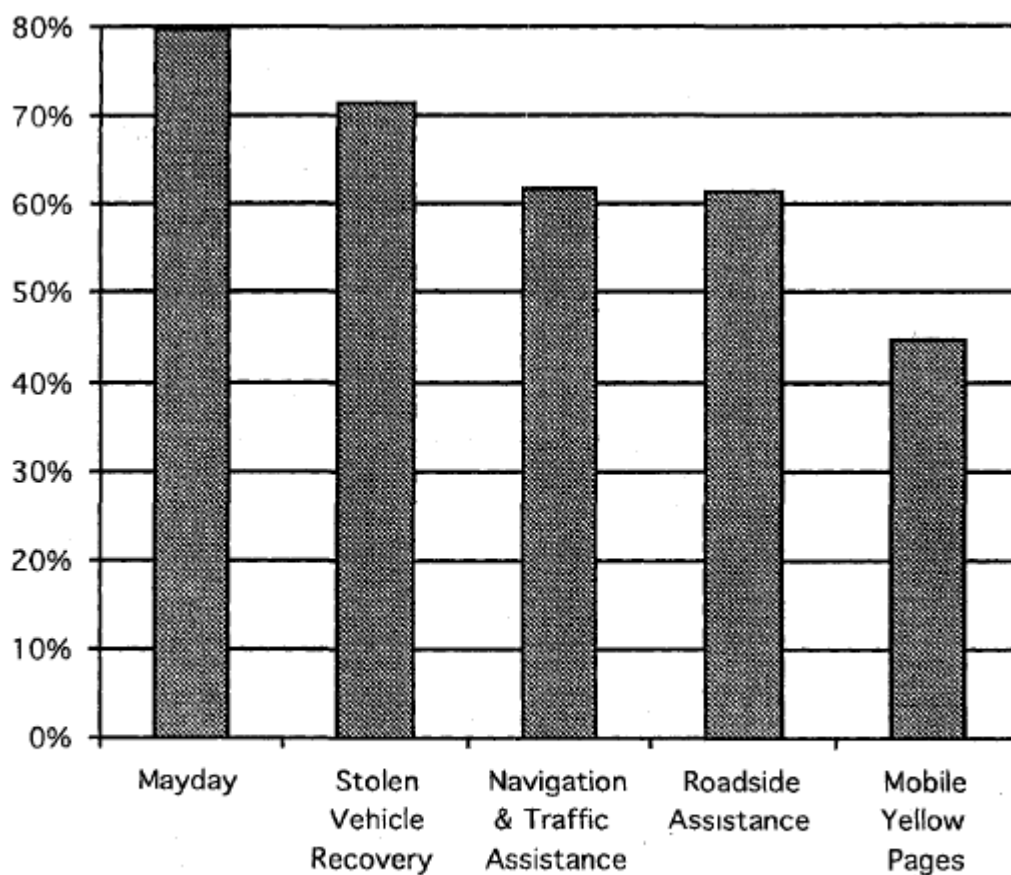


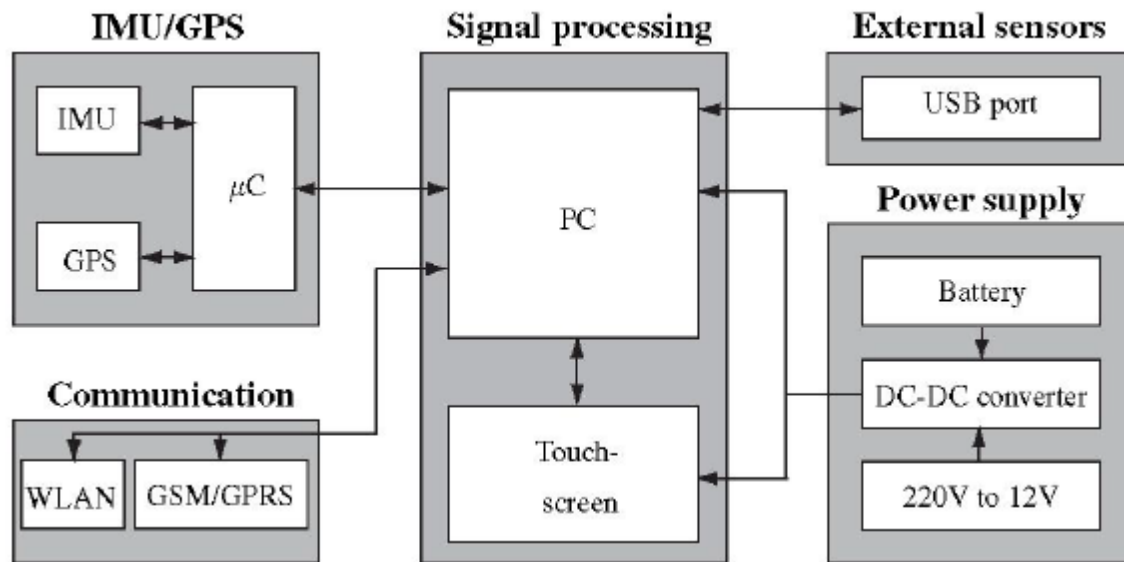
Figure 1.5 American consumer interest in location-based mobile services.

USAA-1027 (Zhao1997), 25

21. Zhao1997 also described sensing devices for facilitating performing vehicle location and navigation. Examples of sensors include odometers, gyroscopes, compasses, and the Global Positioning System (GPS), which were used for methods to fuse “measurements from multiple sensors to provide both an estimate of the current state of a system and a prediction of the future state of the system. *See id.*, 57-95.

22. By 2006, the early concepts discussed in Zhao1997 were expanded to workers in the field of Intelligent Transportation Systems (ITS). For example, Conover2006 recognized the need to include “navigation, telematics, vehicle dynamics control, parking aids, adaptive cruise control, lane departure warning, active safety systems, predictive safety systems (e.g., braking assist, collision warning, and collision avoidance), and vehicle-to-vehicle and vehicle-to-roadside communications” in automotive systems. USAA-1028, 1.

23. Around 2006, there were also systems being fielded for enabling a portable device with well-known hardware elements (e.g., accelerometers, positioning sensors, touch screen display, processor, memory) to wirelessly communicate with an external server. For example, Skog2006 disclosed a portable system that included the essential elements for determining driver behavior that are used in modern smartphones today. USAA-1029, 1-2.



USAA-1029, Fig. 2

24. In addition to the components internal to the mobile device shown above, the Skog system also had the ability to interface with external sensors to facilitate supplementing the internal sensors with other sources of data. *Id.*, 2-3. This configuration of the Skog2006 system is similar to the '728 patent's disclosure that: "[p]referably, the mobile device is arranged to interface with an external device to receive external driving information from said external device. It will be appreciated that the sensor set onboard the mobile device may be supplemented by a sensor set external to the mobile device." USAA-1001, 9:66-10:13.

A. Sensors

25. The sensors used in the '728 patent include, for example, image sensors, audio sensors, accelerometers, a positioning module (e.g., GPS receiver,

inertial measurement unit). These sensors are used to detect the driving behavior of the operator of a vehicle. As discussed in Section X, these sensors were described in several prior art references that render the claims of the '728 patent obvious. *See, generally* USAA-1005; USAA-1006; USAA-1007; USAA-1008; USAA-1030; USAA-1013; USAA-1028; USAA-1029; USAA-1030; USAA-1031; USAA-1032.

26. Additionally, by the Critical Date, several types of mobile devices existed for performing the types of sensing capabilities described in the '728 patent. By 2008, the literature often referred to mobile devices as “smartphones” and these devices included all of the sensing features described in the '728 patent. USAA-1031, 1. Work2008 is one example that included the following description:

Smartphones such as the Nokia N96 now include a video camera, numerous sensors (accelerometers, light sensors, GPS, microphone), wireless communication outlets (GSM, GPRS, WiFi, Bluetooth, infrared), computational power and memory. This phone can be used to listen to the radio, to watch digital TV, to browse the internet, to do video conferencing, to scan barcodes, to read pdfs, etc. The rapid penetration of GPS in smartphones is enabling device geopositioning and context awareness, which in turn is causing an explosion of Location Based Services (heavily relying on mapping) on the devices. USAA-1031, 1.

1. *Image Sensors*

27. The '728 patent describes use of image sensors, such as a camera: “[p]referably, the sensor set comprises an image sensor such as a camera[,]” and “the corresponding sensor data may comprise images and/or a sequence of images generated from the image sensor.” USAA-1001, 8:32-35.

28. By the Critical Date, cameras were ubiquitous on devices such as hand-held mobile phones. For example, in 2005, Flinchbaugh²⁰⁰⁵ included the following description:

Perhaps the single trend with the most far-reaching implications yet to be comprehended is the embedding of smart cameras in wireless phones. This trend began almost instantaneously in 2003 when the number of cellular camera phones exceeded the number of digital still cameras sold.”

USAA-1032, 5. Further, around this time, “[c]ellular phones with digital still camera, digital video recording, and interactive videoconferencing features [were] rapidly evolving.” *Id.*, 8.

29. In 2006, LeBlanc²⁰⁰⁶ described an experimental road departure crash warning system that used a camera similar to those found in cellular telephones to detect when a vehicle was crossing lanes. LeBlanc²⁰⁰⁶ included the following description:

The forward-looking LDW camera was a small “thumb” camera mounted inside the cabin near the top of the windshield just to the passenger side of the rear-view mirror. The camera was mounted behind a composite shroud to reduce reflections and to discourage tampering by the participants.

USAA-1033, 37. The reference also described monitoring lane position: The LDW alerts were issued when the lane position of the vehicle at some point in the near future was expected to exceed a threshold. The threshold was modulated to reflect both the driver’s selection of sensitivity for the LDW, as well as the presence of currently- or previously-observed objects alongside the original lane of travel.

Id., 44. Based on these descriptions, both the addition of cameras to cellular telephones and the use of such cameras inside a vehicle for detecting driving incidents were well known by the Critical Date.

2. *Audio Sensors*

30. The ’728 patent includes use of audio sensors and, specifically, “[p]referably, the sensor set comprises an audio sensor such as a microphone.” USAA-1001, 9:5-6. However, the Nokia N96 cellular phone (which predates the Critical Date) had a microphone, which would have been understood as a necessary component for the device to operate as a cellular telephone. Indeed, Mohan2008 stated that “[a]ll phones have a microphone that can serve as a readily available sensor.” USAA-1032 (Mohan), 10.

31. Indeed, by 2008, Mohan2008 described a Nericell system that was “a system that performs rich sensing by piggybacking on smartphones that users carry with them in normal course.” *Id.*, 1. It also described that “Nericell uses honk detection to identify noisy and chaotic traffic conditions like that at an unregulated intersection.” *Id.* Based on these descriptions, the addition of a microphone to a cellular phone, and the use of such microphones inside an automobile to detect traffic conditions or incidents was well known by the Critical Date.

3. *Accelerometers*

32. The '728 patent describes use of accelerometers:

The accelerometer 23 is arranged to provide information regarding the motion of the automobile 3 along all three dimensional axes. For example, the accelerometer 23 provides information regarding the pitch, yaw and roll of the automobile 3. Sensor data captured from the accelerometer 23 may be used to determine the g-forces the automobile has been subjected to.

USAA-1001, 15:63-16:2.

33. By the Critical Date, mobile devices, such as smartphones, were known to contain multi-axis accelerometers. For example, in the Nericell system described in Mohan2008, “[a] phone might include any or all of a microphone, camera, GPS, and accelerometer, each of which could be used for traffic sensing functions.” USAA-1032 (Mohan), 1. As another example, Reddy2008 described a

system that used “the Nokia N95 for [] data collection, which contains a three axis accelerometer with a sensitivity of $\pm 2G$ and bandwidth of 35 Hz and a built-in GPS receiver that can sample at 1 Hz.” USAA-1034, 2. This mobile phone was used “to determine the transportation mode of an individual – whether the user is stationary, walking, running, biking or in motorized transport.” *Id.*, 1. Based on these descriptions, both the addition of accelerometers to cellular telephones and the use of such accelerometers inside a vehicle for detecting driving incidents were well known by the Critical Date.

4. *Positioning Devices*

34. One of the sensors identified in the '728 patent specification is a positioning module. The specification provides two examples of a positioning module, one using the Global Positioning System (GPS) and another using positioning techniques based on cell towers. It includes the following description:

Preferably, the sensor set comprises a positioning module arranged to determine the position of the mobile device. The positioning module may comprise a GPS module. The positioning module may be arranged to utilise the wireless telecommunication module to self-localise, for example by determining a position relative to one or more mobile telecommunication cell tower.

USAA-1001, 9:10-16. Additionally, “the corresponding sensor data may comprise latitude, longitude, elevation, speed and other data obtainable from positioning

modules such as GPS modules as is known in the art.” *Id.*, 9:20-23. The ’728 patent admits that such positioning modules were already known in the art.

35. By the Critical Date, multiple technologies were known to determine the position of a mobile device. For example, by 2002, Zhao2002B described several techniques for determining the location of a mobile phone, including “cell-ID-based, assisted GPS, and TDOA-based methods, such as OTDOA, E-OTD, and A-FLT.” USAA-1035, 1. Zhao2002B recognizes that “[t]here are three most commonly used location technologies: standalone, satellite-based, and terrestrial-radio-based...” including “a typical standalone technology is dead reckoning; a typical satellite-based technology is GPS; and a typical terrestrial radio-based technology is the ‘C’ configuration of the Long Range Navigation (LORAN-C) system.” *Id.*, 2.

36. The addition of positioning modules in cellular telephones and the use of such positioning modules inside a vehicle for detecting driving incidents were well known by the Critical Date. For example, by 2008, Mohan2008 described a system where “[a] phone might include any or all of a microphone, camera, GPS, and accelerometer, each of which could be used for traffic sensing functions.” USAA-1032 (Mohan), 1.

5. *Proximity Sensors*

37. The '728 patent describes a registration module to determine if a mobile device is located in a vehicle, and includes the following description:

To this end, the adapter and/or the mobile device may comprise a registration module configured to register the installation of the mobile device to the vehicle and/or the adapter. The registration module may comprise a proximity sensor to detect the proximity of the mobile device to the vehicle. The registration module may comprise a NFC (near field communication) device.

USAA-1001, 3:47-54.

38. By the Critical Date, near-field communications (NFC) were used by mobile devices to communicate with external devices. For example, by 2007, Strömmer²⁰⁰⁷ described that NFC “support[ed] the use of mobile handsets by touch-based interaction, which is an intuitive and user-friendly way of establishing connections and exchanging information between mobile handsets and other devices. USAA-1036, 1-2. Based on these descriptions, the use of proximity sensors were well known by the Critical Date.

6. *Orientation Sensors*

39. The '728 patent describes use of an orientation sensor:

Preferably, the sensor set comprises an orientation sensor for determining the orientation of the mobile device. Said orientation

sensor may comprise an electronic compass for determining a bearing,
and so the direction in which the mobile device is facing.

USAA-1001, 9:24-28.

40. The use of orientation sensors in mobile devices were well known by the Critical Date. For example, Schott2007 described the details of an electronic compass suitable for inclusion in a mobile phone and that “[p]ossible host systems for such a miniature complete electronic compass system range from watches to mobile phones to automobiles.” USAA-1037, 11.

B. Accident Detection

41. By the Critical Date, several systems were known to detect vehicular accidents based on data from mobile phones. For example, Liutkauskas2004 described a number of location-based services that could be provided by mobile phones. USAA-1038, 1. Liutkauskas2004 also recognized that:

The most relevant class of Commercial Assistance Services based on wireless location systems is represented by Driver Assistance services. The attention has been focused on breakdown assistance, car accident detection and rescue and car theft recovery.

USAA-1038, 5. Other examples of mobile device accident detection systems included Thompson2010 and Cheng2010, which are discussed in at least Section XI below. See USAA-1008, 1-7, Fig. 2; USAA-1030, 1-3, Figs. 4, 5

C. Emergency Response Services

42. Commercial vehicle emergency systems were available by the Critical Date. Examples of such systems included the Ford Motor Company RESCU system and the General Motors OnStar system. These systems were built into vehicles. The interest in providing emergency services for mobile device-based systems were similarly well known by the Critical Date. *See, e.g.*, USAA-1039; USAA-1040; USAA-1041.

D. Mobile Vehicle Monitoring

43. Systems and techniques for monitoring vehicles using a mobile device were well known by the Critical Date. One example is “Floating Car Data” (FCD), which refers to a technique of using data collected from mobile phones to assess/predict driving conditions, driver behavior and insurance adjustments. The interest in using mobile devices for vehicle monitoring was similarly well known by the Critical Date. *See, e.g.*, USAA-1042; USAA-1043; USAA-1044.

E. Insurance Adjustment

44. Systems and techniques for adjusting insurance plans for users based on monitoring vehicle activity were well known by the Critical Date. One example is “Floating Car Data” (FCD), which refers to a technique of using data collected from mobile phones to assess/predict driving conditions, driver behavior and insurance adjustments. Additionally, the prior art (Curry, USAA-1006) described

that driving safety scores can be used by “insurance agencies to determine insurance premiums for related drivers.” USAA-2003, 7:5-22. The interest in using vehicle monitoring to determine and/or adjust insurance was similarly well known by the Critical Date. *See, e.g.*, USAA-1045; USAA-1045.

VII. OVERVIEW OF THE '728 PATENT

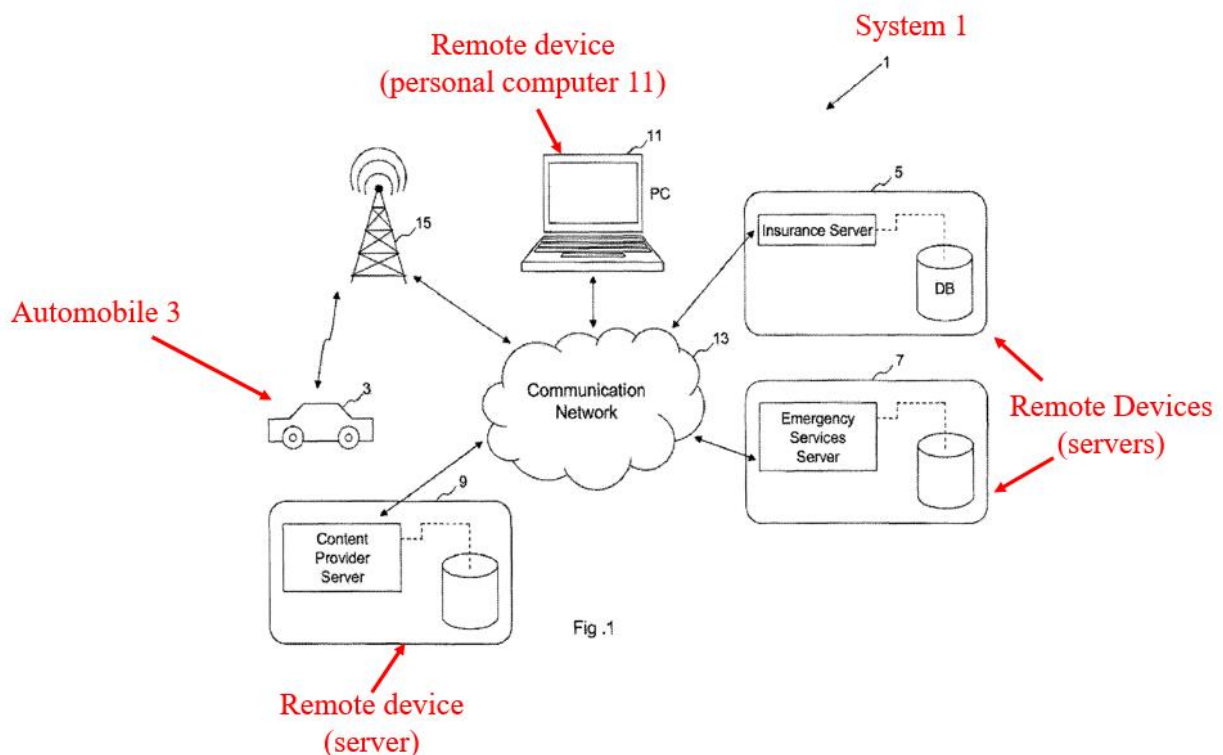
A. Specification

45. The '728 patent is directed to “methods and systems for logging driving information associated with a vehicle when driven...” USAA-1001, Abstract. A mobile device is “adapted for installation to a vehicle” and logs driving information, such as “video footage associated with how a vehicle is driven.” *Id.*, 1:25-35. The driving information can be used to “determine the cause of an accident,” “modify driver behaviour” or “determine insurance premiums.” *Id.* While the '728 patent purports that “data logging devices for road vehicles are less prevalent,” it otherwise acknowledges that “uptake of data logging devices that can be retrofitted to road conditions” are “known in the art.” *Id.*, 1:51-60. This is consistent with the existence of several well-known vehicle monitoring technologies that were conventional by the Critical Date.

46. Various embodiments described in the '728 patent generally relate to a “mobile telecommunications device adapted for installation to a vehicle and configured to log driving information associated with the vehicle when driven...”

USAA-1001, 1:25-35. The device is “loaded with an application,” i.e., a “mobile app,” that is “arranged to record and document events,” such as a “vehicle collision.” *Id.*, 13:61-67. The mobile application is referenced throughout the ’728 patent specification as the “‘Witness’ application.” *See, e.g., id.*, 13:59-14:20, 14:38-44; 23:40-24:67.

47. Figure 1 shows a system 1 placed in automobile 3:



USAA-1001, Fig. 1 (annotated)

48. System 1 includes “a mobile telecommunications device executing the Witness application...” USAA-1001, 14:3-20. The mobile telecommunications device can “communicate with one or more remotely located devices or

systems[,]” such as “an emergency services server 7, a content provider server 9, and a personal computer 11.” *Id.* The mobile telecommunications device is configured to “monitor and process sensor data” to “derive driving information associated with the moving automobile 3.” *Id.*, 14:21-37. The “driving information” can be used to “determine if a driving incident or event has occurred.” *Id.* The term “driving incident” relates to an “event,” such as “a collision, a near-miss, dangerous driving, erratic driving or similar[,]” or “a means for monitoring a driver's driving performance,” such as “a driving characteristic, or user profile for the subject driver.” *Id.* Additionally, the sensor data and/or the driving information may be used for determinations, such as “if the driver is a cautious driver, or a reckless driver[,]” and “to conduct a risk assessment and to tailor an insurance premium to the subject driver on the basis of a determined driving characteristic.” *Id.*

B. Claims

49. The table below includes identifiers for the '728 patent claims and limitations, which are referenced throughout.

Claim	Identifier	Claim Language
1	[1.1]	A data-logging system configured to monitor how safely a vehicle is being driven by a driver throughout a driving period and to log, during the driving period, driving information representing movement of the vehicle whilst the vehicle is being driven by the driver, the data-logging system comprising:

Claim	Identifier	Claim Language
	[1.2]	a remote data-logging server;
	[1.3]	a mobile telecommunications device including a user interface, a processor, a memory, and a sensor set comprising at least an accelerometer and a positioning module; and
	[1.4]	an application comprising computer-executable instructions downloaded onto the memory, wherein the computer-executable instructions, when executed by the processor, cause the mobile telecommunications device to:
	[1.5]	process, using the processor, raw sensor data representing at least acceleration of the vehicle and position of the vehicle from the sensor set to generate derived driving information representing how safely the vehicle is being driven by the driver throughout the driving period,
	[1.6]	wherein the driving period is defined by a duration of a vehicle journey, and the derived driving information includes a driving score, and
	[1.7]	wherein the processing of the raw sensor data, by the processor, includes determining a driving incident occurring within the driving period by comparing the raw sensor data against at least one predetermined threshold value and detecting the driving incident when the raw sensor data exceeds the at least one predetermined threshold, the driving incident including at least one of harsh braking, harsh acceleration, harsh swerving or a vehicle accident;
	[1.8]	generate the derived driving information without data from vehicle sensors throughout the driving period in which the mobile telecommunications device is within the vehicle and the vehicle is being driven by the driver; and
	[1.9]	transmit at least some of the derived driving information including the driving incident to the remote data-logging

Claim	Identifier	Claim Language
		server,
	[1.10]	wherein the remote data-logging server is configured to log the at least some of the derived driving information received from the mobile telecommunications device
	[1.11]	[the data-logging server] comprises: a database for storing a plurality of accounts, at least one of the plurality of accounts having a unique identifier, and the database being configured to store the selection of the derived driving information transmitted from the mobile telecommunications device to the at least one account, the derived driving information being associated by the unique identifier to the vehicle and the driver; and
	[1.12]	a communications interface configured to communicate with the mobile telecommunications device and receive therefrom:
	[1.13]	the unique identifier for association of the mobile telecommunications device with the at least one of the plurality of accounts; and
	[1.14]	the at least some of the derived driving information transmitted from the mobile telecommunications device to be logged to the at least one of the plurality of accounts.
2	[2.1]	The data-logging system of claim 1, wherein execution of the computer-executable instructions by the processor further causes the mobile telecommunications device to: store the raw sensor data relating to the driving incident; and
	[2.2]	transmit the stored raw sensor data to the remote data-logging server.
3	[3]	The data-logging system of claim 2, wherein execution of the computer-executable instructions by the processor further causes the mobile telecommunications device to store the raw sensor data generated before, during, and

Claim	Identifier	Claim Language
		after the driving incident that is continuously collected, associated with the driving incident.
4	[4]	The data-logging system of claim 1, wherein execution of the computer-executable instructions by the processor further causes the mobile telecommunications device to register a start of the driving period in response to an initialization input generated automatically in response to the raw sensor data having predetermined values.
5	[5]	The data logging system of claim 1, wherein the remote data-logging server is further configured to process the derived driving information logged to the at least one of the plurality of accounts over a plurality of driving periods, including the driving period, to generate an aggregated driving score used to determine a risk profile for at least one of the vehicle and the driver.
6	[6.1]	The data logging system of claim 1, wherein the driving period comprises a plurality of portions of time throughout the driving period, and
	[6.2]	the execution of the computer executable instructions by the processor further causes the processor to select a portion of time related to the driving incident from the plurality of portions of time for transmission to the remote logging server and to reduce the amount of data transmitted by transmitting raw sensor data relating to the selected portion of time to the remote data logging server.
7	[7]	The data-logging system of claim 6, wherein the driving incident, determined by the processor, is defined by a marked variation in a change of the raw sensor data over at least a portion of the plurality of portions of time during the driving period indicative of a difference in a state of motion of the vehicle occurring over the at least a portion of the plurality of portions.
8	[8]	The data-logging system of claim 7, wherein execution of the computer-executable instructions by the processor

Claim	Identifier	Claim Language
		further causes the mobile telecommunications device to select, prior to transmitting the derived driving information, the raw sensor data relating to the driving incident.
9	[9]	The data-logging system of claim 8, wherein, to select the raw sensor data relating to the driving incident, execution of the computer-executable instructions by the processor further cause the mobile telecommunications device to select the raw sensor data generated before, during, and after the driving incident.
10	[10]	The data-logging system of claim 9, wherein execution of the computer-executable instructions by the processor further causes the mobile telecommunications device to transmit the selected raw sensor data to the remote data-logging server.
11	[11]	The data-logging system of claim 7, wherein the at least a portion of the plurality of portions comprises a five-minute time period.
12	[12]	The data logging system of claim 6, wherein the remote-logging server is configured to store the raw data relating to the selected portion of time related to the driving incident to the at least one account.
13	[13.1]	A data-logging system configured to monitor how safely a vehicle is being driven by a driver throughout a driving period and to log driving information representing movement of the vehicle whilst the vehicle is being driven by the driver during the driving period, the data-logging system comprising:
	[13.2]	a remote data-logging server;
	[13.3]	a mobile telecommunications device including a user interface, a processor, a memory, and a sensor set comprising at least an accelerometer and a positioning module; and

Claim	Identifier	Claim Language
	[13.4]	an application comprising computer-executable instructions downloaded onto the memory, wherein the computer-executable instructions, when executed by the processor, cause the mobile telecommunications device to:
	[13.5]	process, using the processor, raw sensor data from the sensor set representing at least acceleration of the vehicle and position of the vehicle, to generate derived driving information representing how safely the vehicle is being driven by the driver throughout the driving period,
	[13.6]	wherein the driving period is defined by a duration of a vehicle journey comprising a plurality of portions of time, and
	[13.7]	wherein processing of the raw sensor data, by the processor, includes determining a driving incident occurring within the driving period by comparing the raw sensor data against at least one predetermined threshold value and detecting the driving incident when the raw sensor data exceeds the at least one predetermined threshold, the driving incident including at least one of harsh breaking, harsh acceleration, harsh swerving or a vehicle accident;
	[13.8]	generate the derived driving information without data from vehicle sensors during throughout the driving period in which the mobile telecommunications device is within the vehicle and the vehicle is being driven by the driver; and
	[13.9]	transmit at least some of the derived driving information including the driving incident to the remote data-logging server;
	[13.10]	wherein the remote data-logging server is configured to log at least some of the derived driving information, including the driving incident, received from the mobile telecommunications device and

Claim	Identifier	Claim Language
	[13.11]	[the remote data-logging server] comprises: a database for storing a plurality of accounts, at least one of the plurality of accounts having a unique identifier, and the database being configured to store the selection of the derived driving information, associated by the unique identifier to the vehicle and the driver, to the at least one account; and
	[13.12]	a communications interface configured to communicate with the mobile telecommunications device, and receive therefrom:
	[13.13]	the unique identifier for association of the mobile telecommunications device with the at least one of the plurality of accounts; and
	[13.14]	the derived driving information transmitted from the mobile telecommunications device to be logged to the at least one of the plurality of accounts, and
	[13.15]	wherein the remote data-logging server is further configured to process the derived driving information logged to the at least one of the plurality of accounts to determine a risk profile for at least one of the vehicle and driver.
14	[14]	The data-logging system of claim 13, wherein the at least one driving incident is defined by an occurrence of the sensor data exceeding a predetermined value during the driving period.
15	[15.1]	The data-logging system of claim 14, wherein execution of the computer-executable instructions by the processor further causes the mobile telecommunications device to: store the raw sensor data relating to the at least one driving incident; and
	[15.2]	transmit the stored raw sensor data to the remote data-logging server.
16	[16]	The data-logging system of claim 15, wherein execution of the computer-executable instructions by the processor

Claim	Identifier	Claim Language
		further causes the mobile telecommunications device to store the raw sensor data generated before, during, and after the at least one driving incident.
17	[17]	The data-logging system of claim 13, wherein execution of the computer-executable instructions by the processor further causes the mobile telecommunications device to determine the at least one driving incident as a marked variation in a change of the raw sensor data over at least a portion of the plurality of portions of time during the driving period indicative of a difference in a state of motion of the vehicle occurring over the at least a portion of the plurality of portions.
18	[18]	The data-logging system of claim 17, wherein execution of the computer-executable instructions by the processor further causes the mobile telecommunications device to select, prior to transmitting the selection of the derived driving information, the raw sensor data relating to the at least one driving incident.
19	[19]	The data-logging system of claim 18, wherein to select the raw sensor data relating to the at least one driving incident, execution of the computer-executable instructions by the processor further causes the mobile telecommunications device to select the raw sensor data generated before, during, and after the at least one driving incident.
20	[20]	The data-logging system of claim 19, wherein execution of the computer-executable instructions by the processor further causes the mobile telecommunications device to transmit the selected raw sensor data to the remote data-logging server.
21	[21]	The data-logging system of claim 13, wherein the sensor set further comprises an image sensor.
22	[22]	The data-logging system of claim 13, wherein the driving information further comprises one or more of

Claim	Identifier	Claim Language
		velocity, direction of travel, an indication of exceeding a velocity limit, or data representing jerky steering.
23	[23]	The data-logging system of claim 13, wherein execution of the computer-executable instructions by the processor further causes the mobile telecommunications device to register the start of the driving period in response to an initialization input generated automatically in response to the raw sensor data having predetermined values.
24	[24.1]	A data-logging system configured to monitor how safely a vehicle is being driven by a driver throughout a driving period and to log driving information representing movement of the vehicle whilst the vehicle is being driven by the driver during the driving period, the data-logging system comprising:
	[24.2]	a remote data-logging server;
	[24.3]	a mobile telecommunications device including a user interface, a processor, a memory, and a sensor set comprising at least an accelerometer and a positioning module;
	[24.4]	an application comprising computer-executable instructions downloaded onto the memory, wherein the computer-executable instructions, when executed by the processor, cause the mobile telecommunications device to:
	[24.5]	process, using the processor, raw sensor data from the sensor set representing at least acceleration of the vehicle and position of the vehicle, to generate derived driving information representing how safely the vehicle is being driven by the driver during throughout the driving period,
	[24.6]	wherein the driving period is defined by a duration of a vehicle journey comprising a plurality of portions of time, and

Claim	Identifier	Claim Language
	[24.7]	wherein the driving information includes at least one driving incident, the at least one driving incident being determined by the processor establishing by an occurrence of the raw sensor data exceeding a predetermined value during the driving period, the driving incident including at least one of harsh braking, harsh acceleration, harsh swerving, or a vehicle accident;
	[24.8]	generate the derived driving information without data from vehicle sensors during throughout the driving period in which the mobile telecommunications device is within the vehicle and the vehicle is being driven by the driver;
	[24.9]	store the raw sensor data relating to the at least one driving incident; and
	[24.10]	transmit at least some of the derived driving information, including the at least one driving incident, and the stored raw sensor data corresponding to the at least one driving incident;
	[24.11]	wherein the remote data-logging server is configured to log the derived driving information and the raw sensor data received from the mobile telecommunications device and
	[24.12]	[the data-logging server] comprises: a database for storing a plurality of accounts, at least one of the plurality of accounts having a unique identifier and the database being configured to store the at least some selection of the derived driving information associated by the unique identifier to the vehicle and the driver, and the raw sensor data, to the at least one of the plurality of accounts;
	[24.13]	a communications interface configured to communicate with the mobile telecommunications device, and receive therefrom:

Claim	Identifier	Claim Language
	[24.14]	the unique identifier for association of the mobile telecommunications device with the at least one of the plurality of accounts; and
	[24.15]	the at least some the derived driving information and the raw sensor data to be logged to the at least one of the plurality of accounts,
	[24.16]	wherein the remote data-logging server is further configured to process the derived driving information and the raw sensor data logged to the at least one of the plurality of accounts to determine a risk profile for at least one of the vehicle and driver.
25	[25.1]	A mobile telecommunications device configured to log driving information associated with how safely a vehicle is being driven, the mobile telecommunications device comprising:
	[25.2]	a sensor set comprising at least an accelerometer and a positioning module;
	[25.3]	a processor;
	[25.4]	a memory; and
	[25.5]	an application comprising computer-executable instructions downloaded onto the memory, wherein the computer-executable instructions, when executed by the processor, cause the mobile telecommunications device to:
	[25.6]	determine, based on the raw sensor data from the sensor set, a start of a driving period at which the mobile telecommunications device is within the vehicle and the vehicle is in use,
	[25.7]	wherein the driving period is defined by a duration from a start to an end of a vehicle journey and the duration is comprised of a plurality of portions of time;
	[25.8]	process, using the processor, the raw sensor data from the sensor set representing at least acceleration of the vehicle and position of the vehicle throughout the

Claim	Identifier	Claim Language
		driving period to derive driving information associated with how safely the vehicle is driven by the driver, the driving information representing movement of the vehicle whilst the vehicle is being driven by the driver throughout the driving period,
	[25.9]	wherein the processing of the raw sensor data, by the processor, includes determining a driving incident occurring within the driving period by comparing the raw sensor data against at least one predetermined threshold value, and detecting the driving incident when the raw sensor data exceeds the at least one predetermined threshold, the driving incident including at least one of harsh braking, harsh acceleration, harsh swerving or a vehicle accident;
	[25.10]	wherein the driving information is derived without data from vehicle sensors throughout the driving period and wherein the selection is determined by identifying a portion of the plurality of portions of time;
	[25.11]	transmit at least some of the derived driving information including the driving incident to a remote data-logging server; and
	[25.12]	wherein the mobile telecommunications device is controlled by a downloaded application to register the start of the driving period in response to an initialization input generated automatically in response to the sensor data having a predetermined start value.
26	[26]	The mobile telecommunications device of claim 25, wherein execution of the computer-executable instructions by the processor further causes the mobile telecommunications device to detect the end of the driving period in response to an ending input generated automatically in response to the raw sensor data having a predetermined end value.

Claim	Identifier	Claim Language
27	[27.1]	The mobile telecommunications device of claim 25, wherein the driving period comprises a plurality of portions of time throughout the driving period, and
	[27.2]	the execution of the computer executable instructions by the processor further causes the processor to select a portion of time related to the driving incident from the plurality of portions of time for transmission to the remote logging server and to reduce the amount of data transmitted by transmitting raw sensor data relating to the selected portion of time to the remote data logging server.
28	[28]	The mobile telecommunications device of claim 25, wherein execution of the computer-executable instructions by the processor further causes the mobile telecommunications device to determine the at least one driving incident as a marked variation in a change of the raw sensor data over at least a portion of the plurality of portions of time during the driving period indicative of a difference in a state of motion of the vehicle occurring over the at least a portion of the plurality of portions.

C. Prosecution History

50. During prosecution of the '728 patent, the examiner rejected the claims over U.S. 2010/0131304 ("Collopy"). See USAA-1002, 231-50.

51. Specifically, the patent examiner issued a Non-Final Office Action on July 31, 2024. *Id.* The Non-Final Office Action rejected pending claims 24-53 under 35 U.S.C. § 102 over Collopy. *Id.*, 235-63.

52. Applicant filed a Reply to Non-Final Office Action on October 31, 2024. *Id.*, 201-25. The Reply amended several claims in response to the rejections

cited in the Non-Final Office Action. For example, the Reply amended pending claim 24 to add the feature of “wherein the processing of the raw sensor data, by the sensor, includes determining a driving incident occurring within the driving period by comparing the raw sensor data against at least one predetermined threshold value and detecting the driving incident when the raw sensor data exceeds the at least one predetermined threshold, the driving incident including at least one of harsh braking, harsh acceleration, harsh swerving or a vehicle accident.” *Id.*, 203.

53. The Reply included arguments attempting to distinguish the Collopy reference. *See id.*, 221-24. The Reply explained that “the Collopy system is primarily a system which still relies heavily on the vehicle sensors” *Id.*, 221. The Reply further explained that “sensor data from [vehicle] sensors (even if located within [a] mobile device) is not processed on the mobile device itself but rather by the driving analysis component 150 of the insurance provider system 135...” *Id.* Further, “[t]here is simply no processing of the sensor data on a processor of the mobile device as is required by revised Claim 24.” *Id.*

54. The Reply also explained that “amended Claim 24 now explicitly recites the processing of raw sensor data (to determine derived driving information) is carried out by the processor of the mobile device and that includes determining a specific driving incident (event) by comparison of the raw sensor

data against a predetermined threshold value with the incident being detected if the raw sensor data exceeds the threshold value.” *Id.*, 223. Additionally, “the driving incident is specified as being on of a list of specific incidents (harsh braking, harsh acceleration, harsh swerving or a vehicle accident).” *Id.*

55. The Reply also explained that “[t]he presently claimed invention is inventive in that it is a system that is clearly independent of the vehicle in which it is used.” *Id.*, 224. “There is no need to connect to any of the vehicle sensors for any of the raw data which is used to determine incidents.” *Id.* Additionally, “as so much processing of raw data is carried out on-board the mobile device itself, the amount of data to be transmitted to the remote data logging server can be significantly lower.” *Id.*

56. The patent examiner issued a Notice of Allowance on November 14, 2024. *Id.*, 39-52. While the Notice of Allowance included a “Allowable Subject Matter” section, the notice did not identify specific features that were deemed to lead to have led to allowance. *See id.*, 45-51.

57. Based on my review of the prosecution history, features to which arguments were directed in distinguishing prior art of record during prosecution are addressed in a fresh way by combinations proposed in this declaration that leverage Callopy, Curry, Thompson, Warren, and Katayama. None of these

references were applied by the Examiner in a ground of rejection during the prosecution history.

VIII. CLAIM INTERPRETATION

58. I understand that, for purposes of my analysis in this *inter partes* review proceeding, the terms appearing in a patent claim should be interpreted according to their “ordinary and customary meaning of such claim as understood by one of ordinary skill in the art and the prosecution history pertaining to the patent.” 37 C.F.R. § 42.100(b).

59. I understand that the best indicator of claim meaning is its usage in the context of the patent specification as understood by a POSITA. I further understand that the words of the claims should be given their plain meaning unless that meaning is inconsistent with the patent specification or the patent’s history of examination before the Patent Office.

60. I also understand that the words of the claims should be interpreted as they would have been interpreted by a POSITA at the time of the invention was made (not today). Because I do not know at what date the invention as claimed was made, if ever, I have used the Critical Date of the ’728 patent as the point in time for claim interpretation purposes. My opinion does not change if the invention date was as early as December of 2010.

61. Based on my review and assessment of the claim language and the '728 patent specification, I find that none of the claim terms require specific definitions to understand how claims are pertinent to the teachings of the prior art. While plain meaning alone is sufficient to assess the prior art, I provide an analysis of a POSITA's understanding of the plain meaning of certain terms in the following paragraphs.

A. Driving Period (Claims 1, 13, 24, 25)

62. Claims 1, 13, 24, and 25 have various limitations that reference the element ***driving period***. See [1.1], [1.5]-[1.8], [13.1], [13.5]-[13.8], [24.1], [24.5]-[24.8], [25.1], [25.6]-[25.10], [25.12].

63. Based on my review of the claim language, I note that there is no specific definition of the phrase “driving period.” If there is any claim language narrowing the scope of this phrase in claims 1, 13, and 24, it is the phrase “duration of a vehicle journey” described within [1.6], [13.6], [24.6]. See, e.g., [1.6] (“the driving period is defined by a duration of a vehicle journey...”). Limitations [1.6], [13.6], [24.6] use the transitional phrase “defined by” to relate the phrases “driving period” and “duration of a vehicle journey.” Given the use of this transitional phrase, a POSITA would have recognized that the scope of the ***driving period*** within claims 1, 13, and 24 is related to the “duration of a vehicle journey.” That is, if the ***driving period*** is interpreted to be defined such that the claim element is

limited to specific types of driving periods, the interpretation is satisfied by driving periods that represent a “duration of vehicle journey.” As discussed below, the claim language only references “duration” and not specific types of durations. Claims 13 and 24 specify that the “duration” comprises “a plurality of portions of time” (*see* [13.6], [24.6]), but this refers to manner in which data is collected during a particular duration of time. As such, a POSITA would have recognized that the ***driving period*** in claims 1, 13, and 24 is broad enough to encompass a driving period defined by a duration of a vehicle journey, where the duration is the entire period of driving. Similarly, the claimed ***driving period*** in claims 1, 13, and 24 is also broad enough to encompass a driving period defined by a duration of a vehicle journey, where the duration is the only a portion of the entire time period of driving. *See* USAA-1048, 7 (“period” means “a length or portion of time”).

64. Additionally, if there is any claim language narrowing the scope of this phrase in claim 25, it is the phrase “duration from a start to an end of a vehicle journey” described within [25.7]. *See, e.g.*, [25.7] (“the driving period is defined by a duration from a start to an end of a vehicle journey and the duration is comprised of a plurality of portions of time”). Limitation [25.7] uses the transitional phrase “defined by” to relate the phrases “driving period” and “a duration from a start to an end of a vehicle journey.” Given the use of this transitional phrase, a POSITA would have recognized that the scope of the ***driving period*** within claim 25 is

related to the “duration from a start to an end of a vehicle journey.” That is, if the ***driving period*** is interpreted to be defined such that the claim element is limited to specific types of driving periods, the interpretation is satisfied by driving periods that represent a “duration from a start to an end of a vehicle journey.” Claim 25 only references “duration” with a “start” and an “end” of a “vehicle journey.” As discussed in Section VIII.B, the plain meaning of “vehicle journey” is “something suggesting travel or passage by a vehicle from one place to another.” As such, a POSITA would have recognized that the ***driving period*** in claim 25 is broad enough to encompass a driving period defined by a duration of a vehicle journey, where the duration is the entire period of driving. Similarly, the claimed ***driving period*** in claim 25 is also broad enough to encompass a driving period defined by a duration of a vehicle journey, where the duration is the only a portion of the entire time period of driving (e.g., the start of the vehicle journey is after the start of a vehicle being driven).

65. Based on my review of the '728 patent specification, I also note that there is no specific definition of the phrase “driving period.” The '728 patent specification instead uses the phrase in multiple contexts, indicating how it is determined and used. In one example, the '728 patent specification describes that a driving period may start automatically when sensor data meets a predefined condition (e.g., having predetermined values). USAA-1001, 3:40-4:2. Specifically,

“if the sensor data reflects a detected speed above a predetermined threshold—for example, 20 kilometres per hour—then this can be used to trigger the start of the driving period.” *Id.* This description would have led a POSITA to recognize that the ’728 patent specification describes examples of driving periods that do not necessarily begin when the vehicle is turned on and/or when the vehicle starts moving.

66. As another example, the ’728 patent specification describes that a driving period is relevant to how data is recorded by a mobile device. Specifically, “[an] executed application is arranged to control the mobile device to process sensor data from the sensor set during a plurality of driving periods to derive driving information associated with when and/or how the vehicle is driven for each of the driving periods.” USAA-1001, 6:22-40. This description indicates that a driving period serves as a unit of analysis, and does not necessarily encompass an entire period of driving.

B. Duration Of A Vehicle Journey (Claims 1, 13, 24)

67. Claims 1, 13, and 24 have limitations that describe the element ***duration of a vehicle journey***. See [1.6], [13.6], [24.6].

68. Based on my review of the claim language, I note that there is no specific definition of the phrase “duration of a driving period.” Limitations [13.6] and [24.6] include further language that the “duration of a driving period”

comprises “a plurality of portions of time.”¹ If there is any claim language that narrows the scope of “duration” in claims 13 and 24, it is the phrase “a plurality of portions of time.” That is, if the **duration** described in claims 13 and 24 is interpreted to be defined in a specific manner to specific types of vehicle journeys, the interpretation includes vehicle journeys that are segmented in time to include “a plurality of portions of time.”

69. Based on my review of claims 1, 13, and 24, I note that the claims also do not specifically define the phrase “vehicle journey.” The ’728 patent specification also does not use the term “vehicle journey.” Based on my review of the ’728 patent specification, there is also no specific teaching or suggestion that would have led a POSITA to recognize that patentee desired a narrower interpretation of the phrase “vehicle journey” than its plain and ordinary meaning. As a result, a POSITA would have used ordinary reasoning to understand what is represented by a “vehicle journey” within the claims.

70. The phrase “vehicle journey” uses the term “vehicle” as an adjective to modify the term “journey.” The plain and ordinary meaning of “journey” is “an act of traveling from one place to another.” USAA-1048, 6. Based on this, the plain meaning of “vehicle journey” means “an act of traveling from one place to

¹ This language is not present in [1.6].

another.” This plain meaning understanding is not limited by a specific type of start or end. That is, under its plain meaning, the “vehicle journey” is broad enough to encompass examples where the start is represented by the start of driving and other examples where the start instead is represented by occurrence of an event after the start of driving.

71. Based on the plain meaning of “vehicle journey” discussed above, the phrase “duration of a vehicle journey” refers to a duration of time (or time period) during travel or passage by a vehicle from one place to another. As discussed above, while the term “duration” implies existence of a start and an end, the claims do not specify how the start of the “duration of a vehicle journey” is determined. See USAA-1048, 4 (“duration” means “the time during which something continues”).

72. A POSITA would have understood and found obvious that the ***duration of a vehicle journey*** of claims 1, 13, and 24 includes examples of a time duration with a start determined after the start of driving. As described in the ’728 patent specification, a mobile device “may be configured to initiate the driving period once sensor data above a minimum threshold value is recorded, indicative of the vehicle being in motion[,]” e.g., “once a velocity greater than 20 kilometres per hour is detected.” *Id.* From this description, a POSITA would have understood and found obvious that one way in which the “duration of a vehicle journey” is

started is by a vehicle speed satisfying a specified speed threshold (e.g., “kilometres per hour”). The description of this example within the ’728 patent confirms that the “duration of the vehicle journey” is not necessarily limited to an entire period of driving (e.g., a time period defined by a first time point when a vehicle begins moving to a second time point when the vehicle stops moving).

C. ***Duration From A Start To An End Of A Vehicle Journey*** (Claim 25)

73. Claim 25 has a limitation that describes the element ***duration from a start to an end of a vehicle journey***. See [25.7].

74. Based on my review of the claim language, I note that there is no specific definition of the phrase “duration from a start to an end of a vehicle journey.” Limitation [25.7] includes further language that the “duration” comprises “a plurality of portions of time.”² If there is any claim language that narrows the scope of “duration” in claim 25, it is the phrase “a start to an end of a vehicle journey.” That is, if the ***duration*** described in claim 25 is interpreted to be defined in a specific manner to specific types of vehicle journeys, the interpretation includes vehicle journeys that are segmented in time to include “a plurality of portions of time.”

² This language is not present in [1.6].

75. Based on my review of claim 25, I note that the claim also does not specifically define the phrase “vehicle journey.” The ’728 patent specification also does not use the term “vehicle journey.” Based on my review of the ’728 patent specification, there is also no specific teaching or suggestion that would have led a POSITA to recognize that patentee desired a narrower interpretation of the phrase “vehicle journey” than its plain and ordinary meaning. As a result, a POSITA would have used ordinary reasoning to understand what is represented by a “vehicle journey” within the claims.

76. As explained in Section VIII.B, the plain meaning of “vehicle journey” is “something suggesting travel or passage by a vehicle from one place to another.” The phrase “duration from a start to an end of a vehicle journey” refers to a duration of time (or time period) during travel or passage by a vehicle from one place to another. While claim 25 expressly specifies a “start” and an “end” of the “vehicle journey,” the claim does not specify how the start or the end are determined.

77. A POSITA would have understood and found obvious that the ***duration from a start to an end of a vehicle journey*** of claim 25 includes examples of a time duration with a start determined after the start of driving. As described in the ’728 patent specification, a mobile device “may be configured to initiate the driving period once sensor data above a minimum threshold value is

recorded, indicative of the vehicle being in motion[,]” e.g., “once a velocity greater than 20 kilometres per hour is detected.” USAA-1001, 14:45-57. From this description, a POSITA would have understood and found obvious that one way in which the “start” of the “vehicle journey” is started is by a vehicle speed satisfying a specified speed threshold (e.g., “kilometres per hour”). The description of this example within the ’728 patent confirms that the “duration from a start to an end of a vehicle journey” is not necessarily limited to an entire period of driving (e.g., a time period defined by a first time point when a vehicle begins moving to a second time point when the vehicle stops moving).

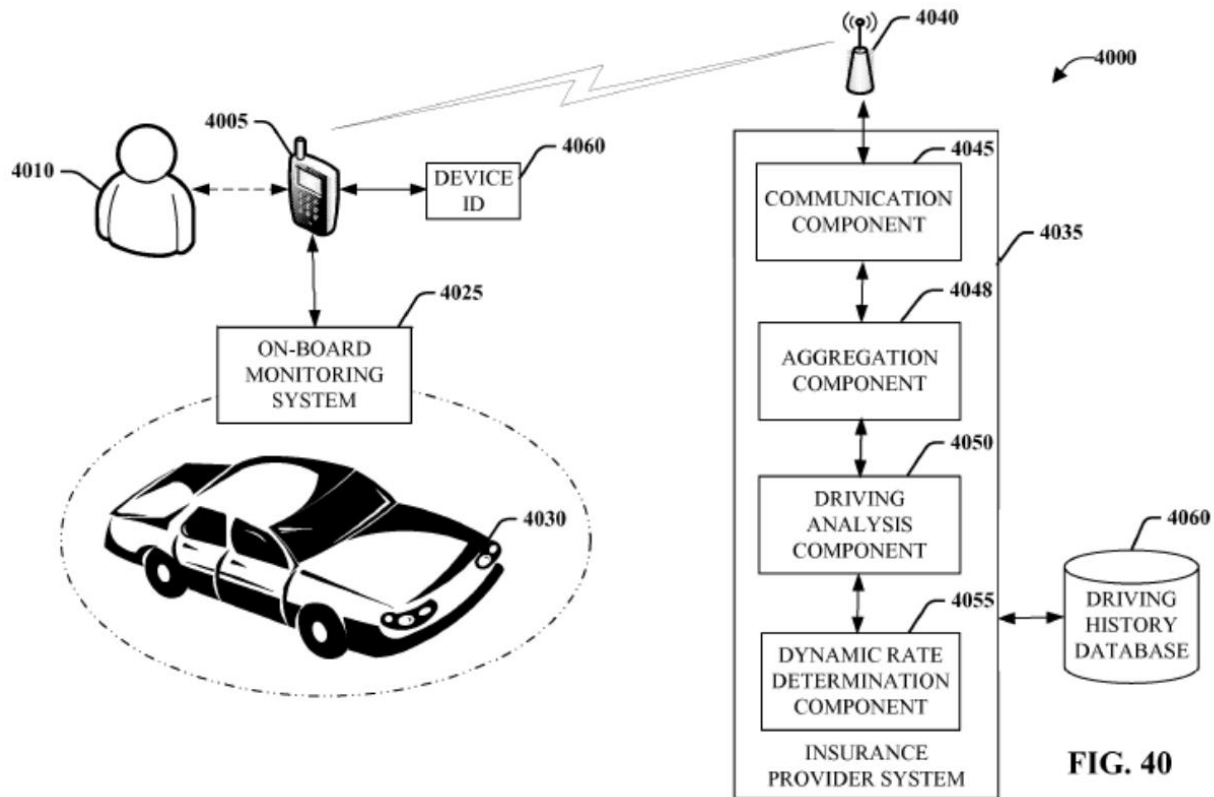
IX. SUMMARY OF RELEVANT PRIOR ART

A. Callopy

78. Callopy discloses a method wherein “insurance offers” are generated based on information collected regarding vehicle operation, using a mobile device equipped with various sensors. Callopy teaches that sensors embedded within the mobile device, such as a GPS module and an accelerometer, can collect data while the vehicle is in operation. For example, Callopy states that the sensors, including the GPS and accelerometer within the mobile device, enable real-time collection of driving data as the vehicle is being operated. USAA-1005, [0165], [0321]-[0323].

79. Figure 40 shows “a system for real-time monitoring of a driver to facilitate determination of insurance rates(s).” USAA-1005, [0085], [0307]. The

system 4000 includes a mobile device 4005 (with GPS 4110 and accelerometer 4120), on-board monitoring system 4025, and a vehicle 4030, where mobile device 4005 wirelessly communicates with insurance provider system 4035. *Id.*, [0307], [0323]-[0324].



USAA-1005, FIG. 40

80. The mobile device 4005 “monitors and gathers information regarding driver 4010’s driving skills, habits, etc. and forwards the information to the insurance provider 4035” and wirelessly communicates with an “insurance provider system 4035 via a transceiver 4040 and a communication component 4045.” USAA-1005, [0307]. The Callopy system allows for driver identification

and authentication using a “unique identifier,” which is associated with mobile device 4005 and stored in system 4035’s database. *Id.*, [0334], FIG. 42.

B. Curry

81. Curry describes using a “mobile wireless computing device” with embedded accelerometers and/or positioning sensors (e.g., an “iPhone 3G smart phone[]”) to “detect and prevent unsafe driving behavior[s]”, and generate related “driving safety...score[s]” for determining insurance premiums. USAA-1006, Abstract, 2:1-27,³ 3:24-4:11, 7:5-22, Fig. 1.

82. Curry’s Figure 1 (below) shows an exemplary system including a driving safety data server 104 in wireless communication with a “mobile phone” 106, which “can include any type of electronic mobile computing device that may be used while traveling in a vehicle.” USAA-1006, 7:23-26; *see id.*, 8:21-27. A client application 110, which can be downloaded “from the server 104 to the mobile phone 106,” enables phone 106 to monitor vehicle movement (e.g., evaluating “location, speed, and acceleration data” from an embedded “GPS sensor 114 and accelerometer 116”) and determine whether the vehicle is being driven. USAA-1006, 8:21-9:3. Client 110 also monitors phone usage (e.g., texting/calling while driving) and other unsafe driving behaviors (e.g., “speeding, abnormal

³ Citations refer to PDF pages of USAA-1006.

acceleration, abnormal deceleration, and taking sharp turns”). USAA-1006, 3:24-4:6; *id.*, 7:5-22, 8:30-9:33.

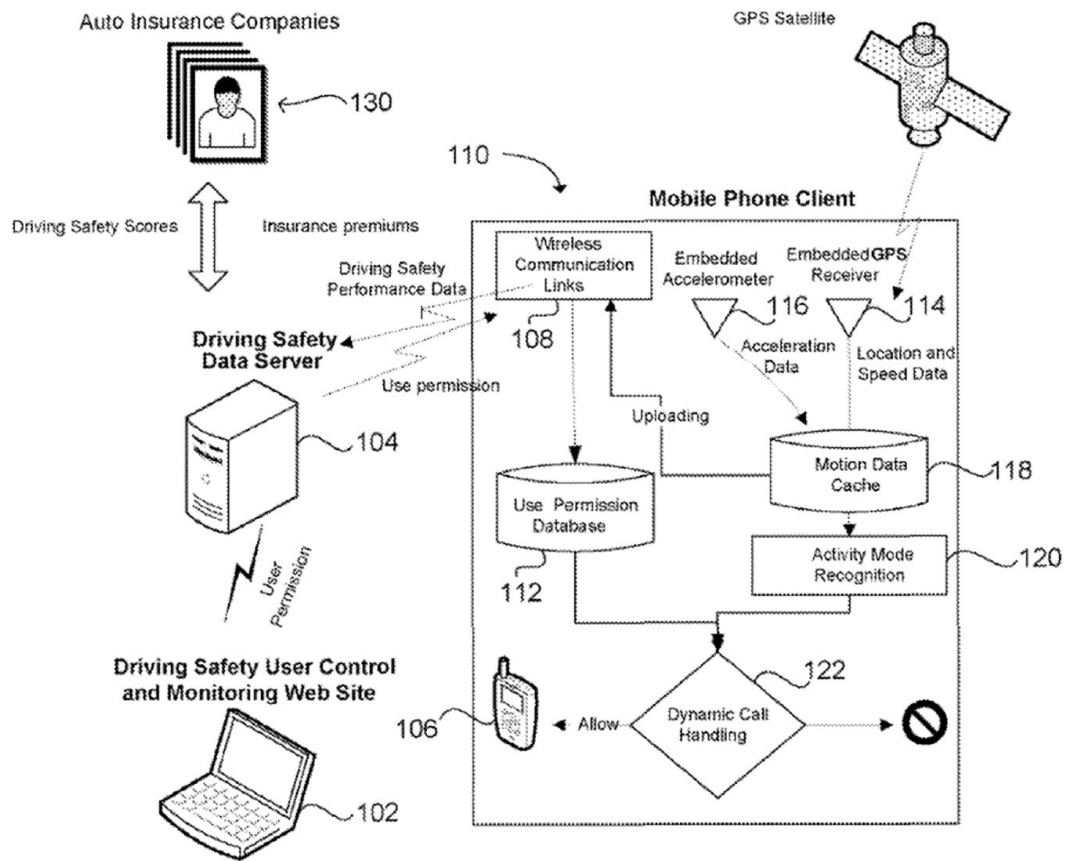


FIG. 1

USAA-1006, Fig. 1

83. Raw data and resolved driving behavior information are stored in the phone (e.g., “motion data cache 118,” “local driving safety performance database 324”) and processed to (1) determine an operating mode of the phone (e.g., “GPS monitoring/navigation mode,” “communication mode”) and (2) generate a user

“driving safety score.” USAA-1006, Abstract, 3:2-4:6, 13:3-14:26, 17:1-18:3,
Figs. 1, 3, 6.

C. Thompson

84. Thompson2010 offers techniques focused on smartphone-based accident detection applications. It describes how smartphones “can capture the streams of data provided by their accelerometers, compasses, and GPS sensors to provide a portable ‘black box’ that detects traffic accidents and records data related to accident events, such as the g-forces (accelerations experienced by the driver).” USAA-1007, 30. Figure 2 shows a smartphone-based accident detection system.

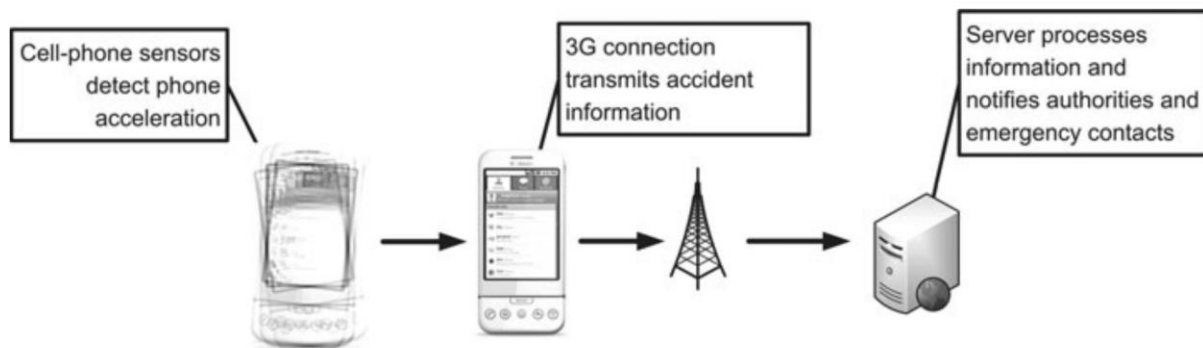


Fig. 2. Smartphone-Based Accident Detection System

USAA-1007, Fig. 2

85. Thompson’s system employs a client-server architecture in which “sensors built into a smartphone detect a major acceleration event indicative of an accident and utilize the built-in 3G data connection to transmit that information to a central server.” USAA-1007, 30. The server “then processes the information and

notifies the authorities as well as any emergency contacts.” *Id.* This client-server architecture (“WreckWatch”) is a “mobile client/server application [] developed to automatically detect car accidents.” USAA-1007, 30.

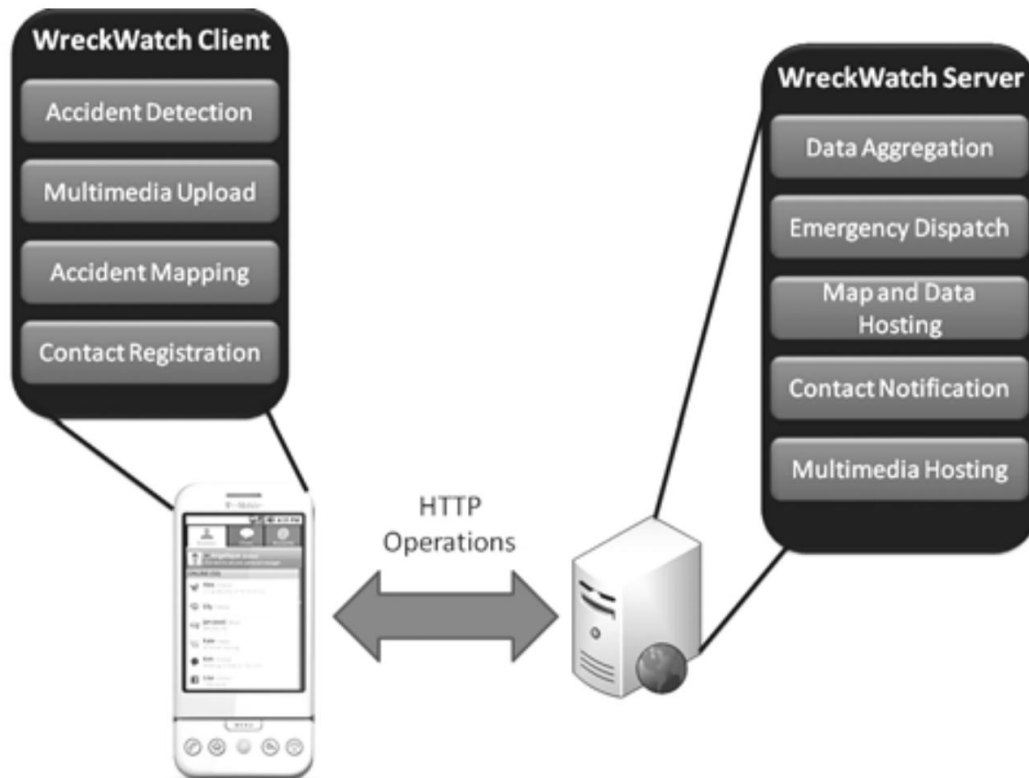


Fig. 3. WreckWatch Architecture Diagram

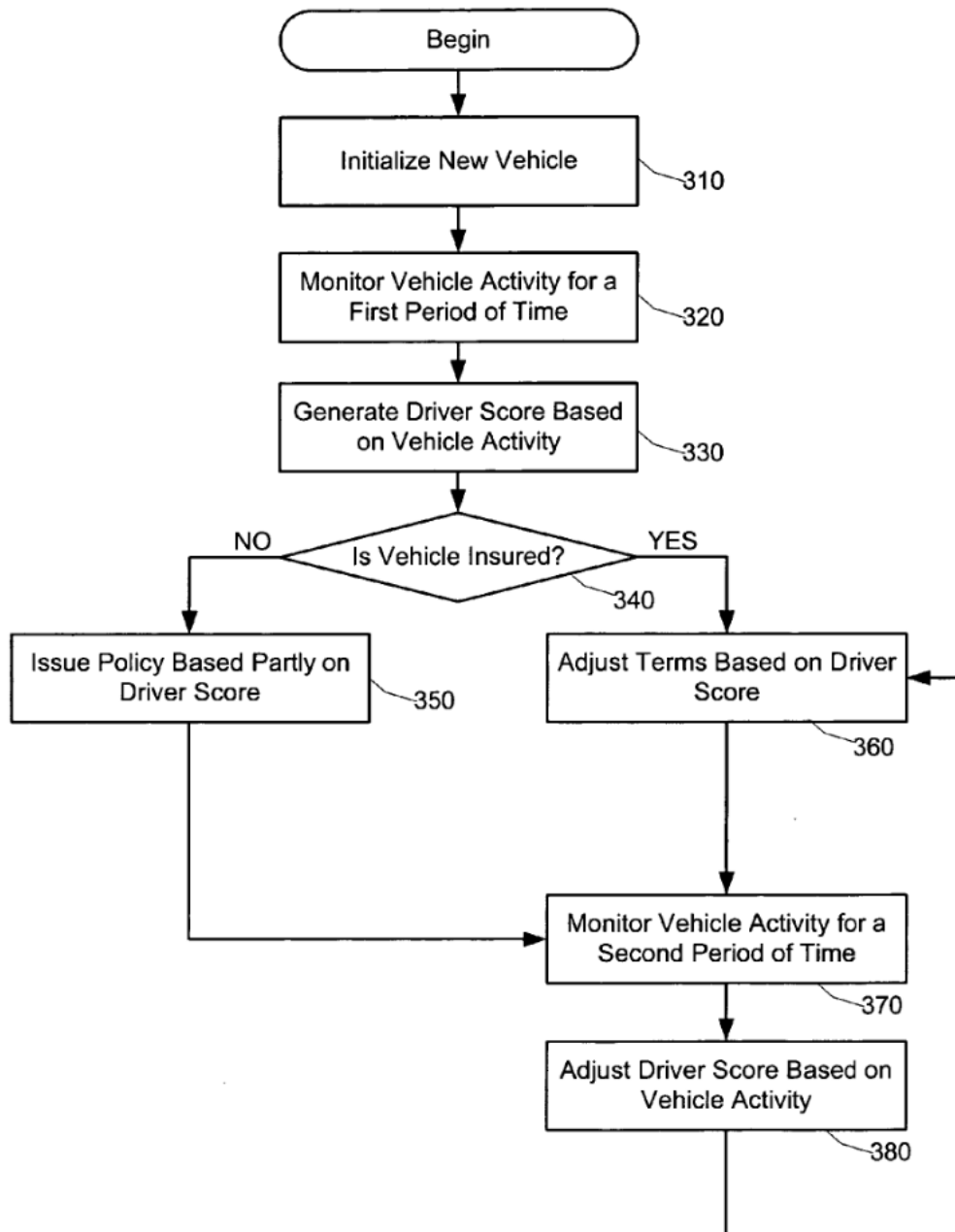
USAA-1007, Fig. 3

D. Warren

86. Warren describes calculating a “driver score” based on “monitoring vehicle operation[,]” such as “the times the vehicle is operated, the locations the vehicle is operated and the speeds or other characteristics of how the vehicle is operated[.]” USAA-1008, Abstract. The driver score is “applied to ascertain the

risk of insuring a particular driver” and “a tool for defining or adjusting the terms of an insurance policy for an insured driver.” *Id.* The driver score reflects “a risk level associated with insuring a particular driver[,]” (USAA-1008, [0024]) and “an insurance risk and is used to either increase or decrease an insurance premium or otherwise modify the terms of an insurance policy” (*id.*, [0026]). *See* USAA-1008, [0024].

87. An example of the process of determining a driving score is shown in Figure 3:



USAA-1008, FIG. 3

88. As shown above, at step 310, “a new vehicle is selected for driver score based insurance.” USAA-1008, [0049]. Upon initialization, the system “begins to monitor the vehicle activity for a first period of time 320.” *Id.*, [0050].

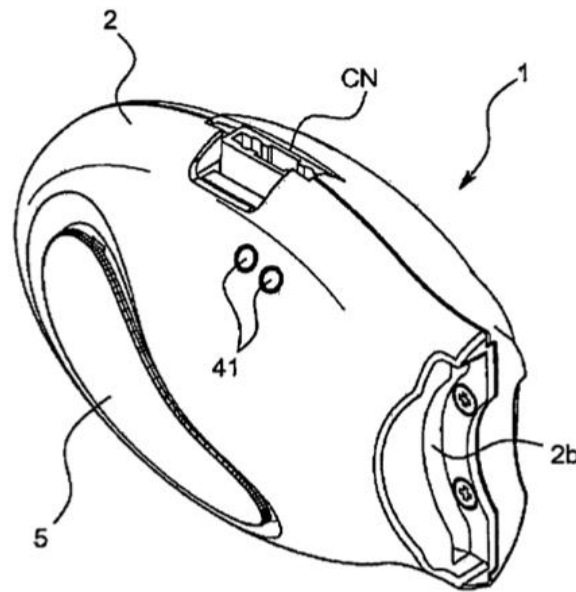
The period of monitoring is “sufficiently long to obtain data that is an accurate portrayal of the vehicle activity,” including “a shorter period of time that encompasses enough variants in the individuals schedule.” *Id.*, [0050]. Once this period has been “satisfied,” “a variety of parameters with various weights applied to the parameters” are used to determine a driver score. *Id.*, [0051].

E. Katayama

89. Katayama describes a “driving recorder” that records “situation data” that indicates the “surrounding situation or the like of a motor vehicle during a certain period before and after a time of an accident or...risk incident” in which “a driver...is close to [being] involved in an accident....” USAA-1009, [0001], [0011], [0058].

90. Through “after-the-fact analysis” of recorded data, the recorder can, for example, provide insights into driving behavior that may have contributed to the occurrence of a given accident or “risk incident.” USAA-1009, [0001][0002].

91. Figure 2 (below) shows an exemplary driving recorder 1.



USAA-1009, FIG. 2

Recorder 1 detects occurrence of accidents and/or risk incidents based on “situation data” that includes both sensor data and information derived therefrom, including “acceleration data indicating acceleration applied to a vehicle, [and] position data indicating a position of the vehicle....” USAA-1009, [0013].

92. Figure 4 (below) depicts components of an exemplary recorder 1, including both internal accelerometer and GPS sensors and an “internal memory 82” that is configured to store sensor data and related derived information. USAA-1009, [0034], [0044].

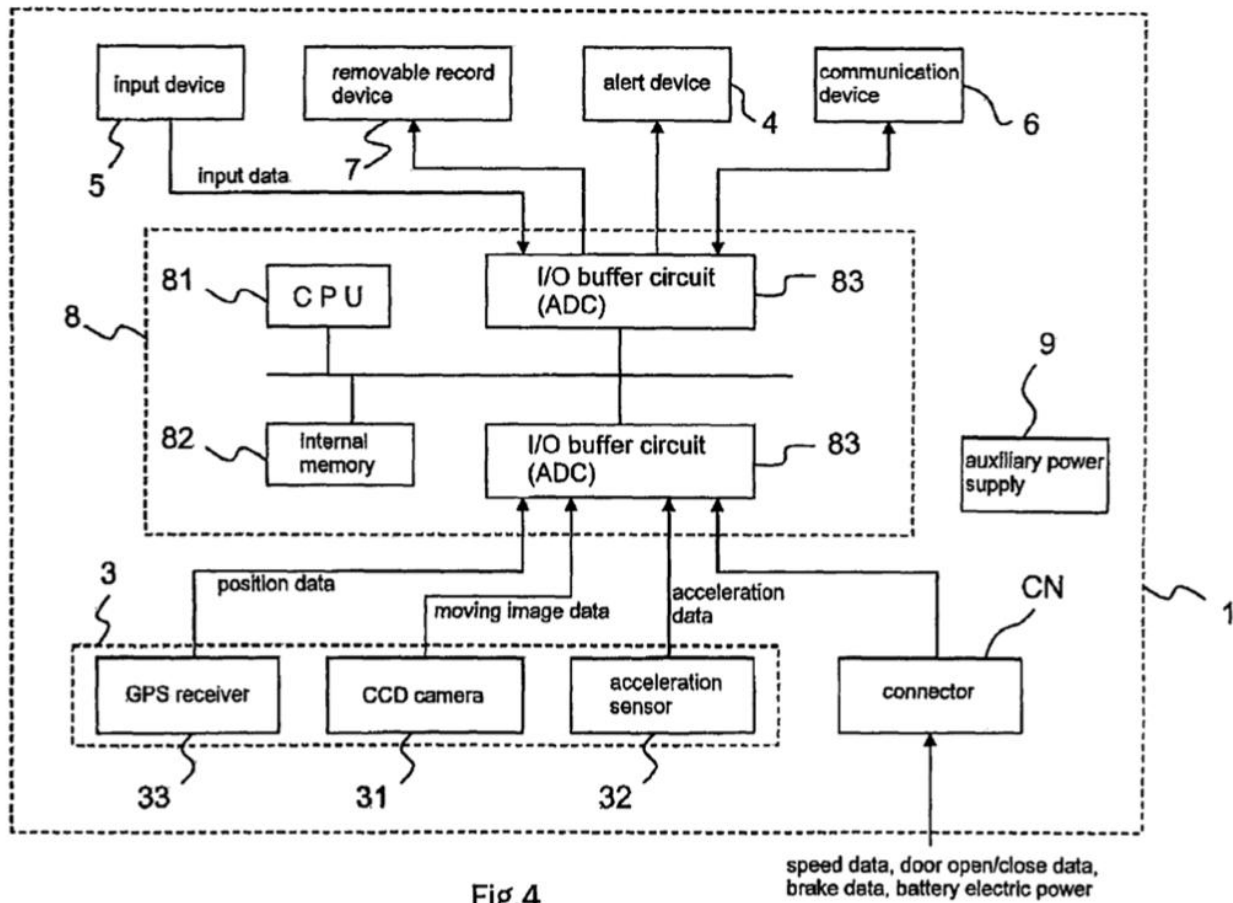
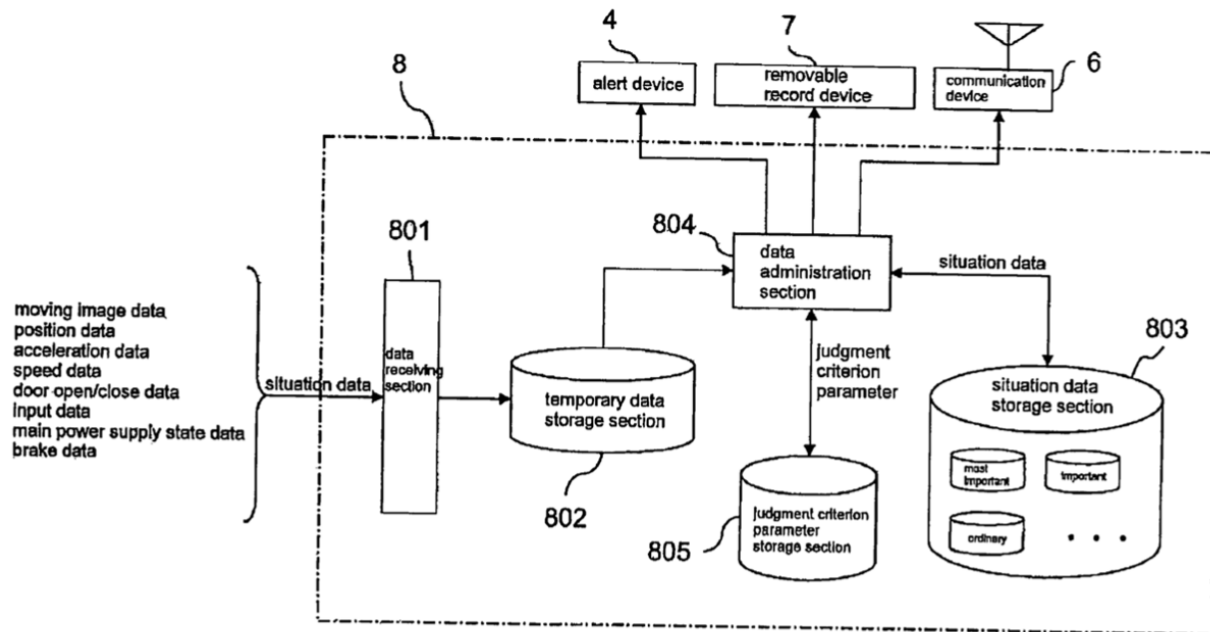


Fig.4

USAA-1009, FIG. 4

93. Figure 5 (below) is a “functional block diagram” of the recorder. USAA-1009, [0028], [0044]-[0045]. As shown, the recorder “is controlled...by operating the CPU 81 in accordance with programs stored in a predetermined area of the internal memory 82.” *Id.*



USAA-1009, FIG. 5

94. As described, memory 82 features an architecture with multiple sections, including “temporary data storage section 802” and “situation data storage section 803.” *Id.*, [0044]. Relatedly, Katayama describes data handling techniques that enable “effective use” of the memory’s limited capacity, and ensure that “important data will not be erased,” but instead will remain available for easy and accurate “after-the-fact analysis” of accidents and/or risk incidents. *Id.*, [0016].

95. Data receiving section 801 receives “situation data” including sensor data “at a constant sampling time one after another in a chronological order and writes the received situation data” in memory 82’s temporary data storage section

802. *Id.* Due to that area's limited capacity, "old data is sequentially erased" and replaced over time with "new situation data." USAA-1009, [0045], [0016].

96. To avoid erasing situation data that might prove useful, data administration section 804 determines at the "time of recording" whether temporarily stored situation data meets one or more predetermined criteria for long term storage. USAA-1009, [0001]-[0002], [0016], [0046]-[0050]. If so, the recorded situation data is, for example, classified with an identifier marking it as "important," and then transferred with the identifier to long term "situation data recording section 803." *See* USAA-1009, [0001]-[0002], [0011]-[0016], [0027], [0046]-[0050], [0054], [0083]. In contrast, situation data that is marked with an identifier as less than important remains in temporary storage until eventually overwritten. *See* USAA-1009, [0011]-[0016], [0054].

97. Criteria used in determining whether to mark and/or transfer a given set of accelerometer data may include, for example, "whether or not the acceleration" indicated exceeds a "predetermined" threshold, and "whether or not the acceleration continues for more than or equal to a certain period [of time]." USAA-1009, [0011]-[0016], [0027], [0046]-[0050], [0054], [0083].

98. To enable these and other determinations to take place, "the value (the content) of each situation data is, for example, digitalized in accordance with the judgment criterion parameter" or parameters against which it will be compared,

and the resulting “digitalized” values are temporarily stored. *See* USAA-1009, [0047]-[0049]. “[W]hether or not the content of each situation data meets” a “predetermined condition” for marking and/or transfer may then be judged based on logical comparisons between the stored values and the corresponding parameter(s). USAA-1009, [0049].

X. CALLOPY, CURRY, AND THOMPSON MAKES CLAIMS 1-4 OBVIOUS

99. For the reasons discussed below, and based on my review of the ’728 patent, the file history, and the prior art references cited here, a POSITA would have understood that the teachings of Callopy, Curry, and Thompson make the elements of claims 1-4 obvious.

A. Proposed Combination

7. Callopy and Curry

100. Callopy describes a system for dynamic insurance adjustment based on real-time data gathered using a mobile device in a vehicle. *See* Section IX.A; USAA-1005, Abstract, [0017]-[0018], [0165], [0321]-[0323], FIGS. 40-42. To determine “an appropriate insurance rate[,]” a mobile device 4005 (with GPS and accelerometer) is used to capture, process, and communicate driving-related data to insurance provider system 4035. USAA-1005, [0306]-[0357], FIGS. 40-42. While Callopy broadly describes its system as using “various analytical methods” to “facilitate determination of an appropriate insurance rate,” it otherwise does not

provide specific implementation detail on how the rate is calculated. *Id.*, [0307]; *id.*, [0004]. Without such detail, a POSITA seeking to implement Callopy's teachings would have been motivated to seek well-known insurance rate calculation techniques for further guidance.

101. As noted in Section XI.B, Curry describes well-known insurance rate calculation techniques through use of scoring to reflect risk factor assessment of driving-related information captured by mobile device sensors. USAA-1006, 10:2-12, 11:15-25, 13:27-14:4. Curry explains that a "cost of the insurance premium for the user can be reduced or increased based on the safety score of the user," which can further be used to "encourag[e] the vehicle operator to operate the vehicle within acceptable parameters." *Id.*, 10:2-12. A POSITA would have been motivated to incorporate these features into the Callopy system, to enhance Callopy's insurance rate calculation techniques in a predictable way. Given the overlap in functionality between Callopy and Curry, the incorporation of Curry's teachings into the Callopy system would have been obvious.

102. In combining the teachings of Callopy and Curry, a POSITA would have incorporated functionality associated with client 110 running on Curry's mobile phone 106 (e.g., monitoring involving the calculation and use of driver safety statistics, activity mode recognition and monitoring) into the pre-existing mobile device 4005 within the Callopy system. As noted in Section IX.B, Curry's

client 110 provides functionality relating to modules (e.g., activity mode recognition module, driving safety evaluation module) that evaluate recorded sensor data in calculating values for safety scores (e.g., driver safety statistic). USAA-1006, 3:24-4:6, 9:31-33, 11:3-14, 12:3-18, Figs. 1, 3. Callopy also teaches sensor data evaluation capabilities within its mobile phone 4005 in assessing “driving skills, habits, etc.” USAA-1005, [0307]. A POSITA would have perceived the incorporation of Curry’s client 110 and its associated module functionality into Callopy’s mobile device 4005 a natural modification that is consistent with the disclosures of each reference. USAA-1005, [0307]. Based on this incorporation, the Callopy-Curry phone provides the combined functionality of Callopy’s local application 4180 and Curry’s client 110.

103. Implementation of the Callopy-Curry phone aligns with standard insurance evaluation methods and encourages the adoption of Curry’s scoring method within Callopy’s system. Use of the Callopy-Curry phone also enhances the sensor-based driving evaluation described in Callopy by leveraging the capabilities of Curry’s mobile device 106, which is capable of log data and processing safety statistics in determining a driver risk profile for insurance purposes. USAA-1006, 3:24-4:6, 9:31-33, 11:3-14, 12:3-18, Figs. 1, 3. Curry further supports the combination through a broader motivation towards “programs and initiatives to reduce traffic-related fatalities and injuries.” USAA-1006, 2:9-21.

104. The modification discussed above would have also been obvious for several reasons. First, a POSITA would have recognized that Callopy's system (which collects and transmits driving data for risk assessment) and Curry's system (which processes sensor data to compute a driving score for insurance purposes) can be predictably combined to evaluate and log driver risk. USAA-1005, [0307]; USAA-1006, 7:5-22. Callopy already describes storing historical driving data and analyzing risk factors, and Curry states that a driving score is calculated from acceleration and speed data to determine risk. *Id.* Both references focus on insurance-based driver evaluation, their combination would involve nothing more than applying known techniques for their intended purpose.

105. Additionally, Curry's scoring technique reflects a predictable solution to Callopy's desire to assess driver risk for insurance purposes. A POSITA would have recognized that incorporation of Curry's safety score calculation into Callopy's system provides an enhanced and quantifiable risk assessment that follows a finite number of identified, predictable solutions to improve driver risk profiling. *Id.* The predictability is further supported by each reference expressly teaching a mobile device capable of collecting acceleration and speed data. USAA-1005, [0308]; USAA-1006, 3:24-4:6.

106. Configuring Callopy's systems to leverage Curry's teachings would have required only routine programming knowledge well within the skill of a

POSITA prior to the earliest effective filing date. The change would have amounted to nothing more than the use of a known technique (programming) to improve similar devices. Specifically, mobile devices equipped with generic sensors and monitoring software and third party insurance providers determining appropriate insurance premiums are improved in a similar way. This makes combining the elements of Callopy and Curry to be one that involves using known methods to achieve the predictable results described above.

107. The elements of the combination would also each perform functions they had been known to perform prior to the combination. Mobile device 4005 (modified to incorporate functionality Curry's client 110 and associated modules) would perform the same functions as taught in Callopy in capturing driving-related data for determining insurance premiums. A POSITA would have had more than a reasonable expectation of success when incorporating Curry's teachings into Callopy since the modifications only require the routine programming of similar computing devices.

108. A POSITA would have had more than a reasonable expectation of success in combining the teachings of Callopy and Curry in the manner discussed above. Both Callopy and Curry employ similar sensor configurations within standard mobile devices. Both systems also utilize accelerometers and GPS receivers housed within smartphones to capture driving behavior data. This

hardware commonality would have led a POSITA to recognize that, for instance, Curry's safety scoring methodology could be implemented within Callopy's framework without requiring any modification to the underlying hardware platform. This represents a significant technical compatibility that would have provided confidence in the viability of the combination.

109. The architectural framework employed by Callopy and Curry also follows the same fundamental client-server paradigm that was well-established around the Critical Date. Callopy's system utilizes a mobile device 4005 that communicates wirelessly with an insurance provider system 4035, while Curry employs a mobile phone 106 that transmits data to a driving safety data server 104. This shared architectural approach means that the data transmission protocols, communication methods, and processing distribution between client and server would have been understood to be compatible by a POSITA. The integration would have involved established networking and data synchronization techniques that were routine in the field at the relevant time.

110. The systems described in Callopy and Curry were also designed with the purpose of analyzing driving behavior for insurance assessment, creating a direct functional alignment. Callopy describes gathering driving skills and habits for determining an appropriate insurance rate, while Curry specifically details how driving data should be processed to calculate a driver safety statistic that can be

used to determine insurance premiums. This alignment of purpose means that the data being collected in Callopy's system is precisely the type of information that Curry's algorithms were designed to process. A POSITA would have recognized this functional compatibility as indicating that the combination would be technically operable.

8. *Thompson and Callopy-Curry*

111. Callopy and Curry each describe techniques relating generally to driving-related risk assessment. Neither reference explicitly describes detecting vehicle emergencies or taking actions specifically in response to detected emergencies. USAA-1005, Abstract, [0017], [0018], [0165], [0321]-[0323]; USAA-1006, 4:16-28, 10:16-26, cl. 9.

112. Callopy describes a system for dynamic insurance adjustment based on real-time data gathered using a mobile device in a vehicle. *See* Section IX.A; USAA-1005, Abstract, [0017], [0018], [0165], [0321]-[0323], FIGS. 40- 42. Data can be gathered “while a vehicle is in operation” and “over a period of hours, days, weeks, and so forth,” using, for example, a mobile device’s GPS and/or accelerometer. *Id.*, [0165], [0321]-[0323]. Based on the gathered data, insurance offers can be generated and presented to the driver through an interface, thus performing the function of providing driving information to both the driver and the insurance company. *Id.*, [0024], [0166], [0233], [0310], [0314]-[0316].

113. Curry provides a broader motivation toward “programs and initiatives to reduce traffic-related fatalities and injuries.” See Section IX.B; USAA-1006, 2:9-21. Curry also expresses concerns regarding motorized vehicle accidents and deaths. A POSITA would have recognized that incorporating accident detection techniques would logically advance Curry’s explicitly stated objective of reducing vehicular casualties. Based on this motivation, a POSITA would have been prompted to consider and incorporate known accident detection methodologies to enhance the risk assessment capabilities described by the combined teachings of Callopy and Curry.

114. Thompson describes a system where sensor data collected by a smartphone, such as acceleration data, is utilized in the detection of vehicle accidents. USAA-1007, 30, Fig. 2. Thompson’s described smartphone contains sensor components analogous to those identified in Curry and Callopy, including an accelerometer and a GPS sensor. Thus, the smartphone-based accident detection functionality described by Thompson would be directly applicable to the systems disclosed in Callopy-Curry. USAA-1007, 2, 8-10. The sensors used for accident detection within Thompson are also already available in the mobile devices described in Callopy and Curry. A POSITA would have been motivated to incorporate Thompson’s accident detection capabilities into the Callopy-Curry

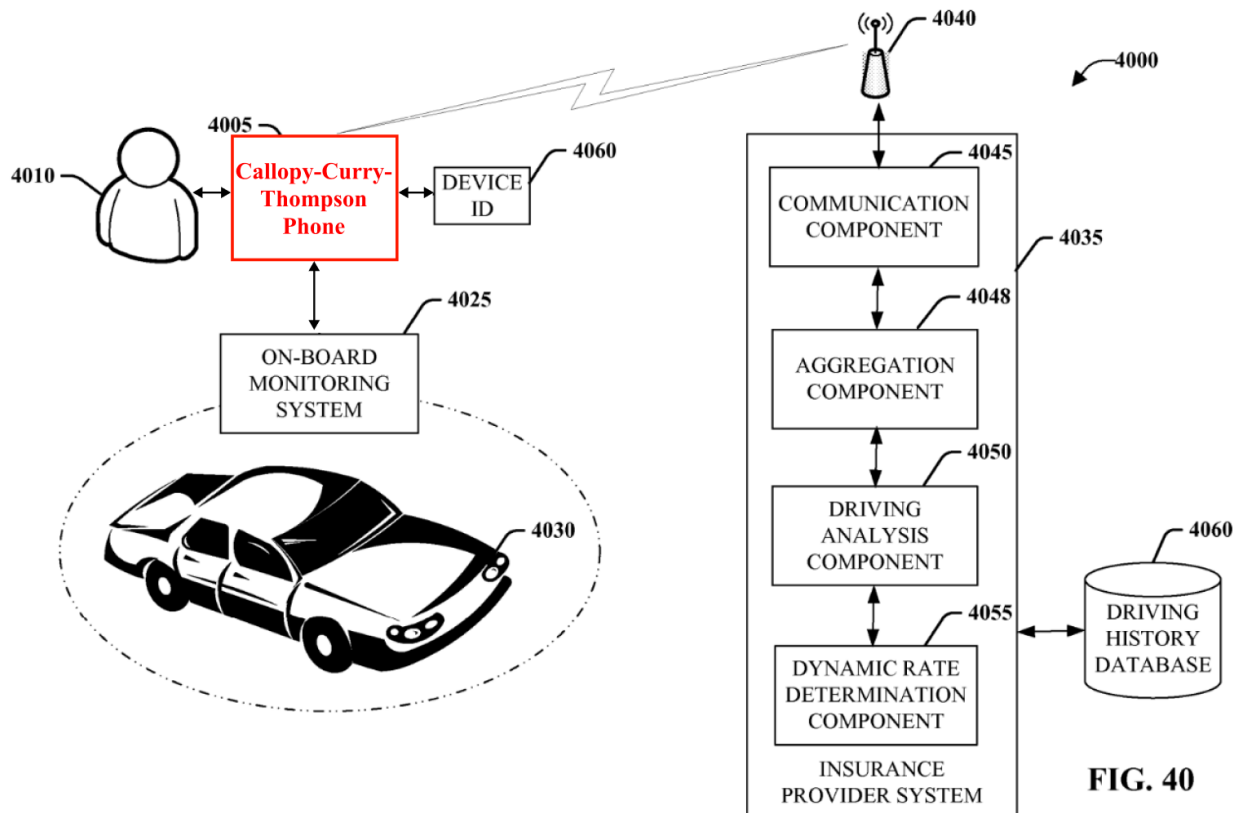
phone discussed above in Section X.A.1 with minimal or no changes to its hardware.

115. In incorporating Thompson's teachings into the Callopy-Curry system, a POSITA would have adapted the mobile device of Callopy-Curry to incorporate functionality provided by Thompson's WreckWatch application. When combined, the Callopy-Curry-Thompson phone ("CCT phone") includes an application with the combined functionality of Callopy's local application 4180, Curry's client 110, and Thompson's WreckWatch application. This integration logically advances Callopy and Curry's explicitly stated motivations to mitigate vehicular accidents and resultant casualties. USAA-1007, 2, 8-10. Additionally, this adaptation enables Curry's motion recording technique to benefit from advantages explicitly outlined by Thompson with respect to smartphone-based accident detection, including a reduction in overall traffic congestion and improved emergency response preparedness. USAA-1007, Abstract.

116. The CCT phone provides each of the monitoring functionality described in Callopy, Curry, and Thompson, including recording sensor data relating to driving safety statistics and detecting driving-related incidents (e.g., accident events, abnormal acceleration, abnormal braking). *See* USAA-1005, [0307]-[0310], [0314]-[0324]; USAA-1006, Abstract, 2:1-27, 3:1-4:28, 7:5-29, 8:21-27, 10:15-12:18, Figs. 1, 3. This combination is effectuated by incorporating

the software modules disclosed by Curry, including the activity mode recognition module and driving safety evaluation module, along with Thompson's software components, specifically the WreckWatch client, into Callopy's mobile device 4005. *Id.*

117. Additionally, to enable Thompson's described accident detection capability, the insurance provider system 4035 incorporates functionality consistent with Thompson's disclosed WreckWatch server, including data aggregation and communication infrastructure facilitating emergency responder notifications. USAA-1007, 6-7. An illustrative example of the integrated Callopy-Curry-Thompson system featuring the CCT phone is depicted in an annotated version of Callopy's Figure 40 below:



Callopy-Curry-Thompson

118. Configuring the Callopy-Curry system to leverage Thompson's teachings would have required only routine programming knowledge well within the skill of a POSITA prior to the earliest effective filing date. The change would have amounted to the use of a known technique to improve similar devices. In each instance, a smart phone equipped with a generic sensors and monitoring software is improved in a similar way. The combination is also performed according to known methods to yield the predictable results described above.

119. The modifications to Callopy-Curry based on Thompson's teachings would have involved use of a known technique (Thompson's accident detection

techniques) to improve similar types of mobile devices (mobile devices with accelerometers and GPS sensors, as described in Callopy and Curry). Thompson's accident detection techniques involve use of sensors already present in Callopy's mobile device 4005 and Curry's mobile phone 106 such that implementation of the CCT phone may be achieved without any changes to its underlying hardware. This involves combining prior art elements according to known methods to yield the predictable results described above.

120. A POSITA would have had more than a reasonable expectation of success when incorporating Thompson's teachings into Callopy-Curry. All three references utilize similar or identical hardware components, such as smartphones equipped with accelerometers and GPS sensors. As discussed above, implementation of the CCT phone would not required hardware modifications beyond the capabilities of a POSITA. Thompson's accident detection algorithms could be seamlessly integrated into the existing mobile application framework of the Callopy-Curry system through routine programming, as all systems already successfully process accelerometer and GPS data for vehicle monitoring purposes. The client-server architecture employed by all three references follows the same fundamental design pattern where mobile devices collect sensor data and transmit it to server systems for processing, making the communication infrastructure fully compatible for integration.

121. As discussed above, Thompson's accident detection algorithms process accelerometer readings to identify crash events by detecting large accelerations that exceed predefined thresholds. These are the same sensors already present and actively being used in the Callopy-Curry system. A POSITA would have recognized that the existing sensor infrastructure in the Callopy-Curry phone could supply all necessary data inputs for Thompson's accident detection algorithms without requiring any hardware modifications. This hardware compatibility would have provided strong confidence in the technical feasibility of the integration.

122. Callopy, Curry, and Thompson also employ a client-server architectural framework that follows a similar design pattern. Callopy's mobile device 4005 communicates with an insurance provider system 4035, Curry's mobile phone 106 transmits data to a driving safety server 104, and Thompson's WreckWatch client sends information to a WreckWatch server. This architectural consistency means that the communication protocols, data transmission methods, and server-side processing approaches would have been understood to be compatible. A POSITA would have recognized that Thompson's client-side accident detection algorithms and server-side emergency notification systems may be integrated into the existing communication infrastructure of the Callopy-Curry phone using standard networking techniques that were well-established in the art.

123. Thompson's contextual filtering approach to prevent false positives also aligns with speed data already being collected in the Callopy-Curry phone. The contextual information required for Thompson's filtering mechanisms was therefore already available within the Callopy-Curry phone. A POSITA would have recognized this data compatibility as indication that Thompson's accident detection capabilities could be implemented within the Callopy-Curry framework.

B. Analysis of Claims 1-4

1. Claim 1

[1.1] A data-logging system configured to monitor how safely a vehicle is being driven by a driver throughout a driving period and to log, during the driving period, driving information representing movement of the vehicle whilst the vehicle is being driven by the driver, the data-logging system comprising:⁴

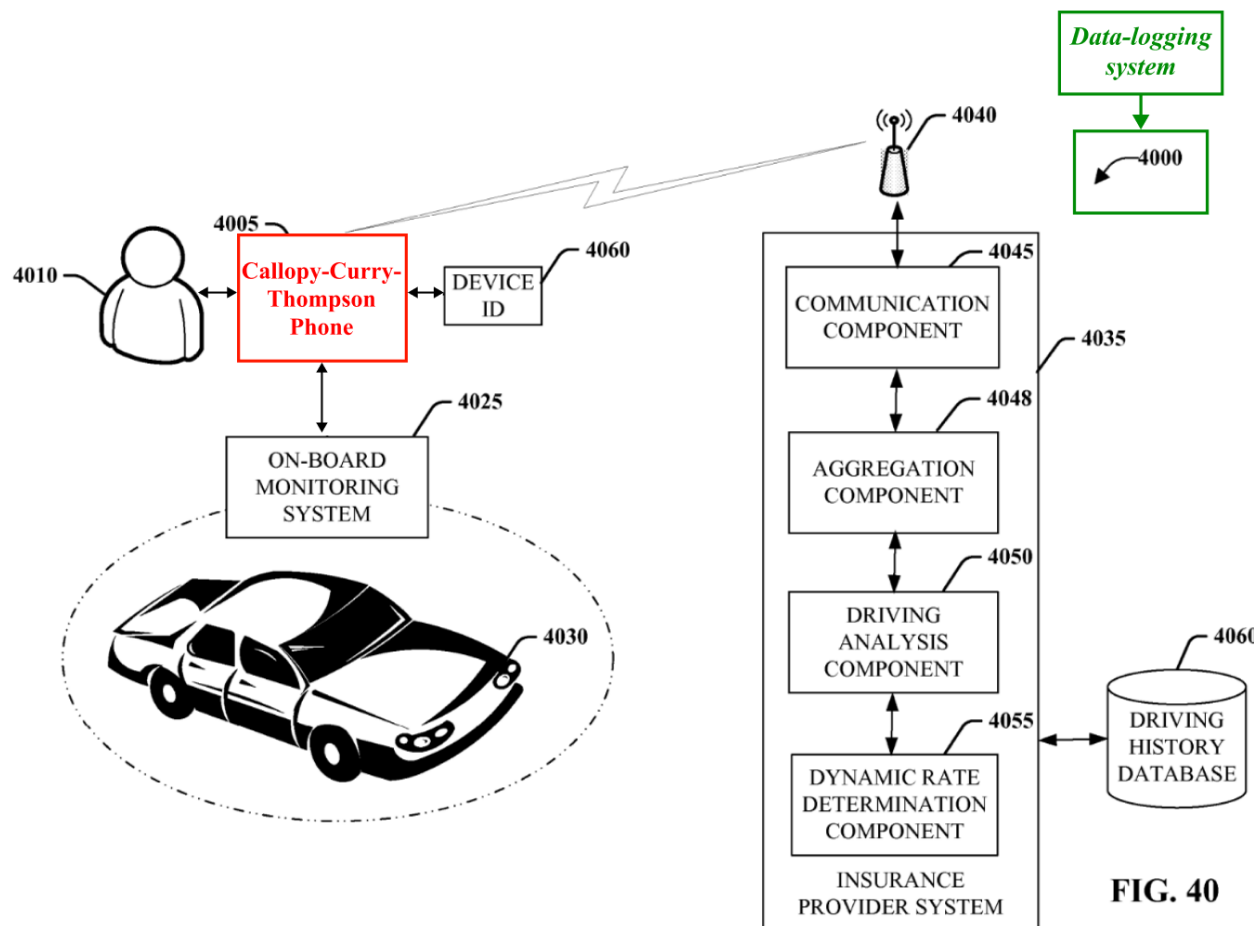
124. To the extent that the preamble is limiting, Callopy-Curry-Thompson makes it obvious. The combination provides functionality of Callopy's "system 4000" (***data-logging system***), including real-time monitoring of driving activity data associated with the CCT phone, and an insurance provider system 4035. USAA-1005, [0307]. The insurance provider system 4035 communicates with the CCT phone using wireless communications (as taught in Callopy). *Id.*

125. Callopy teaches examples of various analytical methods to facilitate determining a driver's safety profile, which involves monitoring how safely the

⁴ Reference to claim language is in bolded and italicized font.

vehicle is being driven. *See, e.g.*, USAA-1005, [0004], [0307], [0308]. The collected driving information includes real-time data that is continuously transmitted and logged during the driving period. *Id.* Curry further reinforces the concept of monitoring vehicle movement by teaching a system that records acceleration, deceleration, and location information to assess driving safety.

USAA-1006, 3:24-4:6.



USAA-1005, FIG. 40 (annotated)

126. As discussed for [1.5] below, the combined system provides a phone capable of deriving the various types of ***driving information*** described in each reference. For instance, Callopy describes “monitor[ing] and gather[ing] information regarding driver 4010’s driving skills, habits, etc.” USAA-1005, [0307]; *id.*, [0320]. Curry similarly describes “driving behavior” information, such as “talking...or texting...while driving” (USAA-1006, 7:5-29) and “speeding, abnormal acceleration, abnormal deceleration, and taking sharp turns” (*id.*, 3:24-4:6). Finally, Thompson describes “detect[ing] accidents by polling smartphone system sensors, such as the GPS receiver and accelerometers” using a smartphone software client. USAA-1007, 5. This functionality is provided during a time period when a vehicle is being driven (***driving period***). *Id.*

127. Callopy also describes a data-logging system that not only records sensor readings but also processes, analyzes, and derives higher-level driving information for evaluating driving safety. For example, Callopy states that its insurance provider system 4035 employs various analytical methods to determine a risk level associated with a driver or vehicle, which suggests processing and evaluating driving behavior rather than merely storing raw sensor data. USAA-1005, [0307]. A POSITA would have understood that implementing analytical methods on a computing device involves performing computations (i.e. processing) raw data to extract information.

128. Callopy also discloses that the system stores previous driving history and other data related to driver behavior. *Id.*, [0308]. This indicates that the Callopy system is configured to track and analyze historical trends to assess risk. Callopy also describes detecting and recording driving events, such as acceleration and deceleration patterns from GPS and accelerometer data, which are then used in determining insurance rates. *Id.*, [0323]-[0324]. Furthermore, Callopy suggests that its mobile device applications process data locally before transmission, reinforcing that driving information is not limited to raw sensor readings but includes processed insights. *Id.*, [0330]. These disclosures confirm that Callopy provides a comprehensive evaluation of driving safety and risk, well beyond mere data collection, supporting that it would have been obvious that Callopy suggests a data-logging system capable of evaluating driver performance.

129. As explained in Section VIII, claim 1 lacks any particular context with respect to the start or end of the ***driving period***, or a specific type of duration (i.e., a duration representing by the vehicle being in motion). As such, under its plain meaning, the ***driving period*** encompasses a time period representing a ***vehicle journey*** whether its start is at the start of driving or at some later time point during driving.

130. If the ***driving period*** were interpreted to require a time period associated with the start of driving, such a configuration is made obvious by

Callopy-Curry-Thompson. Given Callopy's suggestion that its mobile device 4005 monitors a variety of driver information, a POSITA would have found it advantageous to configure the CCT phone to initiate a recording period (***driving period***) at the start of driving to, for instance, collect additional information about "driving skills, habits, etc.," each of which is pertinent to insurance calculations. USAA-1005, [0307].

131. Curry also describes that activation of a "motion recording process" on its mobile phone can be accomplished "through an automated process by the mobile phone client when a selected type of motion is detected." USAA-1006, 13:20-26. Further, an "activity mode recognition module 306" on the mobile phone is configured to "use recorded time stamped data to estimate the type of activity," including "driving, walking, running or remaining substantially still." *Id.*, 13:27-14:4. From these descriptions, a POSITA would have recognized Curry suggests or renders obvious scenarios in which a start of driving is used to detect the activity type as "driving," which then results in an "automated process" by the mobile phone to activate a motion recoding process. Depending on the sensitivity of such a configuration, a POSITA would have recognized that the mobile phone may be configured to detect the activity type of "driving" at, for instance, the start of driving. In these circumstances, the CCT phone would have activated a motion

recording process at the start of driving such that the recording period represents an entire period of driving.

132. Each of Callopy, Curry, and Thompson teach mobile devices with accelerometers and GPS sensors, and given the availability of motion detection capabilities within the CCT phone, ; a POSITA would have found it obvious to leverage such capabilities to detect, for instance, motion associated with a vehicle being driven. *See, e.g.*, USAA-1005, [0323] (“The GPS 4110 provides information regarding the location of the respective device to which it is communicatively coupled.”).

[1.2] a remote data-logging server;

133. In Callopy-Curry-Thompson, Callopy’s insurance provider system 4035 (***remote data-logging server***) is configured to communicate with the CCT phone by “employing wireless communications” “via a transceiver 4040 and a communication component 4045.” USAA-1005, [0307]. This is shown in the annotated Figure 40 below. As discussed for [1.10]-[1.14], *infra*, Callopy’s insurance provider system 4035 includes functionality for the additional limitations recited in claim 1 for the ***remote data-logging server***.

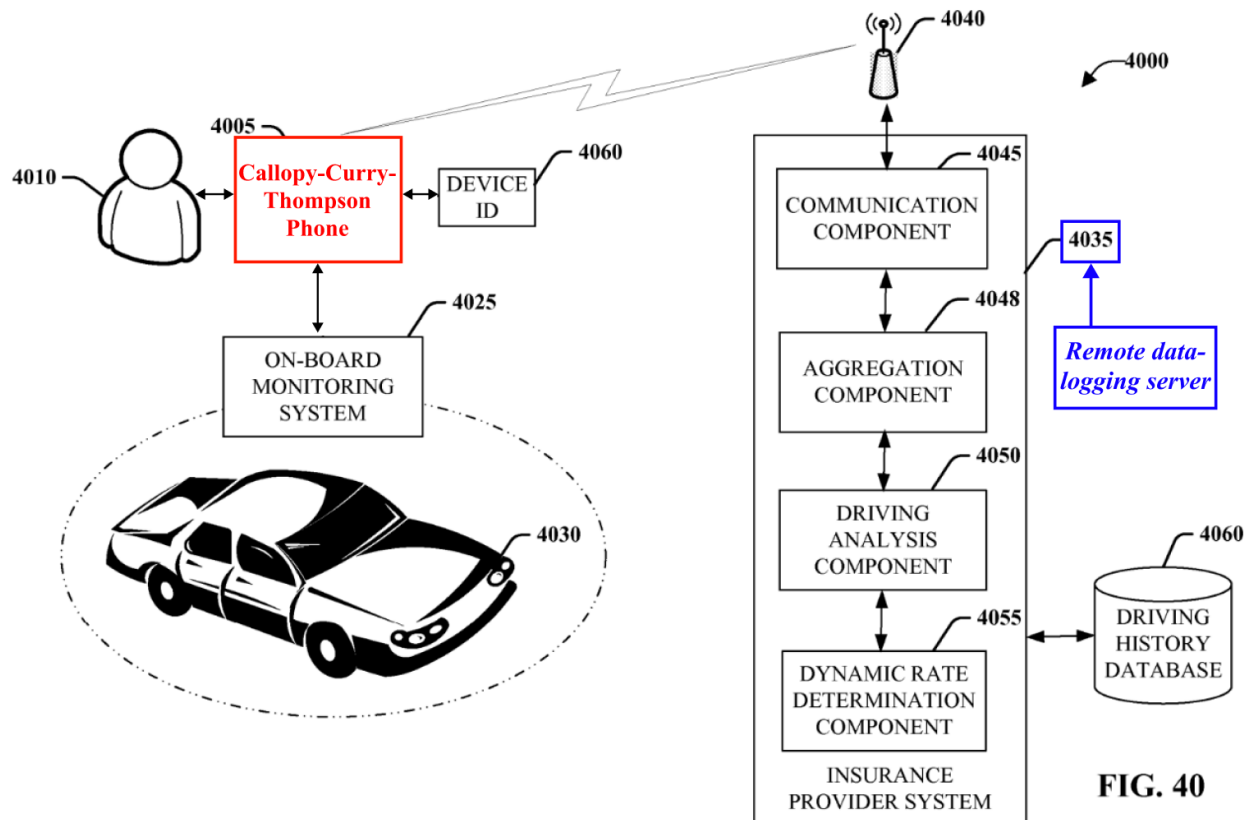
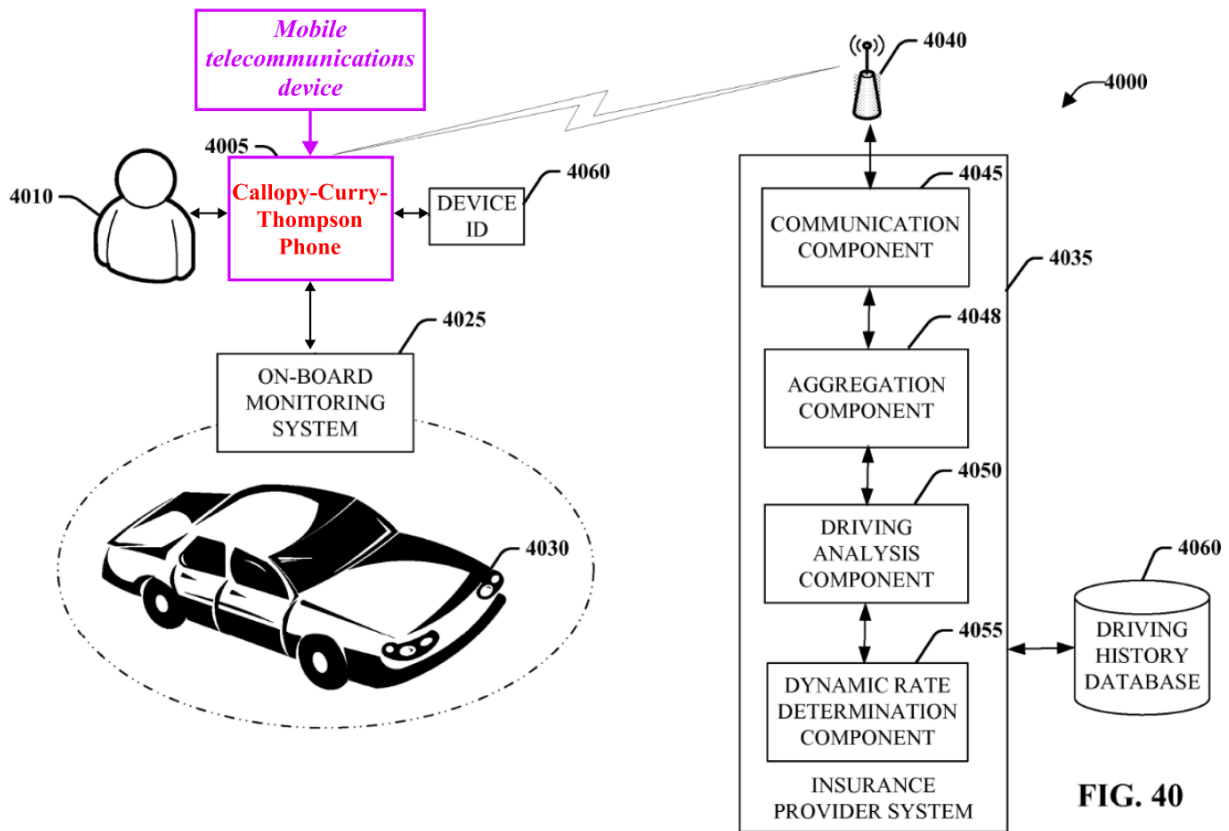


FIG. 40

USAA-1005, FIG. 40 (annotated)

[1.3] a mobile telecommunications device including a user interface, a processor, a memory, and a sensor set comprising at least an accelerometer and a positioning module; and

134. In Callopy-Curry-Thompson, the CCT phone (**mobile telecommunications device**) is configured as a smart phone with the combined functionality of Callopy's mobile device 4005, Curry's mobile phone 106, and Thompson's smartphone. See USAA-1005, [0307]-[0310], [0314]-[0324]; USAA-1006, Abstract, 2:1-27, 3:1-4:28, 7:5-29, 8:21-27, 10:15-12:18, Figs. 1, 3. This is shown in the annotated Figure below:



USAA-1005, FIG. 40 (annotated)

135. As discussed in Section X.A.2, the CCT phone includes an application with the combined functionality of Callopy’s local application 4180, Curry’s client 110, and Thompson’s WreckWatch application. This configuration enables determination of whether an associated vehicle is being driven. USAA-1006, 8:20-9:33. The application running on the CCT phone additionally enables the CCT phone to process “raw data” collected during a driving period to log driving activity and derive information associated with a user’s driving behavior. USAA-1006, 8:30-9:3; *id.*, Abstract, 3:24-4:6, 11:3-14, Figs. 1, 3, 5.

136. The CCT phone includes features corresponding to the requisite elements recited in [1.3]. The CCT phone features a “graphical ***user interface***” (USAA-1006, 8:5-27) configured to display data (*id.*, 21:23-25) and to enable user interactions. Curry also describes various examples of UI-enabled user interactions including receiving a phone call while driving, and manually switching activity modes. USAA-1006, 7:5-27, 8:5-27, 9:5-28, 10:15-25, 13:20-26, 16:7-22, 21:23-25. Callopy and Thompson similarly describe mobile devices with user interfaces. *See, e.g.*, USAA-1005, [0346] (“Via an interface associated with the on-board monitoring system 4025, or the mobile device 4005, the user can respond by selecting the appropriate reason from a list of reasons”); USAA-1007, 32-33, Fig. 3.

137. The CCT phone also includes a ***processor***. As described in Callopy, a mobile phone includes any combination of components that allow gathering, processing, transmission, presentation, evaluation determination of insurance rates and any pertinent information...” USAA-1005, [0321]; *see id.*, [0321] (describing that mobile device 4005 can “comprise of any combination of components that allow gathering, processing, transmission, presentation, evaluation, determination of insurance rates and any pertinent information, and any components to assist and enable the identification of the driver to the insurance provider system 4035”). Curry similarly teaches processes may be “implemented in software for execution

by various types of processors.” USAA-1006, 6:3-10. For example, “[a] user can download...required software...to the mobile phone [] to set up the client unit [110],” and “client 110 can record location, speed and acceleration data from [embedded] sensors...to a local motion data cache 118 for further processing.” USAA-1006, 3:24-26, 8:20-27. Based on data stored in a “local” cache within the phone “for further processing,” and other references to “mobile computing,” a POSITA would have considered the existence of a **processor** within the same phone to have been implicitly disclosed, and if not, obvious. USAA-1006, 8:20-27, Fig. 1; USAA-1021, 237-250. See USAA-1006, 2:22-27, 6:3-10; USAA-1021, 4; USAA-1024, 2-8; USAA-1022, ¶¶[0046]-[0063], FIG. 3. Thompson similarly describes mobile devices with processors. USAA-1007, 29 (“For example, the Nexus One has a 1Ghz processor and 512MB of RAM compared to the older Palm Treo’s 312Mhz processor and 64MB of RAM”).

138. Similarly, the CCT phone also includes **memory**. As described in Callopy, a mobile phone includes a “memory buffer 4170” that “allows data to be gathered and stored” in relation to local applications 4180 running on the mobile phone. USAA-1005, [0329]; see *id.*, [0330] (describing that mobile device 4005 includes one or more local applications 4180, which can “process the data as it is gathered thereby allowing the processed data to be stored as opposed to the raw data, where it is envisioned that the processed data occupies less memory than the

raw data”). Curry also describes “memory devices” that store sensor data, derived information, and “executable code.” USAA-1006, 6:11-20. A POSITA would therefore find understood and find obvious that the CCT phone includes memory devices for storing data, e.g., raw sensor data and information derived from the raw sensor data. USAA-1006, 7:5-22, 8:29-9:28, 13:20-15:6, Fig. 3. Thompson similarly describes mobile devices with memory. USAA-1007, 32-33.

139. The CCT phone also includes a **sensor set**. As described in Callopy, a mobile phone includes an “accelerometer” (**accelerometer**) and a “GPS” sensor (**positioning module**). USAA-1005, [0032]; *see id.*, [0323] (“...GPS 4110 and the accelerometer 4120 can be located in the mobile device 4005...”); *see also id.*, [0038]. Curry also describes embedded sensors, including accelerometer 116 and GPS receiver 114. USAA-1006, 2:23-27, 3:2-15, 7:23-8:2, 8:30-9:3, 10:16-26, 11:15-25, Fig. 1; USAA-1024, 2-3; USAA-1025, 87, 88, 108. Thompson similarly describes mobile devices with sensor sets, including an accelerometer and positioning sensors. *See, e.g.*; USAA-1007, Abstract (“[s]martphones and their onboard sensors (such as GPS receivers and accelerometers) are promising platforms...”).

[1.4] an application comprising computer-executable instructions downloaded onto the memory, wherein the computer-executable instructions, when executed by the processor, cause the mobile telecommunications device to:

140. As discussed in Section X.A.2, the CCT phone includes an application (**application**) with the combined functionality of Callopy's local application 4180, Curry's client 110, and Thompson's WreckWatch application. Based on Curry, an application may be downloaded a server (e.g., Curry's server 104) onto the CCT phone (**downloaded onto the memory**). USAA-1006, 7:5-29, 9:5-11, 8:21-9:33. The application enables the CCT phone to perform various actions, including processing sensor data from a driving period to derive information associated with a user's driving behavior, and processing the stored information to determine a mode within which the phone should operate. The application includes software logic (**computer-executable instructions**) to cause the CCT phone to provide such functionality. *Id.*

[1.5] process, using the processor, raw sensor data representing at least acceleration of the vehicle and position of the vehicle from the sensor to generate derived driving information representing how safely the vehicle is being driven by the driver throughout the driving period

141. As explained in Section VIII (and for [1.1]), the claim language does not require the **driving period** to be defined by an entire time period of driving. The **driving period** is described in relation to a **duration of a vehicle journey**. See [1.6], *infra*. This lacks any attributes with respect to the start or end of the **driving period**, or a specific type of duration (i.e., a duration representing by the vehicle

being in motion). Under its plain meaning, the ***driving period*** encompasses a time period representing a ***vehicle journey***. The claim does not require the time period to start at a specific time point within a vehicle being driven so it may be at the start of driving or at some later time point during driving.

142. As discussed above for [1.1], if the ***driving period*** were interpreted to require a time period associated with the start of driving, such a configuration is made obvious by Callopy-Curry-Thompson. Given Callopy's suggestion that its mobile device 4005 monitors a variety of driver information, a POSITA would have found it advantageous to configure the CCT phone to initiate a recording period (***driving period***) at the start of driving to, for instance, collect additional information about "driving skills, habits, etc.," each of which is pertinent to insurance calculations. USAA-1005, [0307].

143. Curry also describes that activation of a "motion recording process" on its mobile phone can be accomplished "through an automated process by the mobile phone client when a selected type of motion is detected." USAA-1006, 13:20-26. Further, an "activity mode recognition module 306" on the mobile phone is configured to "use recorded time stamped data to estimate the type of activity," including "driving, walking, running or remaining substantially still." *Id.*, 13:27-14:4. From these descriptions, a POSITA would have recognized Curry suggests or renders obvious scenarios in which a start of driving is used to detect the activity

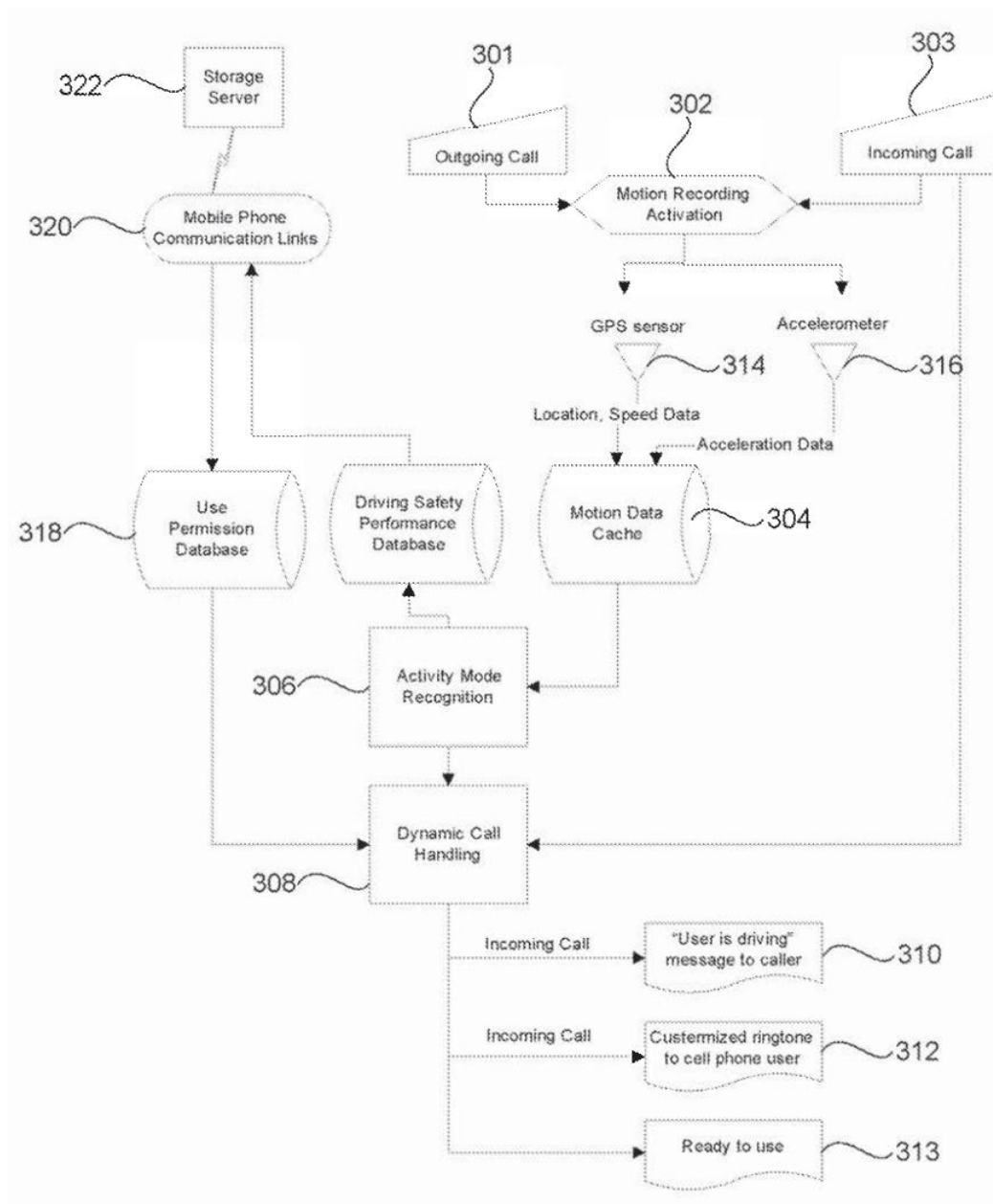
type as “driving,” which then results in an “automated process” by the mobile phone to activate a motion recoding process. Depending on the sensitivity of such a configuration, a POSITA would have recognized that the mobile phone may be configured to detect the activity type of “driving” at, for instance, the start of driving. In these circumstances, the CCT phone activates a motion recording process at the start of driving such that the recording period represents an entire period of driving.

144. Each of Callopy, Curry, and Thompson teach mobile devices with GPS sensors, and given the availability of motion detection capabilities within the CCT phone. A POSITA would have found it obvious to leverage such capabilities to detect, for instance, motion associated with a vehicle being driven. *See, e.g.,* USAA-1005, [0323] (“The GPS 4110 provides information regarding the location of the respective device to which it is communicatively coupled.”).

145. The CCT phone is also configured to process sensor acceleration data (***acceleration of the vehicle***) and movement data (***position of the vehicle***) recorded from its embedded sensors (e.g., accelerometer, GPS sensor) during the driving period to generate various types of derived information relating to driving (***driving information***). For example, in Curry, a mobile phone processes sensor data to derive “driving behavior” information, e.g., “talking...or texting...while driving” and “speeding, abnormal acceleration, abnormal deceleration, and taking sharp

turns.” USAA-1006, 7:5-29, 8:21-27, 8:30-9:33, 10:15-26, 11:3-14. Callopy similarly describes that its mobile device derives, from acceleration and position data, “information regarding driver 4010’s driving skills, habits, etc.” USAA-1005, [0307]. Thompson likewise processes accelerometer data to determine accidents. USAA-1007, 8.

146. For example, in Curry’s Figure 3 (below), “[e]ach motion measurement” is associated “with a timestamp” and stored “in a local motion data cache 304 for each pre-specified sampling interval.” USAA-1006, 13:27-31. An “activity mode recognition module 306” uses the “recorded time stamped data to estimate the type of activity” (e.g., “driving, walking, running or remaining substantially still”) “in real-time,” both “to allow or disallow users to receive or make a call, text...or use...software programs,” and to derive driving information that is stored in local memory. USAA-1006, 13:20-26, Fig. 3.



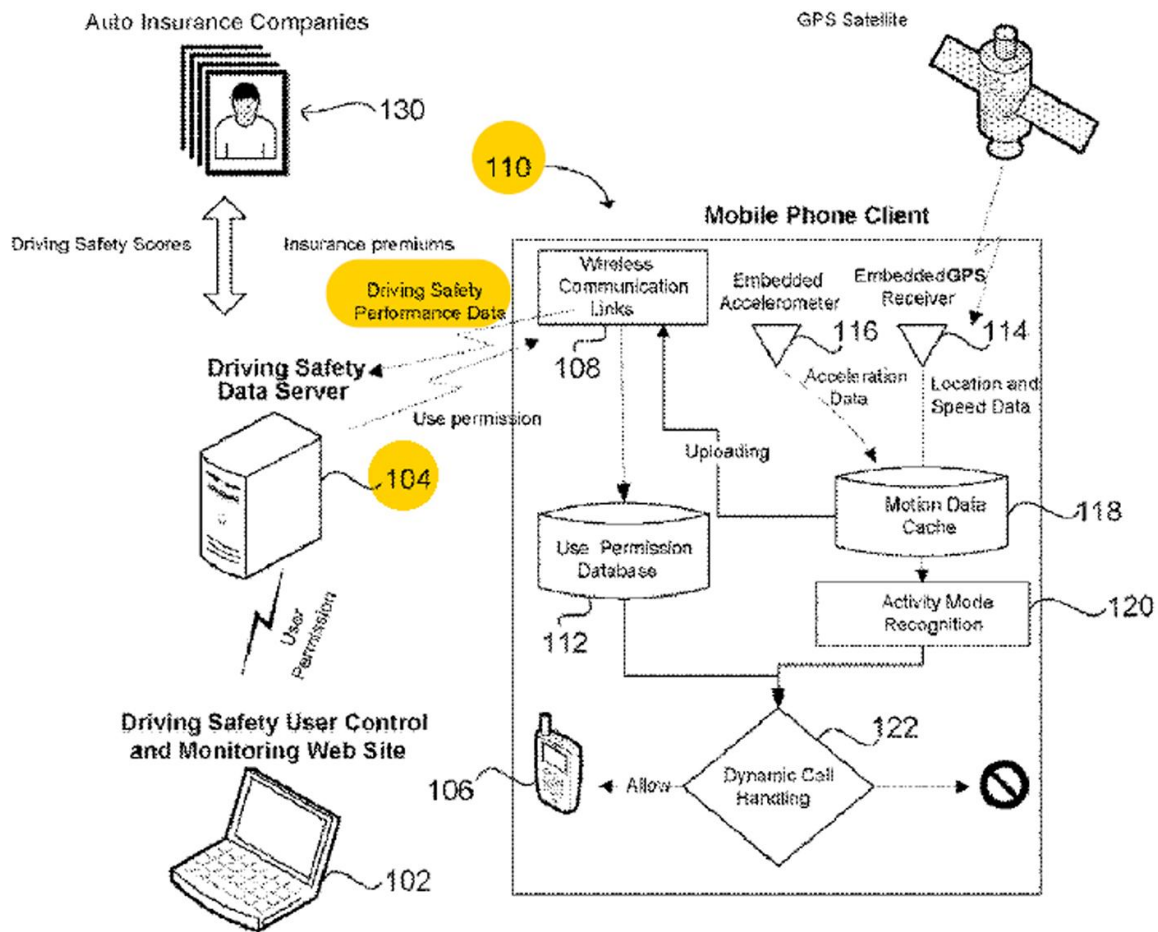
USAA-1005, FIG. 3

147. From this and related descriptions, a POSITA would have understood and/or found obvious processing sensor data during the driving period to generate **derived driving information**, e.g., “talking...or texting...while driving” and “speeding, abnormal acceleration, abnormal deceleration, and taking sharp turns.”

USAA-1006, 7:5-29, 8:21-27, 8:30-9:33, 10:15-26, 11:3-14, Figs. 1, 3; USAA-1021, 233-250.

148. Based on Curry's disclosures, a POSITA would have also understood and found obvious the CCT phone is configured to locally process sensor data collected by its sensors (e.g., accelerometer, GPS sensor) prior to transmitting information to an associated server. Curry describes "sensors embedded in mobile phones" are used to track "location, speed, and acceleration data of a driver[,] and further, that "[t]he communication links in the mobile phone can be used to [transmit] driving safety performance data to a central data server." USAA-1006, 11:15-25. These descriptions follow one another within the same paragraph, suggesting that "location, speed, and acceleration data" are examples of "driving safety performance data" (i.e., data indicating safety performance associated with driving).

149. Additionally, "driving safety data" is "recorded" (e.g., processed) on a mobile phone and "transmitted" to a server via "communication links," further confirming processing of such data by the mobile phone. USAA-1006, 7:5-22. As highlighted below, in Curry's system, the "driver safety performance data" is recorded/processed by mobile phone client 110 (running on a mobile phone) is transmitted to driving safety data server 104:

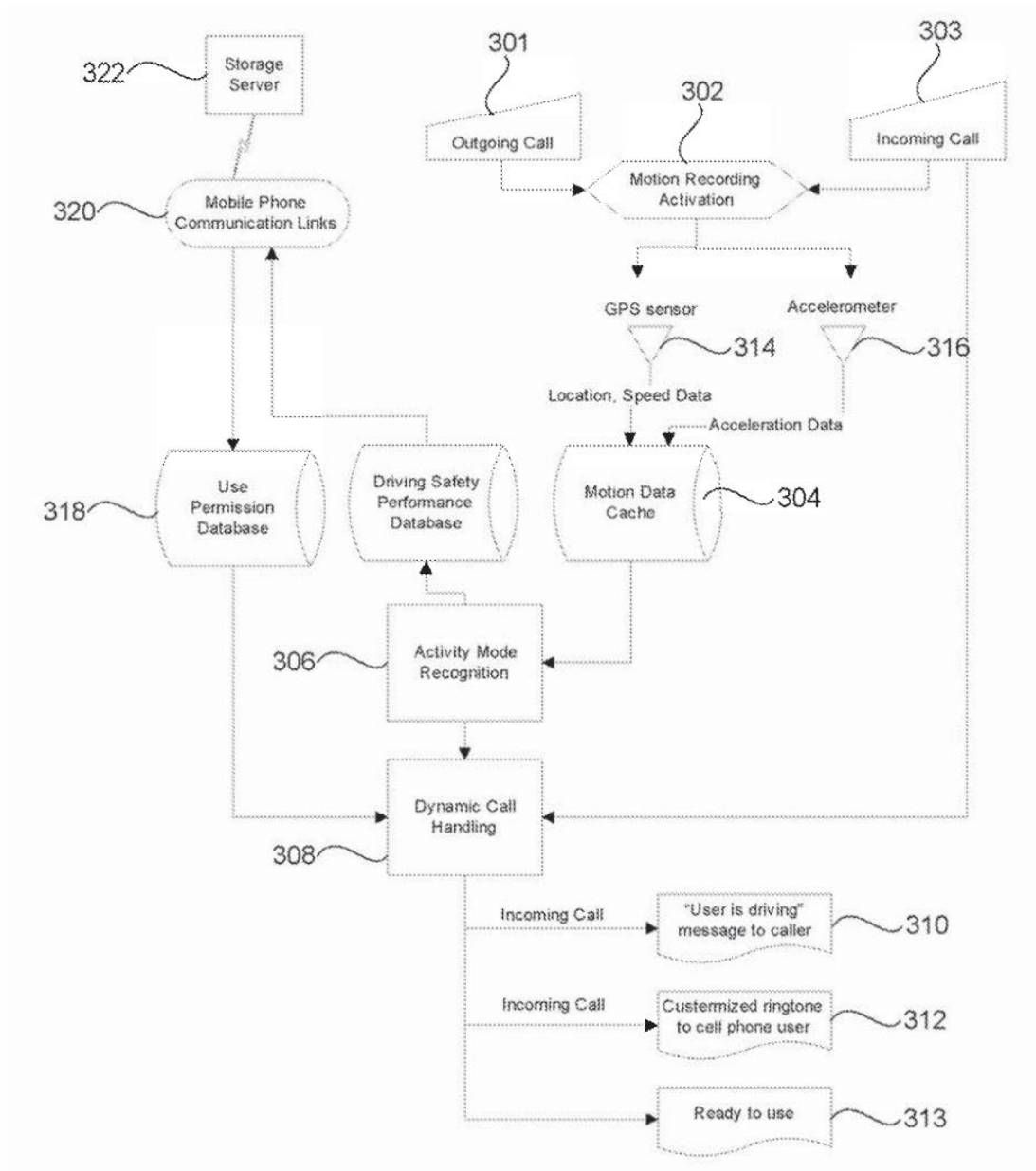


USAA-1006, FIG. 1 (annotated)

150. Curry also teaches its mobile phone 106 collects other types of driving information, such as “[a] safety statistic and other information,” which are then “made available to the selected individuals...” USAA-1006, 4:7-11. The safety statistic can be “reported to” a data server, which confirms location processing of the safety statistic on the mobile phone. *Id.*, 3:24-4:6. For example, “the driver safety statistic may be decreased for certain user behaviors, such as use of the

device while driving...,” further confirming calculation of a value of the driver safety statistic on the mobile phone. *Id.*, 3:24-4:6; *see id.*, 21:4-6.

151. Another example of local processing is shown in Curry’s Figure 3. In this figure, when the monitoring mode is activated, “the motion recording processed can be activated 302 on the phone,” which may be accomplished “through an automated process by the mobile phone client...” USAA-1006, 12:20-26. In this scenario, Curry confirms that sensor data collected upon activation of the monitoring mode is raw data that is from a driving period (i.e., a period during which a vehicle is being driven and a phone call is received). Curry also confirms this because “mobile phone client 110 can record location, speed, and acceleration data” “[w]hen a call is made or received.” USAA-1006, 8:29-9:11.



USAA-1006, FIG. 3

[1.6] wherein the driving period is defined by a duration of a vehicle journey, and the derived driving information includes a driving score, and

152. Callopy-Curry-Thompson renders this limitation obvious. As discussed for [1.3], in the combination, the CCT phone includes an application with the combined functionality of Callopy's local application 4180, Curry's client

110, and Thompson's WreckWatch application. This configuration would have made it obvious that a recording period associated with vehicle monitoring by the CCT phone (***driving period***) is defined by a time duration associated with vehicle travel (***duration of a vehicle journey***). The CCT phone is configured to start the recording period based on sensor data (e.g., a measured speed satisfying a threshold, a detected change in activity mode to driving). *See* USAA-1005, [0307]; USAA-1006, 13:20-26; USAA-1007, 8. Smartphone configurations for using sensor data in relation to starting and terminating driving-related monitoring periods were well-known by the Critical Date. *See, e.g.*, USAA-1010, 11:21-40, USAA-1049, 198-99.

153. As explained in Sections VIII.A-C (and for [1.1] and [1.5]), claim 1 does not limit the ***driving period*** to an entire time period associated with driving. The scope of the ***driving period*** is limited by reference to a ***duration of a vehicle journey***. Claim 1 also does not describe attributes with respect to the start or end of the ***driving period***, or a specific type of duration (i.e., a duration representing by the vehicle being in motion). As explained in Section VIII.A the plain meaning of the ***driving period*** encompasses a time period representing a ***vehicle journey*** whether its start is at the start of driving or at some later time point during driving.

154. Additionally, if the ***driving period*** were interpreted to represent an entire period of driving, this interpretation would have been obvious over Callopy-

Curry-Thompson. Given Callopy's suggestion that its mobile device 4005 monitors a variety of driver information, a POSITA would have found it advantageous to configure the CCT phone to initiate a recording period (***driving period***) at the start of driving to, for instance, collect additional information about "driving skills, habits, etc.," each of which is pertinent to insurance calculations. USAA-1005, [0307].

155. Curry also describes that activation of a "motion recording process" on its mobile phone can be accomplished "through an automated process by the mobile phone client when a selected type of motion is detected." USAA-1006, 13:20-26. Further, an "activity mode recognition module 306" on the mobile phone is configured to "use recorded time stamped data to estimate the type of activity," including "driving, walking, running or remaining substantially still." *Id.*, 13:27-14:4. From these descriptions, a POSITA would have recognized Curry suggests or renders obvious scenarios in which a start of driving is used to detect the activity type as "driving," which then results in an "automated process" by the mobile phone to activate a motion recoding process. Depending on the sensitivity of such a configuration, a POSITA would have recognized that the mobile phone may be configured to detect the activity type of "driving" at, for instance, the start of driving. In these circumstances, the CCT phone would have activated a motion

recording process at the start of driving such that the recording period represents an entire period of driving.

156. Thompson also teaches the capability to determine each of the start and the end of monitoring, thereby rendering obvious the capability to determine the ***duration of a vehicle journey***. For example, a “[s]peed filter” is used to “determine[] whether users are in vehicles” and, in some embodiments, the phone “begins recording accelerometer information and looking for potential accidents above 15mph.” USAA-1007, 8. Further, the phone maintains this monitoring context “until the device is unplugged...” *Id.* From these disclosures, a POSITA would have understood that the CCT phone may be similarly configured, for example, to use a speed filter to initiate the monitoring of sensor data in relation to the ***driving period*** such that the monitoring period is ***defined*** by a vehicle’s travel when speed is above 15mph and until the CCT phone is unplugged (***duration of a vehicle journey***).

157. Thompson also recognizes that the speed threshold “may be adjusted at compile time.” USAA-1008, 8. Based on this suggestion, a POSITA would have understood and found obvious that, in some implementations, the CCT phone may be configured to use a lower speed threshold (e.g., 1mph). This configuration would have allowed a mobile device capture a greater portion of the time a vehicle is being driven. Use of lower speed threshold values is also consistent with

Thompson's suggestion that its application is configured to maintains recording "until the device is unplugged, which prevents Wreck-Watch system from shutting off at stop lights." USAA-1008, 8.

158. Consistent with the teachings of Callopy and Curry, the CCT phone is also been configured to calculate scores associated with monitored sensor information, rendering the **driving score** obvious. Curry describes calculating driving safety scores based on driving behavior information derived from sensor data, " talking...or texting while driving" (USAA-1006, 12:3-19) and "speeding, abnormal acceleration, abnormal deceleration, and taking sharp turns" (*id.*, 3:24-4:6).

159. Additionally, Curry's mobile phone 106 adjusts a driver safety statistic based on previously-collected motion data. Specifically, the "activity mode recognition module" (which runs locally on a phone) is configured to "adjust the related safety score for the user if a violation is identified." USAA-1006, 10:7-10. A POSITA would have recognized that "adjust[ing]" indicates calculation of a new value for the "safety score" on the phone, which suggests local calculation of a score on the phone. See USAA-1006, Abstract, 2:1-3:6, 7:5-22, 8:29-11:18, 12:319, 13:27-14:26, 15:13-18, 16:1-17:4. It would have been obvious for the CCT phone to be similarly configured to locally calculate a driving score.

[1.7] wherein the processing of the raw sensor data, by the processor, includes determining a driving incident occurring within the driving period by comparing the raw sensor data against at least one predetermined threshold value and detecting the driving incident when the raw sensor data exceeds the at least one predetermined threshold, the driving incident including at least one of harsh braking, harsh acceleration, harsh swerving or a vehicle accident

160. Limitation [1.7] does not require determination of each of **harsh braking, harsh acceleration, harsh swerving** and **a vehicle accident**. This list represents categorical options for the **driving incident**, and the claim language confirms the determination operation may be met by a driving incident that is **at least one** of these categorical options. The CCT phone is configured to detect multiple of these categorical options in any event.

161. As discussed for [1.3], the CCT phone includes an application with the combined functionality of Callopy's local application 4180, Curry's client 110, and Thompson's WreckWatch application. In Thompson, a smartphone is configured to process accelerometer data (**raw sensor data**) in detecting an accident occurring within a monitoring period (**driving incident occurring within the driving period**). USAA-1007, 8-10. For example, the smartphone "detects traffic accidents and records data related to accident events, such as the G-forces (accelerations) experienced by the driver." *Id.*, 2. The CCT phone is similarly configured to detect an accident event (**vehicle accident**).

162. To detect accident events, the CCT phone compares values specified in accelerometer data (**comparing**) with a threshold (e.g., 4g measured acceleration) (**at least one predetermined threshold value**) to differentiate between normal movement and a car accident. USAA-1007, 8 (“This value is designed to detect even minor accidents but filter out a drop or sudden stop.”). This differentiation allows the detection of accidents based on values exceeding 4g’s (**detecting the driving incident when the raw sensor data exceeds the at least one predetermined threshold**).

163. Beyond accident detection, the CCT phone is also configured to determine other types of driving incidents recited in [1.7]. As discussed above, consistent with Curry’s teachings, the CCT phone detects “abnormal acceleration” (**harsh acceleration**), “abnormal deceleration” (**harsh braking**), and “taking sharp turns” (**harsh swerving**). USAA-1006, 3:24-4:6. A POSITA would have understood and found obvious that these parameters may be determined through use of an appropriate threshold value.

164. As explained above, the CCT phone is capable of processing raw sensor data locally to determine driving incidents occurring within a driving period by evaluating whether sensor values exceeded predetermined thresholds. These capabilities are well-supported by the underlying hardware capabilities and software functionalities described in Callopy, Curry, and Thompson. The CCT

phone also incorporates the necessary sensor hardware to detect various driving incidents.

165. The teachings of Callopy, Curry, and Thompson also support threshold-based detection of each of the types of driving incidents recited in [1.7] using locally processed sensor data. As for **harsh braking**, this would be detectable by the CCT phone through sudden negative acceleration (deceleration) measured by the phone's accelerometer (e.g., along the forward axis). When this deceleration exceeds a predetermined threshold (e.g., -0.5g), it would be classified as a harsh braking event. Curry and Thompson specifically demonstrates this capability through measuring deceleration. USAA-1006, 3:24-4:6 ("...the wireless device may collect speed and location information" including "abnormal deceleration"); USAA-1007, 9-10 (describing the ability to monitor "a vehicle by reaching a speed of approximately 25 mph and engaging in a sudden stop.").

166. As for **harsh acceleration**, this would be detectable by the CCT phone through sudden positive acceleration measured by the phone's accelerometer (e.g., along the forward axis). When this acceleration exceeds a predetermined threshold (e.g., +0.4g), it would be classified as a harsh acceleration event. Curry specifically demonstrates this capability through measuring acceleration. USAA-1006, 3:24-4:6 ("...the wireless device may collect speed and location information" including "abnormal acceleration"). Curry also identifies abnormal acceleration as one type

of unsafe driving behavior, which makes clear that this detection involves comparing measured acceleration values against threshold values that define normal versus abnormal acceleration. *Id.*

167. As for **harsh swerving**, this would be detectable by the CCT phone through sudden lateral acceleration measured by the phone's accelerometer (e.g., along the side-to-side axis). When this lateral acceleration exceeds a predetermined threshold (e.g., $\pm 0.4g$), it would be classified as a harsh swerving event. Curry and Thompson specifically demonstrates this capability through measuring motion along multiple axes. Curry teaches the ability to detect "taking sharp turns." USAA-1006, 3:24-4:6. Similarly, Thompson's multi-axis analysis capability enables detection of swerving incidents through threshold-based evaluation of lateral acceleration. USAA-1007, 10-11, Fig. 8.

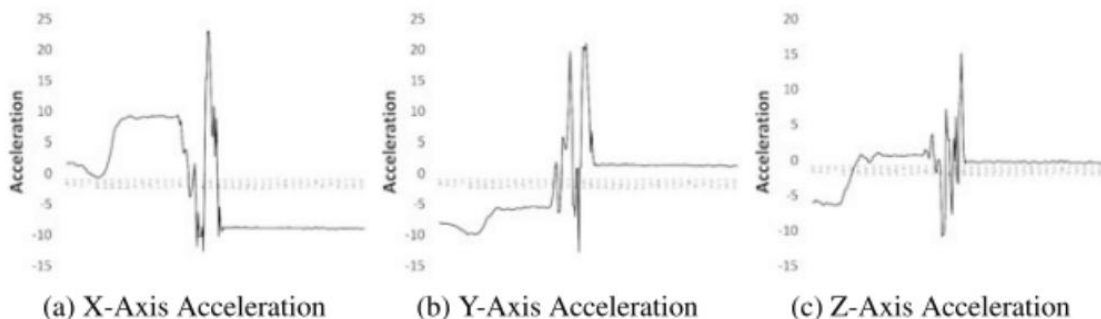


Fig. 8. Acceleration During a Sudden Stop

USAA-1007, Fig. 8

[1.8] generate the derived driving information without data from vehicle sensors throughout the driving period in which the mobile telecommunications

***device is within the vehicle and the vehicle is being driven by the driver;
and***

168. Callopy-Curry-Thompson makes this limitation obvious. As discussed for [1.5], the CCT phone generates ***derived driving information*** based on sensor data collected by mobile device sensors (GPS, accelerometer). USAA-1005, [0308], [0323]-[0324], [0330], [0333]-[0334], [0342], [0346], [0388]. This information may include “information regarding driver 4010’s driving skills, habits, etc.” (USAA-1005, [0307]) and “driving behavior” information, such as “talking...or texting...while driving” (USAA-1006, 7:5-29) and “speeding, abnormal acceleration, abnormal deceleration, and taking sharp turns” (*id.*, 3:24-4:6).

169. Given that the CCT phone includes requisite sensing and processing capabilities to generate the ***derived driving information***, a POSITA would have understood and found obvious that the information may be generated without reliance on ***vehicle sensors***. Callopy explains that the “GPS 4110 and the accelerometer 4120 can be located in the mobile device.” USAA-1005, [0323]. Callopy also describes video cameras 4140 that can be located on a vehicle 4030 but does not teach that the cameras are vehicle sensors. *See id.*, [0327]. Callopy’s discussion of sensors in relation to Figure 41 are contrasted with Callopy’s discussion of a separate and different “real-time insurance system” (in Figure 43)

that explicitly includes “an on-board monitoring system [] installed in a vehicle to facilitate the collection of real-time data from the vehicle.” *Id.*, [0358]; *see also*, 157 (claim 109). To the extent that Callopy discusses vehicle sensors with respect to Figures 40-42, it describes permissive, not mandatory, language. *Id.*, [0325]-[0326] (“can”).

170. A POSITA would have found obvious that, based on the above examples, the CCT phone may be configured to derive driving information without data from the vehicle sensors, at least because some of those examples focus only on leveraging driving data (GPS and accelerometer data) from sensors “located in the mobile device,” rather than collecting data from the vehicle. USAA-1005, [0323], [0358]. Further, from Callopy’s teaching, a POSITA would have understood there to be no need to use data from vehicle sensors to derive driving information and would have found obvious that derivation of that driving information without data from the vehicle’s sensors provides an elegant and cost-effective means of obtaining driving information, without the complexities and costs that might potentially be involved in obtaining and integrating data from a vehicle’s sensors. USAA-1005, [0306], [0366]; USAA-1006, 11:15-25.

[1.9] transmit at least some selection of the derived driving information including the driving incident to the remote data-logging server,

171. The CCT phone is configured to send (**transmit**) at least some of its derived driving information (**at least some selection of the derived driving information**) to insurance provider system 4035 (**remote data-logging server**) for further processing, e.g., insurance rate calculations. As discussed above, the information sent to the insurance provider system 4035 may identify various types of **driving incidents** recited in [1.7], such as an accident event (**vehicle accident**), “abnormal acceleration” (**harsh acceleration**), “abnormal deceleration” (**harsh braking**), and “taking sharp turns” (**harsh swerving**). See USAA-1007, 2, 8-10; USAA-1006, 3:24-4:6. This is consistent with the teachings of Callopy, Curry, and Thompson, which teach a mobile phone providing data monitoring functionality through communicating derived information to an associated server. The CCT phone is similarly configured to send **derived driving information including the driving incident** to the insurance provider system 4035.

172. For example, Thompson describes that upon detecting an accident, a smartphone sends accident-related information to a server for further processing (e.g., to notify authorities about a detected accident). USAA-1007, 2-3, Fig. 2. Curry and Callopy each describe techniques for their respective mobile devices to provide communications relating to monitored information to a central server. See,

e.g., USAA-1005, [0307]; USAA-1006, 8:21-27, 9:23-28. Thus, in the combined system, the CCT phone is similarly configured to send accident-related information to the insurance provider system 4035 for additional processing.

[1.10] wherein the remote data-logging server is configured to log the at least some of the derived driving information received from the mobile telecommunications device

173. Callopy-Curry-Thompson renders [1.10] obvious. In the combination, insurance provider system 4035 (***remote data-logging system***) is configured to store derived driver information generated by the CCT phone (***derived driving information received from the mobile telecommunications device***). As explained for [1.5], examples of such information include “information regarding driver 4010’s driving skills, habits, etc.” (USAA-1005, [0307]), information identifying “talking...or texting...while driving” (USAA-1006, 7:5-29), and “speeding, abnormal acceleration, abnormal deceleration, and taking sharp turns” (*id.*, 3:24-4:6).

174. In Callopy, insurance provider system 4035 stores “any information gathered or generated by the various components of system 4000,” including “information retrieved from the mobile device 4005,” among other information. USAA-1005, [0309]. Further, various information can be obtained and/or processed by the mobile device 4005 (and its various components) and retrieved from the insurance provider system 4035. *Id.*, [0323]-[0324], [0330], [0346],

[0347], [0388]. For example, using an “interface associated with ... the mobile device 4005, the user can respond” to user prompts and provide feedback that is gathered. *Id.*, [0346]. Additionally, GPS 4110 located in the mobile device 4005 can “provide information regarding the location” of the mobile device 4005, which “can be forwarded to the insurance provider system 4035 for processing as part of an insurance rate determination.” *Id.*, [0323]. Similarly, accelerometer 4120 located in the mobile device 4005 “can be employed to monitor the rate of acceleration/deceleration of the vehicle being driven, with the captured data being employed by the insurance provider system 4035 as part of a determination of insurance rate.” *Id.*, [0323]-[0324].

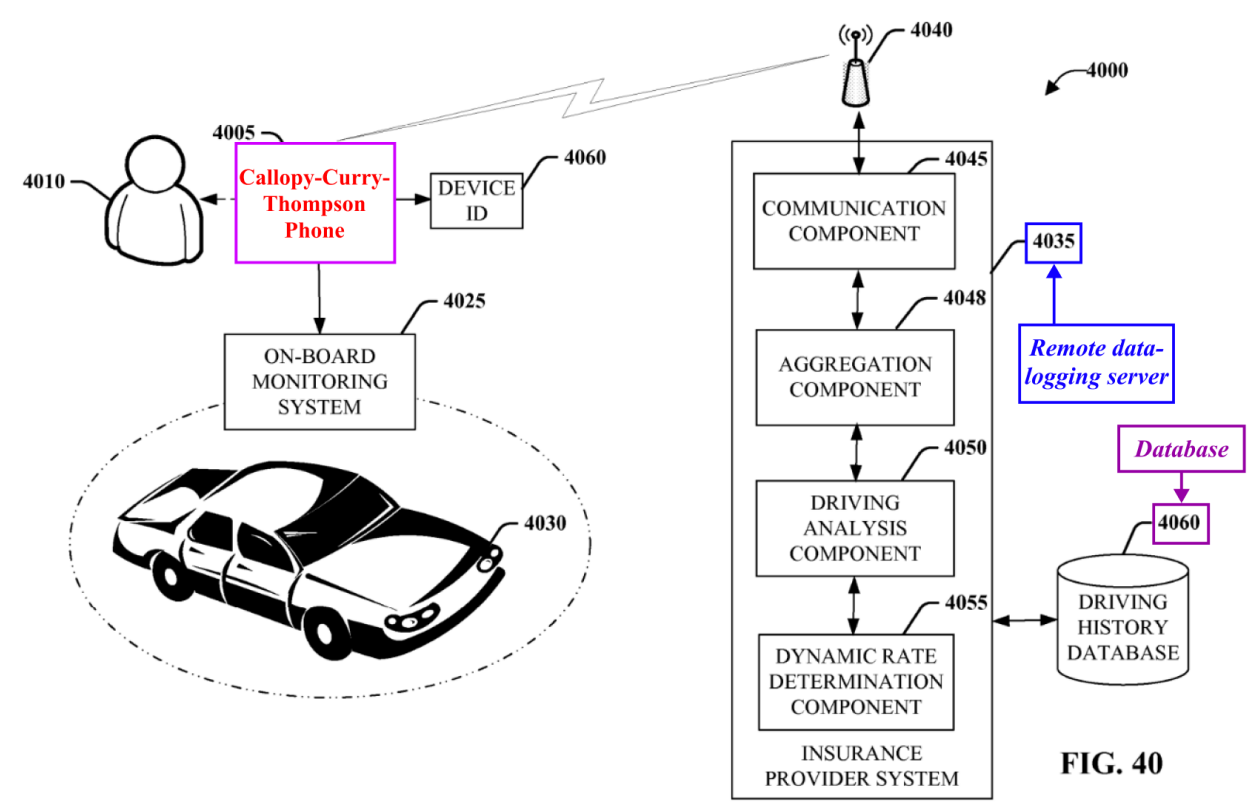
175. Callopy further explains that the mobile device 4005 “can include one or more local applications 4180 to facilitate monitoring, processing, and generation of data for insurance purposes.” *Id.*, [0330]. The location applications 4180 “can process the data as it is gathered thereby allowing the processed data to be stored as opposed to the raw data, where it is envisioned that the processed data occupies less memory than the raw data.” *Id.* This processed data from the mobile device 4005 (including both data input through the user interface and sensor data from the GPS and accelerometer) provides driving information for the particular driver. The driving information for the particular driver is then monitored and subsequently logged with the user’s account after identification of the driver. USAA-1005,

[0342] (“After the driver has been identified ... the driver can proceed to drive the vehicle and monitoring of their driving is conducted.”), [0350], [0333]-[0334], [0308] (“database 4060 which stores information pertaining to the vehicle operator 4010, e.g., previous driving history, along with other data as required”); see [1.11].

[1.11] [the remote data-logging server device] comprises: a database for storing a plurality of accounts, at least one of the plurality of accounts having a unique identifier, and the database being configured to store the selection of the derived driving information transmitted from the mobile telecommunications device to the at least one account, the selection derived driving information being associated by the unique identifier to the vehicle and the driver;

176. In Callopy-Curry-Thompson, insurance provider system 4035 (**data-logging server**) includes a database (e.g., database 4060, storage device 4250) (**database**) that “stores information pertaining to the vehicle operator 4010, e.g., previous driving history, along with other data as required.” USAA-1005, [0308]; see *id.*, [0332]. A POSITA would have understood and found obvious that the database stores driver account information for a multiple users (**storing a plurality of accounts**) because Callopy teaches using identifiers to identify specific drivers. See, e.g., *id.*, [0317].

177. One example of the database discussed above is shown in the annotated Figure 40 below:



USAA-1005, FIG. 40 (annotated)

178. Another example of the database is shown in the annotated Figure 42:

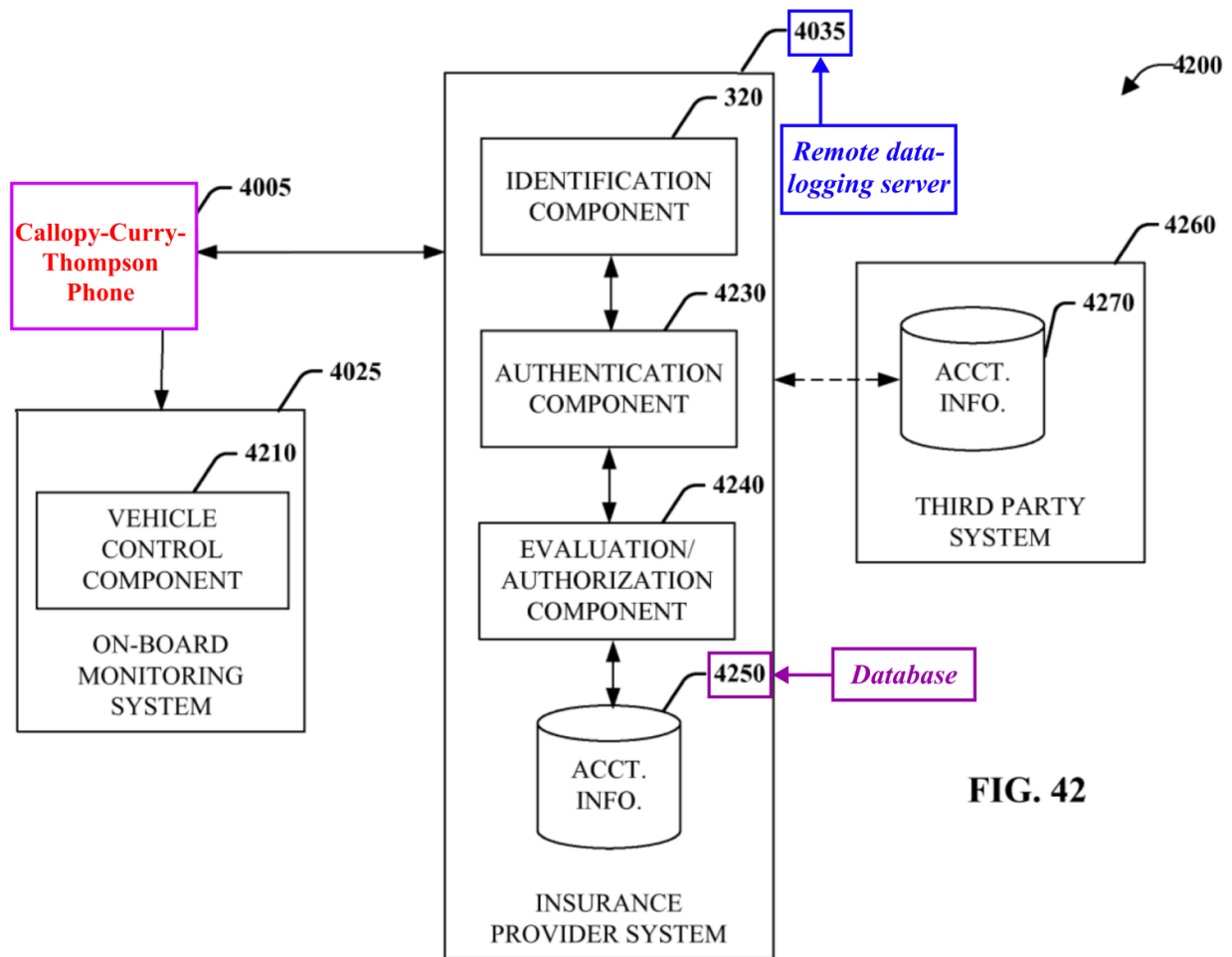


FIG. 42

USAA-1004, FIG. 42 (annotated)

179. Data stored in the database includes “driver account information” to “identify a driver and control their operation of a vehicle as required.” USAA-1005, [0332]. Specifically, an “identification component 4220” accesses the database to “retrieve any user account information contained therein that is associated with the IMSI number, and, using the retrieved information, identify the user associated with the mobile device 4005 and accordingly the prospective driver of vehicle 4030.” *Id.*, [0333]. One of the accounts stored in the database (at least

one of the plurality of accounts) includes an identifier (e.g., IMSI number) (**unique identifier**). This identifier is used to “identify an individual, associated with mobile device 4005 and driver data” stored in the database. USAA-1005, [0334].

180. The database is also “employed to store any information gathered or generated by the various components of system 4000[,]” including “information retrieved from the mobile device 4005 or information associated therewith.” USAA-1005, [0309]. In Callopy-Curry-Thompson, the database is configured to store data deriving information generated by the CCT phone and associated with a driver (***the selection of the derived driving information transmitted from the from the mobile telecommunications device to the at least one account***). As explained for [1.5], this information may include “information regarding driver 4010’s driving skills, habits, etc.” (USAA-1005, [0307]) and “driving behavior” information, such as “talking...or texting...while driving” (USAA-1006, 7:5-29) and “speeding, abnormal acceleration, abnormal deceleration, and taking sharp turns” (*id.*, 3:24-4:6).

181. As discussed above, the driver data stored in the database (***derived driving information***) is associated with an identifier (e.g., IMEI number) (**unique identifier**). USAA-1005, [0332]-[0334]. The identifier corresponds to an associated vehicle and a driver (***the vehicle and the driver***) since the insurance provider system 4035 uses the identifier to “retrieve any user account information”

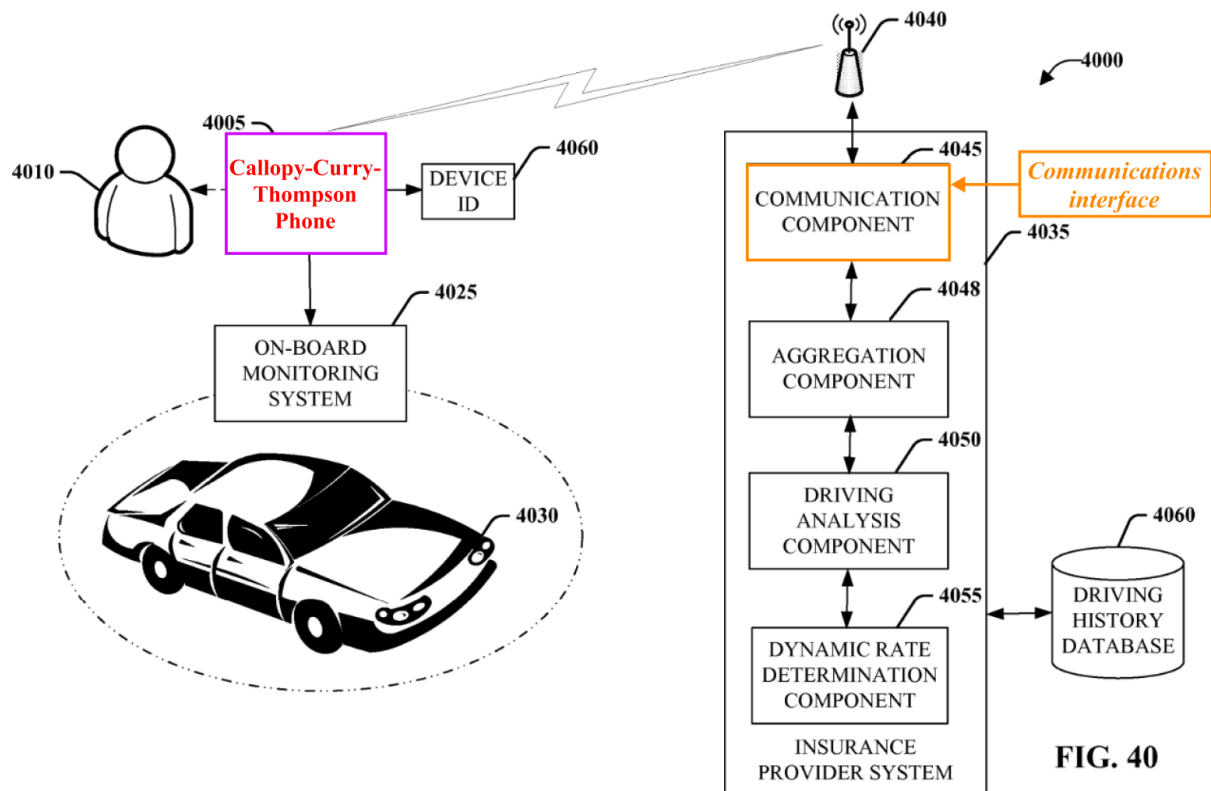
and then use the retrieved information to identify “the **user** associated with the mobile device 4005 and accordingly the prospective driver of **vehicle 4030**.” *Id.*, [0333] (emphasis added).

182. Callopy also describes that “[a] range of methods and systems can be utilized to allow a driver to be associated with a vehicle.” USAA-1005, [0317]. Specifically, the insurance provider system 4035 stores a unique identifier (e.g., IMSI number) (***each account having a unique identifier***) retrieved from a mobile device that is used to identify “an individual[] associated with mobile device 4005 and driver data stored in database 4250.” *Id.*, [0333]-[0334]. A POSITA would have understood that Callopy’s database stores driver account information for a multiple users (***storing a plurality of accounts***) that are used to identify a particular driver.

[1.12] a communications interface configured to communicate with the mobile telecommunications device and receive therefrom:

183. In Callopy-Curry-Thompson, insurance provider system 4035 (***data-logging server***) includes a communication component 4045 (***communications interface***) configured to communicate with and receive information from the CCT phone (***mobile telecommunications device***). Callopy explains that “[b]y employing wireless communications, the mobile device 4005 is in communication with [the] insurance provider system 4035 via a transceiver 4040 and a communication

component 4045.” USAA-1005, [0307]; *see also id.*, FIGS. 40-42. Additionally, Callopy’s Figure 59 shows interfaces for communicating with remote computers. *Id.*, [0443]-[0445], FIG. 59. Given that the mobile device 4005 and the insurance provider system 4035 can communicate, it would have been obvious to a POSITA that the insurance provider system 4035 includes a communications interface arranged to communicate with the mobile device 4005. USAA-1005, [0307]-[0308], [0322], [0329].



USAA-1005, FIG. 40 (annotated)

[1.13] the unique identifier for association of the mobile telecommunications device with the at least one of the plurality of accounts; and

184. As discussed for [1.12], in Callopy-Curry-Thompson, the database of the insurance provider system 4035 includes an identifier (e.g., IMSI number) (***unique identifier***). USAA-1005, [0332]-[0334]. The identifier is used to identify driver data for a vehicle and driver, including derived driving information generated by the CCT phone, and thus, is ***for association of the mobile telecommunications device with the at least one of the plurality of accounts. Id.***

185. Specifically, Callopy teaches that, “[t]o enable the correlation of a unique identifier” to a driver, “user identification information can be retrieved from the mobile device 4005 and forwarded” to insurance provider system 4035. USAA-1005, [0333]. The user identification information can comprise, for example, an IMSI number retrieved from mobile device 4005. *Id.* The insurance provider system 4035 “can access storage device 4250, retrieve any user account information contained therein that is associated with the IMSI number, and, using the retrieved information, identify the user associated with the mobile device 4005 and accordingly the prospective driver of vehicle 4030.” *Id.*, [0333]-[0342].

[1.14] the at least some of the derived driving information transmitted from the mobile telecommunications device to be logged to the at least one of the plurality of accounts

186. Callopy-Curry-Thompson renders this limitation obvious. As discussed above [1.10]-[1.13], in the combination, insurance provider system 4035

receives derived driving information generated by the CCT phone and stores the received information as driver data in a database. The stored information is associated with an identifier to allow identification of an associated vehicle and driver. At least some of the information received from the CCT phone (***at least some of the derived driving information transmitted from the mobile telecommunications device***) is therefore stored to (***logged to***) an account specified in the database (***at least one of the plurality of accounts***).

187. Specifically, in Callopy, “any information gathered or generated by the various components of system 4000,” which “can include data gathered by the on-board monitoring system 4025, information provided by operator 4010, information retrieved from the mobile device 4005,” among other information. USAA-1005, [0309]. Callopy further describes the various information that is obtained and/or processed by the mobile device 4005 (and its various components) and retrieved from the mobile device 4005. *Id.*, [0323]-[0324], [0330], [0346], [0388]. For example, using an “interface associated with ... the mobile device 4005, the user can respond” to user prompts and provide feedback that is gathered. *Id.*, [0346]. Additionally, GPS 4110 located in the mobile device 4005 can “provide information regarding the location” of the mobile device 4005, which “can be forwarded to the insurance provider system 4035 for processing as part of an insurance rate determination.” *Id.*, [0323]. Similarly, accelerometer 4120

located in the mobile device 4005 “can be employed to monitor the rate of acceleration/deceleration of the vehicle being driven, with the captured data being employed by the insurance provider system 4035 as part of a determination of insurance rate.” *Id.*, [0323]-[0324].

2. *Claim 2*

[2.1] The data-logging system of claim 1, wherein execution of the computer-executable instructions by the processor further causes the mobile telecommunications device to: store the raw sensor data relating to the driving incident; and

188. The CCT phone stores accelerometer data (***raw sensor data relating to the driving incident***) locally. In Curry, “data can be recorded to a local motion data cache 118 for further processing.” USAA-1006, 8:30-9:3. Thompson similarly describes mobile device instructions that cause the device to store raw sensor data related to an accident. USAA-1007, 2, 7; *id.*, 9 (“WreckWatch recorded acceleration on three axes at the highest possible rate and wrote these values to a CSV file on the SD card in the device.”). The data stored includes accelerometer readings (forces experienced in different directions), GPS location and speed data, and timestamped event logs for later accident reconstruction.

189. A POSITA would have understood and found it obvious that the CCT phone stores raw sensor data before or during an accident. Thompson explicitly describes recording acceleration data on three axes at the highest possible rate and storing it on the SD card for later analysis. USAA-1007, 2, 9. Since WreckWatch

relies on acceleration thresholds (e.g., 4g) to detect an accident, a POSITA would recognize that raw sensor data are captured and processed in real-time to determine if an accident has occurred, which involves storage at least during the accident event. *Id.*

190. The storage of raw sensor data before occurrence of an accident also represents an obvious engineering choice to ensure proper event reconstruction. A POSITA would have recognized that post-accident analysis capabilities (which are suggested in each of Curry and Thompson) benefits from the storage of data leading up to the crash to understand its cause and severity. This is a well-established principle in accident data recorders. Thompson further supports this understanding through description that “[i]n the event of an accident, the smartphone will experience the same forces and accelerations experienced by the occupants of the vehicle[,]” suggesting that the sensor data collected by the mobile device (and stored thereon) is used for accident detection. USAA-1007, 9.

[2.2] transmit the stored raw sensor data to the remote data-logging server.

191. See [1.9]. The CCT phone is configured to transmit both processed sensor data and raw values used for processing (***stored raw sensor data***) to the insurance provider system 4035 (***data-logging server***). Curry describes that its mobile device uses “mobile phone communication links” to transmit “motion data and activity mode estimation results of a user” to a “driving safety data server

104.” USAA-1006, 9:23-28. In Curry, because “local data cache can be used to store raw data for an extended time period of time,” a POSITA would have found it obvious to configure the CCT phone to transmit raw data to a server. *Id.*, 8:30-9:3. Such a configuration also promotes the broad objective of Callopy and Curry of using recorded sensor data relating to driving to improve insurance rate determinations (e.g., by making more data available to the server for rate determinations). USAA-1005, [0017]-[0018]; USAA-1006, 4:7-15, 11:26-12:2.

3. *Claim 3*

[3] The data-logging system of claim 2, wherein execution of the computer-executable instructions by the processor further causes the mobile telecommunications device to store the raw sensor data generated before, during, and after the driving incident that is continuously collected, associated with the driving incident.

192. See [2.1]. The CCT phone is configured to collect sensor data in ***before, during, and after*** a vehicle accident (***driving incident***) based on the teachings Thompson and Curry. In Thompson, a smartphone is configured to record “the path, speed, and forces of acceleration on a vehicle **leading up to and during an accident.**” USAA-1007, 2. Further, because Thompson’s technique involves accident detection based on comparison to a threshold, a POSITA would have found it obvious that the collection of acceleration values is ***continuously collected, and associated with the driving incident.*** USAA-1007, 8 (“WreckWatch uses the smartphone’s GPS to determine device and (consequently) vehicle

speed”). Relatedly, Curry describes that a local data cache on a mobile device can “store raw data for an extended time period of time in order to provide sufficient information for a user activity mode recognition program 120.” USAA-1006, 8:30-9:3; *see id.*, 16:7-22.

4. Claim 4

[4] The data-logging system of claim 1, wherein execution of the computer-executable instructions by the processor further causes the mobile telecommunications device to register a start of the driving period in response to an initialization input generated automatically in response to the raw sensor data having predetermined values.

193. Callopy-Curry-Thompson renders [4] obvious. In Thompson, a smartphone is configured to initiate recording of sensor data (**register a start of the driving period**) once a vehicle speed is “above 15 mph.” USAA-1007, 8. A POSITA would have understood that using a threshold vehicle speed to initiate data collection is an example of an **initialization input generated automatically in response to the raw sensor data having predetermined values**. This understanding is consistent with the specification, which describes that “if the sensor data reflects a detected speed above a predetermined threshold—for example, 20 kilometers per hour—then this can be used to trigger the start of the driving period. USAA-1001, 3:40-4:2.

XI. CALLOPY, CURRY, THOMPSON, AND WARREN MAKES CLAIM 5 OBVIOUS

194. For the reasons discussed below, and based on my review of the '728 patent, the file history, and the prior art references cited here, a POSITA would have understood that the teachings of Callopy, Curry, Thompson, and Warren make the elements of claim 5 obvious.

A. Proposed Combination

195. As discussed in Section X.A, Callopy-Curry-Thompson provides a comprehensive system for monitoring driving behavior and generating insurance risk assessments. A POSITA seeking to implement this system would have sought enhance risk assessment methodologies based on Callopy's suggestion that "[t]he automobile insurance industry has been exploring ways in which it can take advantage of information about a vehicle's location, conditions of operation, and other factors, to assess risk dynamically and thereby adjust insurance rates." USAA-1004, [0010]. This would have predictably led the POSITA to the teachings of Warren as a result.

196. Warren describes techniques that offer nuanced approaches to risk assessment through calculation and adjustment of driving scores that span multiple recording periods. USAA-1008, [0024], [0050]-[0056]. As noted in Section IX.D, in Warren, an overall period of monitoring is "sufficiently long to obtain data that is an accurate portrayal of the vehicle activity," including "a shorter period of time

that encompasses enough variants in the individuals schedule.” *Id.*, [0050]. Once this period has been “satisfied,” “a variety of parameters with various weights applied to the parameters” are used to determine a driver score. *Id.*, [0051]; *see id.*, FIG. 3. A POSITA seeking to refine and broaden the Callopy-Curry-Thompson system would be motivated to incorporate Warren’s scoring techniques to provide improved insurance offerings, consistent with Callopy’s objectives of “optimizing insurance from the perspective of both the insurance provider and the insurance purchaser.” USAA-1005, [0014]. This represents a natural technological progression that addresses a clear need identified within the disclosures of Callopy, Curry, and Thompson.

197. In incorporating Warren’s teachings into Callopy-Curry-Thompson, a POSITA would have introduced logic relating to Warren’s iterative scoring modules into the CCT phone. This would have allowed a phone of Callopy-Curry-Thompson-Warren (“CCTW phone”) to calculate and adjust driving scores at intervals determined by usage patterns, changes in driving behavior, or detection of major events such as accidents. *See* USAA-1008, [0050]-[0055]. The CCTW phone would have been configured to leverage existing sensors described in Callopy, Curry, and Thompson (e.g., GPS, accelerometer) to feed driving information into Warren’s scoring module. *See* USAA-1008, [0014], [0023]-[0024]. This configuration would have also enabled forward-looking and

retroactive adjustments to insurance terms based on accumulated scores, as taught in Warren, thereby complementing the dynamic insurance rate assessments suggested in Callopy and Curry. *Id.*, [0012], [0055].

198. The resulting Callopy-Curry-Thompson-Warren system would have yielded several predictable and beneficial results resulting to insurance offerings contemplated in Callopy and Curry. Warren teaches that continuously updated driver scores lead to more accurate insurance policy adjustments, aligning closely with Callopy's objective of risk-based pricing and real-time driver monitoring. *See* USAA-1005, [0004], [0307], [0321]. A POSITA would have thereby recognized that Warren's mechanism for aggregating risk data over time with the accident detection capabilities of Thompson and the real-time driving data analysis of Callopy and Curry predictably achieve a more robust, data-driven insurance framework. Incorporation of Warren's scoring techniques would have further enabled refined risk profiles, continuous feedback to insured parties, and improved insurance product offerings. *Id.*

199. As discussed above, Callopy, Curry, Thompson, and Warren each share a common technological foundation. All four systems utilize substantially identical hardware components to collect driving behavior data, such as mobile devices equipped with GPS receivers and accelerometers. This hardware compatibility is important to understanding why a POSITA would view these

references as natural companions. Their teachings represent different software approaches and analytical methodologies operating on the same basic hardware platform. Each reference also addresses a different but complementary aspect of the same technological problem. Callopy provides the core infrastructure for collecting vehicle operation data through mobile devices and wirelessly transmitting it to insurance systems. Curry introduces the concept of safety scoring based on driving behaviors detected through mobile sensors. Thompson adds specialized accident detection capabilities using acceleration thresholds and contextual filtering. Warren completes the picture by offering a sophisticated, multi-dimensional scoring methodology specifically designed to translate driving data into insurance premium adjustments

200. A POSITA would have also had more than a reasonable expectation of success when incorporating Warren's teachings into Callopy-Curry-Thompson. As discussed above, each of the references share common sensor technologies (GPS, accelerometers), similar goals of driver risk assessment, compatible mobile device architectures, and complementary approaches to processing driving information. A POSITA would have perceived the incorporation to represent applying a known technique (e.g., Warren's driving score techniques) to a known system (e.g., mobile devices with accelerometers and GPS sensors, as described in Callopy, Curry, and Thompson) to improve a similar device in a predictable way.

Since the hardware used in each of these systems is substantially similar, a POSITA would understand the integration of these techniques to require nothing more than routine software design and programming.

201. Additionally, the data inputs implicated in Warren's scoring algorithm (e.g., time of day, geographic location, speed, and acceleration) are already being collected by the sensors part of the CCT phone. This means the necessary raw data is already available within the system, requiring only the application of Warren's mathematical formulas to transform it into a driver score.

202. The client-server architecture described in all four references follows the same basic pattern. The architecture includes a mobile device that collects data and transmits it to a central server for processing and response. Warren's scoring methodology would fit naturally into this existing architectural framework, with the scoring algorithms implemented either on the mobile device, the server, or a combination of both. *See* USAA-1008, [0015].

203. The mathematical operations required to implement Warren's scoring algorithm (e.g., calculating percentages, applying risk factors, summing weighted scores) are also basic statistical operations well within the capabilities of a skilled software developer. The implementation would involve only routine programming techniques that were well-established in the art at the time.

204. Callopy, Curry, Thompson, and Warren also address the same technological domain (e.g., using mobile device sensors to monitor driving behavior and assess risk). They share the same fundamental goal of improving insurance risk assessment through data collection and analysis. This shared purpose and technological approach ensures that the combination would work harmoniously toward a common objective.

B. Analysis of Claim 5

1. Claim 5

[5] The data logging system of claim 1, wherein the remote data-logging server is further configured to process the derived driving information logged to the at least one of the plurality of accounts over a plurality of driving periods, including the driving period, to generate an aggregated driving score used to determine a risk profile for at least one of the vehicle and the driver.

205. Callopy-Curry-Thompson-Warren renders this claim obvious. In the combination, the CCTW phone is configured to process driving behavior information (***derived driving information***) collected over a time frame to determine a driving score (***aggregated driving score***). USAA-1008, [0024], [0051]-[0054], FIG. 3. The driving score “operates to establish a risk level associated with insuring a particular driver” and is ***used to determine a risk profile for...the driver. Id.***, [0024] (the driving score also “reflects a qualitative view of the driving characteristics for a particular vehicle or a combination of a vehicle and driver”).

206. A POSITA would have found it obvious that the driving score generated by the CCTW phone based on processing of deriving driving information collected ***over a plurality of driving periods, including the driving period***. Warren explains that “the monitoring and recording system begins to monitor the vehicle activity for a first period of time 320.” USAA-1008, [0050]. The period of time 320 includes multiple recording periods (***plurality of driving periods***) because its length is “sufficiently long to obtain data that is an accurate portrayal of the vehicle activity.” *Id.*

207. Additionally, a two to four week period of time may be sufficient if during that period of time, a POSITA would have understood and found obvious that multiple vehicle journeys may be performed within the period of time 320. Thus, “[o]nce the first period of time has been satisfied,” and the CCTW phone “generate[s] the driver score 330,” the score reflects an ***aggregated driving score*** as far as its value reflects the aggregation of driving behavior information collected for multiple vehicle journeys that occur within the period of time 320. USAA-1008, [0051].

208. Additionally, Warren provides mathematical formulas showing how multiple parameters collected over time are combined into a single aggregated score. *See, e.g.*, USAA-1008, [0044]. The CCTW phone therefore leverages these formulates to determine risk profiles given Warren’s suggestion that “the driver

score reflects a risk level associated with insuring a particular driver.” *Id.*, [0024].

Warren also reinforces the aggregation across multiple driving periods by explaining that “the driver score and the terms of the insurance policy can be continually updated as the system collects further information about the vehicle activity.” USAA-1008, [0054]. A POSITA would have understood and found obvious that this is an ongoing process where new driving data is incorporated into the existing score to maintain an up-to-date risk assessment that spans a selected time period (e.g., 1 year or 2 years).

XII. CALLOPY, CURRY, THOMPSON, AND KATAYAMA MAKES CLAIMS 6-28 OBVIOUS

209. For the reasons discussed below, and based on my review of the ’728 patent, the file history, and the prior art references cited here, a POSITA would have understood that the teachings of Callopy, Curry, Thompson, and Katayama make the elements of claims 6-28 obvious.

A. Proposed Combination

210. A POSITA would have found it obvious to enhance the CCT phone through implementation both of Katayama’s teachings on partitioning local memory into several sections (including sections for temporary and long term storage), and Katayama’s related teachings on data handling. USAA-1009, [0012], [0015], [0048], [0049]. This includes both the comparison at the time of recording of digitalized sensor data against judgment criteria representative of specific

driving behaviors, and storage in appropriate sections of memory of digitalized data with metadata identifiers indicating determinations made through those comparisons. USAA-1009, [0012], [0015], [0048], [0049]. The resulting phone provided by Callopy-Curry-Thompson-Katayama (“CCTK phone”) embodies these and other advantages discussed below.

211. A POSITA would have found obvious that, like Katayama’s local memory 82, the local memory featured in the CCT phone has limited capacity for accommodating both continuously and sequentially received sensor data, and derived information. *See* USAA-1005, [0330]; USAA-1006, 6:3-10, Fig. 1. Curry explains, for example, that “mobile phone client 110 can record location, speed and acceleration data from sensors embedded in the wireless device...to a local motion data cache 118” prior to later transmission of derived driving behavior information. USAA-1006, 8:30-9:3; *see id.*, 3:24-4:6, 7:5-22, 8:20-27, 13:20-15:6, Figs. 1, 3. Curry also describes “further processing” of data stored in cache 118 by a “user activity mode recognition program 120,” the transmission of “activity mode estimation results” from mobile phone 106 to a driver safety data server, and the display through “an interactive website” of derived driving behavior information including “possible violations of mobile phone use or unsafe driving behavior.” USAA-1006, 7:29-8:28. A POSITA would have found obvious that derived

driving behavior information is stored in local memory prior to its later transmission and display. USAA-1006, 7:5-22, 8:29-9:28, 13:20-15:6, Fig. 3.

212. A POSITA would have reasonably expected the enhancements of the CCTK phone to produce multiple benefits. For example, the combination provides more effective use of the CCTK phone's local memory given storage constraints of mobile device memory. This would have improved retention of important information for analysis while also allowing continually updates to the memory with new sensor data and related information. USAA-1006, 2:2-15, 2:24-3:6; USAA-1009, [0014]-[0016], [0045], [0053].

213. The combination also prevents inadvertent erasure of data from the CCTK phone's local memory that might be useful in assessing driving behavior. USAA-1009, [0001]-[0002], [0016], [0045]-[0050]. As discussed in Section IX.E, Katayama describes a memory architecture and data handling techniques that permit the partitioning of data temporarily stored in a temporary section and important data being stored for longer time periods in a storage section. Because the CCTK phone is used for driver monitoring using sensor data collected by embedded sensors of the phone, a POSITA would have recognized that the partitioning described in Katayama is a suitable solution to prevent erasure of potentially important data.

214. Additionally, the combination enables generation of more sophisticated and accurate user driving scores derived from information further indicating whether a driver may have been involved in an accident or “risk incident.” USAA-1006, 7:5-22, 9:31-33, 10:3-12, 11:3-14, 13:3-19; USAA-1009, [0044]-[0046]. A POSITA would have understood that Katayama’s techniques of detecting accidents or risk incidents advances Curry’s overall motivation to “reduce traffic-related fatalities and injuries.” USAA-1006, 2:3-8. The combination further enables association of a detected unsafe driving behavior (as described in Curry) and a detected risk incident (as described in Katayama), thereby enabling confirmation of correlations between certain driving behaviors (talking on the phone while driving) and occurrence of risk accidents.

215. Another improvement is enhanced utility for third parties in leveraging the CCTK phone’s improved driving scores when, for example, determining insurance premiums. USAA-1006, 4:7-11, 7:5-22, 10:3-12, 11:26-12:2. As discussed above, Katayama’s storage technique provides a way for the CCTK phone to acquire data without requiring updates to storage capacity. Over time, this would have provided new data to compute and/or update driver score values to reflect, for instance, any changes in driving behaviors of the user. Another advantage is enhanced utility for third parties in leveraging the increased

accuracy of driving scores in, for example, determining insurance premiums.

USAA-1006, 4:7-11, 7:5-22, 10:3-12, 11:26-12:2.

216. The combination also enables an improved after-the-fact accident reconstruction by third parties utilizing the CCTK phone in support of, for example, legal and insurance-related inquiries. USAA-1006, 10:26-33, 11:1-2; USAA-1009, [0027], [0031]. The combination enables the detection of accidents or risk incidents while a user is performing actions while driving, which enables aggregation of data collected for multiple users and confirmation of specific driver behaviors (texting while driving, talking on the phone while driving) that are likely to cause subsequent occurrence of risk incidents.

217. A POSITA would have also recognized that important information stored in Curry's local memory is subject to the risk of being inadvertently erased and overwritten with new data, and would have recognized in Katayama's teachings a solution that could be readily applied in the context of the CCT phone: bifurcation of the local memory into temporary and long term sections, with storage of information identified as important in the long term section. USAA-1009, [0001]-[0002], [0016], [0044]-[0051], [0057].

218. Further, a POSITA would have also recognized that configuring the CCTK phone's memory in this manner while generally applying Katayama's related data storage techniques would "enable[] effective use of the memory

without erasing important situation data” and “eliminat[e] accumulation of useless data,” while at the same time furthering Curry’s goals of “detect[ing] and prevent[ing] unsafe driving behavior[s]” and generating related “driving safety...score[s]” by enabling the CCT phone to detect both accidents and “risk incidents.” USAA-1006, Abstract, 2:1-27, 3:24-4:6, 4:7-11, 7:5-22, 9:31-33, Fig. 1; USAA-1009, [0016], [0053], [0044], [0046].

219. As taught by Katayama, the POSITA would have configured the CCT phone to receive “situation data” including sensor data “at a constant sampling time one after another in a chronological order,” and to write “the received situation data” in a temporary data storage section within the CCT phone’s local memory. USAA-1009, [0016], [0044]-[0049]. To avoid erasure of situation data that might be useful in determining the cause of an accident or risk incident, or in otherwise analyzing driving behavior as taught by Curry, the POSITA would have further configured the CCT phone to “digitalize” temporarily stored situation data for purposes of determining, at the “time of recording,” whether that digitalized situation data meets one or more predetermined criteria for long term storage (for example, whether a value of temporarily stored digitalized accelerometer data exceeds a predetermined threshold). USAA-1009, [0001]-[0002], [0011]-[0016], [0027], [0046]-[0050], [0054], [0083].

220. For example, Katayama states that “the value (the content) of each situation data is, for example, digitalized in accordance with the judgment criterion parameter.” USAA-1009, [0048]. Katayama also describes the following:

Later, whether or not the content of each situation data meets the predetermined condition is judged based on results of the digitalized values on which a logical operation such as an AND/OR operation is performed. Some may be judged by combining a content of the situation data with a content of other situation data depending on the variety or the content of the situation data and some may be judged based on a content of a single situation data. For example,... it is judged that the predetermined condition is satisfied at a time when two events are satisfied; both the acceleration data exceeds the predetermined judgment criterion and the acceleration data continues over a certain period.

USAA-1009, [0049]. A POSITA would have recognized this description as being pertinent to Callopy-Curry-Thompson. USAA-1009, [0001]-[0002], [0011]-[0016], [0027], [0046]-[0050], [0054], [0083].

221. Consistent with Katayama’s teachings, the POSITA would have configured the CCT phone to record situation data determined to be “important” with a metadata “identifier” marking it as such, and to transfer situation data with the identifier from the local memory’s temporary storage to its long term recording section.” USAA-1009, [0001]-[0002], [0011]-[0016], [0027], [0046]-[0050], [0054], [0083]. And, again consistent with Katayama’s teachings, the POSITA

would have configured the CCT phone to store situation data determined to be less than important with a metadata “identifier” marking it as such, until such time as the unimportant situation data is overwritten with new data. USAA-1009, [0011]-[0016], [0054].

222. As noted above, a POSITA would have understood and found obvious that the CCTK phone resulting from these collective enhancements would, in comparison with the CCT phone, enjoy improved data management with reduced likelihood of erasure of important data. USAA-1006, 2:2-15, 2:24-3:6; USAA-1009, [0014]-[0016], [0045], [0053]. Further, the POSITA would have understood and found obvious that the above enhancements would improve Curry’s driving safety monitoring techniques, by enabling identification of accidents and “risk incidents”, with corresponding improvements to the sophistication of driving safety metrics.⁵ USAA-1006, 1-4:6, 2:3-2:28, 7:522, 8:29-12:18, 13:27-14:26, 15:8-16:33, 17:1-18:4; USAA-1009, [0044]-[0046].

⁵ For example, a POSITA would have recognized that Katayama’s techniques for managing “situation data” would advantageously enable the CCT phone to determine the “surrounding situation or the like of a motor vehicle during a certain period before and after a time of an accident or...risk incident,” and to “very easily

223. Configuring the CCT phone to leverage Katayama's teachings would have also involved routine knowledge of programming and common electronic components. This was well within the skill of a POSITA prior to the Critical Date. The changes would have amounted to nothing more than the use of known techniques (software programming) to improve similar devices. In each instance, a device for recording and analyzing driving information equipped with a sensor set and a form of electronic storage. This involves combining prior art elements according to known methods to yield the predictable results described above.

224. The elements of Callopy-Curry-Thompson-Katayama would also each perform functions they had been known to perform prior to the combination. The CCTK phone would store sensor data and related information but, in the specific manner taught by Katayama, would identify and preserve information determined to be important in a form of long-term storage. A POSITA would have naturally expected success when incorporating Katayama's teachings into the CCT phone.

225. A POSITA would have had more than a reasonable expectation of success when incorporating Katayama's teachings into Callopy-Curry-Thompson. Implementation of the CCTK phone would primarily involve software

and accurately[,]” enable “after-the-fact analysis” of accidents and risk incidents by third parties. USAA-1009, [0001], [0027].

modifications to the application of the CCT phone, rather than hardware changes.

As discussed above, the application would be modified to incorporate Katayama's memory management architecture, with the local storage partitioned into temporary and long-term sections. This would have involved routine programming to implement the memory allocation and data management routines described in Katayama.

226. The application provided by the CCTK phone would also implement Katayama's data digitalization and evaluation logic, which converts raw sensor data into digital values that can be compared against predetermined judgment criteria. This would involve standard signal processing techniques to transform accelerometer and GPS data into normalized values, followed by logical operations (such as AND/OR operations) to determine whether specific events or conditions have occurred.

227. The memory management techniques described in Katayama also involve standard software routines for data classification, storage, and retrieval that would have been well within the capabilities of a POSITA. The digitalization of sensor data for comparison against predetermined thresholds, and the logical operations performed on these digitalized values, involve basic signal processing and conditional logic that were well-established in the art.

228. The data transmission protocols used in Callopy, Curry, Thompson, and Katayama also similarly involve wireless communication between mobile devices and central servers. They follow standard networking patterns that allows for seamless integration. The client-server architecture employed by all four references would therefore have supported the combined functionality of the combination without requiring architectural redesign

229. The combined Callopy-Curry-Thompson-Katayama system also operates within the established capabilities of mobile device hardware available at the time. As explained above, this would not require any novel changes to hardware components or configurations. The memory partitioning described by Katayama would work within the constraints of mobile device storage capacity, improving the efficiency of memory usage rather than increasing memory requirements.

B. Analysis of Claims 6-28

1. Claim 6

[6.1] The data logging system of claim 1, wherein the driving period comprises a plurality of portions of time throughout the driving period, and

230. Callopy-Curry-Thompson-Katayama renders this limitation obvious. In the combination, the CCTK phone collects and processes sensor data during a time period when a vehicle is being driven (***driving period***). See [1.1]. Sensor data is collected based on the storage architecture and techniques described in

Katayama. In Katayama, sensor data is collected and stored sequentially in temporary data storage section 802 “at a constant sampling time one after another in a chronological order.” USAA-1009, [0045].

231. A POSITA would have understood and found obvious that continuously sampling data at a defined frequency involves segmenting collected data for a driving period into discrete blocks. Data representing each block point arrives on a fixed schedule (for example, every few milliseconds or seconds), such that a block represents a sampling period from a start point to an end point. *Id.*; USAA-1009, [0045]. Because a driving period includes multiple blocks, recorded sensor data for a driving period includes multiple time sampling periods (***plurality of portions of time throughout the driving period***). *Id.* Katayama confirms this understanding since “situation data **during a certain period** is transferred from the temporary data storage section 802 to the situation data storage section 803 only after the driver determines the situation as the hiyari hatto (risk incident),” suggesting the capability of its system to recognize periods of time associated with recorded sensor data. USAA-1009, [0051].

232. A POSITA would have also recognized that the ***plurality of portions of time*** recited in [6.1] can be logically represented by a sampling rate or a collection of samples over time. For example, determining a discontinuity in acceleration implies that the acceleration is known over some period prior to the

determined discontinuity. A POSITA would have also known of techniques for interpreting accelerometer data might that includes performing a fast Fourier transform (FFT) over a time window to detect events based on the frequency content in the acceleration signal. Performing an operation such as an FFT involves collecting a set of data samples over a specific time period (i.e. a window of 512, 1024, 2048 samples).

[6.2] the execution of the computer executable instructions by the processor further causes the processor to select a portion of time related to the driving incident from the plurality of portions of time for transmission to the remote logging server and to reduce the amount of data transmitted by transmitting raw sensor data relating to the selected portion of time to the remote data logging server.

233. Callopy-Curry-Thompson-Katayama renders this limitation obvious. The CCTK phone detects incidents (e.g., accidents) based on locally processing sensor data. See [1.7]. In Katayama, event-specific data is preserved and ultimately transmitted, rather than continuously transmitting the entire drive's recordings. USAA-1009, [0046]. By storing only the data that includes the event timeframe, the CCTK device similarly **select[s] a portion of time related to the driving incident** of captured data. Further, as discussed for [1.9], the CCTK phone is configured to transmit (**transmit**) the selected information (e.g., accident-related information) to insurance provider system 4035 (**remote logging server**) for further

analysis, consistent with the teachings of Callopy, Curry, and Thompson. USAA-1005, [0307]; USAA-1006, 8:21-27, 9:23-28; USAA-1007, 2-3, Fig. 2.

234. Further, a POSITA would have been obvious that the configuration of the CCTK phone (based on Katayama's storage techniques and architecture) ***reduce[s] the amount of data transmitted.*** In Katayama, section 803 only stores "situation data whose content meets the predetermined condition," thereby reducing the amount of available data that, in Callopy-Curry-Thompson-Katayama, is transmitted to a server. USAA-1009, [0046]. A POSITA would have further recognized that transmitting only that incident-linked data to the server involves less data than sending the entire driving record.

235. A POSITA would have also recognized that "plurality of portions of time" could logically be considered a sampling rate, or possibly a collection of samples over time. For example, determining a discontinuity in acceleration implies that you know what the acceleration is over some period prior to the change. Also, some techniques for interpreting accelerometer data might include doing an FFT over a time window to detect events based on the frequency content in the acceleration signal. Performing an operation such as an FFT necessarily requires collecting a set of data samples over a specific time period (i.e. a window of 512, 1024, 2048 etc., samples).

2. Claim 7

[7] The data-logging system of claim 6, wherein the driving incident, determined by the processor, is defined by a marked variation in a change of the raw sensor data over at least a portion of the plurality of portions of time during the driving period indicative of a difference in a state of motion of the vehicle occurring over the at least a portion of the plurality of portions.

236. See [1.7]. The CCTK phone is configured to detect a vehicle accident (**driving incident**) by comparing values specified in accelerometer data to an acceleration threshold (e.g., 4g measured acceleration). USAA-1007, 8. Thus, when an accident is detected during a time period when a vehicle is being driven and includes multiple sampling periods (**at least a portion of the plurality of portions of time during the driving period**), the detection is based on changes in acceleration values over time (**a change of the raw sensor data**). USAA-1009, [0046]. Thompson describes that when a smartphone is placed in a vehicle, “the smartphone would experience the same forces as vehicle occupants,” and thus acceleration measurements characterize **motion of the vehicle** during the time period when a vehicle is being driven. USAA-1007, 7. Where measured acceleration values change over time and at least one measured value exceeds the threshold, this represents **a marked variation** indicative of a change in acceleration (**a difference in a state of motion**).

237. A POSITA would have also recognized that the CCTK phone is capable of detecting driving incidents defined by marked variations in raw sensor

data over time portions indicating changes in vehicle motion state because the references teach this functionality through complementary approaches.

Thompson's system detects large accelerations exceeding specific g-force thresholds that indicate accident events, while Katayama enhances this capability by identifying incidents where “acceleration exceeding a certain level continues for more than a certain period.” USAA-1009, [0015]. This description directly addressing the temporal aspect of motion state changes. Curry further contributes by monitoring for “abnormal acceleration, abnormal deceleration, and sharp turns” that represent distinctive deviations from normal driving patterns. USAA-1006, 3:24-4:6. Together, these references establish a comprehensive detection framework that identifies significant variations in sensor readings across multiple time segments, capturing the precise moment when a vehicle transitions between motion states. These transitions may be from normal driving to sudden braking, steady cruising to rapid acceleration, straight-line travel to swerving, or ordinary operation to collision.

3. *Claim 8*

[8] The data-logging system of claim 7, wherein execution of the computer-executable instructions by the processor further causes the mobile telecommunications device to select, prior to transmitting the derived driving information, the raw sensor data relating to the driving incident.

238. See [1.7], [1.9], [2.1], [3], [4]. A POSITA would have found it obvious that in certain implementations, the CCTK phone may be configured to

transmit processed sensor data and raw values used for processing (*raw sensor data*) to the insurance provider system 4035 (*data-logging server*). A POSITA would have found it obvious that transmission of raw values used for processing involves a *select[ing]* operation prior to the *trans[mission]* insofar as the CCTK phone determines that the information should be transmitted to the insurance provider system 4035.

239. In the context of a client-server computing system, a POSITA would have recognized that Thompson's disclosure of transmitting accident-related information involves a selection process before transmission. This selection is how a POSITA would have recognized that computing systems operate to optimize data transmission, especially in resource-constrained environments like smartphones. In a client-server model, a smartphone client does not transmit all available data but rather selects relevant data for efficient transmission. In the context of Thompson's disclosure, the WreckWatch application running on the smartphone monitors sensor data continuously but does not transmit all raw data in real time. Thompson describes that the application detects an accident first (based on threshold conditions such as exceeding 4g's of acceleration), and only then does it transmit information. USAA-1007, 2. A POSITA would have understood that this means that accident detection acts as a selection step, ensuring that only accident-related data, rather than all raw sensor data, is transmitted.

4. *Claim 9*

[9] The data-logging system of claim 8, wherein, to select the raw sensor data relating to the driving incident, execution of the computer-executable instructions by the processor further cause the mobile telecommunications device to select the raw sensor data generated before, during, and after the driving incident.

240. See [1.9], [2.1], [3], [8]. The CCT phone stores accelerometer data (*raw sensor data relating to the driving incident*) locally. In Curry, “data can be recorded to a local motion data cache 118 for further processing.” USAA-1006, 8:30-9:3. Thompson similarly describes mobile device instructions that cause the device to store raw sensor data related to an accident. USAA-1007, 2, 7; *id.*, 9 (“WreckWatch recorded acceleration on three axes at the highest possible rate and wrote these values to a CSV file on the SD card in the device.”). The data stored includes accelerometer readings (forces experienced in different directions), GPS location and speed data, and timestamped event logs for later accident reconstruction.

5. *Claim 10*

[10] The data-logging system of claim 9, wherein execution of the computer-executable instructions by the processor further causes the mobile telecommunications device to transmit the selected raw sensor data to the remote data-logging server.

241. See [1.9], [2.2], [3], [8]. The CCT phone is configured to send (*transmit*) at least some of its derived driving information (*at least some selection of the derived driving information*) to insurance provider system 4035 (*remote*

data-logging server) for further processing, e.g., insurance rate calculations. As discussed above, the information sent to the insurance provider system 4035 may identify various types of ***driving incidents*** recited in [1.7], such as an accident event (***vehicle accident***), “abnormal acceleration” (***harsh acceleration***), “abnormal deceleration” (***harsh braking***), and “taking sharp turns” (***harsh swerving***). See USAA-1007, 2, 8-10; USAA-1006, 3:24-4:6.

6. *Claim 11*

[11] The data-logging system of claim 7, wherein the at least a portion of the plurality of portions comprises a five-minute time period.

242. Callopy-Curry-Thompson-Katayama renders this claim obvious based on Katayama’s storage techniques, which involve a constant sampling rate for data collection and storage. See [6.1], [7]; USAA-1009, [0045]. A POSITA would have recognized a ***five-minute time period*** for sampling as a design choice because a sampling period represents one of multiple available options for collecting sensor data during a time period associated with driving.

243. The specification references sequential capture of recorded data “over a period of five minutes.” See USAA-1001, 18:3-29. However, there is no explanation of why this specific duration is superior to shorter or longer time frames. The specification also does not teach that a five-minute duration as providing any functional advantage. A POSITA would have therefore perceived

the five-minute period as not producing any new or unexpected result over the storage techniques already described in Katayama.

244. In Katayama, data is collected “during a certain period” and then “transferred from the temporary data storage section 802 to the situation data storage section 803,” thereby preventing excessive accumulation. *See* USAA-1009, [0045] (“If a capacity of the temporary data storage section 802 runs out, old data is sequentially erased and new situation data is written in the temporary data storage section 802”). A POSITA would have recognized that five minutes represents one implementation choice that balances the need to capture sufficient context around an incident while maintaining efficient memory usage. This implementation choice addresses Katayama’s concern about how it may be “extremely difficult to extract the situation data” if too much data is recorded. USAA-1009, [0005]. Additionally, a POSITA would have known that collection periods in the range of several minutes were contemplated within the Katayama system’s design parameters.

245. A POSITA would have also recognized that five-minute sampling periods for collecting sensor data using telematics systems were conventional by the Critical Date. For example, “a traffic information and control center may wish to update the travel speeds for a freeway segment every 5 minutes[,]” and “[i]n this case, estimates of travel speed are needed every 5 minutes[,]” and “the travel speed

estimate would be based on average travel times recorded by probe vehicles over a 5-minute time period (fixed or rolling).” USAA-1050, 5.

7. *Claim 12*

[12] The data logging system of claim 6, wherein the remote-logging server is configured to store the raw data relating to the selected portion of time related to the driving incident to the at least one account.

246. See [1.10], [6.1], [6.2]. Callopy teaches that its database 4060 (incorporated into insurance provider system 4035) (**remote-logging server**) stores “any information gathered or generated by the various components of system 4000,” including mobile device 4005. USAA-1005, [0309]. In the combination, insurance provider system 4035 stores accident-related information received from the CCTK phone, including sensor data relating to a detected accident (**raw data relating to the selected portion of time related to the driving incident**). USAA-1007, 2, 8-10; see USAA-1005, [0308], [0333], [0334]. For instance, Callopy states that its insurance provider system (4035) stores driving data in database 4060. USAA-1005, [0308]. Callopy also describes associating stored driving data with a **unique identifier corresponding to a driver account**. USAA-1005, [0333]-[0334].

247. A POSITA would have found it obvious to store raw sensor data associated with the detected accident because Callopy already describes storing driving-related data in an account-linked database (USAA-1005, [0308], [0333]-

[0334]), and Curry explicitly teaches processing sensor data to evaluate driving behavior (USAA-1005, 7:5-22, 10:2-12). A POSITA would have recognized that a system capable of processing raw sensor data would naturally be configured to retain the sensor data from the critical time period surrounding the event for analysis and risk assessment, ensuring accurate insurance or emergency response determinations. Since Callopy teaches account-based data storage and Curry processes driving behavior data, combining these with an accident-detecting smartphone would predictably result in storing raw sensor data corresponding to the detected accident in an account-based format, as described in claim 12.

8. *Claims 13, 24*

248. Callopy-Curry-Thompson-Katayama make independent claims 13 and 24 obvious for similar reasons discussed above for claim 1. Below is a table identifying the correspondence between individual limitations of claims 1, 13, and 24. The table also identifies relevant analysis in the paragraphs above that address claim 1 limitations.

Claim Limitation	Corresponding Claim 1 Limitation	Relevant Analysis
[13.1], [24.1]	[1.1]	Paragraphs 124-132
[13.2], [24.2]	[1.2]	Paragraph 133

[13.3], [24.3]	[1.3]	Paragraphs 134-139
[13.4], [24.4]	[1.4]	Paragraph 140
[13.5], [25.5]	[1.5]	Paragraphs 141-151
[13.7], [24.7]	[1.7]	Paragraphs 160-167
[13.8], [24.8]	[1.8]	Paragraphs 168-170
[13.9], [24.10]	[1.9]	Paragraphs 171-172
[13.10]	[1.10]	Paragraphs 173-175
[13.11], [24.12]	[1.11]	Paragraphs 176-182
[13.12], [24.13]	[1.12]	Paragraph 183
[13.13], [24.14]	[1.13]	Paragraphs 184-185
[13.14], [24.15]	[1.14]	Paragraphs 186-187

249. Additional limitations of claims 13 and 24 that include features not described in claim 1 are addressed below.

[13.6], [24.6] wherein the driving period is defined by a duration of a vehicle journey comprising a plurality of portions of time, and

250. See [1.6], [6.1], [6.2]. The CCTK phone is configured to collect and process sensor data during a time period when a vehicle is being driven (***driving period***). See [1.1]. Sensor data is collected based on the storage architecture and techniques described in Katayama. In Katayama, sensor data is collected and stored sequentially in temporary data storage section 802 “at a constant sampling

time one after another in a chronological order.” USAA-1009, [0045]. Data representing each block point arrives on a fixed schedule (for example, every few milliseconds or seconds), such that a block represents a sampling period from a start point to an end point. *Id.* Because a driving period includes multiple blocks, recorded sensor data for a driving period includes multiple time sampling periods (*plurality of portions of time throughout the driving period*).

[13.15], [24.16] wherein the remote data-logging server is further configured to process the derived driving information logged to the at least one of the plurality of accounts to determine a risk profile for at least one of the vehicle and driver.

251. Callopy-Curry-Thompson-Katayama satisfy these limitations based on teachings relating to risk assessments within Callopy and Curry. In Callopy, insurance provider system 4035 (***remote data-logging server***) is configured to “employ[] various analytical methods” “to facilitate determination of an appropriate insurance rate.” USAA-1005, [0307]. The goal of this analysis is to “determine a risk level associated with a driver or vehicle—based upon the risk level, an amount for the premium can be ascertained,” rendering obvious that the insurance provider system 4035 processes driving information to ***determine a risk profile for...the driver***. *Id.*, [0004]; see *id.*, [0308] (“The system 4035 stores information pertaining to the vehicle operator 4010, e.g., previous driving history, along with other data as required”). Curry similarly suggests determination of a

risk profile through processing of driving data to a driver safety statistic that is used to assess “cost of the insurance premium for the user.” USAA-1006, 10:2-12; *see id.*, 3:24-4:10.

[24.9] store the raw sensor data relating to the at least one driving incident; and

252. The CCTK phone is configured to store sensor data to local memory based on the teachings of Curry and Thompson relating to local data storage. As discussed for [1.7], the CCTK phone is configured to process raw accelerometer data (**raw sensor data**) in detecting an accident occurring within a monitoring period. USAA-1007, 8-10. From Thompson, the CCTK phone is also configured to locally store the raw accelerometer data. *Id.*, 9 (“WreckWatch recorded acceleration on three axes at the highest possible rate and wrote these values to a CSV file on the SD card in the device”). Further, Thompson describes using accelerometer data for post-accident reconstruction, further confirming local storage on a smartphone. *Id.*, 7. Curry similarly describes local storage of raw sensor data on a mobile device (e.g., in motion data cache 118). *See* USAA-1006, 7:5-22, 8:29-10:12, 13:20-16:6, Figs. 1, 3; USAA-1021, 233-250.

[24.11] wherein the remote data-logging server is configured to log the derived driving information and the raw sensor data received from the mobile telecommunications device and

253. *See* [8], [9], [12]. A POSITA would have found it obvious that in certain implementations, the CCTK phone may be configured to transmit

processed sensor data (***derived driving information***) and raw values used for processing (***raw sensor data***) to the insurance provider system 4035 (***data-logging server***). A POSITA would have also found it obvious that transmission of raw values used for processing involves a ***select[ing]*** operation prior to the ***trans[mission]*** insofar as the CCTK phone determines that the information should be transmitted to the insurance provider system 4035.

9. *Claims 14-20, 23, 27, 28*

254. Callopy-Curry-Thompson-Katayama renders these claims obvious in the same manner as explained above for corresponding claim limitations listed in the table below.

Claim	Corresponding Claim(s)/Limitation(s)	Relevant Analysis
[14]	[1.7]	Paragraphs 160-167
[15.1], [15.2]	[2.1], [2.2]	Paragraphs 188-191
[16]	[3]	Paragraph 192
[17], [28]	[7]	Paragraphs 236-237
[18]	[8]	Paragraphs 238-239
[19]	[1.9], [2.1], [3], [8], [9]	Paragraphs 171-172, 240
[20]	[1.9], [2.1], [3], [8], [10]	Paragraph 171-172, 241
[23]	[4]	Paragraph 193

[27.1], [27.2]	[6.1], [6.2]	Paragraphs 230-235
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10. *Claim 21*

[21] The data-logging system of claim 13, wherein the sensor set further comprises an image sensor.

255. Callopy-Curry-Thompson-Katayama renders [21] obvious. As discussed for [1.3], the CCTK phone is configured according to the teachings of Callopy, Curry, and Thompson. In Curry, mobile phone 106 may be implemented using commercially-available smartphones, including the iPhone 3G. USAA-1006, 2:1-27. Around the Critical Date, the iPhone 3G was known to include a built-in camera (**image sensor**), which would have made it obvious for the CCTK phone to similarly incorporate a built-in camera. USAA-1024, 2-3; USAA-1025, 87, 88, 108.

11. *Claim 22*

[22] The data-logging system of claim 13, wherein the driving information further comprises one or more of velocity, direction of travel, an indication of exceeding a velocity limit, or data representing jerky steering.

256. Callopy-Curry-Thompson--Katayama disclose [22] based on the types of monitored information described within their disclosures. Callopy describes collection and monitoring GPS-based velocity data for insurance purposes (**velocity, direction of travel**). USAA-1005, [0323]. Curry likewise describes using GPS to determine vehicle speed. USAA-1006, 7:5-22. Further, in Curry, mobile

phone 106 can detect speeding events by comparing GPS-based velocity against known speed limits (***indication of exceeding a velocity limit***). *Id.* Accelerometer data is also evaluated (i.e., processed) to detect unsafe driving behaviors, including erratic movements like harsh acceleration or swerving (***data representing jerky steering***). *Id.* Thompson similarly describes use of GPS data to monitor ***velocity*** and ***direction of travel***. USAA-1007, 1, 2, 5, 8.

12. *Claim 25*

257. Callopy-Curry-Thompson-Katayama renders independent claim 25 obvious in the same manner as explained above for corresponding claim 1 limitations listed in the table below.

Claim Limitation	Corresponding Claim 1 Limitation	Relevant Analysis
[25.1], [25.2], [25.3], [24.4]	[1.3]	Paragraphs 134-139
[25.5]	[1.4]	Paragraph 140
[25.9]	[1.7]	Paragraphs 160-167
[25.11]	[1.9]	Paragraphs 171-172

[25.6] determine, based on the raw sensor data from the sensor set, a start of a driving period at which the mobile telecommunications device is within the vehicle and the vehicle is in use,

258. As explained in Section VIII.C, under its plain meaning, the ***driving period*** described in claim 25 is not limited to an entire period of driving. The claim language leaves open the possibility of the driving period corresponding to the beginning, middle or end of a vehicle's operation. The '728 patent specification supports this interpretation since it describes an example where the start of a "driving period" is triggered "once a velocity greater than 20 kilometres per hour is detected." USAA-1001, 14:45-57. Because the '728 patent contemplates embodiments in which a start of a driving period occurs at time point after a user has already started to drive, the ***driving period*** is not limited to the entire time period of a vehicle being driven.

259. The CCTK phone is configured to process sensor data (e.g., motion and orientation data) recorded from its embedded sensors (e.g., accelerometer 116) (***raw sensor data from the sensor set***). See [1.3], [1.5]; USAA-1006, 7:5-29, 8:21-27, 8:30-9:33, 10:15-26, 11:3-14. The CCTK phone is also configured to determine a start of a recording period (***determine...a start of a driving period***) based on the sensor data (e.g., a speed from accelerometer measurements satisfying a threshold). See [1.5], [1.6]; USAA-1007, 8 (a "[s]peed filter" is used to "determine[]" whether users are in vehicles" and the phone "begins recording accelerometer information and looking for potential accidents above 15mph"); Further, the CCTK phone maintains this monitoring context "until the device is unplugged..." USAA-1007,

8. Thus, when the recording period is started, the CCTK phone is ***within the vehicle and the vehicle is in use.***

260. Callopy-Curry-Thompson-Katayama also meets [25.6] in multiple ways. One way is a configuration of the CCTK phone in which the phone uses orientation and motion data from its accelerometer to determine vehicle motion upon a user accepting a phone call while driving (i.e., concurrent use of orientation data and user input data). Callopy-Curry-Thompson-Katayama also meets this limitation through other configurations where use input data and orientation data is not concurrently used since the limitation does not include claim language describing concurrent use of user input data or sensor data in determining a start of a driving period.

261. Curry also describes multiple embodiments in which a phone determines a start of a driving period, based on motion sensor data generated by a phone's embedded accelerometer, at which the phone is located within a moving vehicle. For example, in Figure 1, client 110 enables the phone to determine, based on user inputs (e.g., accepting a phone call, manually changing activity modes) and sensor data (e.g., "location, speed, and acceleration data from" an embedded "GPS sensor 114 and accelerometer 116") whether an associated vehicle is being driven. USAA-1006, 7:5-22, 8:5-11, 8:30-9:33, 15:7-22. Client 110 also processes "raw data" from a driving period to derive information associated with a user's driving

behavior, including whether the phone is being used during the driving period in a manner violating permissions, and whether the user engages in other unsafe driving behaviors such as speeding. USAA-1005, 7:5-22, 8:30-9:33.

262. As another example, in Curry's Figure 3, a "driving safety monitoring program on a mobile phone client" determines, based on user inputs (e.g., user interaction with the phone based on receiving an incoming phone call) and "recorded time stamped [sensor] data," whether the phone is located within a vehicle that is in use, and that is further configured both to derive related driving information, and "to allow or disallow users to receive or make a call, text a message...or use other components or software programs," based on that determination. USAA-1006, 13:20-14:26. In Figure 3, Curry also teaches that a "motion recording process can be activated 302 on the phone," where the activation is "accomplished by the user." USAA-1006, 13:20-26. Activation "when an outgoing call 301 is made or an incoming call 303" is one example of activating the motion recording process. *Id.*

[25.7] wherein the driving period is defined by a duration from a start to an end of a vehicle journey and the duration is comprised of a plurality of portions of time;

263. See [6.1]. As explained above, the CCTK phone is configured to collect and process sensor data during a time period when a vehicle is being driven (***driving period***). Sensor data is collected based on the storage architecture and

techniques described in Katayama. In Katayama, sensor data is collected and stored sequentially in temporary data storage section 802 “at a constant sampling time one after another in a chronological order.” USAA-1009, [0045]. A POSITA would have understood and found obvious that continuously sampling data at a defined frequency involves segmenting collected data for a driving period into discrete blocks.

264. Additionally, as explained in Section VIII.C, while claim 25 expressly specifies a “start” and an “end” of the “vehicle journey,” the claim does not specify how the start or the end are determined. A POSITA would have understood and found obvious that the ***duration from a start to an end of a vehicle journey*** includes examples of a time duration with a start determined after the start of driving. As described in the ’728 patent specification, a mobile device “may be configured to initiate the driving period once sensor data above a minimum threshold value is recorded, indicative of the vehicle being in motion[,]” e.g., “once a velocity greater than 20 kilometres per hour is detected.” USAA-1001, 14:45-57. From this description, a POSITA would have understood and found obvious that one way in which the “start” of the “vehicle journey” is started is by a vehicle speed satisfying a specified speed threshold (e.g., “kilometres per hour”). The description of this example within the ’728 patent confirms that the “duration from a start to an end of a vehicle journey” is not necessarily limited to an entire period

of driving (e.g., a time period defined by a first time point when a vehicle begins moving to a second time point when the vehicle stops moving).

265. Callopy-Curry-Thompson-Katayama satisfies [25.7] because a recording period (***driving period***) may be started by the CCTK phone (***start***). For example, Thompson describes using a “[s]peed filter” to “begins recording accelerometer information and looking for potential accidents above 15mph.”

USAA-1007, 8. Curry similarly describes examples of starting recording periods based on motion sensor data generated by a phone’s embedded accelerometer.

USAA-1006, 7:5-22, 8:5-11, 8:30-9:33, 13:20-14:26, 15:7-22.

266. As explained for [6.1], in Callopy-Curry-Thompson-Katayama, the CCTK phone is configured to record data based on data collection techniques described in Katayama. A POSITA would have understood and found obvious that continuously sampling data at a defined frequency involves segmenting collected data for a driving period into discrete blocks. Data representing each block point arrives on a fixed schedule (for example, every few milliseconds or seconds), such that a block represents a sampling period from a start point to an end point. *Id.*; USAA-1009, [0045], [0051]. A POSITA found have also understood and found obvious that the end point of the last block of the driving period represents the ***end of a vehicle journey***. Thompson teaches configurations in which a smartphone ends a monitoring period. USAA-1007, 8 (“After WreckWatch determines that

users are in vehicles, it maintains that as their context until the device is unplugged...”).

267. Further, smartphone configurations for using sensor data in relation to starting and terminating driving-related monitoring periods were well-known by the Critical Date. *See, e.g.*, USAA-1010, 11:21-40 (describing a personal media device (PMD) that uses sensor data to “conclude that it is still in the vehicle but that the vehicle has stopped moving”). A POSITA would have also recognized configuring telematics systems to detect the end of a driving period in response to sensor data reaching a predetermined threshold was a known configuration by the Critical Date. *See, e.g.*, USAA-1049, 198-99 (“Since the intent was to capture lane changes at highway speeds, the data processing system began recording when speed reached 40 miles per hour and cut off when speed dropped below 30 miles per hour.”).

[25.8] process, using the processor, the raw sensor data from the sensor set representing at least acceleration of the vehicle and position of the vehicle throughout the driving period to derive driving information associated with how safely the vehicle is driven by the driver, the driving information representing movement of the vehicle whilst the vehicle is being driven by the driver throughout the driving period,

268. *See* [1.5]. The CCTK phone is configured to monitor both ***acceleration*** and ***position*** of a vehicle in deriving driving behavior information (as taught in Curry) and accident-related information (as taught in Thompson). *See*

USAA-1006, 7:5-29, 8:21-27, 8:30-9:33, 10:15-26, 11:3-14; USAA-1007, 2, 8-10.

In Curry, a mobile phone “records the position, speed, and acceleration data for a certain time period.” USAA-1006, 11:3-14. Similarly, Thompson describes well-known mobile device configurations that “possess a compass, accelerometer, and GPS receiver allowing application developers to determine the geographic position, heading, and movement of the user.” USAA-1008, 2; *see id.*, 8 (describing combining “directionality and movement” of a vehicle using “speed and location information from the GPS receiver...”).

[25.10] wherein the driving information is derived without data from vehicle sensors throughout the driving period and wherein the selection is determined by identifying a portion of the plurality of portions of time;

269. *See* [6.1]. As explained above, the CCTK phone is configured to collect and process sensor data during a time period when a vehicle is being driven (***driving period***). Sensor data is collected based on the storage architecture and techniques described in Katayama. In Katayama, sensor data is collected and stored sequentially in temporary data storage section 802 “at a constant sampling time one after another in a chronological order.” USAA-1009, [0045]. A POSITA would have understood and found obvious that continuously sampling data at a defined frequency involves segmenting collected data for a driving period into discrete blocks. Further, Katayama describes techniques for classifying recorded data with an identifier marking it as “important,” and then transferring the marked

data to long term “situation data recording section 803.” See USAA-1009, [0001]-[0002], [0011]-[0016], [0027], [0046]-[0050], [0054], [0083]. A POSITA would have understood and found obvious that the process of marking recorded data as “important” and transferring the marked data to a storage partition involves a **selection** that is **determined by identifying a portion of the plurality of portions of time**. That is, the marking of recorded data marked as “important” represents a **selection** of a subset of one or more multiple blocks of recorded data (**portion of the plurality of portions of time**).

[25.12] wherein the mobile telecommunications device is controlled by a downloaded application to register the start of the driving period in response to an initialization input generated automatically in response to the sensor data having a predetermined start value.

270. See [4]. In Thompson, a smartphone is configured to initiate recording of sensor data (**register a start of the driving period**) once a vehicle speed is “above 15 mph.” USAA-1007, 8. A POSITA would have understood that using a threshold vehicle speed to initiate data collection is an example of an **initialization input generated automatically in response to the sensor data having a predetermined start value**, e.g., a speed measured at 15 mph. This understanding is consistent with the specification, which describes that “if the sensor data reflects a detected speed above a predetermined threshold—for example, 20 kilometers per

hour—then this can be used to trigger the start of the driving period. USAA-1001, 3:40-4:2.

13. *Claim 26*

[26] *The mobile telecommunications device of claim 25, wherein execution of the computer-executable instructions by the processor further causes the mobile telecommunications device to detect the end of the driving period in response to an ending input generated automatically in response to the raw sensor data having a predetermined end value.*

271. Callopy-Curry-Thompson-Katayama renders this claim obvious. In the combination, the CCTK phone is configured to monitor sensor data consistent with the teachings of Curry and Thompson. USAA-1007, 8. In Curry, a wireless phone includes an “activity recognition module” configured to “identify when a user is substantially stationary.” USAA-1006, 4:12-15. The activity recognition module uses logic to distinguish between activity modes (e.g., “walking, running, or driving”). *Id.* Further, in some implementations, Curry describes that “sensors can continue to collect [sensor] data for an extended time period, e.g., 6 minutes, to determine the type of the current activity.” *Id.*, 16:7-22. Further, “if the user changes the activity mode,” e.g., “from driving to fully stop,” the device “uses acceleration data from the accelerometer to determine the change in activity mode.” *Id.*

272. Based on the teachings of Curry discussed above, a POSITA would have found it obvious to similarly implement the CCTK phone to detect a change

in activity mode from driving to fully stop (*detect the end of the driving period*), where such a determination is made in response to acceleration data indicating a lack of motion (*in response to an ending input generated automatically in response to the raw sensor data having a predetermined end value*). A POSITA would have perceived this configuration detail to represent an implementation detail since Thompson similarly teaches configurations in which a smartphone ends a monitoring period. USAA-1007, 8 (“After WreckWatch determines that users are in vehicles, it maintains that as their context until the device is unplugged...”). Further, smartphone configurations for using sensor data in relation to starting and terminating driving-related monitoring periods were well-known by the Critical Date. *See, e.g.*, USAA-1010, 11:21-40 (describing a personal media device (PMD) that uses sensor data to “conclude that it is still in the vehicle but that the vehicle has stopped moving”).

273. Further, a POSITA would have been motivated to implement the CCTK device as discussed above because terminating a driving period based on collected sensor data was known to produce benefits to smartphone-based vehicle monitoring systems by the Critical Date. Katayama identifies storage constraints for on-board recording devices, which would have prompted a POSITA to seek configurations that reduce the amount of data collected in relation to monitoring driving activity. *Id.* (citing USAA-1009, [0004], [0045]). Callopy also teaches

storing collected data on a mobile device in a manner that it “occupies less memory,” further suggesting a benefit of a recording paradigm that prevents the collection of unnecessary sensor data. *Id.* (citing USAA-1005, [0330]).

274. A POSITA would have also recognized configuring telematics systems to detect the end of a driving period in response to sensor data reaching a predetermined threshold was a known configuration by the Critical Date. *See, e.g.*, USAA-1049, 198-99 (“Since the intent was to capture lane changes at highway speeds, the data processing system began recording when speed reached 40 miles per hour and **cut off when speed dropped below 30 miles per hour.**”). Such systems would have been configured to act based on raw sensor inputs (e.g., vehicle speed) without user intervention. By the Critical Date, a POSITA would have regarded detection of the end of the driving period based on raw sensor data having a predetermined end value as a routine and well-known approach in telematics system design.

XIII. LEGAL PRINCIPLES

275. I am not a lawyer and I will not provide any legal opinions in this IPR. Although not a lawyer, I have been advised that certain legal standards are to be applied by technical experts in forming opinions regarding the meaning and validity of patent claims.

A. Claim Interpretation

276. I understand that claim terms are generally given their plain and ordinary meaning based on the patent's specification and file history as understood by a person of ordinary skill in the art at the time of the purported invention. In that regard, I understand that the best indicator of claim meaning is its usage in the context of the patent specification as understood by a POSITA. I further understand that the words of the claims should be given their plain meaning unless that meaning is inconsistent with the patent specification or the patent's history of examination before the Patent Office. I also understand that the words of the claims should be interpreted as they would have been interpreted by a POSITA at the time of the invention was made (not today).

B. Priority

277. I understand that a continuation application is a later-filed application that has the same disclosure (specification and figures) as an earlier filed application to which the later-filed application claims priority. A continuation is generally entitled to the same priority date as the later-filed application to which it claims priority.

C. Anticipation

278. I understand that a patent claim is invalid as anticipated if each and every element as set forth in the claim is found, either expressly or inherently

described, in a single prior art reference. I also understand that, to anticipate, the reference must teach all of the limitations arranged or combined in the same way as described in the claim. I do not rely on anticipation in this declaration.

279. With respect to inherency, I understand that the fact that a certain result or characteristic may occur or be present in the prior art is not sufficient to establish the inherency of that result or characteristic. Instead, the inherent characteristic must necessarily flow from the teaching of the prior art.

D. Obviousness

280. I understand that a patent claim is invalid if the claimed invention would have been obvious to a person of ordinary skill in the field at the time of the purported invention, which is often considered the time the application was filed. Even if all of the claim limitations are not found in a single prior art reference that anticipates the claim, the claim can still be invalid.

281. To obtain a patent, a claimed invention must have, as of the priority date, been nonobvious in view of the prior art in the field. I understand that an invention is obvious when the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art.

282. I understand that, to prove that prior art or a combination of prior art makes a patent obvious it is necessary to: (1) identify the particular references that, singly or in combination, make the patent obvious; (2) specifically identify which elements of the patent claim appear in each of the asserted references; and (3) explain a motivation, teaching, need, market pressure or other legitimate reason that would have inspired a person of ordinary skill in the art to combine prior art references to solve a problem.

283. I also understand that certain objective indicia can be important evidence regarding whether a patent is obvious or nonobvious. Such indicia include:

- Commercial success of products covered by the patent claims;
- A long-felt need for the invention;
- Failed attempts by others to make the invention;
- Copying of the invention by others in the field;
- Unexpected results achieved by the invention as compared to the closest prior art;
- Praise of the invention by the infringer or others in the field;
- The taking of licenses under the patent by others;
- Expressions of surprise by experts and those skilled in the art at the making of the invention; and

- The patentee proceeded contrary to the accepted wisdom of the prior art.

284. To the extent these factors have been brought to my attention, if at all, I have taken them into consideration in providing my opinions and conclusions.

XIV. CONCLUSION

285. The findings and opinions set forth in this declaration are based on my work and examinations to date.

286. I may continue my examinations. I may also receive additional documentation and other factual evidence over the course of this IPR that will allow me to supplement and/or refine my opinions. I reserve the right to add to, alter, or delete my opinions and my declaration upon discovery of any additional information. I reserve the right to make such changes as may be deemed necessary.

287. In signing this declaration, I recognize that the declaration will be filed as evidence in an IPR before the PTAB. I also recognize that I may be subject to cross-examination in the case and that cross-examination will take place within the United States. If cross-examination is required of me, I will appear for cross-examination within the United States during the time allotted for cross-examination.

Appendix A

Curriculum Vitae for William R. Michalson

Research Associates, LLC
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Douglas, MA 01516
Email: wrn@wmichalson.com
Cell: (508) 331-4134

1. Personal:

1.1 Education

Ph.D. in Electrical Engineering, 1989, Worcester Polytechnic Institute, Worcester, Massachusetts.

Dissertation: *A Parallel Computer Architecture for Real-Time Decision Making*. The dissertation develops a hierarchical, multiple processor, computer architecture for executing artificial intelligence programs in real-time.
Dissertation Directors: Dr. Peter E. Green and Dr. R. James Duckworth.

Minor Areas: Minor sequences completed in Mathematics and Physics.

Specialties: Area examinations passed in the fields of Computer Architecture, Probabilistic Systems Analysis, and State Space Analysis.

M.S. in Electrical Engineering, 1985, Worcester Polytechnic Institute, Worcester, Massachusetts.

Specialties: The courses taken stressed Computer Architecture, Communications Systems, and Solid-State Physics.

B.S. in Electrical Engineering, 1981, Syracuse University, Syracuse, New York.

1.2 Work experiences - Academic.

1991-Present Worcester Polytechnic Institute

Professor of Electrical and Computer Engineering; also holds collaborative appointments as a Professor of Computer Science, a Professor of Mechanical Engineering and a Professor of Robotics Engineering.

Effective Sep, 2016 Granted a collaborative appointment as a Professor of Mechanical Engineering.

Effective July 1, 2005 Promoted to the rank of Full Professor (Professor of Electrical and Professor of Computer Science)

<i>November 17, 2004</i>	Appointed dual professorship, adding the title of Associate Professor of Computer Science.
<i>July 1, 1998</i>	Granted tenure and promoted to the rank of Associate Professor.
<i>August 1, 1992</i>	Assistant Professor of Electrical Engineering (tenure-track).
<i>August 1, 1991</i>	Visiting Assistant Professor of Electrical Engineering.
<i>January 1, 1990</i>	Adjunct Assistant Professor of Electrical Engineering.

1.3 Work experiences other than teaching (chronological).

2024-Present US Coast Guard Auxiliary

Member of the US Coast Guard Auxiliary, focusing on public education, communications, and boat crew operations.

2022-Present BLS, LLC

BLS, LLC is a company formed in 2022 which focuses on the development of non-intrusive technologies for improving firearm safety.

2012-2014 Grid Roots, LLC

Grid Roots, LLC is a company which was formed in 2012 for the purpose of commercializing a navigation and tracking device for use by children and the elderly to allow caregivers to non-intrusively monitor their activities. The system under development integrates GPS, inertial and beacon-based navigation technologies to develop a system for users to track deployed devices. My responsibilities within Grid Roots, LLC relate to hardware and software engineering, as well as the development of IP related to tracking individuals.

1995-Present Research Associates, LLC

Research Associates, LLC is a company I formed in which I perform engineering and consulting in the areas of computer systems, communications and navigation. All of my litigation-related and other consulting activities are performed through Research Associates, LLC.

1988-1991 Raytheon Company

Subsequent to receiving my Ph. D., I returned to the Equipment Division of the Raytheon Company. Shortly after I returned, I was promoted to a title of Engineer, Design and Development which was the highest title I could hold based on my level of education and years of experience. Within a year, I was selected to sit on the engineering staff of a newly formed System Engineering Department of the Division's Computer and Displays Laboratory. In this department I acted primarily as a consultant to other departments within the laboratory. My responsibilities ranged from leading the hardware/software development of supercomputer-class computer systems to performing applied research into the exploitation of new technology. My

role was similar to that of a Principle Investigator in an academic setting as I was responsible for securing funding and personnel, leading research efforts, interacting with the research sponsor, and reporting results. At the time of my departure I was involved with the following projects:

Fault-Tolerant Multiprocessor

The development of a highly fault tolerant, highly reliable, real-time computer system intended for long-duration spaceborne applications. This system is designed to produce in excess of one gigaoperation per second of raw processing power.

Optimal Task Allocation

A program of applied research into the use of Genetic Algorithms for deriving optimal mappings of software tasks to the hardware processing elements in distributed systems.

Performance Modeling and Scaling

This project focused on the development of simulation models for characterizing the performance of a large scale multiple processor system. These models formed a basis for predicting system performance for several different hardware configurations to ensure compliance with system specifications.

High Clutter Signal Detection

A program of applied research into the use of Neural Networks to detect the presence of targets in extremely high clutter environments.

Power Efficient Computing

A program of applied research into an Integrated Optical computer structure that is designed to maximize the number of computations that can be performed per unit of power.

1985-1988 Raytheon Company (Leave of Absence)

In 1985 I became one of two people in the Equipment Division to receive Aldo Miccioli Fellowships. This Fellowship was awarded to allow me to pursue full-time study towards the Ph.D. degree. I returned to Raytheon during the summer of 1986, but otherwise remained on leave of absence to dedicate my time to my studies.

1982-1985 Raytheon Company

Engineer in the VLSI Design Department of the Computer and Displays Laboratory within Raytheon's Equipment Division. I was lead engineer for the design of several semi-custom VLSI circuits for both signal and data processing applications.

1981-1982 Raytheon Company

Engineer in the Cursive Displays Department of the Computer and Displays Laboratory. I designed and debugged circuit assemblies which were used in vector displays for air traffic control applications.

1.4 Consulting experiences.

1.4.1 Law-Related

Commonwealth of Massachusetts v. Bradley Rein

Retained by Fund & FitzGerald as an expert on behalf of defendant Bradley Rein. Case before the Commonwealth of Massachusetts Plymouth, SS. Superior Court Department. Docket No. 2383CR0080). Retained 3/24.

Harley Kaplan and Sybil Kaplan v. New England Paragliding and Hang Gliding Club, et al.,

Retained by Campbell Conroy & O'Neil as an expert on behalf of defendant Matthew Foster. Case before the Commonwealth of Massachusetts Plymouth, SS. Superior Court Department. Docket No. 2183CV0331). Retained 3/24 – 5/24. Submitted expert disclosure. Case dismissed.

Textron Innovations INC. v. SZ DJI Technology Co, LTD. et al.

Retained by Baker Botts, LLP as an expert on behalf of plaintiff Textron. Case before the United States District Court for the Eastern District of Texas (Case No. 2:22-cv-351). Retained 6/23 – 3/24.

Geoscope Technologies Pte. Ltd. V. Google LLC

Retained by William & Connolly LLP on behalf of defendant Google. Case before the United States District Court for the Eastern District of Virginia (Case No. 1:22-cv-01331-MSN-IDD). Retained 2/23 – 9/23, Deposed 8/17/23.

American Patents, LLC v. Texas Instruments, Inc., Realtek Semiconductor Corporation and Mediatek Inc.

Retained by Texas Instruments, Realtek, and Mediatek as an expert on defendants. Case before the United States District Court for the Eastern District of Texas – Sherman Division (Case Nos. 4:22-cv-478, 4:22-cv-479, and 4:22-cv-480). Declaration with respect to claim construction 2/10/23). Retained 1/23 – 4/23.

United Services Automobile Association v. Auto Telematics Ltd.

Retained by Fish & Richardson as an expert on behalf of petitioner United Services Automobile Association. Provided declarations in support of multiple IPR filings (IPR2023-00518, IPR2023-00519, IPR2023-00768, IPR2023-00769, IPR2023-00770, IPR2023-00857, IPR2023-00858, IPR2023-00859, IPR2023-00911, and IPR2023-00912). Retained 12/22.

Railware, Inc. v. National Railroad Passenger Corporation dba Amtrak

Retained by Venable, LLP as an expert on behalf of defendant Amtrak. Case before the United States District Court for the Southern District of New York (Case No. 1:22-cv-05013). Provided declarations in support of multiple IPR filings (IPR2023-1179, IPR2023-1180, and IPR2023-1181). Retained 12/22 – 6/24.

Volvo Penta of the Americas, LLC. v. Brunswick Corporation

Retained by Kilpatrick Townsend & Stockton, LLP as an expert on behalf of petitioner Volvo Penta. Provided declarations in support of multiple IPR filings (IPR2022-01366, IPR2022-01367, IPR2022-01368, IPR2022-01369, and IPR2022-01424). Retained 6/22 – 9/23.

Textron Innovations INC. v. SZ DJI Technology Co, LTD. and DJI Europe B.V.

Retained by Baker Botts, LLP as an expert on behalf of plaintiff Textron. Case before the United States District Court for the Western District of Texas (Case No. 6:21-cv-00740-ADA). Retained 2/22 – 4/23, Deposed 1/22/23 and 1/24/23, Testified 4/17-18.

Smartsky Networks, LLC, v. GOGO Business Aviation, LLC and GOGO INC.

Retained by Sidley Austin, LLP as an expert on behalf of defendant Gogo. Case before the United States District Court for the District of Delaware (Case No. 22-266 UNA). Deposed 5/19/22. Retained 3/22.

Via Transportation, Inc. v. RideCo Inc.

Retained by Erise, IP on behalf of defendant RideCo. Case before the United States District Court for the Western District of Texas, (Case No. No. 6:21-cv-00457). Retained 1/22.

BillJCo, LLC v. Cisco Systems, Inc., Apple Inc., Hewlett Packard Enterprise Co. and Aruba Networks, LLC

Retained by the law firms of Merchant & Gould, P.C., DLA Piper, and Greenberg Traurig, LLP Purpose on behalf of their clients Cisco Systems, Inc., Apple Inc., Hewlett Packard Enterprise Co. and Aruba Networks, LLC for the analysis of certain patents relating to methods and systems for location tracking of mobile devices. Submitted declaration related to IPR2022-420 and IPR2022-00427. Retained 12/21 – 6/23.

Mark Adams, Sr., v. Cataldo Ambulance Service, Inc,

Retained by Morrisson Mahoney, LLP on behalf of defendant Cataldo Ambulance Service. Case before Middlesex Superior Court, Commonwealth of Massachusetts, Civil Action No. 19-CV-1931. Retained 10/21.

Omnitracs, LLC et al. v. Platform Science, Inc.

Retained by Fish & Richardson on behalf of defendant Platform Science, Inc. Case before the Federal District Court Southern District of California. Case No. 3:20-cv-0958-JS-MDD. Retained 8/21 – 9/23, Deposed 8/23-24/23.

LoganTree, LP v. Garmin International, Inc. and Garmin USA, Inc.

Retained by EriseIP on behalf of defendant Garmin. Case before the District of Kansas, Case No. 17-cv-01217 2:16-cv-190 involving U.S. Patent No. 6,059,576. Submitted Expert Report on Non-Infringement; Deposed 12/1/21; Testified in Court 10/26/22; Retained 7/21 - 10/22.

Allstate Insurance Company V. Atos, LLC

Retained by Sidley Austin, LLP on behalf of petitioner Allstate Insurance Company challenging the validity of US Patent Nos. 8,527,140; 9,152,609; and 9,846,174 at the Patent Trial and Appeal Board of the U.S. Patent Office. Submitted declarations in IPR2021-01118, IPR2021-01209, and IPR2021-01449. Deposed 3/31/22 and 4/7/22; Retained 2/21 – 1/23.

R&R Packaging, Inc. D/B/A R&R Solutions v. Evenflo Company, Inc.

Retained by Polsinelli on behalf of Plaintiff R&R. Case before the Western District of Arkansas (Fayettevill Division), Case No. 5-20-cv-05095. Submitted Reports on Claim Construction; Deposed 7/21; Retained 11/20.

InfoGation Corporation v. Google LLC.

Retained by O'Melveny & Meyers, LLP as an expert on behalf of defendant Google Inc. Patents-in-suit are U.S. Patents 6,199,014. Case before the United States District Court for the Southern District of California, San Diego Division (Case No. 3:21-CV-00843-H-JLB). Deposed 2/27/23 - 2/28/23. Retained 8/20 to 6/22.

WSOU Investments LLC v. Dell Technologies Inc. et al.

Retained by Gibson-Dunn on behalf of defendant Dell. Case before the United States District Court for the Western District of Texas, (Case Nos. 20-cv-00473-ADA; 20-cv-00474-ADA; 20-cv-00475-ADA; 20-cv-00476-ADA; 20-cv-00477-ADA; 20-cv-00478-ADA; 20-cv-00479-ADA; 20-cv-00482-ADA). Deposed 5/11/23. Retained 7/20 – 6/22.

Apple v. LBS Innovations, LLC.

Retained by ėrise ip on behalf of petitioner Apple, Inc., challenging the validity of U.S. Patent No. 6,091,956 at the Patent Trial and Appeal Board of the U.S. Patent Office, IPR2020-00696. Retained 02/20 – 8/20. Submitted declaration.

Makor Issues & Rights Ltd. v. Google LLC et al.

Retained by Arnold & Porter Kaye Scholer LLP on behalf of defendant Google. Case before the District of Delaware, Case No. 1:16-cv-00100. Retained 12/19.

Intellectual Ventures I, LLC and Intellectual Ventures II, LLC v. NetApp, Inc.

Retained by Gibson Dunn on behalf of defendant NetApp, Inc. Case before the District of Massachusetts, Case No. 1:16-cv-10868-PBS. Retained 09/19. Submitted Expert Reports on Invalidity and Non-Infringement.

Google, LLC v. Traxcell Technologies, LLC.

Retained by Finnegan, Henderson, Farabow, Garrett & Dunner, LLP on behalf of petitioner Google, Inc., challenging the validity of U.S. Patent Nos. 9,918,196 and 10,820,147 at the Patent Trial and Appeal Board of the U.S. Patent Office, IPR2021-01004 and IPR2022-00442. Retained 06/18 – 1/22. Submitted declarations.

Lipton, et al. v. Knight, et al.

Retained by Campbell Conroy & O'Neil, PC on behalf of defendant First Student. Case before the Superior Court of Massachusetts, Plymouth, Case No. PLCV 2014-00528. Retained 05/19-8/19. Submitted Expert Disclosure.

PPS Data, LLC., v. Jack Henry & Associates, Inc.

Retained by Polsinelli on behalf of defendant Jack Henry and Associates. Case before the Eastern District of Texas. Retained 11/18-9/19. Submitted Expert Reports on Invalidity and Non-Infringement; Deposed 5/29/19, testified in Court 9/11/19.

Cisco Systems, Inc. v. TracBeam, LLC.

Retained by Haynes Boone, LLP on behalf of petitioner Google, Inc., challenging the validity of U.S. Patent Nos. 7,525,484 9,277,525, and 7,298,327 at the Patent Trial and Appeal Board of the U.S. Patent Office, IPR2018-01722 - IPR2018-01728. Retained 06/18. Submitted declarations.

Burris Company, Inc. v. Garmin International, Inc.

Retained by Shook Hardy and Bacon on behalf of defendant Garmin. Case before the District of Oregon, Case No. 6:18-CV-00700. Submitted Declaration wrt Invalidity; Testified in Court (PI hearing) 07/11/18; Retained 04/18-08/18.

American GNC Corporation v. LG Electronics Inc., LG Electronics Mobilecomm U.S.A., Inc., and LG Electronics Mobile Research U.S.A., LLC.

Retained by White & Case on behalf of defendant LG. Case before the Southern District of California, Case No. 3:17-CV-01090-BAS-BLM. Retained 11/17. Submitted Declaration wrt Claim Construction; Deposed 1/18.

Qualcomm v. Apple

Retained by Quinn-Emanuel on behalf of plaintiff Qualcomm. Case before the Southern District of California, Case Nos. 3:17-cv-00108-GPC-MDD and 3:17-cv-01010-GPC-MDD. Retained 10/17-5/19; Submitted Expert Report; Deposed 10/18.

Samantha Ingram v. New England Beauty Academy, LLC a/k/a Toni&Guy Hairdressing Academy, Newell Rubbermaid INC. and Goody Products, INC. d/b/a Solano.

Retained on behalf of plaintiff Samantha Ingram. Case before the Worcester Superior Court, Commonwealth of Massachusetts, Civil Action 1385CV02129D. Retained 09/17-09/18; Submitted Expert Disclosure.

FISERV, INC., Jack Henry & Associates, Inc., Q2 Software, Inc., American National Bank of Texas and Hanmi Bank, Petitioners v. Mirror Imaging LLC., Patent Owner.

Retained by Polsinelli on behalf of petitioners to provide declarations for multiple petitions for covered business methods review. See CBM2018-00012, CBM2018-00014, and CBM2018-00015. Retained 1/18-03/18.

Acceleron v. Dell Inc.

Retained by Baker Botts on behalf of defendant Dell. Case before the Northern District of Georgia, Case No. 1:12-cv-04123-TCB. Submitted Expert Reports related to Claim Construction, Invalidity and Non-Infringement; Deposed 10/13/17 and 6/20/19; Trial 9/6/21 to 9/17/21; Retained 7/17 to 9/21.

Omega Patents, LLC v. CalAmp Corp.

Retained by Sidley Austin on behalf of defendant CalAmp. Case before the Middle District of Florida, Case No. 6:13-cv-1950 involving U.S. Patent Nos. 6,346,876; 6,756,885; 7,671,727 and 8,032,278. Retained 5/17 to 12/17.

Unified Patents, Inc.

Retained by Unified Patents to provide declarations for multiple petitions for *inter partes* review related to patents U.S. Patent No. 7,650,234 and 8,538,498. Retained 03/17-05/17.

Garmin Switzerland GmbH, and Garmin Corporation v. Navico Inc., C-MAP USA, Inc., and C-MAP/Commercial, Ltd.

Retained by Shook, Hardy & Bacon, L.L.P. on behalf of plaintiff Garmin. Case before the District of Kansas, Case No. 16-cv-2706 involving U.S. Patent Nos. 7,268,703 and 6,459,987. Submitted Declaration On Claim Construction; Deposed 12/21/17; Retained 10/16 to 02/18.

Navico Inc. and Navico Holdings AS, v. Garmin International, Inc. and Garmin USA, Inc.

Retained by Paul Weiss on behalf of defendant Garmin. Case before the Eastern District of Texas, Case No. 2:16-cv-190 involving U.S. Patent Nos. 9,223,922 and 9,244,168. Submitted Expert Report on Non-Infringement; Deposed 12/14/16, 5/25/17; Testified in Court 9/7/17; Retained 8/16 to 9/17.

Orbcomm, Inc. v. CalAmp Corp.

Retained by Sidley Austin on behalf of defendant CalAmp. Case before the Eastern District of Virginia, Case No. 3:16-cv-208 involving U.S. Patent Nos. 6,292,724, 6,611,686, 6,651,001, 6,735,150, and 8,855,626. Expert Declaration on Claim Construction, Reports on Invalidity and Non-Infringement; Retained 5/16 to 2/17.

Navico Inc. and Navico Holdings AS, v. Garmin International, Inc. and Garmin USA, Inc.

Retained by Paul Weiss on behalf of defendant Garmin. Case before the Northern District of Oklahoma, Case No. 14-cv-303 involving U.S. Patent Nos. 8,300,499, 8,305,840, and 8,605,550. Deposed 11/8/15; Retained 10/15 to 10/17.

Johnson Outdoors Inc. and Johnson Outdoors Marine Electronics, Inc., v.

Garmin International, Inc. and Garmin USA.

Retained by Paul Weiss on behalf of defendant Garmin. Case before the Middle District of Alabama, Case No. 14-cv-683 involving U.S. Patent Nos. 7,652,952, 7,710,825, and 7,755,974. Retained 10/15 to 5/16. Case dismissed.

Google, Inc. v. Silver State Intellectual Technologies, Inc.

Retained by Paul Hastings on behalf of petitioner Google, Inc. to provide declarations for multiple petitions for *inter partes* review. See IPR2015-01737 and IPR2015-01738. Retained 10/15 to 12/15.

Vehicle IP LLC v. AT&T Mobility, LLC, et al.

Retained by Akin Gump and by Perkins-Coie on behalf of defendants AT&T Mobility LLC; Cellco Partnership; Networks In Motion, Inc.; TeleCommunications Systems, Inc.; and Telenav Inc. Case before the District of Delaware, Case No. 1:09-cv-01007-LPS involving U.S. Patent No. 5,987,377. Expert Report on Invalidity; Deposed 5/20/16; Retained 9/15 to 1/17. Matter settled.

TracBeam, L.L.C. v. T-Mobile US, Inc., et al.,

Retained by Baker Botts on behalf of defendant T-Mobile US, Inc., et al. Case before the Eastern District of Texas (6:14-cv-678-RWS). See also IPR2015-01681, IPR2015-01682, IPR2015-01684, IPR2015-01686, IPR2015-01687, IPR2015-01708, IPR2015-01709, IPR2015-01711, IPR2015-01712, and IPR2015-01713. Expert Report on Invalidity; Deposed 10/04/16; Retained 7/15 to 12/16. Matter settled.

Google, Inc. v. Porto Technology Co., Ltd.

Retained by Fish and Richardson on behalf of petitioner Google, Inc., patent owner Porto Technology Inc. IPR2016-00022 and IPR2016-00045. Expert Declarations; Deposed: 7/14/16 (IPR2016-00022); 7/14/16 (IPR2016-00045). Retained 7/15 to 7/20.

Bradium Technologies LLC v. Microsoft Corporation,

Retained by Perkins Coie on behalf of defendant Microsoft Corporation. Case before the District of Delaware (15-0031-RGA). See also IPR2015-01432, IPR2015-01434, IPR2015-01435, IPR2016-00448 and IPR2016-00449. Expert Declarations; Deposed 8/5/16, 02/21/17; (IPR2015-01432); Retained 3/15 to 10/17.

ACQIS LLC v. EMC Corp.,

Retained by Gibson Dunn on behalf of defendant EMC Corp. Case before the District of Massachusetts (1:14-cv-13560). Expert Report on Invalidity; Retained 2/15 to 2/21.

Locata LBS LLC v. YellowPages.com LLC,

Retained by Baker Botts on behalf of defendant YellowPages.com. Case before the Central District of California (2:13-cv-07664). See also IPR2015-00151. Submitted Declaration. Retained 9/14 to 4/15. Matter settled.

M/A-COM Technology Solutions Holdings, Inc. v. Laird Technologies, Inc.

Retained by Erise IP on behalf of Laird Technologies, Inc., for invalidity consulting regarding U.S. Patent No. 6,272,349. Retained 6/14 to 9/14.

Certusview Technologies, LLC v. S&N Locating Services, LLC and S&N Communications, Inc.,

Retained by Baker & McKenzie on behalf of defendant S&N. Patents-in-suit are U.S. Patents 8,265,344, 8,290,204, 8,340,359, 8,407,001, and 8,532,341. Case before the Eastern District of Virginia, (2:13-cv-346). Expert Report on Non-Infringement; Deposed 11/8/14; Retained 6/14 to 12/14.

adidas AG and adidas America, Inc. v. Under Armour, Inc. and MapMyFitness, Inc.

Retained by Kilpatrick Townsend on behalf of plaintiff adidas. Case before the District of Delaware, (1:14-cv-00130). See also IPR2015-00697, IPR2015-00698, and IPR2015-00700. Deposed: 10/21/16 and 10/22/16 relative to 1:14-cv-00130; 2/5/16 relative to IPR2015-00697; 2/5/16 relative to IPR2015-0068; 2/5/16 relative to IPR2015-0700. IPR Declarations, Expert Report on Validity; Deposed 02/05/16; Retained 5/14 to 7/16.

GeoTag, Inc., v. AT&T Mobility LLC and AT&T Services, Inc.,

Retained by Baker Botts as an expert on behalf of defendant AT&T. Patent-in-suit is U.S. Patent 5,930,474. Case before the Northern District of Texas, Dallas Division, (3:13-cv-00169). Expert Report on Invalidity; Deposed 5/29/14; Retained 1/14 to 9/14. Matter settled.

Nokia Corp v. HTC Corp.

Retained by Quinn Emanuel as an expert on behalf of defendant HTC. Case being litigated in Germany. Patent number EP0766811B1. Retained 12/13 to 2/14. Matter settled.

Porto Technology, Co., Ltd. et al. v. Celco Partnership d/b/a Verizon Wireless

Retained by Wiley-Rein as an expert on behalf of defendant Verizon. Case before the United States District Court for the Eastern District of Virginia (Case No. 3:13-cv-00265). Declaration ISO Claim Construction and Summary Judgement of Invalidity; Expert Report on Invalidity; Retained 10/13 to 2/14. Matter dismissed.

Nokia Corp v. HTC Corp.

Retained by McDermott Will and Emery and White & Case as an expert on behalf of defendant HTC. Case before the United States District Court for the District of Delaware (Case No. Case No. 1:12-cv-00550-UNA and Case No. 1:12-cv-551-UNA. Retained 6/13 to 2/14. Matter settled.

NXP B.V. v. Research In Motion, Ltd., et al.

Retained by Fish and Richardson as an expert on behalf of defendant Research In Motion. Patent-in-suit is U.S. Patent 6,501,420. Case before the United States District Court for the Middle District of Florida (Case No. 6:12-cv-00498). Expert Report on Invalidity, Expert Report on Non-Infringement; Deposed 9/18/13; Testified in Court: 4/1/14 and 4/2/14; Retained 5/13 to 4/14.

Vehicle IP LLC v. Wal-Mart Stores Inc., et al.

Retained by Polsinelli-Shugart, as an expert on behalf of defendant Werner Enterprises. Patent-in-suit is U.S. Patent 5,694,322. Case before the United States District Court for the District of Delaware (Case No. 1:10-cv-00503). Expert Report on Invalidity, Expert Report on Non-Infringement; Deposed 7/15/13 and 9/20/13; Testified in Court: 9/27/13 and 9/30/13; Retained 4/13 to 9/13.

Commonwealth Scientific and Industrial Research Organisation v. Realtek Semiconductor Corporation

Retained by Sidley Austin, LLP as an expert on behalf of defendant Realtek Semiconductor Corporation. Patent-in-suit is U.S. Patent 5,487,069. Case before the United States District Court for the Eastern District of Texas (Tyler Division) (Case No. 6:12-cv-00578). Expert Report on Invalidity, Expert Report on Non-Infringement; Deposed 3/6/15; Retained 4/13 to 4/15. Matter settled.

TracBeam, LLC v. Google Inc.

Retained by Quinn-Emanuel as an expert on behalf of defendant Google. Patents-in-suit are U.S. Patents 7,764,231 and 7,525,484. Case before the United States District Court for the Eastern District of Texas (6:11-cv-00093). Deposed 2/5/14; Retained 3/13 to 6/14.

Microsoft Corporation and Google Inc., v. GeoTag, Inc.

Retained by Perkins-Coie as an expert on behalf of plaintiff Microsoft Corporation. Patent-in-suit is U.S. Patents 5,930,474. Case before the United States District Court for the District of Delaware (1:11-cv-00175). Retained 1/13 to 9/14.

GeoTag, Inc., v. Frontier Communications Corp., et al.,

Retained by multiple firms as an expert on behalf of defendants. Patent-in-suit is U.S. Patents 5,930,474. Case before the Eastern District of Texas, Marshall Division, (2:10-cv-00265; other defendants are listed in case numbers 2:10-cv-00272, 2:10-cv-00437, 2:10-cv-00569, 2:10-cv-00570, 2:10-cv-00571, 2:10-cv-00572, 2:10-cv-00573, 2:10-cv-00574, 2:10-cv-00575, 2:10-cv-00587, 2:11-cv-00175, 2:11-cv-00404, 2:11-cv-00421, 2:11-cv-00424, 2:11-cv-00425, 2:11-cv-00570, 2:12-cv-00043, 2:12-cv-00051, 2:12-cv-00436, 2:12-cv-00438, 2:12-cv-00439, 2:12-cv-00441, 2:12-cv-00442, 2:12-cv-00444, 2:12-cv-00445, 2:12-cv-00446, 2:12-cv-00447, 2:12-cv-00448, 2:12-cv-00449, 2:12-cv-00450, 2:12-cv-00452, 2:12-cv-00454, 2:12-cv-00456, 2:12-cv-00459, 2:12-cv-00460, 2:12-cv-00462, 2:12-cv-00464, 2:12-cv-00466, 2:12-cv-00468, 2:12-cv-00469, 2:12-cv-00470, 2:12-cv-00471, 2:12-cv-00473, 2:12-cv-00474, 2:12-cv-00475, 2:12-cv-00476, 2:12-cv-00476, 2:12-cv-00477, 2:12-cv-00480, 2:12-cv-00481, 2:12-cv-00482, 2:12-cv-00482, 2:12-cv-00483, 2:12-cv-00486, 2:12-cv-00487, 2:12-cv-00520, 2:12-cv-00521, 2:12-cv-00523, 2:12-cv-00524, 2:12-cv-00525, 2:12-cv-00527, 2:12-cv-00528, 2:12-cv-00530, 2:12-cv-00532, 2:12-cv-00534, 2:12-cv-00535, 2:12-cv-00536, 2:12-cv-00537, 2:12-cv-00542, 2:12-cv-00543, 2:12-cv-00545, 2:12-cv-00547, 2:12-cv-00548, 2:12-cv-00549, 2:12-cv-00550, 2:12-cv-00551, 2:12-cv-00552, 2:12-cv-00555, 2:12-cv-00556, 2:12-cv-00570, 2:12-cv-00572, 2:12-cv-00573, 2:12-cv-00575, 2:12-cv-00587, 3:13-cv-00217). Deposed 5/29/14; Retained 1/13 to 9/14.

MOSAID Technologies Inc., v. Realtek Semiconductor Corporation

Retained by Sidley Austin, LLP as an expert on behalf of defendant Realtek Semiconductor Corporation. Patents-in-suit are U.S. Patents 5,131,006; 5,151,920; 5,422,887; 5,706,428; 6,563,786; and 6,992,972. Case before the United States District Court for the Eastern District of Texas (Tyler Division) (Case No. 2:11-cv-00179). Retained 12/12 to 12/12. Matter settled.

Hoyt A. Flemming v. Cobra Electronics Corporation

Retained by Sidley Austin, LLP as an expert on behalf of defendant Cobra Electronics Corporation. Patents-in-suit are U.S. Patents RE39038, RE40653 and RE41905. Case before the United States District Court for the District of Idaho (Case No. 1:12-cv-00392). Retained 11/12 to 06/13. Matter settled.

LBS Innovations LLC v. Aaron Bros., Inc., et al.

Retained as an expert on behalf of defendants Whole Foods Marketplace, Comerica, Hotels.com, Academy, Ltd., and Homestyle Dining. Patent-in-suit is U.S. Patent 6,091,956. Case before the Eastern District of Texas, Marshall Division, (Case No. 2:11-cv-00142-MHS-CMC. Deposed 10/5/12; Retained 7/12 to 12/12. Plaintiff moved to dismiss.

Advanced Media Networks, L.L.C. v. Gogo LLC et al.

Retained by Sidley Austin, LLP as an expert on behalf of defendant Gogo. Patent-in-suit is U.S. Patent 5,960,074. Case before the United States District Court for the Central District of California (Case No. 11-cv-10474). Deposed 2/6/13. Retained 7/12 to 8/13.

Walker Digital, LLC v. Google Inc.

Retained by O'Melveny & Meyers, LLP as an expert on behalf of defendant Google Inc. Patents-in-suit are U.S. Patents 6,199,014. Case before the United States District Court for the

District of Delaware (Case No. 1:11-cv-00309-SLR). Deposed 2/27/13 - 2/28/13. Retained 6/12 to 8/13.

Silver State Intellectual Technologies, Inc. v. Garmin International, Inc., et al.

Retained by Erise IP, P.A. as an expert on behalf of defendants Garmin International, Inc. and Garmin USA, Inc. Patents-in-suit are U.S. Patents 6,525,768; 6,529,824; 6,542,812; 7,343,165; 7,522,992; 7,593,812; 7,650,234; 7,702,455 and 7,739,039. Case before the United States District Court for the District of Nevada (Case No. 2:11-cv-1578). Deposed 2/19/14; Testified in Court: 5/21/15; Retained 4/12 to 5/15.

Beacon Navigation GmbH v. Toyota Motor Corporation, et al.

Retained by Kirkland & Ellis, LLP on behalf of defendants Toyota Motor Corporation; Toyota Motor North America, Inc.; Toyota Motor Sales, U.S.A. Inc.; Toyota Motor Engineering & Manufacturing North America, Inc.; Toyota Motor Manufacturing, Indiana, Inc.; Toyota Motor Manufacturing, Kentucky, Inc.; Toyota Motor Manufacturing Mississippi, Inc.; Mazda Motor Corporation; Mazda Motor of America, Inc.; Fuji Heavy Industries, Ltd.; Fuji Heavy Industries U.S.A. Inc.; Subaru of America, Inc.; Jaguar Land Rover North America, LLC; Jaguar Cars Limited; Land Rover; Volvo Car Corporation; and Volvo Cars of North America, LLC; Adduci Mastriani & Schaumberg, LLP on behalf of defendants Suzuki and Garmin; Crowell-Moring on behalf of General Motors; Dickstein Shapiro on behalf of Chrysler Group, LLC; Finnegan, Henderson, Farabow, Garrett & Dunner on behalf of Bayerische Motoren Werke AG, BMW of North America, LLC, and BMW Manufacturing Co. LLC; Fish & Richardson on behalf of Honda Motor Co., Ltd., Honda North America, Inc., American Honda Motor Co., Inc., Honda Manufacturing of Alabama, LLC, Honda Manufacturing of Indiana, LLC, and Honda of America, Mfg., Inc.; Frommer Lawrence and Haug, LLP on behalf of Dr. Ing. h.c.F. Porsche AG and Porsche Cars North America, Inc.; Hogan Lovells on behalf of Daimler AG, Mercedes-Benz USA, LLC, or Mercedes-Benz U.S. International, Inc.; Quinn-Emanuel on behalf of Nissan and Ford. Case before the US International Trade Commission, Washington D.C., in the matter of: “Certain Automotive Navigation Systems, Components Thereof, and Products Containing Same, Inv. No. 337-TA-814. Case withdrawn by Plaintiff. Retained 1/12 – 4/12.

Beacon Navigation GmbH v. Toyota Motor Corporation, et al.

Retained by Kirkland & Ellis, LLP on behalf of defendants Toyota Motor Corporation; Toyota Motor North America, Inc.; Toyota Motor Sales, U.S.A. Inc.; Toyota Motor Engineering & Manufacturing North America, Inc.; Toyota Motor Manufacturing, Indiana, Inc.; Toyota Motor Manufacturing, Kentucky, Inc.; Toyota Motor Manufacturing Mississippi, Inc.; Mazda Motor Corporation; Mazda Motor of America, Inc.; Fuji Heavy Industries, Ltd.; Fuji Heavy Industries U.S.A. Inc.; Subaru of America, Inc.; Jaguar Land Rover North America, LLC; Jaguar Cars Limited; Land Rover; Volvo Car Corporation; and Volvo Cars of North America, LLC. Multiple cases before the United States District Court for the District of Delaware. Case numbers 1:11-cv-00942-UNA, 1:11-cv-00941-UNA, 1:11-cv-00951-UNA, 1:11-cv-00952-UNA, 1:11-cv-00936-UNA, 1:11-cv-00937-UNA, 1:11-cv-00955-UNA, 1:11-cv-00959-UNA, and 1:11-cv-00960-UNA. Currently stayed. Retained 1/12.

Beacon Wireless Solutions, Inc., et al., v. Garmin International, Inc., et al.

Retained by Shook, Hardy and Bacon, LLP as an expert on behalf of defendant Garmin. Matter involves alleged trade secret misappropriation. Case before the United States District Court for the Western District of Virginia, Harrisonburg Division (Case No. 5:11-cv-00025). Testified in Court: 5/25/12. Retained 12/11 to 5/25/12.

Tramontane IP, LLC v. Garmin Int'l, Inc., et al.

Retained by Shook, Hardy and Bacon, LLP as an expert on behalf of defendant Garmin. Patents-in-suit are U.S. Patents 6,526,268 and 7,133,775. Case before the United States District Court for the Eastern District of Virginia (Case No. 1:2011-cv-00918). Case Settled. Retained 11/11 to 12/11.

Sourceprose, Inc. v. AT&T, Inc., MetroPCS Communications, Inc., et al.

Retained by Kilpatrick Townsend as an expert on behalf of defendant AT&T. Patents-in-suit are US Patent Nos. 7,142,217 and 7,161,604. Case before the United States District Court for the Western District of Texas, Austin Division. Case number 1:11-cv-00117. Retained 11/11 to 3/16.

Furuno Electric Co., Ltd. and Furuno U.S.A., Inc. v. Honeywell International, Inc.

Retained by Quinn-Emanuel as an expert on behalf of complainant Furuno. Case before the US International Trade Commission, Washington D.C., in the matter of: "Certain GPS Navigation Products, Components Thereof, and Related Software," Investigation number 337-TA-810. Patents-in-suit are U.S. Patent Nos. 6,084,565; 7,095,367; 7,089,094; and 7,161,561. Case settled. Retained 8/11 – 12/11.

Honeywell International, Inc. v. Furuno Electric Co., Ltd. and Furuno U.S.A., Inc.

Retained by Quinn-Emanuel as an expert on behalf of respondent Furuno. Case before the US International Trade Commission, Washington D.C., in the matter of: "Certain GPS Navigation Products, Components Thereof, and Related Software," Investigation number 337-TA-783. Patents-in-suit are U.S. Patent Nos. 7,209,070; 6,865,452; 5,461,388; and 6,088,653. Case Settled. Retained 8/11 – 12/11.

Triangle Software, Inc. v. Garmin International, Inc.

Retained by Weil, Gotshal & Manges, LLP., as an expert on behalf of defendant Garmin. Patents-in-suit are US Patents 7,557,730, 7,221,287, 7,375,649, 7,508,321 and 7,702,452. Case before the United States District Court, Eastern District of Virginia, Case No. 1:10-cv-1457 CMH/TCB. Deposed 7/28/11; Testified in Court: 11/3/11 (jury trial). Retained 4/11 to 11/11.

Garmin International, Inc. v. Pioneer Corporation and Pioneer Electronics (USA), Inc.

Retained by Shook, Hardy and Bacon, LLP as an expert on behalf of plaintiff Garmin. Patents-in-suit are U.S. Patents 5,365,448; 5,424,951; and 6,122,592. Case before the United States District Court for the District of Kansas. Case No. 10-CV-2080 JWL/GLR. Declarative Judgment action stayed. Retained 3/11 to 11/11.

Visteon Global Technologies, Inc. And Visteon Technologies, LLC v. Garmin International, Inc.

Retained by Shook, Hardy and Bacon as an expert on behalf of defendant Garmin. Patents-in-suit are US Patents 5,544,060, 5,654,892, 5,832,408, 5,987,375 and 6,097,316. Case before the

United States District Court, Eastern District of Michigan, Case No. 2:10-cv-10578--PDB-MAR. Deposed 10/9/12; Retained 12/10 to 10/17.

Thomson Licensing SAS and Thomson Licensing, LLC. v. Realtek Semiconductor Corporation

Retained by Sidley-Austin as an expert on behalf of respondent Realtek Semiconductor. Case before the US International Trade Commission, Washington D.C., in the matter of: "Certain Liquid Crystal Display Devices, Including Monitors, Televisions, Modules, And Components Thereof," Investigation number 337-TA-741. Patent-in-suit is US Patent 6,121,941. Deposed 6/29/11; Testified in Court: 9/15/11 and 9/16/11. Retained 11/10 – 9/11.

Ambato Media, LLC. v. Clarion Co., LTD., et al.

Retained by Traurig-Greenberg as an expert on behalf of defendant Garmin. Patent-in-suit is US Patent 5,432,542. Case before the United States District Court for the Eastern District Of Texas, Marshall Division. Case number 2:09-CV-242. Deposed 4/26/12 and 5/10/12; Testified in Court: 7/11/12. Retained 10/10 to 7/12.

Gabriel Technologies Corporation and Trace Technologies, LLC, v. Qualcomm Incorporated, Snaptrack, Inc. and Norman Krasner

Retained by Cooley-Godward as an expert on behalf of defendants Qualcomm, Snaptrack, and Krasner. Trade secret misappropriation case related to US Patents 6,377,209, 6,583,757, 6,661,372, 6,799,050, 6,861,980, 6,895,249, 7,254,402, 7,289,786, 7,319,876, 7,421,277, 7,446,655, 7,570,958, 7,574,195, and 7,660,588. Case before the Southern District of California San Diego Division, Case No. 08-cv-1992 MMA POR. Retained 6/10 to 7/12.

SiRF/CSR v. Global Locate/Broadcom Corporation

Retained by Wilmer-Hale as an expert on behalf of defendant Global Locate / Broadcom. Patents-in-suit are US Patents 5,663,735, 6,480,150, 6,519,466, 6,650,879, 6,882,827, 6,934,322, 7,412,157, 7,236,883, and 7,573,422. Case before the Central District of California, Case No. 8:06-cv-01216 and Case No. 8:10-cv-01281. Retained 9/10 to 1/11.

Pioneer Electronics v. Garmin Corporation

Retained by Shook, Hardy and Bacon, LLP as an expert on behalf of respondent Garmin In the matter of Certain Multimedia Display and Navigation Devices and Systems, Components Thereof, and Products Containing Same; Inv. No. 337-TA-694. Patents-in-suit are U.S. Patents 5,365,448; 5,424,951; and 6,122,592. Case before the U.S. International Trade Commission. Deposed on 7/29/10; Testified at technology tutorial (8/27/10) and in the evidentiary hearing (9/20/10). Retained 4/10 to 9/10.

EMSAT Advanced Geo-Location Technology, LLC and Location Based Services LLC, v. AT&T Mobility, LLC

Retained by Baker-Botts as an expert on behalf of defendant AT&T Mobility, LLC. Patents-in-suit are U.S. Patents 7,289,763; 5,946,611; 6,324,404; and 6,847,822. Case before the U.S. District Court for the Northern District of Ohio, Eastern Division, Civil Action No. 4:08 CV 822. Deposed 5/4/10; Testified in Court: 5/10/10 (Markman hearing). Retained 12/09 to 3/11.

Tendler Cellular of Texas, LLC v. AT&T Mobility, LLC, et al.

Retained by Baker-Botts as an expert on behalf of defendants AT&T Mobility, LLC, et al. Patents-in-suit are U.S. Patents 7,447,508; 7,305,243; 7,050,818; and 6,519,463. Case before the U.S. District Court for the Eastern District of Texas (Tyler), Civil Action No. 6:09-CV-00115. Retained 8/09 to 7/10.

Ambit Corporation v. Delta Air Lines, Inc., and Aircell LLC.

Retained by Sidley Austin, LLP., as an expert on behalf of defendants Delta Airlines, Inc., and Aircell, LLC. Patent-in-suit is US patent 7,400,858. Case before the US District Court, District of Massachusetts, Boston, Civil Action No. 1:09-CV-10217-WGY. Deposed 12/4/09; Testified in Court: 12/7/09 (evidentiary hearing), 7/10 (jury trial). Retained 8/09 to 7/10.

GPS Industries, Inc. and Optimal I.P. Holdings, L.P. v. Altex Corporation, et. al.

Retained by Hitchcock-Evert as an expert on behalf of defendants Altex Corporation, Deca International Corporation, Golflogix, Inc. and L1 Technologies. Patent-in-suit is US patent 5,364,093. Case before the US District Court, Northern District of Texas, Dallas Division, Civil Action No. 3-07-CV0831-K. Deposed 6/30/09. Retained 5/08 through 7/09.

Satellite Tracking of People, LLC v. Omnilink Systems, Inc.

Retained by DLA Piper as an expert on behalf of defendant Omnilink Systems, Inc.. Patent-in-suit is US patent RE39,909. Case before the US District Court, Eastern District of Texas, Marshall Division, Civil Action No. 2-08CV-116. 12/08 – 1/11.

SiRF Technology, Inc. v. Global Locate, Inc.

Retained by DLA Piper/WilmerHale as an expert on behalf of Global Locate. Patents-in-suit include US patents 6,304,216; 6,417,801; 6,606,346; 6,651,000; 6,704,651; 6,937,187; 7,043,363; 7,091,904; 7,132,980 and 7,158,080. Case before the US International Trade Commission, Washington D.C., in the matters of: “Certain GPS Devices and Products Containing Same,” Investigation number 337-TA-602 (Global Locate, plaintiff) and “Certain GPS Chips, Associated Software and Systems, and Products Containing Same,” Investigation number 337-TA-596 (SiRF Technologies, plaintiff). My work focused on the 7,043,363 and 7,091,904 patents in defense of Global Locate/Broadcom from June 2007 through March 2008. Deposed 1/18-1/19/08; testified at trial 3/18-3/19/08.

Intellectual Science and Technology

Retained Dykema Gossett, PLLC as a technical expert on patent infringement issues related to “suspend-to-RAM” technologies in personal computers. Pre-litigation work.

Intellectual Science and Technology, Inc., v. Sony, JVC and Panasonic

Retained Dykema Gossett, PLLC as a technical expert on patent infringement issues related to US Patent 5,748,575, US Patent 6,222,799, US Patent 6,785,198, US Patent 6,662,239 and US Patent 6,717,890. Sony Electronics Inc., case number 2:06-CV-10406, JVC Americas Corp., case number 2:06-CV-10409 and Panasonic Corporation of North America case number 2:06-CV-10412. Cases heard in United States District Court, Eastern District of Michigan, Southern Division. Expert for Intellectual Science and Technology, Inc. Dec 2006 – 2008..

Kirsch Technologies v. Xerox, Canon

Retained Dykema Gossett, PLLC as an Expert Witness on patent infringement issues related to US Patent 4,816,911, Canon case number CA 00-72775, Xerox case number CA 00-72778, cases heard in United States District Court, Eastern District of Michigan, Southern Division. Expert for Kirsch Technologies. Nov 2006 – 2008..

American Video Graphics v. ATI Technologies

Retained by Sidley, Austin, Brown & Wood, Dallas, TX as a technical expert on patent infringement issues related to US Patents 5,132,670, 5,109,520, 5,084,830, 4,761,642, 4,742,474, 4,734,690, 4,730,185 and 4,694,286. Hewlett-Packard Co., et al., defendants, case number CA 6:04-CV-379-LED and Sony Corporation of America et al., defendants, case number CA 6:04-CV-399-LED. Cases heard in United States District Court, Eastern District of Texas, Tyler Division. Expert for ATI Technologies, intervener. Jan 2005 – Sep 2005.

Microsoft v. EMC

Dewey Ballantine, LLP, Washington, D.C., as a technical expert on patent infringement issues related to US Patents 5,588,147; 5,689,700; 6,393,466; 6,424,151; 6,490,594; and 6,632,248. Wrote a declaration on behalf of Microsoft. Oct 2004 – Jan 2005.

Optimum Return v. Meier Brothers

Retained by Sidley, Austin, Brown & Wood, Dallas, TX as a technical expert on Copyright infringement allegations related to software owned by Optimum Return, LLC. Cyberkatz Consulting, Inc., Handsquare, LLC, Meier Brothers, et al., defendants, case number CA 3-03CV1064-D. Case heard in United States District Court, Northern District of Texas, Dallas Division. Expert for Meier Brothers. July 2004.

Parental Guide of Texas, Inc. v. Funai Corp., et. al.

Technical expert for defendants JVC and Panasonic in their dispute over non-infringement of US Patent number 4,605,964.

Elonex I.P. Holdings, LTD. and Elonex PLC, Phase II

Expert witness for defendants Chuntex, Acer, Tatung, Lite-On, Daewoo and Envision in their dispute with Elonex non-infringement and validity for US Patent numbers 5,389,952; 5,648,799; and 5,880,719.

Storage Computer Corporation vs. Veritas Software

Technical expert for the plaintiff in matters involving Patents US 5,257,367; US 5,893,919; and US 6,098,128.

Storage Computer Corporation vs. Seagate Technology LLC

Technical expert for the defendant in matters involving US Patent RE 34,100.

Elonex I.P. Holdings, LTD. and Elonex PLC, vs. Packard Bell et. al., CA 98-689-GMS

Expert witness for defendants ViewSonic Corp., Dell Computer Corporation, MAG Technology USA, Princeton Graphic Systems, Inc., Micron Electronics, Sony Electronics and Capetronic

Computer USA in their dispute with Elonex non-infringement and validity for US Patent numbers 5,389,952; 5,648,799; and 5,880,719.

1.4.2 Engineering Consulting

Offspring Media Inc.

Technical consultant for the development of real-time auralization algorithms for integration into a consumer electronics product. Sep 2004.

Raytheon Company, Sudbury, MA

Development of techniques and requirements for implementing a fault tolerant computer system using software implemented fault tolerance (SIFT) techniques on commercial off-the-shelf processing hardware. The resultant system is to be used for highly reliable radar data and signal processing.

TVM Techno Venture Management

Provided consulting services to assist in assessing the technical claims of a company pursuing venture capital investment for a hardware implemented RAID 5 system .

Keyhold Engineering Inc., Northboro, MA.

Development of a prototype system for automatically calibrating multiple channel audio systems.

American Navigation Systems Inc., Milbury, MA.

Consulting on the development of the hand-held personal navigation and mapping system.

Lincoln Laboratory, Bedford, MA.

Simulated, tested and evaluated a GPS integrity monitoring algorithm developed at Lincoln Laboratories.

1.5 Licenses and Certifications

1.5.1 Commercial Radio Operator

General Radiotelephone Operator License
Ship RADAR endorsement

1.5.2 Amateur Radio Operator

Amateur Extra class radio operator license.

1.5.3 Diving Certifications

PADI Open Water Diver (ISO 24801-2 Diver Level 2 – Autonomous Diver)

1.5.4 Other Certifications

Remote Pilot Certificate (FAA Part 107 Small UAs)

2. Courses Taught at WPI

2.1 Course Descriptions

Short descriptions of the courses taught are as follows:

EE572N Advanced System Architecture

This course focuses on the architectural techniques used to achieve high-performance in SISD and SIMD computer systems. In this course the interaction between the software application and hardware architecture and the effect of this interaction on achievable performance is stressed. The course begins by covering the basic architectural tricks used to enhance system performance and ends with a series of case studies that analyze specific architectures such as the CRAY and CDC vector supercomputers, the MasPar, the Connection Machine, the ICL DAP, and others.

ECE505 Computer Architecture

This course is an introductory graduate course in computer architecture. Most aspects of CPU architecture are covered using a combined hardware/software approach. Specific topics include datapath design, memory systems, microprogramming, memory management, operating systems, and instruction set design.

ECE579M Real-Time System Design

This course focuses on the design of computer systems for which the timeliness of producing results is a critical factor for establishing the correctness of the system design. Topics covered include hardware specification, real-time operating systems and programming, scheduling, communications, and validation/verification. Issues and choices arising for single processor and distributed systems are also covered. Both hard and soft real-time system issues and the interactions between real applications and real systems is stressed.

ECE2010 Introduction to Electrical and Computer Engineering.

The objective of this course is to introduce students to the broad field of electrical and computer engineering within the context of real world applications. This course is designed for first-year students who are considering ECE as a possible major or for non-ECE students fulfilling an out-of-major degree requirement. The course will introduce basic electrical circuit theory as well as analog and digital signal processing methods currently used to solve a variety of engineering design problems in areas such as entertainment and networking media, robotics, renewable energy and biomedical applications. Laboratory experiments based on these applications are used to reinforce basic concepts and develop laboratory skills, as well as to provide system-level understanding. Circuit and system simulation analysis tools are also introduced and emphasized.

ECE2019 Sensors, Circuits, and Systems.

This course investigates commonly used sensors such as resistive temperature sensors, capacitive touch sensors, and inductive motion sensors and actuators. Numerous applications are presented to motivate coverage of fundamental operating principles of circuit elements such as resistors, capacitors, and inductors; model the signals produced by these sensors; and analyze the circuits and systems used to amplify and process these signals. After a review of Kirchhoff's current and voltage laws, fundamental analysis techniques such as Thevenin and Norton's theorems and the superposition principle are used to model and analyze sensors, circuits, and systems. Concepts from analysis of linear, time-invariant continuous-time signals and systems are introduced as necessary, including Fourier series and characterization of systems such as filters in both the frequency domain (bandwidth, transfer function) and time domain (rise time, step response). Capacitance, inductance and mutual inductance are explored as energy storage elements, including consideration of resonance and energy losses in power systems. Concepts will be reinforced with the use of laboratory exercises and computer simulation. Recommended background: ECE 2010, MA 1024 (or equivalent), PH 1120/21 and MA 2051 (concurrent) Note: Students who have received credit for ECE 2111 may not receive credit for ECE 2019.

ECE2022 Introduction to Digital Circuits and Computer Engineering.

The objective of this course is to expose students (including first year students) to basic electrical and mathematical concepts that underlie computer engineering while continuing an introduction to basic concepts of circuits and systems in a hands-on environment. Experiments representing practical devices introduce basic electrical engineering concepts and skills which typify the study and practice of electrical and computer engineering. In the laboratory, the students construct, troubleshoot, and test analog and digital circuits that they have designed. They will also be introduced to the nature of the interface between hardware and software in a typical microprocessor based computer.

ECE2801 Foundations of Embedded Systems

This course teaches the principles of programming microprocessors and microcontrollers for real-time applications. Students are introduced to software engineering principles and are taught how to translate product specifications into engineering solutions.

ECE2799 ECE Design

This is a new course added to the curriculum that teaches sophomore Electrical Engineering students the basic principles of design. Topics are covered which range from project planning and management through manufacturing and implementation. Students are exposed to external factors influencing design such as safety, liability, cost, and other constraints.

ECE3801 Logic Circuits

This is an introductory course in logic circuit design. Topics covered include Boolean Logic, Algebraic minimization of logic equations, Karnaugh Maps, sequential machine design and timing analysis.

ECE3803 Introduction to Microprocessor Systems

This is an undergraduate-level first-course in microprocessor design. Topics covered include timing analysis, address decoding, memory system design, assembly language programming, programmed I/O, and digital/analog interfacing. Experiments are run using ISA-bus interfaces to standard PCs.

ECE3810 Advanced Digital System Design

This course addresses the design of advanced digital logic systems using VHDL to design, synthesize and model digital circuits, and to implement these circuits using Xilinx FPGA devices. The course emphasizes understanding functional design, designing for speed and power objectives, and testing. The course ends with students designing moderately complicated “system on a chip” (SOC) based systems

ECE4815 Computer Architecture (crosslisted as CS4515)

A first course in computer architecture. Essential aspects of CPU architecture are covered using a combined hardware/software approach. Students learn how a CPU interprets and processes instructions. Issues associated with interfacing hardware with software are covered in detail as are the hardware/software tradeoffs associated with performance optimization.

ECE4801 Microprocessor System Design

Microprocessor System Design is the second course in the microprocessor sequence. In this course, students learn the advanced concepts used in modern microprocessor systems. Topics such as system organization, dynamic and cache memory systems, communications, mixed language programming, and device driver design are covered.

ECE430X Fundamentals of Navigation Systems

This course introduces students to the fundamentals of navigation using electronic systems. The course covers types of navigation systems, how to interpret sensor data and sources of navigation system error. Topics include: types of navigation systems (dead reckoning, inertial, radio based systems), sensors and error sources, coordinate frames and transformations, system dynamics and measurement processing. Case studies explore the use of accelerometers, gyroscopes, GPS (including, differential and assisted GPS) as well as other types of navigation systems.

RBE 3001 Unified Robotics III

Third of a four-course sequence introducing foundational theory and practice of robotics engineering from the fields of computer science, electrical engineering and mechanical engineering. The focus of this course is actuator design, embedded computing and complex response processes. Concepts of dynamic response as relates to vibration and motion planning

will be presented. The principles of operation and interface methods various actuators will be discussed, including pneumatic, magnetic, piezoelectric, linear, stepper, etc. Complex feedback mechanisms will be implemented using software executing in an embedded system. The necessary concepts for real-time processor programming, re-entrant code and interrupt signaling will be introduced. Laboratory sessions will culminate in the construction of a multi-module robotic system that exemplifies methods introduced during this course.

RBE 3002 Unified Robotics IV

Fourth of a four-course sequence introducing foundational theory and practice of robotics engineering from the fields of computer science, electrical engineering and mechanical engineering. The focus of this course is navigation, position estimation and communications. Concepts of dead reckoning, landmark updates, inertial sensors, vision and radio location will be explored. Control systems as applied to navigation will be presented. Communication, remote control and remote sensing for mobile robots and tele-robotic systems will be introduced. Wireless communications including wireless networks and typical local and wide area networking protocols will be discussed. Considerations will be discussed regarding operation in difficult environments such as underwater, aerospace, hazardous, etc. Laboratory sessions will be directed towards the solution of an open-ended problem over the course of the entire term.

RBE 400x Robot System Engineering and Design

The designers of robotic systems start with a system requirement to define the mechanical, electrical and software systems which must work together to achieve the system goals. Typically, parallel teams of engineers will work concurrently to create the requirements document as well as model various aspects of the system to verify operational capabilities and the ability to meet time and budget constraints. For complex systems, the development of such teams can itself be a complex problem since the project has to be organized in such a way that parallel teams can work independently, yet have excellent communication channels and information passing to insure project success.

This course explores the tools and techniques used to develop complex systems. The topics covered include: requirements development; system architecture and partitioning; requirements flowdown; functional and interface specifications; trade studies; system modeling and simulation; system integration; as well as design verification and validation.

RBE500 Foundations of Robotics

Foundations and principles of processing sensor information in robotic systems. Topics include an introduction to probabilistic concepts related to sensors, sensor signal processing, multi-sensor control systems and optimal estimation. The material presented will focus on the types of control problems encountered when a robot must operate in an environment where sensor noise and/or tracking errors are significant. Techniques for assessing the stability, controllability and expected accuracy of multi-sensor control and tracking systems will be presented. Lab projects will involve processing live and synthetic data, robot simulation and projects involving the control of robot platforms.

RBE502 Robot Control

This course reviews the interplay between control and robotics through introducing theory and demonstrating applications. It aims to provide an in-depth coverage of control design for robotic manipulators and mobile robots. We focus primarily on fundamental theory, control design methods, and their application on practical robotic systems. Topics may include modeling of robotic systems, linear/nonlinear control of robotic systems, control of under-actuated robotic systems, optimal control, adaptive control, behavior-based robots. Course projects will emphasize modeling, simulation and practical implementation of control systems for robot applications.

RBE594 Capstone Project Experience In Robotics Engineering

This project-based course integrates robotics engineering theory and practice, and provides the opportunity to apply the skills and knowledge acquired in the Robotics Engineering curriculum. The project is normally conducted in teams of two to four students. Students are encouraged to select projects with practical significance to their current and future professional responsibilities. The projects are administered, advised, and evaluated by WPI faculty as part of the learning experience, but students are also encouraged to seek mentorship from experienced colleagues in the Robotics Engineering profession.

3. List of Publications:

3.1 Journal Papers

- [1] DiLuoffo, Vincenzo, and William R. Michalson. "A Survey on Trust Metrics for Autonomous Robotic Systems." arXiv preprint arXiv:2106.15015 (2021).
- [2] V. Diluoffo, W. R. Michalson and B. Sunar, "Robot Operating System 2: The need for a holistic security approach to robotic architectures," *International Journal of Advanced Robotic Systems*, 15.3, 2018.
- [3] T. Padir, W.R. Michalson, et. al., "Implementation of an Undergraduate Robotics Engineering Curriculum," *Computers in Education Journal*, vol. I, no. 3, pp. 92-101, 2010.
- [4] W. R. Michalson, A. Navalekar and H. Parikh, "Error mechanisms in indoor positioning systems without support from GNSS," *The Journal of Navigation*, Cambridge University Press, vol. 62, no. 2, pp. 239-49, 2009.
- [5] H.K. Parikh and W. R. Michalson, "Impulse Radio - UWB or Multicarrier UWB for Non-GPS based Indoor Precise Positioning Systems," *NAVIGATION J. Inst. Nav.*, Vol. 55, no. 1, 2008.
- [6] I. F. Proгри, W. R. Michalson, J. Wang and M.C. Bromberg, "Indoor Geolocation Using FCDMA Pseudolites: Signal Structure and Performance Analysis", *NAVIGATION J. Inst. Nav.*, Vol. 54, No. 3, Fall 2007.
- [7] I. F. Proгри, M. C. Bromberg and W. R. Michalson, "Maximum-Likelihood GPS Parameter Estimation", *NAVIGATION J. Inst. Nav.*, vol. 52, no. 4, pp. 229-238, Winter, 2005-2006.

- [8] I.F. Proгри, W.R. Michalson, and D. Cyganski, "An OFDM/FDMA Indoor Geolocation System," *NAVIGATION J. Inst. Nav.*, vol. 51, no. 2, pp. 133-142, Summer, 2004.
- [9] I.F. Proгри, G. Bogdanov, V.C. Ramanna, and W.R. Michalson, "An Investigation Of A GPS Adaptive Temporal Selective Attenuator," *NAVIGATION J. Inst. Nav.*, Vol. 49 No. 3, pp. 137-147, 2002.
- [10] G. Bogdanov, W. R. Michalson, and R. Ludwig, "A new apparatus for non-destructive evaluation of green-state powder metal compacts using the electrical resistivity method," *Measurement Science and Technology*, IOP Publishing, vol. 11, pp. 157-166, January 2000.
- [11] B. Findlen, E. Reuter, R. Campbell, and W. R. Michalson, "Effects of time domain response on the sonic characteristics of microphones," *Journal of the Acoustical Society of America*, vol. 104, no. 3, pt. 2 pp. 1764, September 1998.
- [12] J. Sedgwick, W. R. Michalson, and R. Ludwig, "Design of a Digital Gauss Meter for Precision Magnetic Field Measurements," *IEEE Transactions on Instrumentation and Measurement*, vol. 47, no. 4, pp. 972-977, August 1998.
- [13] J. Stander, J Plunkett, W. Michalson, J. McNeill, and R. Ludwig, "A Novel Multi-Probe Resistivity Approach to Inspect Green-State Powdered Metallurgy Compacts," *Journal of Non-Destructive Evaluation*, vol. 16, no. 4, pp. 205-214, 1997.
- [14] Woltereck, R. Ludwig, and W. Michalson, "A Quantitative Analysis of the Separation of Aluminum Cans Out of a Waste Stream Based on Eddy Current Induced Levitation," *IEEE Transactions on Magnetics*, vol. 33, no. 1, pp. 772-781, January 1997.
- [15] W. R. Michalson, "Auralization on a Laptop PC," abstract appears in *The Journal of the Acoustical Society of America* , vol. 100 No. 4, Pt 2, pp. 2608, October 1996.
- [16] R. H. Campbell, S. K. Martin, I. Schneider, and W. R. Michalson, "Analysis of Mosquito Wingbeat Sound," *The Journal of the Acoustical Society of America* vol. 100 No. 4, Pt 2, pp. 2710, October 1996.
- [17] W. R. Michalson, "Ensuring GPS Navigation Integrity using Receiver Autonomous Integrity Monitoring," *IEEE Aerospace and Electronic Systems Magazine*. vol. 10, no. 10, pp. 31-34, October 1995.
- [18] S. Clayton, R. J. Duckworth, W. Michalson, A. Wilson, "Determining Update Latency Bounds in Galactica Net," *Concurrency: Practice, and Experience*, vol. 7, no. 7, pp. 595-611, October 1994.

3.2 Conference Papers

- [1] E. Skorina, R. Rameshwar, S. Pirasmepulkul, T. Khuu, A. Caracappa, P. Luxsuwong, M. Luo, W. R. Michalson, and C. Onal, "Soft Robotic Glove System for Wearable Haptic Teleoperation," WM Symposium 2018, March 18 - 22, 2018 - Phoenix Convention Center.
- [2] K.C. Seals, W.R. Michalson, R.J. Hartnett and P.F. Swaszek, "Using Both GPS L1 C/A and L1C: Strategies to Improve Acquisition Sensitivity," Proc. 26th International

- Technical Meeting of the Satellite Division of the Institute of Navigation (ION GNSS 2013), Sep. 16-20, 2013.
- [3] K.C. Seals, W.R. Michalson, R.J. Hartnett and P.F. Swaszek, "Semi-Coherent and Differentially Coherent Integration for L1C Acquisition," Proc. 2013 International Technical Meeting of the Institute of Navigation (ION ITM 2013), Honolulu, HI, Apr. 22-25, 2013.
 - [4] J.M. Barrett, M.G. Gennert, W. R. Michalson, et. al., "Development of a Low-Cost, Self-Contained, Combined Vision and Inertial Navigation System," 2013 International Conference on Technologies for Practical Robotic Applications, Boston, MA Apr. 22-23, 2012.
 - [5] K.C. Seals, W.R. Michalson, R.J. Hartnett and P.F. Swaszek, "Analysis of L1C Acquisition by Combining Pilot and Data Components Over Multiple Code Periods," Proc. 2013 International Technical Meeting of the Institute of Navigation (ION ITM 2013), San Diego, CA, Jan. 28-30, 2013.
 - [6] K.C. Seals, W.R. Michalson, R.J. Hartnett and P.F. Swaszek, "Analysis of Coherent Combining for L1C Acquisition," Proc. 25th International Technical Meeting of the Satellite Division of the Institute of Navigation (ION GNSS 2012), pp.384-393, Nashville, TN, Sep. 17-21, 2012.
 - [7] J.M. Barrett, M.G. Gennert, W. R. Michalson and J.L. Center, "Analyzing and Modeling an IMU for Use in a Low-Cost Combined Vision and Inertial Navigation System," 2012 International Conference on Technologies for Practical Robotic Applications, Boston, MA Apr. 23-24, 2012.
 - [8] G. Fischer, W. R. Michalson, T. Padir and G. Pollice, "Development of a Laboratory Kit for Robotics Engineering Education" AAAI 2010 Spring Symposium on Educational Robotics and Beyond: Design and Evaluation, Mar. 22-24, Palo Alto, CA, 2010.
 - [9] W.R. Michalson, and F. J. Looft, "Designing Robotic Systems: Preparation for an Interdisciplinary Capstone Experience," American Society of Engineering Educators 2010 Annual Conference, Louisville, KY, Jun 20-23, 2010.
 - [10] W.R. Michalson, S.J. Bitar and R.C.Labonte, "The Technical, Process, and Business Considerations For Engineering Design – A 10 Year Retrospective," American Society of Engineering Educators 2010 Annual Conference, Louisville, KY, Jun 20-23, 2010.
 - [11] M. Gennert, M. Demetrio and W. R. Michalson, "A Robotics Engineering M.S. Degree," American Society of Engineering Educators 2010 Annual Conference, Louisville, KY, Jun 20-23, 2010.
 - [12] R. Beach, W. R. Michalson, et. al., "Robotics Innovations Competition and Conference (RICC): Building Community Between Academia and Industry Through a University-Level Student Competition," American Society of Engineering Educators 2010 Annual Conference, Louisville, KY, Jun 20-23, 2010.
 - [13] G. Tryggvason, W.R. Michalson, et. al., Teaching Multidisciplinary Design to Engineering Students: Robotics Capstone," American Society of Engineering Educators 2010 Annual Conference, Louisville, KY, Jun 20-23, 2010.

- [14] A.C.Navalekar, W.R. Michalson, "Asymmetric throughput problem due to Push-to-talk (PTT) delays in CSMA/CA based heterogeneous Land Mobile Radio (LMR) networks", accepted for publication, Milcom 2009.
- [15] A. Navalekar and W.R. Michalson, "Effects of Unintentional Denial of Service (DOS) due to PTT delays on performance of CSMA/CA based Adhoc Land Mobile Radio (LMR) networks", accepted for publication, ICST Adhocnet 2009.
- [16] W. R. Michalson, et. al., "Unified Robotics: Balancing Breadth and Depth in Engineering Education", American Society of Engineering Educators 2009 Annual Conference, AC 2009-1681, Austin, TX, Jun 14-17, 2009.
- [17] G. Tryggvason, W.R. Michalson, et. al., "Robotics Engineering: A New Discipline for a New Century", American Society of Engineering Educators 2009 Annual Conference, AC 2009-997, Austin, TX, Jun 14-17, 2009.
- [18] M. DiBlasi, W. R. Michalson, et. al., "Social Networking in the FIRST Robotics Competition Community," ASEE Northeast Section Conference, University of Bridgeport, Apr 3-4, Bridgeport, CT, 2009.
- [19] A. Navalekar, H.K Parikh and William R. Michalson, "Error Mechanisms in Indoor Positioning Systems without Support from GNSS", RIN NAV 08.
- [20] A. Navelekar, W.R. Michalson, et. al., "Effects of Push-To-Talk (PTT) delays on Throughput Performance of CSMA/CA based Distributed Digital Radios (DDR) for Land Mobile Radio (LMR) Networks," 37th International Conference on Parallel Processing (ICPP-08), Portland, OR, Sep. 8-12, 2008.
- [21] M. Ciraldi, W. Michalson, et. al., "The New Robotics Engineering BS Program at WPI," American Society of Engineering Educators 2008 Annual Conference, AC 2008-1048, Pittsburgh, PA, Jun 22-25, 2008.
- [22] A.C.Navalekar, W.R. Michalson, "A New Approach to Improve BER Performance of a High Peak-to-Average Ratio (PAR) OFDM signal over FM based Land Mobile Radios (LMR)", IEEE WTS 08, Pomona, CA.
- [23] A. Navelekar and W.R. Michalson, "Effects of Push-To-Talk (PTT) delays on CSMA based Capacity Limited Land Mobile Radio (LMR) Networks," *Proc. IEEE Intl. Symp. Wireless Pervasive Computing 2008 (ISWPC08)*, Santorini, Greece, May 7-9, 2008.
- [24] H.K. Parikh and W.R. Michalson, "Error Mechanisms In An Rf-Based Indoor Positioning System," *Proc. 2008 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP '08)*, Las Vegas, NV Mar 30 – Apr 4, 2008.
- [25] B. Woodacre, W. Michalson, et. al., "WPI Precision Personnel Locator System - Automatic Antenna Geometry Estimation," to appear, *Proc. ION-NTM 2008*, San Diego, CA, Jan 27-29, 2008.
- [26] H.K. Parikh, A. Navelekar and W.R. Michalson, "Issues in Achieving Precise Positioning Indoors Without Support from GNSS," *Proc. ION-NTM 2008*, San Diego, CA, Jan 27-29, 2008.

- [27] D. Cyganski, W. Michalson, et. al., "WPI Precision Personnel Locator System - Evaluation by First Responders," *Proc. Institute of Navigation GNSS 2007*, Fort Worth, TX, September 25-28, 2007.
- [28] I.F. Progri, W. R. Michalson, et. al., "Maximum Likelihood OFDMA Parameter Estimation," *Proc. Institute of Navigation GNSS 2007*, Fort Worth, TX, September 25-28, 2007.
- [29] C.W. Kelley, W. R. Michalson, et. al., "Discrete vs. Continuous Carrier Tracking Loop Theory, Implementation, and Testing with Large BnT," *Proc. Institute of Navigation GNSS 2007*, Fort Worth, TX, September 25-28, 2007.
- [30] W. R. Michalson and J. W. Matthews, "Distributed Digital Radios and WLAN Interoperability," 2007 IEEE Conference on Technologies for Homeland Security, May 16-17, Woburn, MA, 2007.
- [31] I.F. Progri, W.R. Michalson, J. Wang, M.C. Bromberg, and R.J. Duckworth, "Requirements of a C-CDMA Pseudolite Indoor Geolocation System," *Proc. ION-AM 2007*, Cambridge, MA, pp. 654-658, Apr. 2007.
- [32] D. Cyganski, R. J. Duckworth, S. Makarov, W. R. Michalson, et.al., "WPI Precision Personnel Locator System," *Proc. Institute of Navigation National Technical Meeting (NTM 2007)*, Catamaran Resort Hotel, San Diego, CA, January 22-24, 2007.
- [33] I.F. Progri, M.C. Bromberg, W.R. Michalson, and J. Wang, "A Theoretical Survey of the New GPS Signals (L1C, L2C, and L5)," *Proc. Institute of Navigation National Technical Meeting (NTM 2007)*, Catamaran Resort Hotel, San Diego, CA, January 22-24, 2007.
- [34] I.F. Progri, M.C. Bromberg, W.R. Michalson, and J. Wang, "Field Measurement Data on Support of a Unified Indoor Geolocation Channel Model," *Proc. Institute of Navigation National Technical Meeting (NTM 2007)*, Catamaran Resort Hotel, San Diego, CA, January 22-24, 2007.
- [35] I. F. Progri, J. Maynard, W.R. Michalson, and J. Wang, "The Performance and Simulation of a C-CDMA Pseudolite Indoor Geolocation System," *Proc. Institute of Navigation GNSS 2006*, Fort Worth, TX, September 26-29, 2006.
- [36] I. F. Progri, W. Ortiz, W.R. Michalson, and J. Wang, "The Performance and Simulation of an OFDMA Pseudolite Indoor Geolocation System," *Proc. Institute of Navigation GNSS 2006*, Fort Worth, TX, September 26-29, 2006.
- [37] J.W. Coyne, R. J. Duckworth, W. R. Michalson and H.K. Parikh, "2-D Radio Navigation System Using MC-UWB," *Proc. NAV 2005 – Pushing the boundaries*, Royal Institute of Navigation, London, Nov 1-3, 2005.
- [38] H.K. Parikh, W.R. Michalson and R.J. Duckworth,, "MC-UWB Precise Positioning System –Field Tests, Results and Effect of Multipath," *Proc. Institute of Navigation GNSS 2005*, Long Beach Convention Center, Long Beach, CA, September, 2005.
- [39] R.J. Duckworth, H.K. Parikh and W.R. Michalson, "Radio Design and Performance Analysis of a Multi-carrier Ultrawideband (MC-UWB) Positioning System," *Proc. Institute of Navigation National Technical Meeting (NTM 2005)*, Catamaran Resort Hotel, San Diego, CA, January 24-26, 2005.

- [40] H.K. Parikh and W.R. Michalson, "Performance Evaluation of the Receiver RF Front-End of a Precision Positioning System," *Proc. Institute of Navigation GNSS 2004*, Long Beach Convention Center, Long Beach, CA, September 21-24, 2004.
- [41] W.R. Michalson and H. Ahlehagh, "A 3D Location Discovery Algorithm for Ad Hoc Networks," *ICWN-04, 2004 International Conference on Wireless Networks*, Las Vegas, pp. 567-572, Jun 21-24, 2004.
- [42] I.F. Progri, W.R. Michalson and M.C. Bromberg, "Accurate Synchronization Using a Full Duplex DSSS Channel," *Proc. IEEE PLANS 2004*, Monterrey, CA, pp. 220-226, Apr 26-29, 2004.
- [43] I.F. Progri and W.R. Michalson, "An Investigation of a DSSS-OFDM-CDMA-FDMA Indoor Geolocation SYSTEM," *Proc. IEEE PLANS 2004*, 2004, Monterrey, CA, pp. 662-670, Apr 26-29, 2004.
- [44] D. Cyganski, J.A. Orr, W.R. Michalson, "Performance of a Precision Indoor Positioning System Using a Multi-Carrier Approach," *Proc. Institute of Navigation 2004 National Technical Meeting*, San Diego, CA, pp. 175-180, Jan 26-28, 2004.
- [45] I.F. Progri, W.R. Michalson and M.C. Bromberg, "An Enhanced Acquisition Process of a Maximum Likelihood GPS Receiver," *Proc. Institute of Navigation 2004 National Technical Meeting*, San Diego, CA, pp. 390-398, Jan 26-28, 2004.
- [46] D. Cyganski, J. Orr, W. Michalson, "A Multi-Carrier Technique for Precision Geolocation for Indoor/Multipath Environments", *Proc. Institute of Navigation GPS 2003*, Portland, OR, pp. 1069-1073, Sep 9-12, 2003.
- [47] I.F. Progri, M.C. Bromberg and W.R. Michalson, "The Acquisition Process of a Maximum Likelihood GPS Receiver," *Proc. Institute of Navigation GPS 2003*, Portland, OR, pp. 2533-2542, Sep 9-12, 2003.
- [48] W.R. Michalson, H. Ahlehagh and I.F. Progri, "Dynamic Node Location in an Ad Hoc Indoor Communications and Positioning Network," *Proc. Institute of Navigation GPS 2003*, Portland, OR, pp. 1185-1191, Sep 9-12, 2003.
- [49] J. DeChiaro, C. Strus and W.R. Michalson, "A Personal Navigation Test Platform Based on Low-Cost Inertial Components," *Proc. Institute of Navigation GPS 2003*, Portland, OR, pp. 2869-2877, Sep 9-12, 2003.
- [50] H. AhleHagh, W. R. Michalson and D. Finkel, "Statistical Characteristics of Wireless Network Traffic and its Impact on Ad Hoc Network Performance," *Proc. Applied Telecommunication Symposium 2003 Advance Simulation Technologies Conference*, Orlando, FL, pp. 66-71, Mar 30 – Apr 3, 2003.
- [51] I.F. Progri, W.R. Michalson and D. Cyganski, "An OFDM/FDMA Indoor Geolocation System," *Proc. ION National Technical Meeting*, Anaheim, CA, pp. 272-281, Jan 22-24, 2003.
- [52] I.F. Progri and W.R. Michalson, "Synchronization of Measurements of Power System Harmonics By Means of the Global Positioning System," *Proc. ION Annual Meeting*, Albuquerque, NM, pp. 372-382, Jun 24-26, 2002.

- [53] I.F. Progri, W.R. Michalson, and M.C. Bromberg, "A recursive solution to the generalized eigenvalue problem," *Proc. ION Annual Meeting*, Albuquerque, NM, pp. 154-162, Jun 24-26, 2002.
- [54] I.F. Progri and W.R. Michalson, "A Combined GPS Satellite/Pseudolite System for Category III Precision Landing," *Proc. IEEE PLANS*, pp. 212-218, Apr 15-17, 2002.
- [55] I.F. Progri, W.R. Michalson and M. Bromberg, "A Comparison Between the Recursive Cholesky and MGSO Algorithms," *Proc. Institute of Navigation 2002 National Technical Meeting*, San Diego, CA, pp. 655-665, Jan 28-30, 2002.
- [56] I.F. Progri, W.R. Michalson and M. Bromberg, "A Study of a Blind Adaptive Algorithm in the Time and Frequency Domain," *Proc. Institute of Navigation 2002 National Technical Meeting*, San Diego, CA, pp. 439-447, Jan 28-30, 2002.
- [57] L. Polizzotto and W. R. Michalson, "The Technical, Process, and Business Considerations for Engineering Design," *Frontiers in Education 2001*, Reno, NV, pp. F1G-19-F1G-24, Oct 10-13, 2001.
- [58] I.F. Progri and W.R. Michalson, "An Improved Adaptive Spatial Temporal Selective Attenuator," *Proc. Institute of Navigation GPS 2001*, Salt Lake City, UT, pp. 932-938, Sep 11-14, 2001.
- [59] I.F. Progri and W.R. Michalson, "An Alternative Approach to Multipath and the Near-Far Problem for Indoor Geolocation Systems," *Proc. Institute of Navigation GPS 2001*, Salt Lake City, UT, pp. 1434-143, Sep 11-14, 2001.
- [60] W.R. Michalson and I.F. Progri, "An Investigation of the Adaptive Spatial Temporal Selective Attenuator," *Institute of Navigation GPS 2001*, Salt Lake City, UT, pp 1985-1996, Sep 11-14, 2001.
- [61] I.F. Progri and W.R. Michalson, "The Impact of Proposed Pseudolite's Signal Structure on the Receiver's Phase and Code Error," *Proc. ION Annual Meeting*, Albuquerque, NM, pp. 414-422, Jun 11-13, 2001.
- [62] I.F. Progri, J.M. Hill and W.R. Michalson, "An Investigation of the Pseudolite's Signal Structure for Indoor Positioning," *Proc. ION Annual Meeting*, Albuquerque, NM, pp. 453-462, Jun 11-13, 2001.
- [63] J. M. Hill and W. R. Michalson, "Real Time Verification of Bit-Cell Alignment for C/A Code Only Receivers," *Proc. ION Annual Meeting*, pp. 463-468, Jun 11-13, 2001.
- [64] I. Progri , J. M. Hill and W. R. Michalson, "The Impact of the Proposed Pseudolite's Signal Structure on the Receiver's Phase and Code Error," *Proc. ION Annual Meeting*, pp. 414-422, Jun 11-13, 2001.
- [65] I.F. Progri, W.R. Michalson and R. Chassaing "Fast and efficient filter design and implementation on the TMS320C6711 digital signal processor," *Proc. Student Forum ICASSP*, Salt Lake City UT, May 2001.
- [66] I. Progri and W. R. Michalson, "An Innovative Navigation Algorithm Using a System of Fixed Pseudolites," *Institute of Navigation National Technical Meeting*, pp. 619-627, Long Beach, CA, Jan 22-24, 2001.

- [67] I. Proгри, J.M. Hill and W. R. Michalson, "A Doppler-based navigation algorithm," *Institute of Navigation National Technical Meeting*, pp. 482-490, Long Beach, CA, Jan 22-24, 2001.
- [68] I. Proгри, J. M. Hill and W. R. Michalson, "Assessing the Accuracy of Navigation Algorithms Using a Combined System of GPS Satellites and Pseudolites," *Institute of Navigation National Technical Meeting*, Long Beach, CA, pp 473-481, Jan 22-24, 2001.
- [69] J. M. Hill and W. R. Michalson, "Design of a Stable Discrete Time Costas Loop," *Institute of Navigation National Technical Meeting*, pp. 228-234, Jan 22-24, 2001.
- [70] J. M. Hill and W. R. Michalson, "Techniques for Reducing the Near-Far Problem in Indoor Geolocation Systems," *Institute of Navigation National Technical Meeting*, pp. 860-865, Jan 22-24, 2001.
- [71] I. Proгри and W. R. Michalson, "Adaptive Spatial and Temporal Selective Attenuator in the Presence of Mutual Coupling and Channel Errors," *Institute of Navigation GPS 2000*, Salt Lake City, UT, pp. 462-470, Sep 19-22, 2000.
- [72] W. R. Michalson, J. A. Orr and D. Cyganski, "A System for Tracking and Locating Emergency Personnel Inside Buildings," *Institute of Navigation GPS 2000*, Salt Lake City, UT, pp. 560-568, Sep 19-22, 2000.
- [73] W. R. Michalson and I. Proгри, "Assessing the Accuracy of Underground Positioning Using Pseudolites," *Institute of Navigation GPS 2000*, Salt Lake City, UT, pp. 1007-1015, Sep 19-22, 2000.
- [74] I. Proгри and W. R. Michalson, "Performance Evaluation of Category III Precision Landing Using Airport Pseudolites," *IEEE Conf. Position, Location, and Navigations Systems (PLANS)*, Mar, pp. 262-269, 2000.
- [75] R. Ludwig, G. Bogdanov, W. Michalson, and D. Apelian, "Instrumentation Development for Crack Detection of Surface and Subsurface Defects in Green-State P/M Compacts through Multi-Probe Electric Resistivity Testing," *Review of Progress in NDE*, Snowbird Ski and Summer Resort, Snowbird UT, Jul 19-24, 1998.
- [76] W. R. Michalson, W. Cidela, et. al., "A GPS-Based Hazard Detection and Warning System," in review, " *ION GPS-96, 9th International Meeting of the Satellite Division of the Institute of Navigation*, pp. 167-175, Kansas City, MO, Sep 17-20, 1996.
- [77] W. R. Michalson and R. L. Labonte, "Capstone Design in the ECE Curriculum: Assessing the Quality of Undergraduate Projects at WPI," *American Society of Engineering Educators 1996 Annual Conference (CD-ROM)*, session 1232 Washington, D.C., Jun, 1996.
- [78] W. R. Michalson, J. Single, M. Spadazzi, and M. Wehr, "A Real-Time GPS System for Monitoring Forestry Operations," *Sixth Biennial Forest Service Remote Sensing Applications Conference*, pp. 264-269, Denver, CO, May 1-3, 1996.
- [79] W. R. Michalson and D. Nicoletti, "Computers in Introductory and Upper-Level ECE Courses," *American Society of Engineering Educators 1995 Annual Conference*, Anaheim, CA, Jun 25-28, 1995, pp. 2795-99.

- [80] W. R. Michalson, D. B. Cox, and H. Hua, "GPS Carrier-Phase RAIM," *ION GPS-95, 8th International Meeting of the Satellite Division of the Institute of Navigation*, Palm Springs, CA., pp. 1975-1984, Sep 12-15, 1995.
- [81] J. Bernick and W. R. Michalson, "UDSRAIM: An Innovative Approach to Increasing RAIM Availability," *ION GPS-95, 8th International Meeting of the Satellite Division of the Institute of Navigation*, Sep 12-15, Palm Springs, CA., pp. 1965-1973, 1995.
- [82] C. Easton and W. R. Michalson, "Effects of Worst Case Geometries on RAIM Testing," *ION GPS-95, 8th International Meeting of the Satellite Division of the Institute of Navigation*, Sep 12-15, Palm Springs, CA., pp. 2015-2022, 1995.
- [83] D. B. Cox and W. R. Michalson, "Use of Uncorrected GPS Carrier Phase Measurements for Incremental RAIM with WAAS," *ION 51st Annual Meeting*, Jun 5-7, Colorado Springs, CO., pp. 515-520, 1995.
- [84] W. Michalson, et. al., "RAIM Availability for Augmented GPS-Based Navigation Systems," *ION GPS-94, 7th International Meeting of the Satellite Division of the Institute of Navigation*, pp. 587-95, Sep 20-23, 1994.
- [85] V. G. Virball, W. Michalson, et. al., "A GPS Integrity Channel Based Fault Detection and Exclusion Algorithm Using Maximum Solution Separation," *Proceedings of the 1994 IEEE Position Location and Navigation Symposium (PLANS-94)*, pp. 747-54, Las Vegas, Apr 11-15, 1994.
- [86] W. Michalson and C. Easton, "Experiences Implementing the Supplemental MOPS Off-Line Test Procedure," *ION GPS-93, 6th International Meeting of the Satellite Division of the Institute of Navigation*, pp. 519-27, Sep 22-24, 1993.
- [87] D. Beatovic, P.L. Levin, A. Meroth, M. Spasojevic, W. R. Michalson, A. Unstundag, "Iterative Matrix Solvers for Large Full Systems," *Eighth International Symposium on High Voltage Engineering*, Aug 23-27, Yokohama, Japan, 1993.
- [88] E. Schnieder, W. R. Michalson, "A Comparison of Large Guided-Wave Interconnection Networks for Optical Computation Systems," *SPIE Conf. on Optoelectronic Interconnects OE/LASE 93*.
- [89] E. Schnieder, W. R. Michalson, "Integrated Guided-Wave Crossbar Interconnection of SEED Arrays," *SPIE Conf. on Optoelectronic Interconnects OE/LASE 93*.
- [90] W. R. Michalson, "The Application of Neural Networks to Nonlinear Filtering," *Proc. SPIE Cooperative Intelligent Robotics in Space III*, pp. 219-228, Boston, 1992.
- [91] W. R. Michalson and C. S. Tocci, "Exploiting Programmable Devices in High-Performance System Design: Current Trends," *Proc. Electro 92*, vol 2, pp. 104-109, May 12-14, 1992.
- [92] S. Clayton, R. J. Duckworth, W. Michalson, A. Wilson, "Determining Update Latency Bounds in Galactica Net," *Proc. IEEE Conf. on High-Performance Distributed Computing*, pp. 104-111, Sep 9-11, 1992.
- [93] R. J. Duckworth, J. E. Lavallee, W. R. Michalson, L. Becker, and P. Green, "The Development of Intelligent Real-Time Systems Using Ada," *12th IEEE Symposium on Real-Time Systems*, Dec 3-6, 1991.

- [94] W. Jessop, W. Michalson, and R. Some, "Fault Injection for Verifying Fault Tolerant System Behavior," *Workshop on Experimental Evaluation*, El Segundo, CA, May 1-3, 1990.
- [95] W. R. Michalson and P. Heldt, "A Hybrid Architecture for the ART 2 Neural Model," *Proc. International Joint Conference on Neural Networks*, pp. 167-70, Washington D.C., Jan 15-19, 1990.
- [96] W. R. Michalson, "A Review of the Current State of Logic Synthesis," *2nd Annual IEEE ASIC Seminar and Exhibit*, Rochester, NY, Sep 25- 28, 1989.
- [97] P. E. Green and W. R. Michalson, "Real-Time Evidential Reasoning and Network Based Processing," *Proc. IEEE 1st International Conference on Neural Networks*, pp. 359-365, San Diego, CA, Jun 21-24, 1987.
- [98] P. E. Green, R. J. Juels, and W. R. Michalson, "Real Time Artificial Intelligence Architecture," *Proc. Workshop on Future Directions in Computer Architecture and Software*, pp. 328-330, Charleston, SC, May 5-7, 1986.

3.3 Book Chapters

- [1] W. Michalson and E. Schnieder, "An Approach for Implementing a Reconfigurable Optical Interconnection Network for Massively Parallel Computers," in *Optical Interconnection - Foundations and Approaches*, C. Tocci and H. J. Caulfield Eds., Artech House, proposed release January 1994.

3.4 Patents

Assurance Model for an Autonomous Robotic System feedback user interface

United States Patent Application, October, 2023

Haptic glove as a wearable force feedback user interface

United States Patent 10,551,923, Issued February 4, 2020

A toroidal actuator is responsive to a teleoperator for providing haptic feedback responsive to a curvature or articulated movement applied to a gripped object. The toroidal actuator surrounds an operator member such as a finger, and is responsive to pneumatic pressure for increasing telepresence force defined by resistance encounter against a teleoperated robotic claw. As the teleoperated claw grips an object, increased pneumatic pressure in the toroidal actuator tends to elongate the toroidal shape in a linear manner and oppose a curvature force applied by an inserted operator finger. Resistive force is based on soft sensing of the gripped object, thus the toroidal actuator applies an increasing resistive force to curvature as the robotic claw closes around a gripped object by solenoid regulated air pressure.

Precision location methods and systems

United States Patent 8,928,459, Issued January 6, 2015

The invention describes systems and methods for determining the location of a transmitter by jointly and collectively processing the full sampled signal data from a plurality of receivers to form a single solution.

Tracking device and remote monitoring system

United States Patent Application US20140274115A1

A system includes a remote monitoring device configured to detect and measure one or more signals and to convey detected and measured signal information to a central location. The central location is configured to determine the location of the remote monitoring device based on the received signal information and is also configured to determine at least one hypothetical path of the remote monitoring device. Abandoned.

Apparatus and methods for addressable communication using voice-grade radios

United States Patent 8,284,711, Issued 9 October 2012

The invention relates to methods and apparatus for conducting directed communication using voice-grade radios. The methods and apparatus can be used to form a packet-switched wireless network using legacy analog transceivers, providing, e.g., both data and voice-over-Internet Protocol communication.

Multi-channel electrophysiologic signal data acquisition system on an integrated circuit.

United States Patent 7,896,807, issued 3 March 2011.

A physiologic data acquisition system includes an analog input, a sigma-delta front end signal conditioning circuit adapted to subtract out DC and low frequency interfering signals from and amplify the analog input before analog to digital conversion. The system can be programmed to acquire a selected physiologic signal, e.g., a physiologic signal characteristic of or originating from a particular biological tissue. The physiologic data acquisition system may include a network interface modulating a plurality of subcarriers with respective portions of an acquired physiologic signal. A receiver coupled to the network interface can receive physiologic data from, and send control signals and provide power to the physiologic data acquisition system over a single pair of wires. The network interface can modulate an RF carrier with the plurality of modulated subcarriers and transmit the resulting signal to the receiver across a wireless network. An integrated circuit may include the physiologic data acquisition system. Also included are methods for acquiring physiologic data comprising the step of selectively controlling an acquisition circuit to acquire the physiologic signal.

Methods and apparatus for high resolution positioning. United States Patent 7,292,189. The invention relates to a method of signal analysis that determines the location of a transmitter and to devices that implement the method. The method includes receiving by at least three receivers, from a transmitter, a first continuous-time signal having a first channel. The first channel includes a first plurality of signal carriers having known relative initial phases and having known frequencies which are periodically spaced and which are orthogonal to one another within a first frequency range. The signal analysis method also includes determining the phase shifts of the carriers of the first channel resulting from the distance the carriers traveled in reaching the first

receiver. Analysis of the phase shifts yields time difference of arrival information amongst the receivers, which is further processed to determine the location of the transmitter. 6 Nov 2007.

A Reconfigurable Indoor Geolocation System, US Patent Number 7,079,025. A portable reconfigurable geolocation system is provided. The system includes a portable user node and one or more portable pseudolite nodes in communication one another and with the user node. Each of the user nodes and pseudolite nodes includes a transmitter that generates a signal on one or more carrier frequencies. Each signal is modulated with digital signals necessary to establish distances between the nodes and to convey data between the nodes. Each node also includes a receiver for receiving and demodulating the signals transmitted between the nodes, and a processor for receiving the demodulated signals, extracting data values and derived values from the demodulated signals and determining a three-dimensional position of each node in the system. Issued 18 Jul 2006.

Auto-Calibrating Surround System, United States Patent 7,158,643. A multi-channel surround sound system and method is described that allows automatic and independent calibration and adjustment of the frequency, amplitude and time response of each channel of the surround sound system. The disclosed auto-calibrating surround sound (ACSS) system includes a processor that generates a test signal represented by a temporal maximum length sequence (MLS) and supplies the test signal as part of an electric input signal to a loudspeaker. A microphone coupled to the processor receives the signal in a listening environment. The processor correlates the received sound signal with the test signal in the time domain and determines from the correlated signals a whitened response of the audio channel in the listening environment. Issued 2 Jan 2007.

Hand-held GPS-mapping device, US. Patent Number 5,987,380. A hand-held navigation, mapping and positioning device contains a GPS receiver, a database capable of storing vector or bit mapped graphics, a viewing port, an embedded processor, a simplified user interface, a data compression algorithm, and other supporting electronics. The viewport is configured such that the data presented in the viewport is clearly visible in any ambient light condition. The database stores compressed image data which might include topographical map data, user annotations, building plans, or any other image. The system includes an interface to a personal computer which may be used to annotate or edit graphic information externally to the device for later upload. In addition, the device contains a simple menu-driven user interface which allows panning and zooming the image data, marking locations of interest, and other such functions. The device may be operated from an internal rechargeable battery, or powered externally. Issued 16 Nov 1999.

Hand-held GPS-mapping device, US. Patent Number 5,902,347. A hand-held navigation, mapping and positioning device contains a GPS receiver, a database capable of storing vector or bit mapped graphics, a viewing port, an embedded processor, a simplified user interface, a data compression algorithm, and other supporting electronics. The viewpoint is configured such that the data presented in the viewport is clearly visible in any ambient light condition. The database stores compressed image data which might include topographical map data, user annotations, building plans, or any other image. The system includes an interface to a personal computer which may be used to annotate or edit graphic information externally to the device for later

upload. In addition, the device contains a simple menu-driven user interface which allows panning and zooming the image data, marking locations of interest, and other such functions. The device may be operated from an internal rechargeable battery, or powered externally. Issued 11 May 19/99.

3.5 Professional Presentations

American Ambulance Association Annual Meeting: Low-cost VHF/UHF Interoperability for digital telemetry, Las Vegas, NV, Dec. 2005.

California Ambulance Association, Keynote address: Alternatives to solving interoperability problems in Land Mobile Radios, Lake Tahoe, NV, July 2005.

Museum of Science Lecture Series: The Next Generation of Information and Communications Technologies-What does the Future Hold?, William R. Michalson and Brian King, January 14, 2004.

Agilent Wireless Technology Summit: Dynamic Node Location in an Ad Hoc Indoor Communications and Positioning Network, William R. Michalson, January 27, 2004

Security & Technology Online (SATO) Security Leadership Council. Panel discussion on Smart Surveillance, Command and Control, Oct 28-29, 2004.

“Worcester Polytechnic Institute Barcelona Summit: The Future of Information Technology,” delivered presentation entitled “Personal Navigation in the Information Age,” Apr 2001.

4. Projects advised (undergraduate).

4.1 Major Qualifying Projects (current)

- [1] *Formula SAE Electric*, S. V. Boyd, T.A., T.A. Ninesling, E.R. Robert, J.M. Duffield, B.P. Steeves, J.B. Chase, N.S. Bajakian, N.R. Alescio, R.D. Johnson, C.L. Besch, T.R. Schaeffer, MQP-DCP-AB82/MQP-WZM-EV21, 2021.
- [2] *SailBot 2021*, C.J. Burri, M.J. Laks, L.C. Zebrowski, N.H. Jackson, C.J. Scholler, N.J. Eusman, A.V. Thammana, MQP-WZM-SB21, 2021.
- [3] *Ship Recycling Robot*, N.M. Kalsih, S.I. Morales, J. Cybul, J.D. Hoy, T.H. Reiser, MQP-BC2-SRR1, 2021.
- [4] *Tethered Submersible Surveyor*, B.L. Ward, L.C. Reid, J.A. Conklin, J.Y. Huang, MQP-YGB-SUB2/MQP-WZM-SUB1, 2021.
- [5] *Underwater Communications*, L. Spalding, MQP-WZM, 2021.
- [6] *Lionfish III*, MQP-CBP, 2021.

4.2 Major Qualifying Projects (completed)

- [7] **Remote Water Monitoring*, Daniel Shrives, T. Vose, and B. Rolfes, MQP-WZM-AB0R, 2020. [* Winner – Provost’s MQP Award in Robotics Engineering]
- [8] *SailBot 2019-2020 MQP*, I. Lavryonova, T. Andrews, M. Guzman, and K. Reese, MQP-WZM-ABWT, 2020.
- [9] *Firefighting Remote Exploration Device II*, J. Cheng, D. Karavoussianis, A. Moseley, and L. Sahyun, CP4-MQP-FIRE, co-advised, 2020.
- [10] *Mohamed Bin Zayed International Robotics Challenge at Takemura Lab, Osaka University*, N. Greig and D. McHorney, WZM-MQP-ABVE, 2020
- [11] *Lionfish Harvesting Robot – Phase III*, M. Abadjiev, Q. Chen, C. Ewen, N. Johnson, N. Olgado, H. Saperstein, O. Strickland, and C. Whimpenny, WZM-MQP-ABVF, 2020.
- [12] *Underwater 3D Data Collection*, D. Pelaez, T. LaCroce, and N. Budris, WZM-MQP-ABVK, 2020.
- [13] *Efficient Multi Robot Mapping: Quick and Sustained Environmental Surveying with Limited Communication*, D. Abraham, T. Bergeron, and C. Dembski, WZM-MQP-AB0P
- [14] *Leveraging NVMe Management Interface to Provide SES Support for Enterprise Server Diagnostics*. T. P. Mackintosh, WZM-MQP-ABQ3, 2019.
- [15] *Sailbot 2018-19*. S. T. Palmer, K.B. Randall and S. A. Fisher, MQP-KZS-SBOT/MQP-WZM-SAIL, 2019.
- [16] *Firefighting Remote Exploration Device*, E. M. Barinelli, J. L. Berman-Jolton, G. K. MacNeal, K. R. Naras, M. Tasellari, and Y. A. Verdeja. MQP-CP4-ABQE, 2019.
- [17] *Vertical Take-Off and Landing Autonomous Aircraft Design*, Q. C. Barker, T. P. Bergeron, J. A. Goldsberry, J. Romelle, B. H. Pasculano, B. M. Waterman, T. M. Weiss, and Z. J. Zolotarevsky, MQP-RVC-1901, 2019.
- [18] *Mobile Manipulation Testbed*, N. S. Dennler, M. LeMay, and T. J. Macaluso, MQP-WZM-AD19, 2019.
- [19] *K.O.L.T.: Known Object Localization and Mapping*, N. A. Rosenberg, MQP-WZM-DRMP, 2019.
- [20] *Walking Quadrupedal Platform*, N. C. Franco, N. M. Liedtke, and D. Lu, MQP-WZM-QUAD, 2019.
- [21] *Wolfgang: An Autonomous Mobile Robot for Outdoor Navigation*, A. U. Cookson, M.E. Landergan, and S. T. O’Neil, MQP-XIH-AD19, 2019.
- [22] *MGH Biomedical Imaging Tools*, I. Alexiou, MQP-SNM-SNMA, 2019. *Automated Sandwich Assembly*, Derek W. Feehrer, Carter C. Reynolds, Jaime R. Stephen, Taylor A. Stephen, MQP WZM 17A1, 2018.
- [23] *Localization for FRC*, Hu, J., Mitrano, P., Puczydowski, K. and Vere, N., 2017.
- [24] **Sailbot 2017-2018 Final Report*, Burklund, J., Johnson, H., Norris, T. and Shanahan, L. 2018. [* Winner – Provost’s MQP Award in Robotics Engineering, Winner – Professional Writing Award].

- [25] *QRP – Quadrupedal Robotics Platform*, Armsby, Z., Cole, R., Coll, B., Martin, J., and Nagal, A., 2018.
- [26] *Embedded GPU-Based Image & Signal Processing Prototype*, Baker, L and Song, D. Lincoln Laboratories, 2018.
- [27] *Music and Wearable Technology*, Perry, L.M., Ferguson, E.E., Barreiro, M.P., 2017.
- [28] *Collaborative Robotics Heads-Up Display*, Christopher Bove and Alexander Wald, MQP-WZM-16A1, Lincoln Laboratories, 2017.
- [29] *Low Cost Quadrupeds*, Joshua Graff, Kevin Maynard, and Alonzo Martinz, MQP-WZM-16A2, 2017.
- [30] *Fire Response Drone*, John Lomi, Zachary Hood, Kyle Young, Chase St. Laurent, and William Boyd, MQP-WZM-16A3, 2017.
- [31] *Smart Transradial Prosthesis*, Yesugey Sipka, ID-CDO-1603, 2017
- [32] **Sailbot 2016*, Nicholas Gigliotti, James Kuszmaul, Tucker Martin, and Ryan Wall, 2016. [* nominated for the Provost’s MQP Award in Computer Science].
- [33] *Autonomous Snowblower*, Nicholas Rowles, Daniel Pongratz, Harrison Vaporciyan, , 2017.
- [34] **Body Armor Impact Map System*, Carolyn S. Keyes, ME; Nicholas B. Potvin, ECE; and Zachary R. Richards, CS, MQP-WZM-15A1, 2016. [* winner of the Mechanical Engineering Department’s MQP Award].
- [35] *Highway Safety Merge System*, Dante A. Pace, ECE; and Sunghoon Yoon, CS, MQP-MYE-AAS5, 2016.
- [36] *Highway Safety Merge System*, Christopher M. Ellen, RBE; MQP-MYE-AATK, 2016.
- [37] *Collaborative Robotics Heads-Up Display*, Bove, C.P. and Wald, A., WPI Lincoln Laboratories Project Center, 2016.
- [38] *De-Mining with UAVs*, Gregory G Tighe
- [39] *Arc-Liberation of Intermolecular Bond Energy for Marine Propulsion*, Rohan Jhunjhunwala, ME; James Deane Jackman, CS; Tyler Jon Ewing, ME; Christopher Michael Byrne, ECE; Christopher William Egan, ECE, 2015.
- [40] *Glovesense Data Glove*, Nathan William Joseph Wiegman, ECE,; Nathan Harrison Wells, ECE; Russell Hagan Hedlund, ECE,; and Mert Can Erad, ECE, 2015.
- [41] *Mobile Motion Capture*, Robert Patrick Dabrowski, ID; and Matthew Stephen Costi, ID, 2014.
- [42] *Intelligent LED Display*, Harrison Chabot Williams, ECE; Rayce Coleman Stipanovich, ECE; and Alexander Joseph Ryan, ECE, 2014.
- [43] **Design and Optimization of a FSAE Vehicle*, Justin Shane Paprota, ECE; and Camden Ryan Mallette, ECE, 2014. [* winner of the Provost’s MQP Award in Mechanical Engineering].

- [44] *Sailboat Stabilization System*, Steven Mize Rutledge, ECE; Pedro John Miguel, ECE; Dominic Student author Gonzalez, ECE; and Michael Eric Brendlinger, RBE, 2014.
- [45] *Real Time Person Tracking and Identification using the Kinect sensor*, Nikolaos Matthiopoulos and Matthew Francis Fitzpatrick, 2013.
- [46] *H.E.A.T. – Home Energy Automation Technology*, John Thomas Manero, ECE; Scott James Cloutier, ECE; Michael Dominick Audi, ECE-RBE, 2012.
- [47] *Automated Refueling for Hovering Robots*, Raymond P. Short, RBE; Janine S. Pizzimenti, RBE; and Nigel Bowers Cochran, RBE, 2012.
- [48] *Improved Intelligence and Systems Integration for WPI's UGV – Prometheus*, Gregory Duncan McConnell, RBE; Samson Michael King, RBE; Craig Alan DeMello, RBE; Michael A. Rodriguez, RBE; and Eric J. Fitting, ID, 2012.
- [49] *Aeacus – development of a bio-inspired robotic platform for swarm-based multi-object transport over uneven terrain*, N. Anderson, D. Praetorius and C. Roddy, co-advised with S. Nestinger, 2011.
- [50] *Realization of Performance Advancements for WPI's UGV-Prometheus*, M. Akmanalp, R. Doherty, J. Gorges, P. Kalasuskas, E. Peterson and F. Polido, co-advised with T. Padir, S. Nestinger, M. Ciraldi, K. Stafford, 2011.
- [51] *Optimization of an Autonomous Underwater Vehicle*, J. Baker, C. Frumento, J. Grzyb and T. North, co-advised w/I. Hussein, 2011.
- [14] *Intelligent Tactical Vest*, V. Brisian, J. Fernando, A. Khandaker and J. Zorrilla DeLos Santos, 2011.
- [15] *Quadrotor UAV Interface and Localization Design*, N. Smith, B. Berard and C. Pietre, Lincoln Laboratory Project Center, co-advised with G. Heineman, 2011.
- [16] *Voice Release System*, J. Low, WZM-MQP-1M10, 2010.
- [17] *Design and Realization of an Intelligent Unmanned Ground Vehicle*, J. Barrett, B. Roy and D. Sacco, Co-Advised w/T. Padir, 2010.
- [18] *Real-time Digital Modeling of analog circuitry for audio applications*, B. Gleason, WZM-MB09, 2010.
- [19] *Optimization and Control Design of an Autonomous Underwater Vehicle*, D. Moussette, A. Palooparambil, and J. Raymond, AE- IIH-0003, co-advised w/I. Hussein, 2010.
- [20] *Design of Autonomous Underwater Vehicle and Optimization of Hydrodynamic Properties and Control*, R. David, WZM-3A08, 2009.
- [21] *Autonomous Vehicle Control*, Breznak, R. S., Cunningham, A. G and Kleinfeld, Z., 2008.
- [22] *Roof Robot Phase 2*, Zachary James Strowe, ECE; and Xu Lin, ECE, 2008.
- [23] *The Thumper Robotic Bass*, B. Kosherick, M. Brown, and A. Teti, WZM-RB08, 2008.
- [24] *Public Safety Integration Center*, P. Lucia, I. Levin and M. Barone, WZM-1A08, 2008.

- [25] *Aircraft Lasercom Terminal Compact Optical Module*, B. Scoville and S. Rose, Lincoln Laboratory Project Center, WZM-2A08, 2008.
- [26] *PANSAT Triple Modular Redundant (TMR) Satellite Flight Computer v3*, Kevin Zhang, ECE; and Karim G. Makram, ECE, 2006.
- [27] *GPS Attitude Determination System*, J.P. Salmon, Michael LaBossiere and Mark Minotaur, 2005.
- [28] *FPGA Implementation of an OFDM Modem*, Andrew Dupont and Jack Coyne, 2005.
- [29] *TREMOR – A Triple Modular Redundant Flight Computer for WPI’s PANSAT – Revision 2*, Maulin Patel, Omar Moussa and Matthew Kwiatkowski, 2005.
- [30] *Construction of a GPS Pseudolite*, Tim Coffey, 2005.
- [31] *Dipole Antenna Placement in a Falcon-20 Aircraft*, Emily Anesta and David Plourde, Lincoln Laboratories Project Center, A-Term, 2004.
- [32] *GPS Attitude Determination System*, Joshua Holwell, Himanshu Agrawal and Andrew Coonradt, 2004.
- [33] *TMR Computer System*, Ryan Angilly, Mitch Lauer and Dan Debiasio, 2004.
- [34] *Personal Inertial Navigation System*, Jason DeChiaro and Christopher Strus, 2003.
- [35] WZM-MQP-4A02: *PC I/O in High Stress Environments*, John Niesz and James Kent, 2003.
- [36] WZM-MQP-2A02: *Vacuum Tube Amplifier*, Joseph Kambourakis and Gregory Molnar, 2003.
- [37] *Container Tracking System*, Victoria Chaplick, 2003.
- [38] WZM-MQP-2A03: *Heat Management System for PCs*, Ernest Cardin, Kevin Candiloro and Stephen Leavey, 2002.
- [39] WZM-MQP-1313: *Digital Image Enhancement*, Julie Bolduc, Joeseeph Perry, Wei Fu, 2002.
- [40] WZM-MQP-2A01: *Synchronized Audio Sample Looper*, Joel Gottshalk, Robert Conrad and Sanford Freedman, 2002.
- [41] WZM-MQP-1A01: *Springboard Digital Multimeter*, Pavel Loven and Andrew Young, 2002.
- [42] *Ballistic Missile Defense Analysis Toolkit*, Winfield Peterson, Doug Tilkin and Benjamin Wilson, Lincoln Laboratories Project Center, 2002.
- [43] HU-FB-CS01, *C Sound Synthesizer*, Peter W. DeBonte (co-advised).
- [44] WZM-MQP-1A00: *StrongArm-Based Computer System*, Bradford Snow, 2001.
- [45] WZM-MQP-1C01: *PC Controlled Laser Light Show Device*, Joel Smith, 2001.
- [46] WZM-MQP-1E00: *PIC-based MIDI Sequencer* Malcolm Beaulieu, 2001.
- [47] WZM-MQP-2A00: *Automotive PC Development Platform* Travis Pouliot and David Philips, 2001.

- [48] *The RoadCom Automotive Computing System*, Benjamin Kennedy and John Pong, 2000.
- [49] WZM-MQP-1A99: *Compressed Sample Wavetable Synthesizer*, Justin Brzozoski, 2000.
- [50] WZM-MQP-3499, *Automatically Equalizing Monitor*, Fernando Braghin, Tenzin Lama, Rahul Bhan and Dion Soetadi, 2000.
- [51] 99D163M: *Railroad Communication*, Benjamin Richards, 2000.
- [52] CS-MXC-IE00: *PIC Real-Time Sequencer*, Alexander Goodrich, 2000.
- [53] 99D514M: *Design of a Microphone Preamplifier*, Eric Reuter, 2000.
- [54] WZM-MQP-1A99, *MPEG Audio Deck*, Justin Brzozoski, 2000.
- [55] *Digital Image Enhancement*, Julie Bolduc, Wei Fu and Joseph Perry, 2000.
- [56] WZM-MQP-4A98, *Railroad Communications System*, Matthew Lug, 1999.
- [57] 99D078M: *Modular Effects Processor II*, Erik Neyland, 1999.
- [58] 99D176M: *Portable Digital Audio Recorder* Eric Toledo and Duc Truong, 1999.
- [59] EE-WZM-1A97, *C Sound Synthesizer*, Ross E. Borgeson, Michael W. Hamel and Matthew S. Walsh, 1998.
- [60] EE-WZM-4A97, *Firewire Audio Device*, Daniel R. Stutzbach, 1998.
- [61] EE-WZM-2A97, *Modular Effects Processor*, Michael J. Dellisanti, 1998.
- [62] EE-WZM-3A97, *GPS Personal Navigation*, Jeffery A. Alderson and Helder Machado, 1998.
- [63] HU-FB-CS01, *C Sound Synthesizer*, Peter W. DeBonte (co-advised).
- [64] EE-WZM-1E97, *PM Measurement System*, Yevgeniy Bogdanov.
- [65] EE-REL-C008, *Design and Development of a Microprocessor-Based Gaussmeter*, David M. Burnham.
- [66] EE-WZM-RC01, *Acoustic Guitar Amplifier*, Christopher Thomas.
- [67] EE-WZM-GSD1, *Guitar Sustaining Device*, Paul D'Ambra.
- [68] EE-RXV-5260, *Audio Feedback Elimination System*, Ross D. Pease and John R. Pelliccio.
- [69] EE-RJD-M963, *Embedded Systems Design*, Christopher A. Briggs and Anthony J. Viapiano.
- [70] EE-WHE-9601, *GPS Hazard Detector*, Michael Roberts, William Cidela, and Chris Mangiarelli.
- [71] EE-WZM-2C96, *Flexible Synthesis*, Noah T. Vawter and Luke Demoracski.
- [72] EE-WZM-1A96, *Tap Dancer MIDI Interface*, Thomas Trela and William Dowell.
- [73] EE-WZM-2A96, *GPS Hazard Detector II*, Will Brothers, Jon Day, and John Zaghi.
- [74] EE-WZM-3A96, *Loudspeaker Data Acquisition System*, Adam Gross.
- [75] EE-WZM-4A96, *Audio Morphing Processor*, William Butterfield and Ted Phipps.

- [76] EE-WZM-5A96, *Acoustic Modeling*, Peter DeBonte.
- [77] EE-WZM-1B96, *Distributed Audio Controller*, Stephen S. Richardson.
- [78] EE-WZM-1A95, *Acoustic Hazard Meter*, Ronald D. Slack.
- [79] EE-WZM-2A95, *Forest Service DGPS*, Joshua J. Single and Michael T. Spadazzi.
- [80] EE-WZM-1C95, *Audio to MIDI Converter*, Jennifer R. Principe.
- [81] EE-WZM-1D95, *Low Cost Auralizer*, Jason R. Hills and Mark R. Paulson.
- [82] EE-WZM-3A95, *Passive Radiator Design*, Kevin R. Weldon.
- [83] EE-WZM-1C94, *Char Model Generation*, Colin J. Florendo.
- [84] EE-WZM-1D94, *Wide Area DGPS Simulator*, Daniel Cohen and Robert Schroter.
- [85] EE-WZM-2D94, *Digital Soundcard*, Timothy Alsberg (Russian Project Center).
- [86] EE-WZM-3D94, *Digital Univibe*, Andrew Willis and Daniel Toohey.
- [87] EE-WZM-1A94, *DSP Based Real-Time Audio Feedback Eliminator*, Kevin M. Eddy.
- [88] EE-WZM-2A94, *Digital LCD Oscilloscope*, William F. Brown and John F. Ebersole.
- [89] 93D236M, *MIDI Mapper*, Jonathan Kemble and Brian Candiloro.
- [90] EE-WZM-1C93, *Fault-Tolerant Computer*, Frederick N. Parmenter.
- [91] EE-WZM-1A93, *Wireless MIDI Controller*, Sanjay Raja, Charles Cimalore, Ty Panagoplos.
- [92] EE-WZM-2A93, *Multiple Pitch Detector*, Jeanne A. Sawtelle.
- [93] EE-WZM-3A93, *Multiprocessor Cache Coherence*, Lauren C. Lind and Norman E. Rhodes.
- [94] EE-WZM-1C92, *A Simulation of the DLX Architecture*, Lisa Harlow.
- [95] EE-WZM-2C92, *A New Microprocessor Development System*, Gregory B. Burlingame, David J. Fortin, Kevin S. Pearson.
- [96] EE-WZM-1A92, *Digital Audio Sampler*, Roger D. Gagnon and James M. Lach.
- [97] EE-WZM-2A92, *Intelligent Harmonizer*, Prabhjot S. Anand and Aftab M. Yusuf.
- [98] EE-WZM-3A92, *Computerized Audio Mixer*, Richard J. Wood.
- [99] EE-WZM-1B92, *Real-Time Harmonizer*, Mohiuddin M. Kahn.
- [100] EE-WZM-1A91, *Residue Number System Processor*, Ravdeep S. Anand and Christine A. Easton.
- [101] EE-WZM-2A91, *SCSI Bus Analyzer*, Brian Costello, George Delouriero, Matthew Maguire, and Keith Nevins.

4.3 Interactive Qualifying Projects (completed)

- [1] *Bell Towers*, Bowman, I.H., Casciola, I.O., Adiletta, M.J., Bruneau, C.D., WPI Venice Project Center, advised by W. Michalson and F. Carrera, 2019.
- [2] *Creating a Circular Economy with Urban Farming*, Ward, B.L., Cyran, B., Premo, J., Soens, N., WPI Venice Project Center, advised by W. Michalson and F. Carrera, 2019.
- [3] *Plastic-Free Venice*, S.L. Bonanno, V.C.Nguyen, A.H. Hagedorn, T.S. Howlett, WPI Venice Project Center, advised by W. Michalson and F. Carrera, 2019.
- [4] *30th Anniversary Exhibit*, N. Bajakian, J. Wong, J. DeDonato, and N. Stallings, WPI Venice Project Center, advised by W. Michalson and F. Carrera, 2019.
- [5] *Venice Crowdfunding*, T. Ferrara, F de Leo, M. Bernardo and S. O'Connell, WPI Venice Project Center, advised by W. Michalson and F. Carrera, 2019.
- [6] *Visitor Experiences in Venice*, T. King, C. Anderson, M. Laks, and C. Hoey, WPI Venice Project Center, advised by W. Michalson and F. Carrera, 2019.
- [7] *Venice From Above: Preserving Venetian Bell Towers*, Iuliano, C.T., Kavassalis, F.I., Colucci, N.D., Lessard, P., WPI Venice Project Center, advised by W. Michalson and F. Carrera, 2018.
- [8] *Celebrating 30 Years of the Venice Project Center*, Ellis, E.J., Morton, K.J., Carpinì, N.A.D., Hale, S.A., WPI Venice Project Center, advised by W. Michalson and F. Carrera, 2018.
- [9] *PreserVenice Launch: A Crowdfunding Solution to Preserving Venetian Heritage*, Hetherington, B.F., Berardi, D., Thompson, K.R., Joy, S.P., WPI Venice Project Center, advised by W. Michalson and F. Carrera, 2018.
- [10] *Tech Mecca in Giudecca*, McMahon, A.J., Hiscox, C.A., Maida, P.J., Lee, R.T., WPI Venice Project Center, advised by W. Michalson and F. Carrera, 2018.
- [11] *Exploring Urban Permaculture: Initializing a Path to a Greener Venice*, Jordan, A.S., O'Driscoll, K.J., Manca, R. A., WPI Venice Project Center, advised by W. Michalson and F. Carrera, 2018.
- [12] *Open For Business: Analyzing Venetian Storefronts*, Bartone, J.R., Scales, K.J., Racca, S.R., Chen, Y., WPI Venice Project Center, advised by W. Michalson and F. Carrera, 2018.
- [13] *Venice Without Obstacles*, DeRusha, A.C., Abenante, E.R., DiStefano, M.S., Jones, S.A., WPI Venice Project Center, advised by W. Michalson and F. Carrera, 2018.
- [14] *Documenting and Promoting the Impacts of the Melbourne Project Center*, Seely, C.A., Day, J.L., Cochran, I.L., and Carlson, K.A.M., WPI Melbourne Project Center, advised by S. McCauley and W. Michalson, 2017.
- [15] *Students' Mental Wellbeing in Universities Located in Melbourne*, Isaro, A., WPI Melbourne Project Center, advised by S. McCauley and W. Michalson, 2017.
- [16] *I See a Psychologist -- Reducing Stigma through Normalizing Mental Health Care in Australia*, Vayas, NN., Daci, E.G., and Bianco, C.E., WPI Melbourne Project Center, advised by S. McCauley and W. Michalson, 2017.

- [17] *Improving Web Presence and Stakeholder Interaction for the Emergency Services Foundation*, Savage, H.A, Sanchy, M.T., Capozzi, R. and Babel, B.M., WPI Melbourne Project Center, advised by S. McCauley and W. Michalson, 2017.
- [18] *Understanding Visitor Experiences at the Pauline Gandel Children's Gallery*, Nigro, J.T., France, G.T., Coppolino, J.R. and Blakslee, B.S., WPI Melbourne Project Center, advised by S. McCauley and W. Michalson, 2017.
- [19] *A Citizen Science Platform for Long-Term Monitoring of Microplastic Pollution in Port Phillip Bay*, Bayas, A.C., Buckley, M.J., Ford, C.K. and Lawes, J.A., WPI Melbourne Project Center, advised by S. McCauley and W. Michalson, 2017.
- [20] *A Comprehensive Methodology for Assessing the Quality of Solar Photovoltaic Systems*, Arthur, D.P., Hoey, C.J., Laffer, T. and Westgate, B., WPI Melbourne Project Center, advised by S. McCauley and W. Michalson, 2017.
- [21] *High Efficiency Power Inverter*, Grzegorz J. Klos and Robert Hall, 2015.
- [22] *An Analysis and comparison of affordable and ecological short-term transportation energy solutions*, Bryan Thomas Gleason, 2009.
- [23] *Lens and Lights Operational Overview*, Andrew Thomas Wilkins, ECE; Matthew Houstle, ECE; and Anthony R. Azersky, CS, 2009.

4.4 Graduate Theses Advised and Co-Advised

4.4.1 MS Theses (current)

- [1] Pratik Jawahar, “High-Level Exogenous Fault Detection in Multi Robot Systems with Variational Autoencoders and Normalizing Flows,” MS Thesis, co-advisor, 2022.
- [2] Rohan Walia, “Formation-Centric Software Interface,” MS Thesis, co-advisor, 2022.

4.4.2 MS Theses (completed)

- [1] Nathaniel Michaels, “A Modular Robotic AFO for detecting phase changes during Walking Gait,” MS Thesis, co-advisor, 2020.
- [2] Hernandez, A. C., “Implementing and Comparing Image Convolution Methods on an FPGA at the Register-Transfer Level,” MS Thesis, co-advisor, 2019.
- [3] Katie Gandomi, “Implementation of a Modular Software Architecture on a Real-Time Operating System for Generic Control over MRI Compatible Surgical Robots,” MS Thesis, co-advisor, 2018.
- [4] Adhavan Jayabalan, “Decentralized Persistent Connectivity Deployment in Robot Swarm,” MS Thesis, co-advisor, 2018.
- [5] Janani Mohan, “Dynamic Task Allocation in Robot Swarms with Limited Buffer and Energy Constraints,” MS Thesis, co-advisor, 2018.
- [6] Rogers, J.P., GNSS and Inertial Fused Navigation Filter Simulation, MS Thesis, co-advisor, 2018.

- [7] Christopher Bove, "Constrained Motion Planning System for MRI-Guided, Needle-Based, Robotic Interventions," MS Thesis, co-advisor, 2018.
- [8] Vyas, Shivang, "Feature detection in an indoor environment using Hardware Accelerators for time-efficient Monocular SLAM," MS Thesis, primary advisor, Worcester Polytechnic Institute, 2015.
- [9] Morin, Russell, "A Novel Localization System For Experimental Autonomous Underwater Vehicles," MS Thesis, co-advisor, Worcester Polytechnic Institute, 2010.
- [10] Navalekar, Abhijit, "Design of an OFDM-Based VHF Modem," MS Thesis, primary advisor, Worcester Polytechnic Institute.
- [11] Ahlehagh, Hasti, "Techniques for Communications and Geolocation Using Wireless Ad Hoc Networks," MS Thesis, primary advisor, Worcester Polytechnic Institute, 2004.
- [12] Sebastian, Dalys, "Development of a Field-Deployable Ultrasound Scanner System," MS Thesis, co-advisor, Worcester Polytechnic Institute, 2004.
- [13] Tobgay, Sonam, "Novel Concepts for RF Surface Coils with Integrated Receivers," MS Thesis, co-advisor, Worcester Polytechnic Institute, 2004.
- [14] Breen, Daniel, "Characterization of Multi-Carrier Locator Performance," MS Thesis, co-advisor, 2004.
- [15] Aghogho, Obi, "A Novel Radio Frequency Coil Design for Breast Cancer Screening in a Magnetic Resonance Imaging System," MS Thesis, co-advisor, Worcester Polytechnic Institute, 2003.
- [16] Fei, Ming, "Electromagnetic Detection, Infrared Visualization and Image Processing Techniques for Non-Metallic Inclusions in Molten Aluminum," MS Thesis, co-advisor, 2002.
- [17] Lavoie, Bruce, "Design and Implementation of an N-Channel Self Calibrating Audio System," MS Thesis, primary advisor, Worcester Polytechnic Institute, 2000.
- [18] Bogdonov, Gene, "Theoretical and Practical Implementation of Electrical Impedance Material Inspection of Powder Metallurgy Compacts," MS Thesis, co-advisor, Worcester Polytechnic Institute, 1999.
- [19] Messier, Andrew, "Modeling the Effects of Terrain Masking on GPS Accuracy and Integrity," MS Thesis, primary advisor, Worcester Polytechnic Institute, 1998.
- [20] Antonescu, Bogdan, "Elliptic Curve Cryptosystems on Embedded Microprocessors," Bogdan Antonescu, MS Thesis, co-advisor, Worcester Polytechnic Institute, 1998.
- [21] Lai, Qiang, "Ground-Penetrating Radar Data Processing System," MS Thesis, co-advisor, Worcester Polytechnic Institute, 1998.
- [22] Soria-Rodríguez, Pedro, "Multicast-Based Interactive-Group Object-Replication For Fault Tolerance," MS Thesis, co-advisor, Worcester Polytechnic Institute, 1998.
- [23] Hoy, William, "Audio Signal Denoising Using Wavelets," MS Thesis, primary advisor, Worcester Polytechnic Institute, 1997.

- [24] Proгри, Ilir, "Harmonic Flow Monitoring by means of Global Positioning System," MS Thesis, primary advisor, Worcester Polytechnic Institute, 1997.
- [25] Bretchko, Pavel, "Pulsed Hysteresis Graph System," MS Thesis, co-advisor, Worcester Polytechnic Institute, 1997.
- [26] Repkin, Dmitry V., "A Hierarchical Neural Network Based Data Processing System for Ground Penetrating Radar," MS Thesis, co-advisor, Worcester Polytechnic Institute, 1997.
- [27] Metsis, Sophocles, "Design of a Real-Time Capable, Fault-Tolerant, Distributed System," MS Thesis, primary advisor, Worcester Polytechnic Institute, 1996.
- [28] Hill, Jonathan, "Efficient Implementation of Mesh Generation and FDTD Simulation of Electromagnetic Fields," MS Thesis, primary advisor, Worcester Polytechnic Institute, 1996.
- [29] Dunkelberg, John, "FEM Mesh Mapping to a SIMD Machine Using Genetic Algorithms," MS Thesis, co-advisor, Worcester Polytechnic Institute, 1996.
- [30] Leuenberger, Georg, "Design and Development of a Microprocessor Based Gauss Meter," MS Thesis, co-advisor, Worcester Polytechnic Institute, 1995.
- [31] Valentino, Ralph, "DISC: A Dynamic Instruction Set Coprocessor," MS Thesis, primary advisor, Worcester Polytechnic Institute, 1995.
- [32] Muley, Aalok, "A Fault Tolerant Network for a Real-Time Environment," MS Thesis, primary advisor, Worcester Polytechnic Institute, 1994.
- [33] Mohan, Surrender, "Automatic Surface Mesh Generation for 3D Solid Models Using Delaunay Algorithm," MS Thesis, co-advisor, Worcester Polytechnic Institute, 1994.
- [34] Petrangelo, John, "Experimental Preconditioners for Large Dense Systems," MS Thesis, co-advisor, Worcester Polytechnic Institute, 1994.
- [35] Schneider, Eric, "Design, Simulation, and Analysis of a 3D Integrated Optical Computer," MS Thesis, primary advisor, Worcester Polytechnic Institute, 1993.
- [36] Palmer, Bradley, "A Comparison of Three Protocols Supporting Time-Dependent and Time-Independent Communications," MS Thesis, primary advisor, Worcester Polytechnic Institute, 1992.
- [37] Clayton, Shawn, "An Analysis of the Real-Time Behavior of Galactica Net," MS Thesis, primary advisor, Worcester Polytechnic Institute, 1992.
- [38] Levergood, Thomas, "An Experimental Evaluation of Split User/Supervisor Cache Memories," MS Thesis, primary advisor, Worcester Polytechnic Institute, 1992.
- [39] Lavalee, James, "The Design and Development of Real-Time Systems Using Ada and the Activation Framework," MS Thesis, co-advisor, Worcester Polytechnic Institute, 1992.
- [40] Velazques, Javier, "The Development of a Real-Time Environment Using the Activation Framework," MS Thesis, co-advisor, Worcester Polytechnic Institute, 1992.

4.4.3 Ph. D. Dissertations (current)

- [1] Vincenzo Diluoffo, “Security in the Robot Operating System Version 2 (ROS 2) Environment,” primary advisor.
- [2] Jitesh, “Ad-Hoc Networking for Bandwidth Limited LMR Systems,” primary advisor.

4.4.4 Ph. D. Dissertations (completed)

- [1] Carvalho, P. A., “Advancing Technologies for Interventional MRI Robotics with Clinical Applications,” 2019.
- [2] Ferreira, PVR “SRML: Space Radio Machine Learning,” Ph.D. Dissertation, co-advisor, Worcester Polytechnic Institute, 2017.
- [3] Iyer, Vishwanath, “Broadband Impedance Matching of Antenna Radiators,” Ph.D. Dissertation, co-advisor, Worcester Polytechnic Institute, 2010.
- [4] Navalekar, Abhijit, “Distributed Digital Radios For Land Mobile Radio Applications,” Ph.D. Dissertation, primary advisor, Worcester Polytechnic Institute, 2009.
- [5] Parikh, Hemish, “Design of an OFDM Transmitter and Receiver for Precision Personnel Location,” primary advisor.
- [6] Proгри, Ilir, “An Assessment of Indoor Geolocation Systems,” Ph.D. Dissertation, primary advisor, Worcester Polytechnic Institute, 2003.
- [7] Li, Xinrong, “Super-Resolution TOA Estimation with Diversity Techniques for Indoor Applications,” Ph.D. Dissertation, co-advisor, Worcester Polytechnic Institute, 2003.
- [8] Leuenberger, Gerog H. W., “Electrostatic Density Measurements in Green-State PM Parts,” Ph.D. Dissertation, co-advisor, Worcester Polytechnic Institute, 2003.
- [9] Bogdanov, Gene, “Radio-Frequency Coil Design for High Field Magnetic Resonance Imaging,” Ph.D. Dissertation, co-advisor, Worcester Polytechnic Institute, 2002.
- [10] Elbirt, Adam J., “Reconfigurable Computing for Symmetric-Key Algorithms,” Ph.D. Dissertation, co-advisor, Worcester Polytechnic Institute, 2002.
- [11] Bretchko, Pavel, “Design and Development of Ultra-wideband DC-Coupled Amplifier,” Ph.D. Dissertation, co-advisor, Worcester Polytechnic Institute, 2001.
- [12] Hill, Jonathan, “Development of an Experimental Global Positioning System (GPS) Receiver Platform for Navigation Algorithm Evaluation,” Ph.D. Dissertation, primary advisor, 2001.
- [13] Spasojević, Mirko, “Creation of Sparse Boundary Element Matricies for 2-D and Axis-symmetric Electrostatic Problems Using a Bi-orthogonal Wavelet,” Ph.D. Dissertation, co-advisor, Worcester Polytechnic Institute, 1997.
- [14] Shi, Funan, “Optimal Designs of Gradient and RF Coils for Magnetic Resonance Imaging (MRI) Instrument,” Ph.D. Dissertation, co-advisor, Worcester Polytechnic Institute, 1996.

5. Proposals and Funding:

5.1 Funding Received

\$300,000	MRI: Development of an autonomous, Connected and Data-Driven Vehicle for Multi-Disciplinary Research, Co-PI, 09/13/16.
\$200,000	Advanced Bayesian Methods for Autonomous Navigation, Co-PI, 07/25/11.
\$50,524	PCOG Broadband Modem, PI, \$50,524, 05/15/09.
\$839,000	Real-Time Troop Physiological Status Monitoring System, Co-PI, 09/06/07.
\$83,726	State Communications Interoperability, PI, 07/18/07.
\$224,822	MANET Protocols for Capacity-Limited Channels, PI, 03/08/07.
\$44,366	TATRC: Wireless Sensor Communications, Co-PI, 12/20/06.
\$95,000	Real-Time Troop Physiological Status Monitoring System, Co-PI, 02/13/06.
\$3,225,000	Real-Time Troop Physiological Status Monitoring System, Co-PI, 12/19/05.
\$1,973,286	Precision Indoor/Outdoor Personnel Locator, Co-PI, 09/23/05.
\$25,000	Sensor-on-a-Chip for Electrophysiological Monitoring, Co-PI, 08/08/05.
\$1,245,000	Real-Time Troop Physiological Status Monitoring System, Co-PI, 12/23/04.
\$1,370	WPI-NanoSAT Program, Co-PI, 11/03/04.
\$37,408	Precision Indoor/Outdoor Personnel Locator, Co-PI, 10/05/04.
\$74,048	Real-Time Troop Physiological Status Monitoring System, PI, 09/15/04.
\$813,141	Real-Time Troop Physiological Status Monitoring System, PI, 12/08/03.
\$255,496	Precision Indoor/Outdoor Personnel Locator, Co-PI, 10/31/03.
\$3,246	WPI-NanoSAT Program, Co-PI, 10/20/03.
\$2,789	WPI-NanoSAT Program, Co-PI, 03/06/03.
\$827,000	Real-Time Troop Physiological Status Monitoring System, PI, 11/22/02.
\$14,866	Norfolk County Sheriff's Office Data Mining, Co-PI, 02/01/02.
\$54,483	Auto-calibrating surround sound system, PI, 2001.
\$11,252	Auto-calibrating surround sound system, PI, 2000.
\$18,977	GPS-Based Attitude Determination System, PI, 07/1998.
\$70,000	Development of an Electric Resistivity Instrument for the Testing of Green-State P/M Compacts, Co-PI, 01/1997.
\$10,550	GPS Hazard Detection, Co-PI, 1996.
\$200,000	Integrity for the Global Positioning System - Supplemental Funding I, Co-PI, 1995.
\$3,000	GPS-Based Tracking of Forest Vehicles, PI, 1995.

\$7,200	Acoustic Identification of Mosquito Species, Co-PI, 1995.
\$9,978	Acoustic Identification of Mosquito Species, Co-PI, 1995.
\$11,527	Laboratory Equipment for Microkernel Based Embedded Systems, Co-PI, 1995.
\$74,388	RF Circuit and Antenna Modeling on High Performance Computers, Co- PI, 1994.
\$199,075	Integrity for the Global Positioning system, PI, 1994.
\$326,336	3D Modeling of Microwave Antennas on High-Performance Parallel Computers, Co-PI, 1993.
\$338, 687	Integrity for the Global Positioning system, Co-PI, 1993.

6. Honors, Awards, and Recognitions:

Elected Senior Member of the IEEE.

Joseph Samuel Satin Distinguished Fellowship awarded for the 1994-1995 academic year.

Aldo Miccioli Fellowship recipient from Raytheon Equipment Division.

ION Best Paper Award - GPS-96 for W. R. Michalson, W. Cidela, et. al., “A GPS-Based Hazard Detection and Warning System,” in review, " *ION GPS-96, 9th International Meeting of the Satellite Division of the Institute of Navigation*, pp. 167-175, Kansas City, MO, Sep 17-20, 1996

2nd Place - 2004 ECE Department MQP Award / Provost’s MQP Award for *GPS-Based Orbit and Attitude Determination System for PANSAT*, Joshua Holwell, Andrew Coonradt and Himanshu Agrawal.

1st Place - 2003 ECE Department MQP Award / Provost’s MQP Award for *Personal Inertial Navigation System*, Jason DeChiaro and Chris Struus.

1st Place - 2002 ECE Department MQP Award / Provost’s MQP Award for *Handspring Digital Voltmeter*, Andrew Young and Pavel Loven.

3rd Place - 1998 ECE Department MQP Award / Provost’s MQP Award for *Design of a Personal Handheld GPS Receiver*, Jeffery Alderson and Helder Machado.

2nd Place - 1997 ECE Department MQP Award / Provost’s MQP Award for *Distributed Audio Controller*, EE-WZM-1B96, Stephen S. Richardson.

3rd Place - 1997 ECE Department MQP Award / Provost’s MQP Award for *GPS Hazard Detector II*, EE-WZM-2A96, Will Brothers, Jon Day, and John Zaghi.

1st Place - 1996 ECE Department MQP Award / Provost’s MQP Award for *GPS Hazard Detector*, EE-WHE-9601, Michael Roberts, William Cidela, and Chris Mangiarelli.

6.1 Memberships and offices held in professional society

- Institute of Electrical and Electronic Engineers, Senior Member
- Institute of Navigation
- Royal Institute of Navigation
- American Society of Engineering Educators
- National Academy of Inventors
- Society of Automotive Engineers

6.2 Professional Service

Massachusetts Board of Bar Overseers Hearing Committee Member, 2010-Present.

Steering Committee – 2009 First Annual Robotics Innovations Competition and Conference (RICC '09), Nov 7-8, Worcester, MA, 2009.

Conference Technical Co-Chair – 2009 IEEE International Conference on Technologies of Practical Robot Applications (TePRA 2009), Nov. 9-11, Woburn, MA, 2009.

Reviewer – Proposal number CRDPJ 379622-08, Natural Sciences and Engineering Research Council of Canada (NSERC), Mar. 2009

Co-Chair – Urban and Indoor Geolocation, Institute of Navigation International Technical Meeting (ITM2009), Anaheim CA, Jan. 2009.

Reviewer – Proposal number CRDPJ 379622-08, Natural Sciences and Engineering Research Council of Canada (NSERC), Mar. 2009