

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

TESLA, INC.,

Petitioner,

v.

iQAR INC.,

Patent Owner.

Case No. IPR2024-00543
U.S. Patent No. 10,882,399 B2

DECLARATION OF CRAIG J. HOFF

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I, Craig, J. Hoff, declare as follows:

I. INTRODUCTION

1. I have been retained by iQar Inc. (“iQar”) as an independent expert consultant in this proceeding before the United States Patent and Trademark Office (“PTO”). I am not an employee of iQar or any affiliate or subsidiary of iQar.

2. I have been asked to consider whether certain references teach or suggest the features recited in certain claims of U.S. Patent No. 10,882,399, which I refer to herein as the “’399 patent.”

3. My opinions and the bases for my opinions are set forth below.

4. I am being compensated at my ordinary and customary rate of \$350 per hour for my work, plus reimbursement for any reasonable expenses. My compensation is based solely on the amount of time that I devote to activity related to this case and is in no way contingent on the nature of my findings, the presentation of my findings in testimony, or the outcome of this or any other proceeding. I have no other financial interest in this proceeding.

II. EDUCATION BACKGROUND, PROFESSIONAL EXPERIENCE, AND OTHER QUALIFICATIONS

5. My curriculum vitae (“CV”) is attached hereto and provides an accurate identification of my background and experience.

6. I received a B.S. in Mechanical Engineering in 1979 from Michigan State University, East Lansing, Michigan.

7. I earned my M.S. in Mechanical Engineering in 1981 from Michigan State University, East Lansing, Michigan. My master's thesis focused developing a mathematical model of the thermodilution method of measuring cardiac output.

8. I obtained my Ph.D. in Mechanical Engineering in 1992 from the University of Michigan, Ann Arbor, Michigan. My Ph.D. dissertation focused on the understanding the effects of distributed leakage on pulse propagation in viscoelastic arteries using *in vitro* (physical) models and *in sitio* (computational) models. My research work was a joint project of the University of Michigan and the Cardiovascular Research Lab at Henry Ford Hospital.

9. I am currently a Professor of Mechanical Engineering at Kettering University, Flint, Michigan. I joined Kettering University as an Associate Professor in the Department of Mechanical Engineering in 1999. I was promoted to Professor in 2005, became the Department Head of Mechanical Engineering in 2012, and was appointed as the Founding Dean of the College of Engineering in 2016 and served in that role until 2022.

10. In my role as a professor, I have taught numerous graduate and undergraduate courses related to mechanical and automotive engineering. More specifically, I teach courses in the areas of energy systems and automotive powertrains. The automotive courses include: "Introduction to Automotive Powertrains" (MECH 544), "Hybrid Electric Vehicle Propulsion" (MECH 545), and

“Introduction to Automotive HVAC Systems.” In these courses, I emphasize experiential learning, integrating theoretical knowledge with practical applications through laboratory work and real-world projects.

11. In addition to teaching academic courses, I teach professional development courses in the area of conventional and electric powertrains to practicing engineers. I’ve taught courses for the Society of Automotive Engineers International (SAE), U.S. Army, Toyota, and the Shanghai Automotive Industry Corporation (SAIC). (Both GM/SAIC and VW/SAIC).

12. I have also served as a faculty advisor to student competition teams including the US Department of Energy FutureCar Challenge, where students design, build and compete with a hybrid-electric Ford Taurus, the Formula SAE competition, where students design, build, and compete with a small open-wheel racecar, and the SAE AutoDrive Challenge, where students design, build, and compete with a fully autonomous vehicle.

13. My research has focused primarily on conventional and hybrid automotive powertrains, alternative fuels, Proton Exchange Membrane (PEM) fuel cells, and sustainability. My work includes developing in-vehicle data acquisition systems, developing conventional, electric, and hybrid electric vehicles, creating mathematical models for the same, and establishing vehicle testing facilities. During my time at Kettering University, I have secured over \$2,000,000 in external funding

from agencies such as the Department of Defense, Department of Energy, National Science Foundation, and various industry sponsors. I have supervised six master's thesis students and served on over 15 master's thesis committees.

14. Modeling conventional, electric, and hybrid-electric powertrains requires a detailed understanding of the operation of the various components in the system (engines, motors, transmissions, chassis) and the control of those components.

15. Additionally, modeling automotive powertrains uses techniques called 'design optimization' to improve the design. The goal of optimization techniques is to minimize a 'cost function.' In automotive powertrain studies optimization is applied to components sizes and control algorithms to minimize fuel use and emissions. Optimization techniques can also be applied to path planning for autonomous vehicles (i.e. finding the best safe route to a destination) in order to minimize fuel use, emissions, travel time or travel distance.

16. My research has led to the development of a "Green Mobility Laboratory" which allows small electric vehicle powertrains to be tested, utilizing Department of Energy (DOE) grant funds. I have also developed a chassis dynamometer facility for testing the performance of small electric vehicles. And I have been instrumental in the development of the GM/Kettering University Mobility

Research Center (MRC), a 25 acre facility for automotive testing. I continue to be the main technical advisor to the facility.

17. Throughout my career at Kettering University, I have received several awards and recognitions. I was honored with the Carroll Smith Mentor's Cup by the Sports Car Club of America in 2015 for my work with Formula SAE racing teams and was named the Outstanding Educational Scholar by the Kettering University Center for Education, Teaching, and Learning in 2007. Additionally, I received the SAE Forest R. McFarland Award for my contributions to the dissemination of technical information and the SAE Ralph R. Teetor Award for my significant contributions to teaching, research, and student development in automotive engineering. My contributions to the field have been recognized through various awards and honors which are fully listed in my CV.

18. I have authored more than 30 peer-reviewed journal articles and conference papers. My publications cover a wide range of topics, including combustion and emissions in dual-fuel engines, hybrid electric vehicle design, and environmentally sustainable engineering education. I have also presented numerous invited talks and conference presentations on automotive engineering and sustainability.

19. In addition to my academic and research activities, I have served as a consultant for various organizations, including Ford Motor Company, Society of

Automotive Engineers, and the U.S. Army Tank and Automotive Command (TACOM). My consulting work has involved developing technical solutions for hybrid and fuel-cell vehicles, providing expert testimony in patent cases involving hybrid and electric vehicle control strategies, and conducting technical assessments for automotive and engineering companies.

20. I have been actively involved in professional societies, including the American Society of Mechanical Engineers (ASME), the Society of Automotive Engineers (SAE), and the American Society of Engineering Educators (ASEE). I have served on several committees, including the SAE International Scholarship Committee, the SAE International Engineering Education Board, and the NextEnergy Alternative Energy Education Board. I have also organized and chaired technical sessions at various conferences and served as an external reviewer for graduate programs at other universities.

21. I continue to actively engage in research, teaching, and professional service to advance the field of mechanical and automotive engineering.

22. In my roles as Dean of the College of Engineering, technical adviser to the Mobility Research Center (MRC) and Head of the Department of Mechanical Engineering one of my responsibilities was to regularly engage with university shareholders including alumni and engineering companies that hired our students and graduates to learn about industry trends and needs. Most of the university's

shareholders are involved in the automotive industry. As a result of these interactions and through my research, I have developed a knowledge of topics such as Advanced Driver-Assistance Systems (ADAS) and Vehicle Autonomy. These technologies involve the use of navigation systems (which includes Global Positioning Systems (GPS), Inertial Navigation Systems (INS), along with mapping and route planning systems), vehicle communication systems (such as Vehicle to Vehicle (V2V) and Vehicle to Grid (V2G) systems), in-vehicle data acquisition systems, Controller Area Network (CAN) and Artificial Intelligence (AI) systems.

23. Because of my background in automotive engineering and my connection to Kettering University¹, an institution that is well-known and regarded in the automotive industry, I was asked to join the Smart Belt Coalition² (SBC). SBC is a collaboration between the Departments of Transport in Michigan, Ohio, Indiana, New Jersey, and Pennsylvania, the Turnpike authorities in Ohio, Indiana, New Jersey and Pennsylvania, two large automotive test facilities (the American Center for Mobility, the Transportation Research Center), and the University of Michigan, the Ohio State University, Penn State University, Carnegie Mellon University, Purdue University and Kettering University. The goal of the coalition is to prepare

¹ Kettering University was once owned and operated by the General Motors Corporation as General Motors Institute (GMI).

² <https://www.michigan.gov/smartbelt/about>

the transportation agencies for the integration of electric, connected and automated vehicle technologies. In working with the SBC, I have gained further knowledge on the advanced automotive technologies that I've mentioned previously.

24. Because of my various roles I regularly attended conferences held by the Society of Automotive Engineers International (SAE), the Institute of Electrical and Electronics Engineers (IEEE) Vehicular Technology Society (VTS), and the Intelligent Transportation of America (ITS). I also attended events at automotive suppliers and mobility research centers, where new technology was being demonstrated. At these conferences and events, I both attended and presented numerous technical presentations on the topics that I've discussed previously.

25. I am familiar with the subject matter of this case, and consider myself an expert in, among other things, intelligent transportation systems, vehicle information and communications systems, automotive powertrains and energy systems, and navigation systems.

III. ASSIGNMENT AND MATERIALS CONSIDERED

26. I have been asked to assess the '399 patent, including the state of the art when the '399 patent application was filed. I have also been asked to consider, analyze, and explain certain prior art to the '399 patent, including how that art relates to the challenged claims of the '399 patent and to provide my opinion on the validity of certain of the claims in the '399 patent.

27. The opinions expressed in this declaration are not exhaustive of opinions I may offer in the future regarding the unpatentability of the claims of the '399 patent. Therefore, the fact that I do not address a particular point should not be understood to indicate an agreement on my part that any claim complies with the requirements of any applicable patent or other rule.

28. I reserve the right to amend and supplement this declaration in light of additional evidence, arguments, or testimony presented during this IPR or related proceedings on the '399 patent.

29. In forming the opinions set forth in this declaration, I have considered and relied upon my education, knowledge of the relevant field, knowledge of scientific and engineering principles, and my experience. I have also reviewed and considered the '399 patent (Ex. 1001), its prosecution history (Ex. 1002), the Board's institution decision in this proceeding (Paper 9), and the following additional materials:

Exhibit	Description
Ex. 1003	Declaration and Curriculum Vitae of Dr. Vassilios Morellas
Ex. 1005	Certified Translation of Japanese Pat. Pub. No. JP 2003-276472 ("Hongo")
Ex. 1008	U.S. Pat. No. 6,282,464 ("Obradovich")
Ex. 1009	U.S. Pat. No. 7,059,435 ("Niki")
Ex. 1010	U.S. Pat. App. Pub. No. US 2005/0251325 ("Kudo")

Ex. 1011	U.S. Pat. No. 6,314,347 (“Kuroda”)
Ex. 1012	U.S. Pat. No. 7,552,008 (“Newstrom”)
Ex. 1013	U.S. Pat. No. 8,229,644 (“Boecker”)
Ex. 1014	U.S. Pat. No. 6,420,975 (“DeLine”)
Ex. 1015	Trach, Walter, Jr. et al., “Driver Assistive Systems for Rural Applications: Digital Mapping of Roads for Lane Departure Warnings (“Trach”)
Ex. 1016	Mukhachev P. A. et al., “Modern Machine Learning Methods for Telemetry-Based Spacecraft Health Monitoring,” Automation and Remote Control, 2021, Vol. 82, No. 8, pp. 1293–1320 (2021)
Ex. 1017	Gorjestani A. et al., “Radar Based Longitudinal Virtual Bumper Collision Avoidance System Implemented on a Truck” (Feb. 1999)
Ex. 1018	Walker, Jearl, “Fundamentals of Physics,” 10th Edition, Halliday & Resnick, ISBN 978-1-118-23072-5 (“Walker”)
Ex. 1019	U.S. Pat. App. No. 2004/0180670 (“Pande”)
Ex. 1020	U.S. Patent No. 7,860,647 (“Amano”)
Ex. 1021	U.S. Patent No. 7,460,946 (“Shima”)
Ex. 1022	U.S. Patent No. 6,675,085 (“Straub”)
Ex. 2001	“Frequently Asked Questions About Selective Availability” (Oct. 2001), available at https://www.gps.gov/systems/gps/modernization/sa/faq/
Ex. 2002	Global Positioning System Standard Positioning Service Performance Standard (Oct. 2001)
Ex. 2003	Global Positioning System Standard Positioning Service Performance Standard (Sept. 2008)
Ex. 2004	Bullock et al., “Analysis of the Use of Digital Road Maps in Vehicle Navigation,” IEEE (1994)

Ex. 2005	Liu et al., “Map Matching for Urban High-Sampling Frequency GPS Trajectories,” ISPRS Int’l Journal of Geo-Information (2020)
Ex. 2006	Najjar et al., “A Road-Matching Method for Precise Vehicle Localization Using Belief Theory and Kalman Filtering,” Autonomous Robots 19, 173-191 (2005)

IV. UNDERSTANDING OF THE LAW

30. I am not an attorney, but I have been informed of several legal principles concerning patent validity, which I have employed in forming my opinions in this declaration.

31. I have been informed and understand that each patent claim is considered separately for purposes of validity and that a dependent claim that depends from another claim includes all of the limitations of the claim it depends from.

32. I understand that the first step in comparing an asserted claim to the prior art is for the claim to be properly construed. I address how a person of ordinary skill in the art (a “POSITA”) would have understood the claims of the alleged invention in Section VII below.

33. I understand that a patent claim is “obvious” when the differences between the claimed subject matter 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 to which the subject matter pertains.

34. In making an obviousness determination, I understand that there are several factors to consider: (1) the scope and content of the prior art; (2) the level of ordinary skill in the art at the time the invention was made; (3) the differences between the claimed invention and the prior art, if any, and (4) objective considerations, if any exist, such as any commercial success, copying, prior failure by others, licenses, longstanding need, and unexpected results.

35. I understand that a patent claim composed of several elements is not proved obvious merely by demonstrating that each of its elements was independently known in the prior art, whether those references were set forth in a single reference or in a combination of references. Instead, it must have been obvious to arrange those elements in the same way as the elements in the claim.

36. I understand that either a single reference or multiple references may be the basis for finding that a claim is obvious. A patent challenger, however, must show that there is a reason, suggestion, or motivation that would lead one of ordinary skill in the art to either modify the single reference or combine prior art references to arrive at the claimed subject matter.

37. I understand that there is no single way to define the line between true inventiveness on the one hand (which is patentable) and the application of common sense and ordinary skill to solve a problem on the other hand (which may not be patentable). Thus, when assessing obviousness, a number of different inquiries can

be made and considered. For instance, market forces or other design incentives may be what produced a change in the technology of the prior art, rather than true inventiveness. I further understand that explicit teachings or suggestions in the prior art to make the modification or combination of elements claimed in the patent may be evidence of obviousness. Further, an innovation may be obvious if it applies a known technique that had been used to improve a similar device or method in a similar way. I understand that a claimed invention may be found to be obvious to try if the claimed innovation was one of a relatively small number of possible approaches to the problem with a reasonable expectation of success by those skilled in the art.

38. However, I also understand that it is improper to engage in hindsight when trying to determine the obviousness of a patent claim. Many true inventions might seem obvious with the benefit of hindsight. I understand that the obviousness inquiry must be conducted from the standpoint of a person of ordinary skill in the field at the time the claimed invention was made. What is known today, and what is learned from the teachings and disclosures of the patent itself containing the claim under analysis, should not be considered. Nor should one use the patent claim as a guide to picking out elements of the prior art for combination.

39. I understand that if a claim is not obvious, then the claims that depend from it are not obvious.

40. I provide my opinions in this declaration based on the guidelines set forth above.

V. LEVEL OF SKILL IN THE ART

41. I have been informed and understand that the level of ordinary skill in the relevant art at the time of the invention is relevant to inquiries such as the meaning of claim terms, the meaning of disclosures found in the prior art, and the reasons a POSITA may have for combining references.

42. I have been informed and understand that factors that may be considered in determining the level of ordinary skill include: (1) the education of the inventor; (2) the type of problems encountered in the art; (3) prior art solutions to those problems; (4) rapidity with which innovations are made; (5) sophistication of the technology; and (6) education level of active workers in the relevant field. I have been further informed and understand that a person of ordinary skill in the art (POSITA) is also a person of ordinary creativity.

43. In my opinion, a POSITA in the field of the '399 patent would have had a degree in mechanical engineering, electrical engineering, computer engineering or an equivalent field, along with 2 years of professional experience working with automotive applications including powertrains, vehicle control systems and vehicle navigation systems, or an equivalent level of skill, knowledge, and experience.

44. Based on my education, training, and professional experience in the field of the claimed invention, as discussed in Section II, I was a person of more than the ordinary level of skill in the art as of November 17, 2005

45. In forming my opinion, I have drawn on my academic background and professional experience, including experience hiring and managing engineers engaged in development, research, and consulting projects applying the technologies and applications described in the '399 patent, as well through teaching and managing graduate students working on the same. My opinions herein, however, were formed using the perspective of an ordinarily skilled artisan.

46. I have also reviewed the definition of a POSITA provided by Dr. Morellas. *See* Ex. 1003, ¶ 27. In my opinion, his definition requires an excessive amount of work experience (4 years vs 2). I believe my definition is more representative of the appropriate level of skill possessed by a POSITA. Regardless, I have considered both my definition and that proposed by Dr. Morellas and would have arrived at the same conclusions regarding the claims of the '399 patent under either definition.

VI. THE '399 PATENT

A. Effective Filing Date

47. I understand that the application leading to the '399 patent was filed on June 6, 2019 and was a continuation of a chain of continuation patents stemming

from U.S. Patent Application No. 11/238,137 which was filed on November 17, 2005. This chain of continuations is referenced on the face of the '399 patent. I have been instructed to assume that the patent is entitled to the benefit of this November 17, 2005 date. I understand that Petitioner and Dr. Morellas have done the same.

48. My opinions in this declaration were formed from the perspective of a POSITA as of November 17, 2005, including both the knowledge of a POSITA at that time as well as how a POSITA would have understood the prior art.

B. Overview

49. The '399 patent states that it pertains to “methods and systems for controlling power applied to a vehicle...” Ex. 1001, 1:17-18.

50. The patent states that “FIGS. 1A and 1B compare a traditional ‘cruise control’ device (in FIG. 1A) to” the patent’s “power management device ... (in FIG. 1B).” *Id.*, 6:61-63.

51. The '399 Patent goes on to explain that in Figure 1A that “[a]s the vehicle moves across ... roads having different elevations ..., or through different weather conditions, the traditional cruise control device adjusts the power supplied to the vehicle[] (and thus the speed) based only on the set velocity” and the vehicle’s current condition *Id.*, 6:63-7:7. In other words, in prior art systems like that shown

in the figure, speed adjustments are made continuously based on the vehicle's current speed regardless of the current location of the vehicle. *See id.*

52. The patent then notes that this type of active or continuous “velocity control ... cruise control device” differs from the system described in the '399 patent, as illustrated in FIG. 1B. *Id.*, 7:7-10.

53. As shown in this and other figures in the '399 patent, the patent employs a “the power management system” that “receives ... information” about “the location and grade (e.g., steepness of any uphill/downhill portions) of the road” along the vehicle's route. *Id.*, 7:11-18.

54. Utilizing this current location information and future location information (along the route), along with “information about the state of the vehicle,” the power management system can calculate the power applied to the engine and derive a speed (or set of speeds) that optimizes the applied power on the route to the destination. *Id.*, 7:8-27.

55. The use of future location information in the determination of the applied power is an essential element of the '399 patent. In the patent, upcoming driving conditions are used by the power management system to determine the applied power/speed:

The power management logic may determine an applied power for the vehicle engine based on information about the external environment of the vehicle that is selected from the group

*consisting of: the current location of the vehicle, the elevation of the vehicle, **upcoming** elevations of the vehicle, the current slope/grade of the route, the predicted slope/grade of the **next segments (or upcoming segments)** of the route, speed limit information of the current route segment, speed limit information of **upcoming route segments**, the condition of the known or **predicted** route (or a portion thereof), traffic information or data, traffic surrounding the vehicle, the location of stoplights, the timing of stoplights, a map of the roadway, the present angle of the sun, the **predicted** angle of the sun for upcoming route segments, the weather around the vehicle, present wind direction, the predicted wind direction for **upcoming route segments**, present wind velocity, the predicted wind velocity for **upcoming route segments**, current temperature, the predicted temperature for **upcoming route segments**, current air pressure, predicted air pressure for **upcoming route segments**, time of day, date, day of week, visibility, present road conditions, predicted road conditions for **upcoming route segments**, and the distance to/from other vehicles.*

Ex. 1005 3:55-4:10 (emphasis added).

56. By adjusting the vehicle's speed and power application to better align with the expected route, the '399 patent reduces the vehicle's power consumption compared to a conventional "cruise control system." *Id.*, 7:24-31; Figs. 1A-1B.

57. A key aspect of the '399 patent's power management system is its ability to accept the driver's destination from the driver's input or to "deduce[] information about" the vehicle's destination and "route." *Id.*, 7:14-16, 11:65-67.

58. Once the route is determined, it "may be broken up into segments that may be used by [the] power management device to optimize the power needed to travel th[e] segment." *Id.*, 14:5-32. The segments can be of different lengths, and the route can be continuously re-segmented as the vehicle travels. *See id.*

59. Notably, "the more segments the route is divided into, the more precise the power optimization." *Id.*, 14:38-45.

C. Claims

60. For reference, claims 1-20 of the '399 patent are reproduced below. Of these, claims 1 and 11 are independent.

1. A method of electric vehicle operation, comprising:
 - determining a segment of a vehicle route;
 - determining information about an external environment of a vehicle, information about operational status of the vehicle, information from external command input telemetry in combination with user command inputs to the vehicle including voice command inputs; and
 - applying calculated electric power to the vehicle to travel along the segment of the vehicle route at a calculated speed.

2. The method of claim 1, wherein electric power can be derived from operation of an internal combustion engine.

3. The method of claim 1, further comprising the step of selecting a destination using historical data associated with a driver.

4. The method of claim 1, further comprising the step of selecting a destination using statistical destination logic.

5. The method of claim 1, further comprising the step of selecting a destination by at least one of a driver and a passenger.

6. The method of claim 1, wherein vehicle route segment determination further comprises determining multiple route segments, each route segment having a separate calculated speed and selected drive train parameters.

7. The method of claim 1, wherein the step of determining information about an external environment of a vehicle further comprises the step of communicating with a remote database.

8. The method of claim 1, wherein the step of determining information about operational status of a vehicle further comprises the step of communicating with a remote database.

9. The method of claim 1, wherein voice command inputs are provided to the vehicle by a separate source.

10. The method of claim 1, wherein voice command inputs are provided to the vehicle by a device having GPS functionality.

11. An electric vehicle, comprising:

a vehicle having an electric power source, a communication system, and a user interface system capable of accepting voice command inputs; and

a power management system for the electric power source able to determine information about an external environment of a vehicle, information about operational status of the vehicle, information from external command input telemetry combinable with user command inputs to the vehicle including voice command inputs provided by the user interface system, and one or more operational parameters of the vehicle, with the power management system set to calculate electric power and speed over a segment of a vehicle route and act to apply calculated electric power to the vehicle to travel along the segment of the vehicle route at the calculated speed.

12. The apparatus of claim 11, wherein electric power from the electric power source can be derived from operation of an internal combustion engine.

13. The apparatus of claim 11, wherein vehicle route is set based on a destination determined at least in part using historical data associated with a driver.

14. The apparatus of claim 11, wherein vehicle route is set based on a destination determined at least in part using statistical destination logic

15. The apparatus of claim 11, wherein vehicle route is set based on a destination determined by at least one of a driver and a passenger via the user interface system.

16. The apparatus of claim 11, wherein vehicle route segment determination is based at least in part on determining multiple route segments, each route segment having a separate calculated speed.

17. The apparatus of claim 11, wherein determining information about an external environment of a vehicle further comprises communicating with a remote database.

18. The apparatus of claim 11, wherein determining information about operational status of a vehicle further comprises communicating with a remote database.

19. The apparatus of claim 11, wherein calculated speed is based at least in part on a determined probable optimal speed using historical route information.

20. The apparatus of claim 11, wherein target speed is presented as a range of target speeds.

VII. CLAIM CONSTRUCTION

61. I am not a legal expert or an attorney and offer no opinions on the law. I understand that claim construction is a matter of law.

62. However, I have been informed by counsel of the legal standards that apply to claim construction in an *inter partes* review, and I have applied them in forming my opinions. I understand that during an *inter partes* review, the same claim construction standard used in federal district court is applied when addressing the meaning of claim terms.

63. I have been informed that the words of a claim are generally given the ordinary and customary meaning that the term or phrase would have to POSITA at the time of the invention in view of the surrounding claim language, the specification and the file history (collectively, the “intrinsic evidence” or “intrinsic record”).

64. I also understand that courts may consider extrinsic evidence, such as expert and inventor testimony, dictionaries, and learned treatises (collectively, the “extrinsic evidence” or the “extrinsic record”), but that such extrinsic evidence should be given less weight than the intrinsic evidence.

65. In my opinion, the terms of the '399 patent's claims do not require further construction and can be afforded their plain and ordinary meaning for purposes of the analysis of the prior art that I am conducting in this declaration.

66. In my opinion, the Petition does apply overbroad understandings of certain claim elements. This includes the claim elements referencing a “segment of the vehicle route,” “applying calculated electric power to the vehicle to travel along the segment of the vehicle route at a calculated speed,” and “calculated electric power ... to travel along the segment of the vehicle route at a calculated speed.”

67. In my opinion, the Petition’s and Dr. Morellas’s application of the prior art to these elements effectively renders the elements meaningless and reads them out of the claims. I have discussed what a POSITA would have understood the ordinary meaning of these elements to be in greater detail below.

VIII. THE CLAIMS OF THE ’399 PATENT ARE NOT OBVIOUS

68. As stated above, I understand that, under the law, in order for a patent to be found invalid as obvious, the differences between the claimed subject matter and the prior art are such that the subject matter as a whole must have been obvious at the time the invention was made to a POSITA.

69. As I discuss below, it is my opinion that as of the effective filing date of the ’399 patent, a POSITA would have considered claims 1-20 of the ’399 patent to be non-obvious and patentable, including over the prior art identified by the Petition and Dr. Morellas.

A. Identified Prior Art

70. The following paragraphs provide an overview of the main prior art references I discuss throughout this declaration.

1. “Hongo” (Japanese Pat. Pub. No. JP 2003-276472)

71. The Petition—and Dr. Morellas—primarily rely on a reference “Hongo.” Hongo teaches a cruise control system that automatically adjusts the desired speed of the vehicle according to the current weather and sunlight conditions for the vehicle’s position and historical data stored for that position.

2. “Obradovich” (U.S. Pat. No. 6,282,464)

72. In addition to Hongo, the Petition and Dr. Morellas point to Obradovich as a secondary reference. Obradovich relates generally to a voice-controlled multimedia system for a vehicle.

3. “Niki” (U.S. Pat. No. 7,059,435)

73. Next, the Petition and Dr. Morellas point to another secondary reference to Niki. Niki teaches a hybrid vehicle that makes vehicle power apportionment determinations based on the vehicle’s current condition.

4. “Newstrom” (U.S. Pat. No. 7,552,008)

74. In certain grounds, the Petition and Dr. Morellas point to yet another reference, Newstrom. Newstrom relates to a lane departure warning system on a vehicle.

B. Summary of Opinions

75. The Petition—and the Board’s institution decision—employ the same fundamental argument against both of the ’399 patent’s independent claims (claims 1 and 11): the claims are purportedly obvious over the combination of Hongo, Obradovich, and Niki. Hongo is cited for the vast majority of the claim elements.

76. It is my opinion that there are several key distinctions between the claims of the ’399 patent and the prior art.

77. The ’399 patent describes (and all its claims require) a method and system that determines a “segment of a vehicle route” and then calculates the power that needs to be applied “to the vehicle to travel along the segment” at a “calculated speed.”

78. Essentially, the patent necessitates (1) determining the vehicle’s route, (2) dividing that route into segments, and (3) prospectively calculating the power needed to travel along a yet-to-be-traveled segment (i.e. a future or upcoming segment) of the vehicle route at a specified speed.

79. This approach is not taught by the purported prior art. A brief summary follows. Additional details regarding my reasons for arriving at this conclusion are found in the sections below.

80. Hongo, the primary reference relied upon in the Petition, and of which the Petition relies on for most elements, focuses on an automatic (also called

adaptive) cruise control system that determines the vehicle's current position and collects various other condition information from sensors.

81. Hongo then uses the current position and environmental conditions (weather and sunlight inferred from various on-board sensors) to query stored driving history data for that current position to determine the appropriate speed for the current position/conditions. Hongo does not teach using future or upcoming driving conditions to determine the appropriate speed.

82. Hongo does not take the vehicle's route into account and thus does not determine any route segments as described in '399. In fact, the word "route" and "destination" never appear in Hongo. The historical data Hongo stores (and uses later) is indexed by positions through which the vehicle has previously traveled. But these indexed locations along the road are not equivalent to the claimed **segments of a vehicle route** to a destination to which the vehicle is currently heading. The index locations described by Hongo represent single past vehicle positions. While stored as a range of coordinates spanning a fixed length (Hongo gives an exemplar of 20 meters), this does not somehow transform the stored positions into route segments. The range of coordinates for Hongo's indexed locations are simply map data, not a segment of a vehicle route (or even positions over which the vehicle has ever necessarily travelled). A POSITA would have understood that Hongo stores a range to facilitate its ability to match the vehicle's current measured GPS position

to a map location. Moreover, instead of making a power/speed determination for a future, upcoming route segment, (or any route segment for that matter) Hongo only considers the vehicle's current position and condition along with historical data for that current position when setting the cruise control speed. In fact, Hongo (either alone or in combination of the other art referenced in the Petition) never teaches any power calculations at all, an essential element of '399.

83. It is my opinion that Obradovich and Niki do not resolve this disclosure deficiency. Obradovich pertains to a voice-controlled multimedia system for a vehicle that receives voice commands, while Niki discusses a hybrid vehicle that makes power determinations based on the vehicle's current condition in order to apportion the power being requested by a vehicle between an internal combustion engine and an electric motor. Neither reference teaches making a power calculation in order to set a calculated vehicle speed for a future route segment.

84. Thus, as I discuss below, Hongo, Niki and Obradovich, separately or combined, do not teach what independent claims 1 and 11 of the '399 patent require.

85. Further, these references also do not teach the limitations required by certain dependent claims, including claims 6 and 8.

C. Detailed Assessment of the Prior Art

86. As I discussed above, there are multiple of the '399 patent's claim elements which are not disclosed, and not obvious from the purported prior art.

1. Independent Claims 1 and 11

a. “[A] segment of a vehicle route”

87. Claim 1 requires the step of “determining a segment of a vehicle route.” Ex. 1001, claim 1. Similarly, claim 11 requires the use of “a segment of a vehicle route.” *Id.*, claim 11.

88. I understand the Petition contends that Hongo determines and utilizes the claimed “segment of a vehicle route” because its automatic cruise control (ACC) system “acquires position information (current position coordinates *r*) from the GPS 170.” Petition at 26. According to the Petition, this position information is then divided into “driving blocks (block numbers)” that correspond to “approximately 20m in the driving direction on the road being driven on.” *Id.*

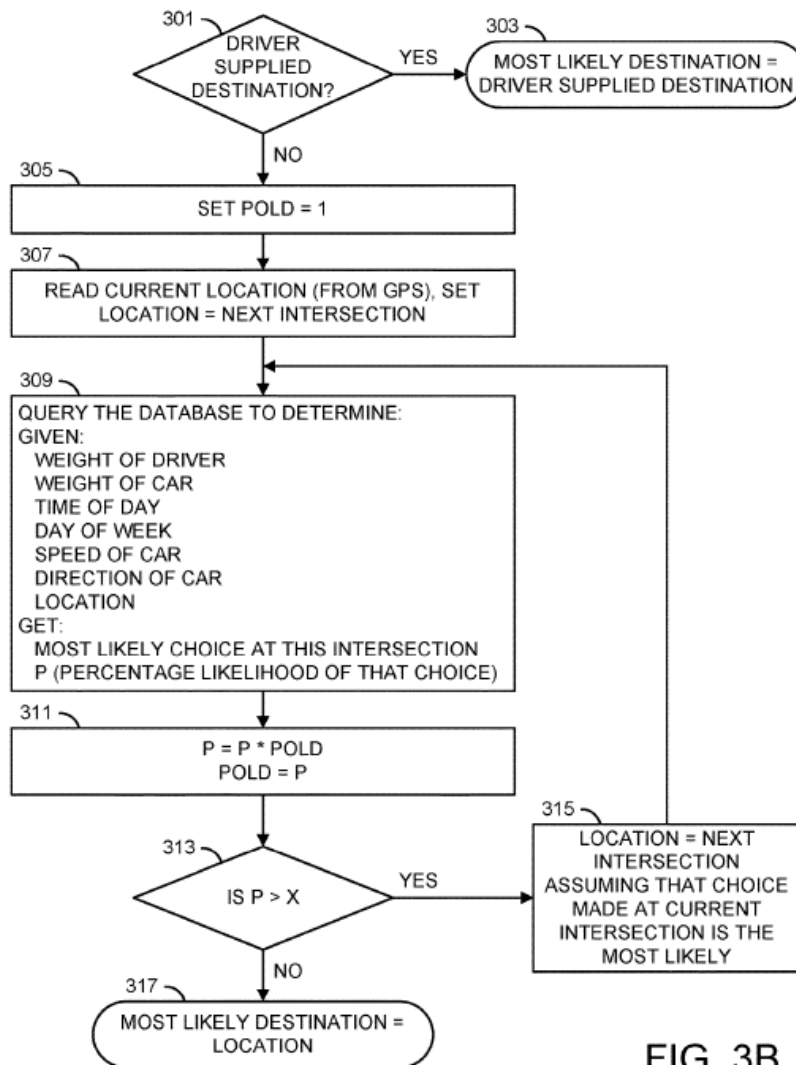
89. In my opinion, this is not what the ’399 patent’s claims require for multiple reasons: (1) Hongo does not know the vehicle’s route and thus cannot segment that route, (2) Hongo’s blocks of historical data represent individual positions, and (3) Hongo’s blocks are merely database identifiers, not route segments.

(1) Hongo’s System Is Unaware of the Vehicle’s Route

90. To start, these claim elements clearly necessitate that the “route” being traveled by the vehicle is known. This in turn requires that the vehicle’s destination be known to plan (or recognize) the route. Without this, the “segment” that is

“determined” in claim 1 or used in claim 11 would not qualify as “a segment *of a vehicle route.*”

91. I note that the '399 patent consistently explains that its system can either accept the driver supplied destination as input or it can “deduce information about the” vehicle’s destination and “*route.*” Ex. 1001, FIG. 3B, 7:14-16; *see also id.*, 5:31-49.



92. I also note that the '399 patent further clarifies that vehicle's "route" is the path the vehicle will travel which is "determined based on the current position of the vehicle and a final destination position." *Id.*, 11:48-49, 11:64-65; *see also id.*, 12:4-5 (referencing a "route to the final destination"); 14:6-10 ("the route ... typically includes a starting position..., an ending position, ... and any intermediate positions between the initial and final positions").

93. I find that the '399 patent makes clear this is the route that has been determined and is the path the vehicle will travel "from point A to point B." *Id.*, 7:14-16.

94. It is this already known and determined route that is then "broken up into segments" or "portions." *Id.*, 14:5-15; *see also id.*, 5:49-51 (explaining that "the route is divided up into segments"); 14:17-18 (again explaining that "the route may be segmented"); 14:38-39 (likewise explaining that "the route (or the predicted route) may be divided up into N segments"); 18:33-36 ("every route may be divided into a finite number of segments"); 20:19-25 (discussing "segmenting the route into segments").

95. Since the "segments" are parts of a known and determined route, the '399 patent's system and method always determine the route *before* segmenting it.

96. Figure 2 illustrates this process. As shown, “a route is” first “determined” at step “201” using the vehicle’s “starting position” and “an actual or estimated ending position.” Ex. 1001, 11:44-50. Then, this determined route is “segmented” at the following step “203 into one or more segments.” *Id.*, 11:50.

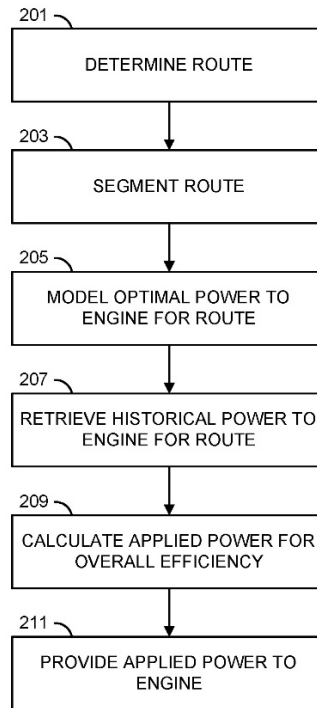


FIG. 2

Id., Fig. 2; *see also id.*, 14:5-45 (similarly explaining that in the '399 patent, an already determined “route” is “broken up, “portion[ed],” “divided,” or “split” into segments).

97. Unlike the '399 patent’s claims (and its consistent specification disclosures), Hongo does not consider or determine the vehicle’s destination. Hongo

is concerned only with the vehicle's current position. As a result, it does not determine the "route" the vehicle will take. In fact, the words "destination" and "route" do not appear in the text of Hongo. Consequently, because it does not know the vehicle's destination and route, Hongo's system also cannot determine or utilize any current or future route "segments" as part of its methodology.

98. A POSITA would understand that doing so would be impossible as without understanding the vehicle's destination or the route it will travel, the task of "determining a segment of a vehicle route" would be impossible.

99. Thus, Hongo's system is incapable of doing so because it does not disclose this.

**(2) Hongo's Block Numbers / BKN Store
Individual Positions, Not "Segment[s]" of a
"Route"**

100. The Petition and Dr. Morellas overlook the fact that Hongo is indifferent and never determines the vehicle's destination and route and nonetheless attempt to equate Hongo's block numbers / BKN with the claimed "segment of a vehicle route."

101. It is my opinion that a POSITA would not consider the Hongo block numbers / BKN to be route "segments."

102. Before explaining why this is the case, I will summarize how the '399 patent characterizes a route "segment[.]"

103. Per the '399 patent, a route includes “a starting position” and “ending position” and possibly “intermediate points between the initial and final position.” Ex. 1001, 14:9-10. The length of the route and the segments making up that route can of course be variable, as they may comprise “any distance to be traveled, including the entire route, or small portions of the route.” *Id.*, 14:13-15

104. The '399 patent also notes that the route segments are based on the driving conditions between the current position and the final destination:

The route may be segmented in any appropriate manner. For example, the route may be broken into segments based on predetermined or anticipated changes in speed (e.g., switching from 65 to 55 mph), changing traffic patterns (e.g., turns, stops, yields, etc.), traffic or anticipated traffic, distance (e.g., x miles), terrain (e.g., the gradient or condition of a road), or the like. In some variations, the route may be segmented based on a combination of such factors.

Id., 14:18-24

105. The number of route segments between the current position and the destination can also be variable and may be changed continuously based on changing driving conditions:

A route may be entirely segmented, or only partially segmented. For example, the power management device may segment only the first part of the route (e.g., the portion containing the current position of the vehicle), or the first few segments. This may be

particularly useful when the destination is an anticipated destination determined by the statistical destination logic, for example. The route may be continuously re-segmented. For example, as the vehicle moves, the power management device may become aware of changing road conditions (e.g., traffic, weather, etc.), or the user may change the route, necessitating re-segmenting. As used herein, "continuously" may mean repeated multiple times, including repeating regularly or periodically.

Id., 14:25-37

106. Moreover, the number of route segments used for a route may be a fixed number or may be variable in that it is tied to the computing power needed for the power management system:

In some variations, the entire route (or the entire predicted route) may be divided up into N segments. The number (N) of segments may be fixed or may depend upon the route. The more segments that the route is split into, the more accurate the model may be. However, more segments may also require more computing power. Thus, the number of segments N may be decided based on the tradeoff between computing power and accuracy.

Id., 14:38-45

107. Now, I will provide a brief overview of what Hongo actually teaches.

108. Hongo teaches an “adaptive cruise control system that automatically controls the speed of a vehicle.” Ex. 1005, ¶¶ [0001]. The system uses the “current position of the vehicle” and “real-time road environment information related to weather and sunlight conditions” to make cruise control speed decisions. *Id.*, ¶¶ [0002], [0008].

109. In addition to collecting current vehicle position and condition information, Hongo’s system utilizes two databases.

110. The first database is described as the “driving history DB 10.” *Id.*, ¶ [0026]. I understand this database to “store[] driving history ... from when the user drove in the past.” *Id.*, ¶ [0003]. Hongo also discloses that the records in this database are indexed by “BKN” or “block number.” *Id.*, ¶ [0027]. Each indexed record includes 20 meters of position data along with various weather, vehicle speed, road curvature, and other data. *See id.*, ¶ [0027]-[0031]; Fig. 3.

111. Hongo also includes another “driving block DB20” that allows the current vehicle position to be converted to a “block number BKN” for querying the driving history database DB 10. *Id.*, ¶¶ [0027], [0032].

112. Hongo explains that historical driving data indexed by “blocks” or “BKN” is generated during a “trace mode.” *See id.*

113. This “trace mode” is separate from, and not used when, Hongo’s cruise control is active. Specifically, Hongo states that “The trace mode is a dedicated

mode for constructing the driving history DB 10 consisting of driving history data; while this trace mode is being implemented, the target vehicle speed V0 is not output, and the above-mentioned ACC system is not used.” *Id.*, ¶ [0026].

114. Returning to the claimed “segment of a vehicle route,” in my opinion a POSITA would not consider Hongo’s blocks to correspond to this claim element.

115. Most importantly, Hongo’s blocks have nothing at all to do with the vehicle’s route or any portion thereof. Instead, they merely reflect the vehicle’s current position.

116. Petitioner’s and Dr. Morellas’s assessment of Hongo and this element is premised on an incorrect assumption.

117. Both assume that Hongo’s system collects GPS position data, and then groups multiple sequentially collected instances of position data into 20 m “blocks” for storage:

Means 140 generally serves two functions in the data flow shown in Figure 2. First, in a “trace mode,” means 140 generates data for storage in “driving block DB 20” (“DB 20”). TESLA-1005, [0027]. This is accomplished by “acquir[ing] position information (current position coordinates r) from the GPS 170” and “dividing it into sections approximately every 20m in the driving direction on the road being driven...” Id. The information is stored in driving block DB 20, which “specif[ies] the block number BKN of [a] driving block,” along with

associated information, such as “block range coordinates (r1, r2) of each driving block,” “legal speed limit Vs of the driving block,” and “the minimum radius of curvature R.” Id.

Ex. 1003, ¶ 41 (emphasis added).

118. In my opinion, this is **not** what Hongo teaches.

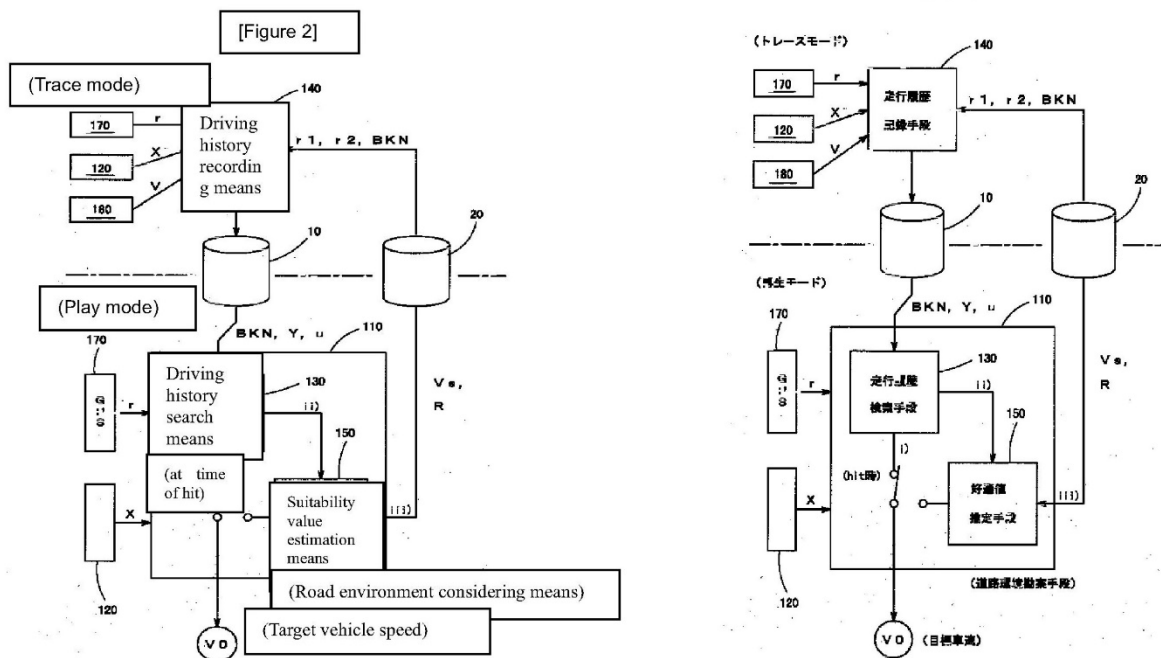
119. Hongo does explain that historical data—indexed with a block number / BKN—is generated by its “driving history recording means 140” during a so-called “trace mode.” (Ex. 1005, ¶¶ [0026]-[0027].) And the means 140 does collect “position information (current position coordinates r)” from GPS 170 during this process. (*Id.*)

120. Hongo does not, however, divide this incoming GPS position information into “sections approximately every 20m” as the Petition and Dr. Morellas argues. Nor does it store any of the incoming GPS position data it collects in DB 20.

121. Instead, Hongo explains (and shows in its figures) that DB 20 provides the driving history recording means 140 with **input** during trace mode. This input includes block number (BKN) and the “block range coordinates (r1, r2)” for the block. According to Hongo, “[t]he block range coordinates (r1, r2) for specifying the block may be **read** directly from the above-mentioned driving block DB 20[.]”

Ex. 1005, ¶ [0044] (emphasis added).

122. This method of operation can also be seen by examination of Figure 2. The figures below are reproduced from both the translated version of Hongo (Ex. 1005) and the original Japanese-language version of the reference (Ex. 1007). The provision of input from DB 20 to means 140—including $r1$, $r2$, and BKN—can be clearly seen in Figure 2 of original, Japanese language version:



Compare Ex. 1005, Fig. 2 with Ex. 1007, Fig. 2.

123. In my opinion, a POSITA would understand that the “block range coordinates ($r1$, $r2$) stored in Hongo’s “driving blocks” are simply *road* sections from map information stored in Hongo’s DB 20 for later use when matching the vehicle’s current position to a past position.

124. Due to limitations of GPS accuracy and on-board computer memory, Hongo stores this road data in “sections approximately every 20m in the driving direction of the road.” Ex. 1005, ¶ [0027]. But these “sections” of road data, are not the claimed *route* segments as they bear no correlation to the path the vehicle is currently travelling. Hongo’s BKN—and the block range coordinates stored in each BKN—simply allow Hongo’s system to log data for rough locations that a vehicle has previously been.

125. Put another way, while Hongo’s system stores “block range coordinates (r1, r2)” in each BKN, these are not points over which the vehicle has (or ever necessarily will) travel. They are just road location data stored in DB 20 that is provided to means 140 when generating historical data for storage in DB 10. *See id.*

126. So, while “block range coordinates (r1, r2)” are stored in each block, Hongo’s system never determines if the vehicle passed coordinate r1. Likewise, Hongo never determines if the vehicle is in fact traveling to coordinate r2. All that matters is that the vehicle is currently located at a point that falls somewhere within the block coordinate range.

127. For example, imagine an example BKN with “block range coordinates (r1, r2)” spanning 20m along a portion of a roadway that includes an exit ramp. As long as Hongo’s GPS 170 collects a position within the range (r1, r2) it will identify

the example BKN regardless of whether the vehicle continues along the roadway or takes the exit ramp. This is because Hongo is concerned only with the vehicle's *current position*. It is indifferent to where the vehicle is going.

128. A POSITA would understand that Hongo is implementing a technique called “map-matching.” The technique of “map-matching” or “localization” involves locating a position on a known road network using GPS data. “Map-matching” was well-known at the time and has been in development since as early as 1994. *See, e.g.,* Ex. 2004.

129. In-vehicle GPS navigation systems for use in map matching systems in the time-period of Hongo sampled data at rates up to 1 Hz (once per second). *See* Ex. 2006 at 185. However, it was not uncommon to use a slower sampling rate (10 seconds to 2 minutes) to allow cheaper receivers to be used or to reduce the amount of data that was collected.

130. A map-matching system employs maps and attempts to match a vehicle's current position—determined via, for instance, GPS—to a location on a map. All maps can be divided into units or sub-divisions. Maps used for map-matching are no different. So, for instance, maps used for matching—like that stored in Hongo's DB 20—can divide the stored road data into “sections”. While this language is somewhat similar to that in the '399 patent, it is conceptually different. The “sections” in a map database are simply the minimum quantum into which the

map data is divided for storage purposes. They are not a portion of the actual route being travelled by a vehicle. This, however, is what the route “segments” are in the ’399 patent: they are a portion or fraction of the vehicle’s route.

131. A POSITA would have considered Hongo’s blocks—and the 20m sections of road represented by block range coordinates (r1, r2)—to be analogous to the fixed, static distance markers on a highway. Highways often include distance markers every 1/10 of a mile to allow drivers to report their position in the event they experience an accident or vehicle breakdown. If a vehicle breaks down right next to a mile marker, the driver is able to determine the vehicle’s position as corresponding to the marker (*i.e.*, “at mile marker 51.7”). However, in many cases, the vehicle breaks down between mile markers resulting in the driver determining the vehicle’s location with less precision (*i.e.*, “between mile marker 51.7 and 51.8”). This corresponds to a “segment of a vehicle route”: it is simply position reported with a reduced amount of precision. Moreover, the mere fact that a vehicle’s route passes over a roadway with mile markers does not transform the space between the mile markers into “segment[s] of a vehicle route.” The mile markers simply represent how the *roadway* is divided. They are not divisions of the vehicle’s route. Likewise, the mere fact that a vehicle’s route takes it over multiple block numbers / BKN stored by Hongo does not transform those block numbers into “segment[s] of

a vehicle route.” They continue to represent only how Hongo has chosen to divide up its stored, static, and fixed *map information*.

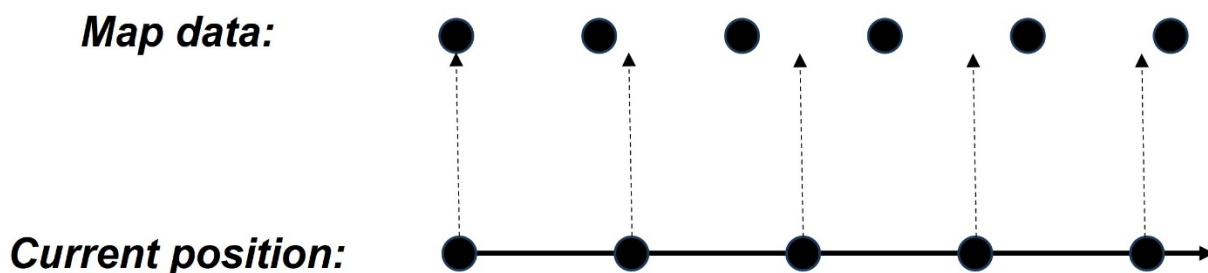
132. A POSITA would understand that map matching systems like that in Hongo divide a map into “sections” for a straight-forward reason: it facilitates matching of the vehicle’s position (determined, for example, via GPS) to a position on a road in a road network in the form of a map.

133. The following example is meant to illustrate this. Again, at the time the ’399 patent was filed, faster GPS systems sampled positions at a rate of about 1 Hz. A sampling rate of 1 Hz would provide position data at 33.5 m intervals at 75 mph (33.5 m/s), 20.1 m intervals at 45 mph (20.1 m/s) and 11.2 m intervals at 25 mph (11.2 m/s).

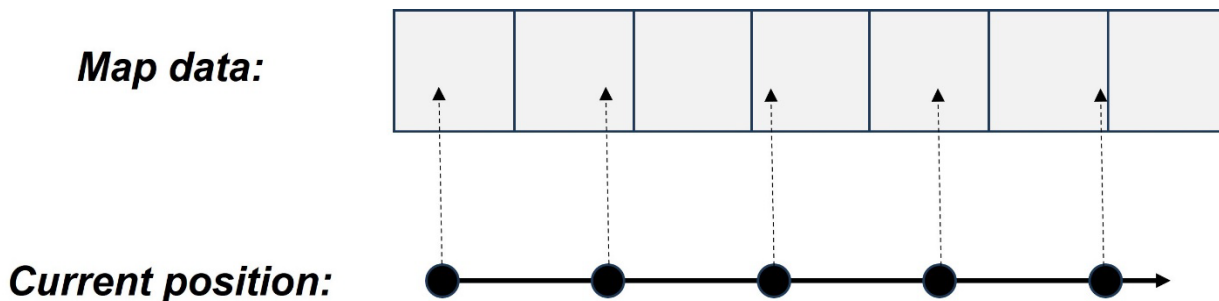
134. Typical GPS position measurements were also not perfectly accurate at the time the ’399 patent was filed. While positional accuracy could of course always be improved, doing so was often computationally expensive or required special equipment not mentioned by Hongo, like a system that performs differential GPS. Thus, in typical systems, position was determined with an accuracy of approximately ± 10 m. *See, e.g.*, Ex. 2001 (“Users in the U.S. and the rest of the world should now be experiencing the same basic GPS accuracy of 10-20 meters or better”); Ex. 2002 at 15 (referencing GPS accuracy in the range of 13-36 meters in the 2001-time

frame); Ex. 2003 at 22 (referencing an accuracy in the range of 6-12.8 meters in the 2008-time frame).

135. This in turn presents issues for map-matching systems. If roads in the map data are represented only as discrete points, it becomes very difficult to match the vehicle's current position (collected, for instance, only 1 time per second with only a ± 10 m accuracy) with the map unless an inordinately large number of points are stored by the map-matching system. An example of this is shown below. As shown, there is only one match between a current position and the stored map-data (which is stored in the form of points):



136. If discrete positions along roads, however, are stored as “sections” instead of points this problem can be mitigated. The vehicle's current position can be more readily matched to its position on a road stored in the map data:

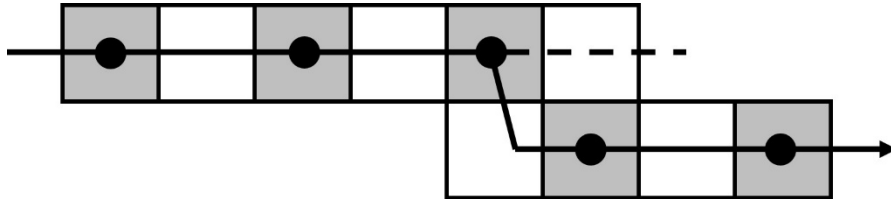


137. This, however, does not transform the stored map data into the route “segments” required by the ’399 patent’s claims. The map data continues to store discrete map positions, just abstracted to and stored as “sections” to facilitate later matching.

138. This is how a POSITA would have understood Hongo to operate. Hongo determines the vehicle’s current position via GPS. Then, it converts this position to a block number (BKN) by querying the driving block (*i.e.*, map) database DB 20. Each block—or road position—stored in this database is represented by “block range coordinates (r1, r2).” Hongo then stores the BKN, block range coordinates (r1, r2), and measured road environmental information in the driving history database (DB 10) for later use when engaging in speed control. *See* Ex. 1005, FIG. 2.

139. Hongo does not teach what sampling rate should be used. But even if one assumes that Hongo’s system was able to obtain GPS position data at a very fast rate such as 1 sample every second, this would not cause it to operate in the way the Petition assumes it does. During the data collection mode (or “trace mode”) driving blocks along the path of vehicle travel would be skipped over and no data collected. Moreover, in many cases, only a single GPS position would be collected per block. Likewise, during playback mode driving blocks stored in DB 10 would be skipped over and not used. The below example shows this. If, for instance, the vehicle is

traveling along a roadway at 90 mph or 40 m/s (a high rate of speed is used to simply the drawing), only every other block will be identified (the gray shading). If the vehicle then exits onto another roadway, the first block on this roadway will be skipped and only the second block will be identified:



140. This again shows that Hongo “driving blocks” are not the ’399 patent’s “route segments[,]” as “route segments” reflect a portion of the route and necessarily must be used to get to the destination. Instead, Hongo’s “blocks” are simply the minimum quantum—20m “sections”—into which it has divided the map data into its DB 20. Once again, Hongo considers only 20m “sections” of road when identifying the vehicle’s current position and correlating it to a past position because using individual points would make matching inordinately difficult.

141. As I have explained, typical GPS systems available at the time of the ’399 patent would have made it difficult to either (1) match current positions with stored positions, or (2) accurately characterize 20m of roadway with collected GPS position information. With ± 10 m accuracy and a 1 Hz sampling rate, some data collected would be assigned to the correct BKN and some data collected would

be assigned to an incorrect BKN. So, a POSITA would understand that storing road data in 20m road “sections” accounted for the limits the technology of the day.

142. Put another way, in my opinion, a POSITA would have understood that Hongo’s blocks are simply designed to address these sampling frequency and GPS accuracy limitations. But this does not transform Hongo’s system from one that merely considers the vehicle’s current position (this is what Hongo does), into one that determines and segments the vehicle’s route (which it does not do).

143. Hongo repeatedly explains that its system considers the “**current position** of the vehicle while driving” when making a speed determination. *E.g.*, Ex. 1007, ¶ [0008] (emphasis added); *see also id.*, ¶¶ [0015] (again noting that “current position of the vehicle” is considered); [0016] (explaining that the system stores vehicle speeds for “a certain passing point”); [0017] (noting that “position” information is stored.)

144. A POSITA would understand that Hongo’s “current position” is nominally somewhere within a predetermined road “section” defined by a map of the road network and block range coordinates (r1, r2) indexed by the block number BKN.

145. Hongo does explain that in its system, “the position of a driving block (block number) ... is defined by dividing it into sections approximately every 20m in the driving direction on the road being driven.” (*Id.*)

146. But here, as I have explained, a POSITA would **not** understand Hongo to be saying that it collects significant volumes of position data and then divides that data into 20 m blocks. The road “sections” and blocks are predefined and stored in the driving block database DB 20. They are just the unit into which the stored map data has been divided. They do not correlate to the route being traveled by the vehicle.

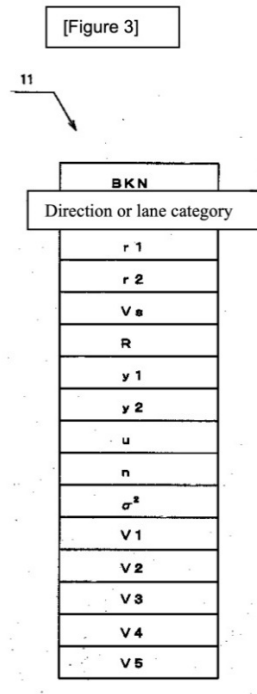
147. Because of this, in my opinion, a POSITA would not understand Hongo’s blocks to be “segment[s]” of a route. They are nothing more than sections of a road network stored in a map database that are used to index historical data for that road section, formatted in a way to ensure Hongo’s system operates as intended.

(3) Hongo’s Block Numbers / BKN Are Simply Database Identifiers, Hongo does not “Determine egment[s]” of a “Route”

148. Hongo’s block numbers / BKN are not “segment[s] of a vehicle route” for yet another reason: they are simply an identifier Hongo uses to organize and index data in its historical database. Simply put, a road “section” or BKN used for indexing (Hongo) is not the same as segments of a vehicle **route** as taught in ‘399.

149. As shown in Figure 3 below, each collection of “driving history data 11” “recorded in the driving history DB 10” is indexed by a BKN. In other words, the block numbers /BKN serve as identifiers used by Hongo to organize and index data in its “driving block DB20” and “driving history DB10.” Ex. 1005, ¶¶ [0027]-

[0028]. So, each “BKN” is simply the label applied to the data Hongo collects for each individual position stored in its database:



Id., Fig. 3.

150. It should be noted that Hongo also explicitly states this, explaining that the position and other data in these databases are stored “*in association* with the block number BKN.” *Id.*, ¶ [0027] (emphasis added).

151. Hongo also consistently clarifies that its BKNs function merely as database indexes rather than route segments, stating that the system uses the BKN as a “key” to retrieve and search for data entries in its driving history DB 10. *Id.*, Abstract; ¶¶ [0032], [0050].

152. The nature of the data linked to each of Hongo's BKNs further demonstrates that they are not "segments of a vehicle route." All the data indexed by BKN is historical, pertaining only to past vehicle travels and not the current route the vehicle is on.

153. I understand that Hongo clarifies that its cruise control system operates in both a "trace mode" and a "playback mode." Ex. 1005, ¶ [0025].

154. However, the "trace mode is a dedicated mode for constructing the driving history DB 10 consisting of driving history data." *Id.*, ¶ [0026] (emphasis added). So, each block or BKN does not store data relating to the vehicle's current route. It stores only past data. Once again, Hongo's system operates to control speed as the vehicle moves from position-to-position. The historical database simply informs the system of the speed that should be employed at each position. There is no planning (or 'determining') a route in Hongo as required by the '399 patent. There is only a method of reacting to a location that the vehicle has been before with a target vehicle speed that is based, in part, on vehicle speeds that have been used previously.

155. Not only is the data associated with each BKN historical, but it is also collected during multiple, different past drives.

156. As illustrated in Hongo's Figure 3, a single BKN can include several "valid vehicle speed data" entries, such as speed data "V1 to V5" as the vehicle may

“travel at the same point” multiple times at different speeds. *Id.*, ¶ [0031]; Fig. 3; *see also id.*, ¶ [0015] (“there may be a plurality of vehicle speeds V”).

157. Notably, all these different speeds are stored under the same BKN. Moreover, the data associated with a BKN does not even have to be the vehicle driver’s own data. In fact, the data in the “driving history DB” can be “public, shared, or integrated (sharing) with others (or other vehicles).” *Id.*, ¶ [0069]. Hongo states this as the BKN stored in DB 10 can be “standardized” and “shared among a plurality of drivers.” *Id.*, ¶ [0070].

158. It is thus my opinion that Hongo is missing the limitation that corresponds to ’399 patent’s claim to that of a “determining a segment of a vehicle route.” As I have explained above, there are multiple reasons for this.

159. First, because Hongo never determines the vehicle’s route it therefore cannot “determines a segment of a vehicle route.”

160. Second, a POSITA would have understood each block to represent only a single point along a road (just abstracted to a range of positions to facilitate position matching).

161. Third, Hongo’s block numbers / BKNs are merely database indexes used to store historical data gathered from multiple past drives, including those made by other drivers.

162. In my opinion that a POSITA would find this to be different to what the '399 patent's claims require and does not render those claims obvious.

b. “*[A]pplying calculated electric power to the vehicle to travel along the segment of the vehicle route at a calculated speed*”

163. After “determining a segment of a vehicle route,” claim 1 of the '399 patent requires “applying calculated electric power to the vehicle to travel along the segment of the vehicle route at a calculated speed.” Ex. 1001, Claim 1.

164. Similarly, claim 11 of the '399 patent necessitates the system to “calculate electric power and speed over a segment of a vehicle route” and then “apply calculated electric power to the vehicle to travel along the segment of the vehicle route at the calculated speed.” *See id.*, Claim 11.

165. I understand that the Petition asserts that “[i]n Hongo, the ‘target speed’ is ‘determined based on the past driving history in which both the position and road environment real-time road information match.’” Petition at 40 (quoting Ex. 1005, ¶ [0017]). More specifically, I understand that the Petition claims that a “target speed” is “calculated based on means 140 determining a block number BKN identifying a driving block in the driving block DB 20”” *Id.*

166. The calculations taught by Hongo include calculating a target vehicle speed based on the average of the previous vehicle speeds (u) from data stored in the history database (Ex. 1005, ¶ [0033]) or calculating the target vehicle speed based

on coefficients (α and β) that “depends on detected or estimated weather” and “detected or estimated sunlight conditions” (*Id.*, ¶ [0035]). Neither of these calculations can be construed as calculating the “electric power to the vehicle to travel along the segment of the vehicle route at a calculated speed”

167. It is my opinion that this interpretation does not align with the claims.

(1) Hongo Does Not Determine Any Route Segments and Thus Cannot Perform the Claimed Calculations or Power Application

168. First, as I mentioned above, Hongo’s system does not determine any “segments of a vehicle route.” Hongo’s system lacks awareness of the vehicle’s route, and Hongo’s block numbers / BKNs represent individual points and are merely database indexes, not “route segments.”

169. Without determining any “route segments,” Hongo’s system cannot “apply calculated electric power to the vehicle to travel along the *segment* of the vehicle route at a calculated speed.”

(2) Hongo Only Controls Speed for Current Position (not Future Positions)

170. Second, even if one incorrectly assumes that Hongo’s block numbers / BKNs are “segments of a vehicle route,” in my opinion, this claim element would still not be met.

171. Both claims 1 and 11 require a sequential, two-step process (or a system configured to perform such a two-step process).

172. Step one of this process, as claimed in claim 1 of the '399 patent, involves “determining a segment of a vehicle route.”

173. The second step is then that “calculated electric power” must be “applied” to the vehicle to travel along the segment at a calculated speed.

174. I find that Claim 11 of the '399 patent is very similar, claiming that the first step of the process requires “calculating electric power and speed over a segment of a vehicle route.” Claim 11’s second step is then that the “calculated electric power” must be “applied” to the vehicle to travel along the segment at the calculated speed.

175. Thus, it is my opinion that claims 1 and 11 require that the “segment of a vehicle route” be a route that the vehicle has yet to travel.

176. If the “segment of a vehicle route” were not determined in advance before the vehicle reaches that segment and power is calculated, the claims would be nonsensical.

177. It is impossible to “apply[] calculated electric power to the vehicle to travel along the segment of the vehicle route at a calculated speed” if the vehicle is already traveling over, or has completed traveling over, that route segment. In other words, it would be too late to apply the “calculated” power to travel “along” the

segment at a “calculated speed” because the vehicle would have already traveled the entire or a portion of the route segment.

178. In my opinion, the claims require prospective speed/power calculations: calculations must be performed for upcoming, not yet reached route segments to allow the vehicle to subsequently travel over those segments at the calculated speed using the calculated power.

179. Again, this is required by the claim language itself: a “segment” must be determined. Then, calculations must be performed for this already known “segment.” Then finally, the calculations must allow the vehicle to travel “along”—not just for a single point within—the segment at a “calculated speed.”

180. This two-step requirement is precisely what the ’399 patent discloses.

181. Specifically, the ’399 patent uses information about “the next segments (or upcoming segments)” —which are “predicted”—to calculate power and speed. Ex. 1001, 3:55-4:10; *see also id.*, 5:49-55 (noting that “speeds for current and upcoming route segments can also be calculated”); Fig. 2 (showing that power is applied at step 211 after it is calculated for a segment at 209).

182. I recognize that the Petitioner argues that interpreting the ’399 patent’s claims to require prospective power/speed determinations somehow “departs from plain meaning.” Preliminary Reply (Paper 7) at 2.

183. Similarly, the Board stated that there is no “requirement in claim 1 that electric power and speed for a route segment be calculated prior to the vehicle traveling along the segment.” Institution Decision (Paper 9) at 16; *see also id. at 22*. According to the Board, “claim 1 does not specify how or when electric power and speed are calculated.” *Id.*

184. In my opinion, this interpretation is incorrect.

185. A POSITA would have understood that the ’399 patent’s claims *do* require a determination of power and speed prior to the vehicle traveling the segment.

186. According to the ’399 patent’s claims 1 and 11, the applied “calculated electric power” must cause “the vehicle to travel along the segment of the vehicle route” that has been determined “at a calculated speed.”

187. In other words, the claims require that the application of the calculated power have the specific result of the vehicle traveling “along” an already determined “segment of the vehicle route” at a calculated speed.

188. It is not sufficient to simply “apply calculated electric power” and travel “at a calculated speed.” To practice the claims, there must be travel “at a calculated speed” “along” a determined segment. If mere travel for some indeterminate time at a particular speed is enough, the requirement that there be “travel along the segment” “at a calculated speed” would be read out of the claims.

189. I also recognize that the Petitioner also argues that the “specification refutes” this straightforward claim interpretation. Preliminary Reply at 1. I also recognize that the Board similarly noted in its Institution Decision that the ’399 patent’s claims should be broadly interpreted because the patent “explicitly discloses calculating and applying power to a vehicle based on the route segment in which the vehicle is currently traveling.” Institution Decision at 17.

190. However, it is my opinion that nothing in the ’399 patent’s specification necessitates omitting an element from the claims.

191. The specification clearly and plainly describes prospective determinations/calculations.

192. For example, Figure 2 depicts an ordered process where a route is determined/segmented at steps 201 and 203, power is calculated at step 209, and then calculated power is applied at step 211. Ex. 1001, Fig. 2; *see also* 11:44-50.

193. Further, the ’399 patent specification describes determine the vehicle’s “*next* segment (or **upcoming** segments)” and calculate power and speed for that segment. *Id.*, 3:55-4:10 (emphasis added); *see also* 5:49-55 (“speeds for **upcoming** route segments can also be calculated.”) (emphasis added).

194. It is my opinion that this prospective nature is in fact the purpose of the ’399 patent.

195. At the time the patent was filed, “traditional ‘cruise control’ devices” simply “adjust the power supplied to the vehicles (and thus the speed) based only on the difference between the set velocity and the actual velocity of the vehicle.” No information about the current location or the future locations on the route is used. *Id.*, 6:61-7:10.

196. The ’399 patent improves on this by considering and accounting for the “route” over which the vehicle *will be* traveling. *Id.*, 7:11-18.

197. The ’399 patent does explain that power/speed determinations can optionally *also* use the vehicle’s current position.

198. Specifically, the ’399 patent states that “applied power *may* be calculated continuously for current and upcoming route segments.” Ex. 1001, 5:38-55 (emphasis added).

199. In other words, per the specification, determining the current speed is an optional—but not required—functionality. Once again, the claims plainly require determining the speed to travel over future, prospective segments. I see nothing in the claims that would justify removing this prospective requirement.

200. I also recognize that the ’399 patent’s specification also shows the use of the vehicle’s current position and historical data to determine energy-efficient vehicle speeds. Ex. 1001, 5:51-55.

201. However, this also does not change what the claim language requires, as I discussed above. In any case this is identified in the specification as optional, alternative functionality present only in “some variations.” *Id.*

202. It is my opinion that, in fact, a POSITA would understand the disclosure of this alternative variation, using the current position, as a demonstration that the claimed language is that of the prospective variety and not this alternative variation. Otherwise, there would be no need to disclose the alternative variation.

203. I also recognize that the '399 patent's specification discloses the use of a vehicle's current position to look up historical speed data as an *alternative* to the calculation of power and speed on a segment-by-segment basis: “[i]nstead of trying to calculate the predicted power usage based on physics modeling, this method looks at all the previous data to determine the power that would be utilized to drive each segment at a particular speed.” *Id.*, 18:4-9.

204. However, I note the *claims require* the calculation of energy/speed for an already determined route segment.

205. In my opinion, the fact that the '399 specification includes passages that sound somewhat similar to Hongo's active cruise control system does not establish obviousness. While Hongo does reference a “section” of road, this is essentially just a map location. The '399 patent, however, uses the word “segment” to represent a segment of a planned route from the current location to the destination. I understand

that the prior art must be compared to the claims. Comparisons with the specification do not show obviousness.

206. In fact, I again find such an alternative to be demonstrative that the primary function which is *claimed*, is different than the alternative, otherwise there would not be a need to state the alternative. Hongo's system determines a target vehicle speed in reaction to being at a current location which it has been before, while in the '399 patent's claims, the system determines a target vehicle speed by planning (or determining) the route segments over which the vehicle will travel between the vehicle's current position and its final destination and calculating the power requirements for those route segments.

207. Further, I understand the prior art must teach the *claimed* subject matter, which it does not, and it is my opinion a POSITA would agree and not find the claimed subject matter in the '399 patent to be obvious.

208. I also note that the Petition does not explain this difference. Hongo's is a traditional automatic cruise control system (ACC) and while it does make a determination regarding appropriate cruise control speed, it does not do so in the manner required by the '399 patent's claims.

209. Specifically, Hongo's ACC system consistently clarifies that "speed determinations" are made by referencing the "current position of the vehicle" in its databases and retrieving the corresponding speed stored for that location. Ex. 1005,

[0008]; *see also id.*, [0015] (noting that the “current position of the vehicle currently driving and the real-time road environment information” to search historical data for speed calculation purposes). In other words, Hongo utilizes a lookup method to determine the appropriate speed by referencing historical data on the vehicle’s current position against the position ranges in the stored data records indexed by block number. *See* Ex. 1005, ¶ [0032] (“The driving history DB 10 is searched for driving history data with matching keys (BKN,Y)” either by searching DB 20 for a BNK or by “directly using r (coordinates as a key).”).

210. Essentially, Hongo involves a straightforward lookup: the vehicle’s current position is used to query stored speed data to find out the speed at which the vehicle previously traveled at that location.

211. However, Hongo does not perform the two critical steps required by the ’399 patent: (1) determining a route segment, and (2) prospectively calculating the power necessary for the vehicle to travel at a calculated speed over that route segment. These steps are fundamental to the ’399 patent and its claims and are required.

212. Because Hongo employs the vehicle’s current position to determine cruise control speed, by the time Hongo’s system determines the speed, the vehicle will have already entered the position range of the data record. Hongo simply does not “apply calculated electric power to the vehicle to travel along the segment of the

vehicle route at a calculated speed” because the vehicle would have already traveled at least part of the "segment."

(3) Hongo Does Not Control Speed When It Is Creating Blocks

213. There are still further reasons why, in my opinion, this limitation is not satisfied by Hongo.

214. Specifically, Hongo specifies that data records associated with BKNs are created and stored in its databases exclusively during a separate “trace mode.” Ex. 1005, Abstract (“The trace mode is a dedicated mode for constructing a driving history DB 10 consisting of driving history data”); ¶ [0026] (same).

215. Hongo also states that “while trace mode is being implemented, the target vehicle speed V_0 is not output, and the above-mentioned ACC system is not used.” *Id.*, ¶ [0026]. Vehicle speed is only determined and managed during a distinct “playback mode.” *Id.*, ¶ [0032].

216. Thus, Hongo employs *separate* methods—performed at separate times—for (1) storing data with associated block numbers (BKNs) and (2) controlling vehicle speed.

217. This, however, is different than what the ’399 patent claims require. The claims require performance of a single method that entails both (1) determining a segment and then (2) calculating and applying power and speed. More particularly, claim 1 requires “applying calculated power” to the vehicle “to travel along *the*

segment of the vehicle route at a calculated speed.” By referring back to “the segment,” the claim makes clear that calculated power must be applied to travel at a calculated speed for the previously determined “segment of a vehicle route” and not just any segment.

218. It is my opinion that these differences—and the resultant missing claim elements—are not addressed by any of the other references cited in the Petition.

219. I recognize the Petition references Obradovich solely for its voice control features. *See, e.g.*, Petition at 15.

220. Similarly, I recognize the Petition cites Niki exclusively for its description of a hybrid vehicle. *See Id. at 21*. Although Niki discusses how its hybrid vehicle’s engine and electric motor power should be apportioned to meet torque demands for the vehicle, this assessment is based only on the vehicle’s current operating state, meaning the torque required at that moment. *See, e.g.*, Ex. 1009, 8:35-63 (determining torque requirements either by driver input or cruise control system); 9:1-10:23 (distributing the currently required torque between motor and engine as per Niki’s guidelines). Niki’s cruise control system is controlled to “satisfy *predetermined* travel conditions previously set according to the input operation of the *driver[.]*” *Id.*, 8:47:50. It is this predetermined condition—and not some calculation performed by the power management system—that determines power.

Like Hongo, Niki does not calculate the power needed to maintain speed over a route segment that has not yet been traveled.

**c. *“[C]alculated electric power ... to travel along the
segment of the vehicle route at a calculated speed”***

221. Claims 1 and 11 of the '399 patent stipulate a method that determines and a system that employs both a “calculated electric power” and a “calculated speed.”

The Petitioner asserts that Hongo’s cruise control inherently meets these requirements because it can “calculate[] speed.” Petition at 37-38. Petitioner contends that “controlling vehicle movement using the target vehicle speed involves calculating and applying a power corresponding to the target vehicle speed [of] the vehicle engine.” *Id. at* 39. In my opinion, however, this interpretation effectively omits an element from the claims. The claims explicitly require both a “calculated speed” and “calculated electric power.” Simply calculating speed alone does not fulfill the claim requirements.

222. I also recognize that when instituting the IPR, the Board asserted that calculating speed alone (but not power) suffices because “the '399 patent discloses calculating power as a function of the calculated speed.” Institution Decision at 22.

223. This interpretation mischaracterizes how cruise control (CC) systems typically work and there is nothing in Hongo’s specifications and claims that would lead one to believe that Hongo’s system behaves differently. Typically, CC systems

control vehicle speed using a Proportional-Integral-Derivative (PID) controller. A PID control adjusts a throttle setting based on the error between the set vehicle speed (v_{set}) and the actual vehicle speed (v)³. In the case of a purely electric vehicle the current applied to the motor (I) would be set by:

$$I = K_c (v_{set} - v) + \frac{1}{\tau_I} \int (v - v_{set}) dt + \tau_D \frac{d(v_{set} - v)}{dt} + C_{offset}$$

224. In the above formula, K_c , τ_I , and τ_D are calibration constants set during the development of the vehicle. The PID controller **adjusts** the current to the motor, which in turn **adjusts** the power to the motor, but there is no **calculation** of the power. The only calculation that is performed is for error ($v_{set} - v$). In other words, in Hongo's device there is a calculation of v_{set} , but that is not a calculation of power.

225. Although the specification does describe embodiments where only speed calculations are performed (*see, e.g.*, Ex. 1001, 2:53-55), the '399 patent also details other embodiments that involve **both** speed and power calculations. *See, e.g., id.*, 5:31-38. The claims at issue here necessitate both types of calculations.

³ [https://eng.libretexts.org/Bookshelves/Industrial_and_Systems_Engineering/Chemical_Process_Dynamics_and_Controls_\(Woolf\)/06%3A_Modeling_Case_Studies/6.08%3A_Modeling_and_PID_Controller_Example_-_Cruise_Control_for_an_Electric_Vehicle](https://eng.libretexts.org/Bookshelves/Industrial_and_Systems_Engineering/Chemical_Process_Dynamics_and_Controls_(Woolf)/06%3A_Modeling_Case_Studies/6.08%3A_Modeling_and_PID_Controller_Example_-_Cruise_Control_for_an_Electric_Vehicle)

226. Again, I find the fact that the specification mentions alternative embodiments does not warrant omitting limitations from the claims or interpreting those claims in a manner that contradicts their clear meaning. In fact, as before, I find such an alternative to be demonstrative that the primary function which is *claimed*, is different than the alternative, otherwise there would not be a need to state the alternative.

227. Next, the Petitioner references Niki, asserting that it independently teaches “control[ling] the internal combustion-engine E and the motor M so that the vehicle travelling speed VP detected in a vehicle speed sensor S1 becomes the target vehicle speed.” Petition at 39.

228. However, Niki does not “calculate[] electric power” needed to “travel along the segment of the vehicle route at a calculated speed,” as required by the ’399 patent’s claims 1 and 11.

229. Instead, it only performs instantaneous power and speed calculations and apports that power between two devices (an engine and a motor). Ex. 1009, 8:35-63; 9:1-10:23. Furthermore, diverging significantly from the ’399 patent, Niki’s power calculations are not based on a prospective route segment but rather on the current state of battery charge. *Id.*, 2:20-25 (using “state of charge” to control “lock-up clutch” that determines the transmission of motor power to the driveshaft);

3:26-54 (similar); 10:18-23 (utilizing “state of charge” of the battery to “limit power”); 14:50-56 (similar).

2. Dependent Claims 6 and 7

a. *Claim 6*

“The method of claim 1, wherein vehicle route segment determination further comprises determining multiple route segments, each route segment having a separate calculated speed and selected drive train parameters.”

230. I also find that a POSITA would not find that the ’399 patent claim 6 is obvious.

231. This claim, which depends on claim 1, specifies that the “vehicle route segment determination” must “further comprise determining *multiple route segments*, each route segment having a separate calculated speed and selected drive train parameter.”

232. Because it specifies that the “vehicle route segment determination” step entails “determining multiple route segments,” this claim plainly requires that multiple route segments must be identified simultaneously as part of the same segment determination step, with distinct speeds and drive train parameters calculated for each segment.

233. The ’399 patent’s specification clarifies that this method of segmentation where it states that “divid[ing] the route up into N segments”—enhances the accuracy of power and speed calculations. Ex. 1001, 14:38-35.

234. I recognize that the Petition (incorrectly) contends that “each block being a 20m portion means a route longer than 20m includes multiple driving blocks.” Petition at 45-47.

235. What the Petitioner seems to be saying is Hongo’s system uses the vehicle’s position at one moment to identify a data record indexed by one block number, and then at a later moment, uses the new position to identify a different data record indexed by another block number, continuing this process over time.

236. All that this means, however, is that Hongo’s system identifies one block number at any given moment. Once again Hongo’s driving blocks are “sections” of a road network, they are not “segments of a vehicle route.”

237. For instance, Hongo states that “[I]n step 41, the block on which the vehicle is running is specified based on the input current position $r[\cdot]$ ” Ex. 1005, ¶¶ [0044]; *see also* ¶¶ [0046]-[0048] mentioning that the “vehicle speed” is updated if the “block number BKN has changed.”); *see also* Figure 6.

238. But what Hongo does not do is determine multiple such blocks simultaneously. Because of this, a POSITA would understand that Hongo’s system does not determine “multiple route segments” as required by this claim.

239. Likewise, Hongo’s system never identifies “separate calculated speed[s] and selected drive train parameter[s]” for multiple route segments.

240. The Petition points only to calculations performed by Hongo when “block number BKN misses.” Petition at 47 (quoting Ex. 1005, ¶ [0036]).

241. These “misses” are when Hongo’s system fails to determine the block number corresponding to the vehicle’s current position, meaning no “segment of the vehicle route” has been determined.

242. When a block number is identified, Hongo uses an alternative method to determine vehicle speed. *See* Ex. 1005, ¶¶ [0033]-[0035] (discussing speed determination when “two keys are hit” or when “only block number BKN is hit”).

243. The Petition does not explain why it would be obvious to replace the speed determination Hongo uses when a block number is identified with the one used when there is a miss.

244. Moreover, Hongo’s system performs only a single speed determination at any given time. *See generally id.*, Fig. 6; ¶¶ [0043]-[0063].

245. As a result, Hongo’s system never determines “separate calculated speeds and selected drive train parameters” for multiple segments concurrently, as required by the ’399 patent’s claims.

b. Claim 8

“The method of claim 1, wherein the step of determining information about operational status of a vehicle further comprises the step of communicating with a remote database.”

246. Dependent claim 8 requires “determining information about the operational status of a vehicle” “further comprises the step of communicating with a remote database.”

247. The Petition suggests that it would have been obvious to integrate the lane departure warning system from Newstrom into Hongo. See Petition at 77-82; Ex. 1012.

248. Newstrom does employ a “geospatial database 20” that is stored within the vehicle itself for identifying lane departures. Ex. 1012, 4:12-16; Fig. 1.

249. A database stored on the vehicle does not meet the requirement of a “remote database” as specified in claim 8.

250. To address this shortfall, it seems the Petition argues that in Newstrom, “database 20 can be loaded by database manager 22... through a ‘wireless connection’ to server[.]” Petition at 83.

251. This statement, however, does not correctly characterize Newstrom.

252. Newstrom does explain that its database manager 22 can load different portions of the database 20 (which are already stored on the vehicle) as the vehicle travels to different locations. See Ex. 1012, 8:29-38.

253. Separately, Newstrom explains that a wireless connection can be used when “database manager 22 is *first initialized*.” *Id.*, 8:27-28 (emphasis added). Newstrom does not, however, teach the use of a “wireless connection” to a server during vehicle operation.

254. Once initialized, Newstrom’s in vehicle database remains static and unchanging while the vehicle is in traveling to a destination. Moreover, it would be impractical for Newstrom’s system to query a remote database for lane departure determinations, as these decisions must be made swiftly and without delay. Communication with a remote database would introduce latency into the process. Instead, Newstrom just employs locally stored data during this time.

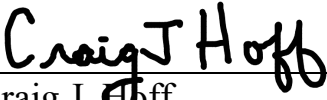
255. Additionally, I do not find anywhere the Petition specifying the location of the “server” in Newstrom, leaving open the possibility that it could be another internal storage unit within the vehicle rather than the “remote database” required by the ’399 patent’s claims.

256. Once again, claim 8 specifically requires “communicating with a remote database” when “*determining information about the operational status of a vehicle*.” No such database is employed by Newstrom—or any of the other prior art the Petition cites—during vehicle operation.

I declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willfully false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1101 of Title 18 of the United States Code.

Date: November 4, 2024

Location: Grand Blanc, MI

Signature: 
Craig J. Hoff

ATTACHMENT

CRAIG J. HOFF, Ph.D., P.E.

EDUCATION

- **Ph.D., Mechanical Engineering**, University of Michigan, Ann Arbor, MI (1992)
- **M.S., Mechanical Engineering**, Michigan State University, East Lansing, MI (1981)
- **B.S., Mechanical Engineering**, Michigan State University, East Lansing, MI (1979)

CERTIFICATION/LICENSURE

- Registered Professional Engineer, State of Michigan No. 31637
- SME Certified Manufacturing Engineer (CMfgE)

PRIMARY EMPLOYMENT HISTORY

- **2016 - Present: Founding Dean, College of Engineering**, Professor, Mechanical Engineering, Kettering University, Flint, MI.
- **2012 - 2016: Department Head, Mechanical Engineering**, Professor, Mechanical Engineering, Kettering University, Flint, MI.
- **2005 - 2012: Professor, Mechanical Engineering**, Kettering University, Flint, MI.
- **1999 - 2005: Associate Professor, Mechanical Engineering**, Kettering University, Flint, MI.
- **1995 - 1999: Department Chair, Mechanical Engineering**, Associate Professor, Mechanical Engineering, Lawrence Technological University, Southfield, MI.
- **1992 - 1995: Associate Professor, Mechanical Engineering**, Lawrence Technological University, Southfield, MI.
- **1985 - 1992: Assistant Professor, Mechanical Engineering**, Lawrence Technological University, Southfield, MI.
- **1981 - 1985: Lecturer, Mechanical Engineering**, Lawrence Technological University, Southfield, MI.
- **1979 – 1981: Michigan State University**, East Lansing, MI, Department of Mechanical Engineering. Part-time graduate teaching assistant.

ADMINISTRATIVE EXPERIENCE

- **Founding Dean, College of Engineering, Kettering University, Flint, MI**
 - Administered academic programs in Computer Engineering, Electrical Engineering, Industrial Engineering, and Mechanical Engineering for 1400 undergraduate students and 100 graduate students. Supervised 61 full-time faculty and 12 staff members.

- Lead efforts in strategic planning, curriculum development, faculty development, student engagement, international programs, industry engagement, and fundraising,
- **Department Head, Mechanical Engineering**, Kettering University, Flint, MI.
 - Administered academic program for 1000 undergraduate students and 80 graduate students and \$4M annual budget. Supervised 34 full-time faculty and 6 staff members.
 - Lead efforts in curriculum development, faculty development, student engagement, strategic planning, and assessment.
 - Prepared the department's successful 2015 ABET accreditation report.
- **Chair, Department of Mechanical Engineering**, Lawrence Technological University, Southfield, MI.
 - Administered day and evening programs for 800 undergraduate students and 100 graduate students. Supervised 16 full-time faculty, 30 adjunct faculty and 6 staff members.
 - Prepared the department's successful 1997 ABET accreditation report.

TEACHING EXPERIENCE

- **Professor, Department of Mechanical Engineering**, Kettering University, Flint, MI, 48504 (June 2006 – Present)
 - Teaching:
 - Strong proponent of experiential learning as a necessary complement to classroom education
 - Developed and taught graduate/undergraduate courses in automotive engineering, including: Introduction to Automotive Powertrains, Hybrid Electric Vehicle Propulsion, and Introduction to Automotive HVAC Systems
 - Cooperatively developed and taught an NSF funded, team-delivered multidisciplinary course: Environmentally Benign Design and Manufacturing
 - Undergraduate courses in thermal design, including: Thermodynamics, Fluid Mechanics, Heat Transfer, and Energy Systems Lab
 - Undergraduate courses in mechanical design, including: Statics, Dynamics, Solid Mechanics, and Design of Mechanical Components.
 - Developed and delivered courses in distance-learning format
 - Research:
 - Research Areas: Conventional Automotive Powertrains, Hybrid Automotive Powertrains, Alternative Fuels, PEM Fuel Cells, and Sustainability
 - Over \$2,000,000 in external funding (DOD, DOE, NSF, State of Michigan, and Industry sponsorships), in collaboration with colleagues
 - Supervised six master's thesis students and served on over 15 master thesis committees
 - Directed the development of a "Green Mobility Laboratory" which allows small electric vehicle powertrains to be simulated, utilizing DOE grant funds
 - Created an Electric Vehicle Testing facility, utilizing NextEnergy grant funds

- Developing an Electric Vehicle Testing Laboratory that can handle full-size vehicles
- Service:
 - Supervised over 120 undergraduate co-op student thesis projects
 - Served on numerous departmental and university committees, including chairing the Promotion and Tenure Committee and Academic Review Committee
 - Served on numerous professional society committees, particularly for the Society of Automotive Engineers (SAE)
 - Served as the faculty advisor to the Formula SAE race team (1985-present)
- **Visiting Professor, Fakultät Technik (TEC)**, Reutlingen University, Reutlingen, Germany (Fall 2011). Graduate course on Hybrid Electric Vehicle propulsion.
- **Associate Professor, Department of Mechanical Engineering**, Kettering University, Flint, MI, 48504 (April 1999 – June 2006).
- **Associate Professor of Mechanical Engineering**, Lawrence Technological University, Southfield, MI, 48075 (July 1995 – March 1999). Undergraduate courses in manufacturing, mechanical design and thermal design.
- **Associate Professor of Mechanical Engineering**, Lawrence Technological University, Southfield, MI, 48075 (July 1992 – July 1995).
- **Assistant Professor of Mechanical Engineering**, Lawrence Technological University, Southfield, MI, 48075 (1985 – 1992).
- **Instructor of Mechanical Engineering**, Lawrence Technological University, Southfield, MI, 48075 (1981 – 1985).
- **Graduate Teaching Assistant, Michigan State University**, East Lansing, MI (1979 – 1981). Undergraduate courses in Engineering Graphics, Introduction to Control Systems, Fluid Mechanics Laboratory.

RESEARCH / CONSULTING / ENTREPRENEURIAL

- **Ford Motor Company**, Dearborn, MI (2014 – Present). Expert witness in a patent case involving hybrid electric vehicle control strategies.
- **Accelerated Engineering, LLC**, Grand Blanc, MI (2008 – 2011). In collaboration with a former graduate student, started a company providing design and prototyping services to startup companies.
- **Society of Automotive Engineers**, Warrendale, PA (2003 – Present). Developed and regularly teach a professional seminar *Powertrain Selection for Acceleration and Fuel Economy*.
- **Select Engineering Service**, Layton, UT (2005 – 2012). Technical expert on multiple projects for U.S. Army TACOM, including:
 - Developed a data acquisition system for a fuel-cell powered tow tractor.
 - Converted a diesel-electric hybrid tow tractor into a fuel-cell powered tow tractor.

- Developed a mathematical model for a diesel-electric hybrid tow tractor using Argonne National Lab's Powertrain System Analysis Toolkit (PSAT) and validated it against experimental data.
- Developed a remote data acquisition for a fleet of Ford Escape Hybrids equipped with hydrogen internal combustion engines.
- Acted as lead technical expert for SES & Ricardo, LLC on the design of TACOM's Fuel Efficient Demonstrator (FED) vehicle.
- Developed remote data acquisition systems for the FED-Alpha and FED-Beta vehicles.
- **Weinstein, Kitchenoff & Asher, LLC**, Philadelphia, PA. (2012) Technical expert for product liability case on automotive HVAC control systems.
- **BAE Systems**, Troy, MI (2010). Developed and taught a review course in Fluid Mechanics for practicing engineers.
- **Dickinson Wright PLLC**, Ann Arbor, MI (2009). Technical expert in the development of patent for a novel engine concept.
- **Oblon, Spivak, McClelland, Maier & Neustadt, P.C.**, Alexandria, VA (2007). Technical expert for a patent case on automatic transmission design.
- **Welsh & Katz/ArvinMeritor**, Troy, MI (2004 – 2007). Technical expert/expert witness in a patent case involving heavy truck transmissions.
- **Convergence, LLC**, Howell, MI (2003 – 2007). Founding member and technical expert on technical advisory board of a fuel cell start-up company, working to develop fuel cells for residential applications.
- **Toyota Motor Company**, Torrance, CA (2004 & 2005). Prepared and delivered a custom seminar *Powertrain Selection for Acceleration and Fuel Economy*.
- **Welsh & Katz/Molon Electric Motors**, Chicago, IL (2005). Technical expert in a patent case involving worm gears.
- **Laboratory Assessment Bureau**, Fort Wayne, IN (2004). Technical expert for an ISO17025 laboratory assessment.
- **Anuvu Corporation**, Sacramento, CA (2002 – 2005). Fuel cell development for automotive applications.
- **National Technology Transfer Center**, Wheeling, WV (2003 – 2005). Evaluated patents for potential commercial applications.
- **Richard Nash, Attorney**, Dryden, MI (2003). Technical expert with respect to a product liability case involving a farm tractor accident.
- **Magna Mirror Systems**, Lowell, MI (2003). Resolved quality control problem in automotive mirror production.
- **Wilkie Brothers Conveyors, Inc.**, Marysville, MI (2003). Technical expert to evaluate Ford Motor Company specifications for conveyors bearings.
- **Battelle/U.S. Army Tank and Automotive Command (TACOM)**, Warren, MI (1997–2001). Investigated heat transfer techniques for cooling electronic equipment in ground combat vehicles.
- **Black and Veatch**, Ann Arbor, MI (2000). Developed and taught a several training course including: Cooling Towers, Heat Exchangers, and Mathcad.

- **Monarch Design Company**, Farmington Hills, MI (1984 – 1999). Developed finite element programs that are used to design paint distribution systems for automobile plants. These programs are capable of modeling the behavior of viscoelastic waterborne paints.
- **Altair Engineering**, Troy, MI (1994). Developed training material for Altair's *HyperMesh* program, a pre- and post-processor for Finite Element Analysis. Assisted in the development of a training course in Finite Element Analysis using NASTRAN, and FEA optimization using GENESIS.
- **Acme Mills Co.**, Detroit, MI (1994). Developed a computer model to simulate the behavior of Dymetrol fabric relative to the filming of a television commercial.
- **Ford Motor Company**, Dearborn, MI (1985–1986). Developed and taught a course in *Manufacturing Processes* for design engineers.
- **Schering-Plough**, Miami, FL (1985). Resolved a manufacturing problem relative to the thermal processing of transdermal patches.
- **Ford Motor Company**, Dearborn, MI (1984–1985). Developed and taught a course in *Design for Assembly* for Ford's PN38 Advanced Truck group.
- **Eaton Corporation**, Southfield, MI (1983). Developed and taught a course in Fluid Mechanics for practicing engineers.
- **General Motors Corporation** – Pontiac Division, Pontiac, MI (1982–1983). Developed and taught a course in technical mathematics for designers.
- **Engineer Trainee, Saab-Scania**, Sodertjale, Sweden (1980). Summer intern at an automotive assembly plant.
- **Product Engineer, Firestone - Hamill Manufacturing Division**, Washington, MI (1978 & 1979). Designed fixtures for reaction injection molding operation as part of a quality control function.
- **Production Worker, Hamilton Manufacturing Company**, Warren, MI (1977). Worked on die casting and chrome plating machines.

PUBLICATIONS

Journal & Peer Reviewed Publications

- Dewan, A., Ramadan, B.H., and **Hoff, C.**, "A Numerical Study on Combustion and Emissions in A Dual Fuel Directly Injected Engine Using Biogas and Diesel". ASME-ICEF2014-5541, ASME Internal Combustion Engine Division 2014 Fall Technical Conference, Columbus, IN, 2014.
- Wu, Y.Y, Duan, C., Hong, K.X., Tsai, H.C., **Hoff, C.J.**, "Design, Modeling and Development of a Serial Hybrid Motorcycle with HCCI Engine", *Advances in Automobile Engineering Journal*, 2013.
- Aurandt, J., Borchers, A.S., Lynch-Caris, T.L., El-Sayed, J., and **Hoff, C.J.**, "Bringing Environmental Sustainability to Undergraduate Engineering Education: Experiences in an Inter-Disciplinary Course," *Journal of STEM Education*, Volume 13, Issue 2, April 2012.
- Fahland, J., **Hoff, C.J.**, Brelvi-Fornari, J, "Evaluating Impact Attenuator Performance for a Formula SAE Vehicle," SAE Paper 2011-01-1106, SAE World Congress, Detroit,

MI, 2011. Also published in: *SAE Int. J. of Passeng. Cars – Mech. Syst. June 2011* 4:836-847.

- **Hoff, C.J.**, and Davis, G.W., “The Effect of Using Ethanol-Blended Gasoline on the Performance and Durability of Fuel Delivery Systems in Classic Automobiles,” SAE Paper 2010-01-2135, SAE Powertrain, Fuels, and Lubrication Conference, San Diego, CA, October 2010.
- Thompson, M.G, **Hoff, C.J.**, and Gover J.E., “A Model to Estimate the Effect of DC Bus Voltage on HEV Powertrain Efficiency,” IEEE Vehicle Power and Propulsion Conference, Lille, France, September 2010.
- Gover, J.E., Thompson, M.G., **Hoff, C.J.**, “Design of a Hybrid Electric Vehicle Education Program Based on Corporate Needs,” IEEE Vehicle Power and Propulsion Conference, Lille, France, September 2010.
- Rising, D., Kane, J., Vernon, N., Adkins, J., **Hoff, C.J.**, Brelin-Fornari, J., “Analysis of a Frontal Impact of a Formula SAE Vehicle,” SAE Paper 2006-01-3627, SAE Motorsports Engineering Conference, Dearborn, MI, October 2006.
- Borchers, A., Doyle, D., El-Sayed, J., Harding, T., **Hoff, C. J.**, Lynch-Caris, T., Redekop, B., “Undergraduate Course in Environmental Design and Manufacturing,” Journal of Manufacturing Systems, Vol. 24, no. 3, 2005.
- Block, C., Carrick, N., Maurer, J., Davis, G., **Hoff, C.J.**, “The Development of a Clean Snowmobile for the 2004 SAE Clean Snowmobile Challenge,” SAE Paper 04SETC-83, SAE Small Engine Technology Conference, Gratz, Austria, September 2004.
- **Hoff, C.J.** and Yang, W.J., “Distributed Flow Leakage in Viscoelastic Tubes: An Experimental Study,” Journal of Mechanics and Medicine in Biology, Vol. 4, Number 2, June 2004
- Ku, J., Ottenstein, L., Kaya, T., Rogers, P., and **Hoff, C.J.**, “Testing of A Loop Heat Pipe Subjected to Variable Accelerations, Part 1: Start-up,” 30th SAE International Conference on Environmental Systems, SAE 2000-01-2488, Toulouse, France.
- Ku, J., Ottenstein, L., Kaya, T., Rogers, P., and **Hoff, C.J.**, “Testing of A Loop Heat Pipe Subjected to Variable Accelerations, Part 2: Temperature Stability,” 30th SAE International Conference on Environmental Systems, SAE 2000-01-2489, 2000, Toulouse, France.
- Rogers, P., Ku, J., and **Hoff, C.J.**, “Suitability of Loop Heat Pipes for Thermal Management of Ground Vehicles,” IMechE Paper No. C543-41, 4th SAE Vehicle Thermal Management Conference, London, May 1999.
- Davis, G.W., and **Hoff, C.J.**, “The Development of an Electro-Hydraulically Controlled, Five-Speed Transmission for a Hybrid Electric Vehicle,” SAE Transactions – Journal of Passenger Cars, 1998.
- Davis, G.W., and **Hoff, C.J.**, “The Development of an Electro-Hydraulically Controlled, Five-Speed Transmission for a Hybrid Electric Vehicle,” SAE-980830, 1998.
- **Hoff, C.J.** and Yang, W.J., “A Review of Pulse Propagation in Viscoelastic Arteries with Distributed Flow Leakage,” Bio-Medical Materials and Engineering, 4:419-437; 1994.

SAE Special Publications

- Steketee, R., Osborne, T., Michelini, J., **Hoff, C.**, Atwater, P., Grabowski, T., Brown, R., Brancik, B., Mase, B., Chu, B., “Design and Development of a Parallel Hybrid Electric Vehicle for the 1998 FutureCar Challenge,” SAE Special Publication 1452, 1999.
- Swan, J., Spravsow, J., Davis, G., Brancik, G., Beattie, E., Dombrowski, J., Settle, B., Day, R., Kornosky, P., Okubo, F., Silas, R., Johnson, R., **Hoff, C.J.**, “Design and Development of Hyades, a Parallel Hybrid Electric Vehicle for the 1997 FutureCar Challenge,” SAE Special Publication 1359, 1998.

Reviewed Conference Proceedings

- **Hoff, C.J.**, Aurandt, J., O’Toole, M.R., Davis, G.W., Nartker, S., “Motivating Student Learning Using Biofuel-based Activities,” ASEE Conference Proceedings, Atlanta, GA, June 2013
- Hoff, K.L., **Hoff, C.J.**, and Davis, G.W., “A Peer-Tutor’s Perspective on Peer-Tutoring in Thermodynamics,” ASEE Annual Conference, San Antonio, TX, June 2012.
- Davis, G.W., and **Hoff, C.J.**, “Incorporating Entrepreneurship into Mechanical Engineering Automotive Courses: Two Case Studies,” ASEE Annual Conference, Vancouver, BC, June 2011.
- Thompson, M.G., **Hoff, C.J.**, Gover, J., Taylor, A.R., Pomeroy, M.R., and Bai, K.H., “HEV Green Mobility Laboratory,” ASEE Paper AC 2011-1013, Society for Engineering Education Annual Conference, Vancouver, BC, June 2011. **Nominated for best conference paper.
- Davis, M.G., **Hoff, C.J.**, and Riffe, W.J., “Incorporating Entrepreneurship into Mechanical Engineering Automotive Courses: Two Cased Studies,” ASEE Paper AC 2011-2443, Society for Engineering Education Annual Conference, Vancouver, BC, June 2011.
- **Hoff, C.J.** and Davis, G.W., “Using Professional Engineering Standards as a Resource for Improving Undergraduate Education,” 8th ASEE Global Colloquium on Engineering Education, Budapest, Hungary, October 2009.
- **Hoff, C.J.** and Davis, G.W., “Promoting Professional Development in Undergraduate Engineering Using Laboratory Team Projects: A Case Study,” 7th ASEE Global Colloquium on Engineering Education, Cape Town, South Africa, October 2008.
- **Hoff, C.J.** and Davis, G.W., “Promoting Professional Development in Undergraduate Engineering Using Laboratory Team Projects: A Case Study,” ASEE Annual Conference, Pittsburgh, PA, June 2008.
- Lemke, B. and **Hoff, C.J.**, “Fuel Cell Education at the College Level,” Fuel Cell Magazine Conference and Expo, Long Beach, CA, May 2008.
- Davis, G.W., Hoff, C.J., “Using the SAE Collegiate Design Series to Provide Research Opportunities for Undergraduates,” ASEE Annual Conference, Honolulu, HI, June 2007.
- Lovria, N., **Hoff, C.J.**, “Utilizing a Fuel Cell to Extend the Range of a Global Electric Motorcar,” Fuel Cell Seminar, Honolulu, HI, November 2006.

- **Hoff, C.J.** and Davis, G.W., “Using the SAE Collegiate Design Series to Provide Hands-on Team Project Experience for Undergraduates,” ASEE Annual Conference, Chicago, IL, June 2006.
- Lynch-Caris, T.M., Harding, T., Borchers, A., Redekop, B., El-Sayed, J., **Hoff, C.J.**, “Creating A Multi-Disciplinary Course With Industrial Input,” American Society of Engineering Education, Conference Proceedings, Chicago, IL, June 2006.
- **Hoff, C.J.** and Davis, G.W., “The Integration of Hands-on Team Projects into an Engineering Course to Help Students Make the Transition from Student to Professional Engineer,” ASEE Annual Conference, Portland, OR, 2005-2130, June 2005.
- Borchers, A., Harding, T., Lynch-Caris, Redekop, B., **Hoff, C.J.**, El-Sayed, J., and Doyle, D., “Undergraduate Course in Environmental Design and Manufacturing,” SME Innovations in Manufacturing Engineering Education Conference, San Luis Obispo, CA, June 2005.
- Van Tiem, R., **Hoff, C.J.**, Berry, K.J., “Modeling of a Fuel Cell Hybrid Vehicle,” ASME Annual Fuel Cell Conference, Ypsilanti, MI, May 2005.
- White, C.V., Dippery, R.E., and **Hoff, C.J.**, “Using Failure Analysis as a Capstone Design Tool,” Integrating Practice into Engineering Education Conference, University of Michigan – Dearborn, October 2004.
- **Hoff, C.J.**, Slagle, T., Lo, A., Zang, P., “Early Introduction of CAE Tools Enhances Success in Student Design Competitions,” ASEE/IEEE Frontiers in Education Conference, Savannah, GA, October 2004.
- Anzieck, J., Berry, K.J., **Hoff, C.J.**, et al., “Fuel Cell Hybrid Vehicle Development at Kettering University,” Electrical Manufacturing and Coil Winding Association: Electrical Manufacturing Expo 2004 Conference, September 2004.
- Waldron, W.K., Echempati, R., **Hoff, C.J.**, and Zang, P., “Learning Module for using Dynaform to Study the Effects of Die-Entry and Punch-Nose Radii on Drawing Cups,” 8th International LS-DYNA Users Conference, May 2004.
- **Hoff, C.J.**, Dippery, R.E., Knapp, J., “Stress Evaluation of a Bicycle Crank Arm Connection Using BEM,” 15th International Conference on Boundary Element Technology, Detroit, MI, 2003.
- Dippery, R.E., **Hoff, C.J.**, White, C.V., “Failure Analysis of a Structural Weld Using BEM,” 15th International Conference Boundary Element Technology, Detroit, MI, 2003 (Invited Paper).
- White, C.V., Dippery, R.E., and **Hoff, C.J.**, “Failure Analysis as a Design Tool for Non-Material Engineers,” ASM Materials Solutions 2003, Pittsburgh, PA, October 2003.
- **Hoff, C.J.** and Rogers, P.D., “Correlation of a Sinda/Fluint Model for a Switchbox Loop Heat Pipe,” ASME Paper No. NHTC2000-12160, National Heat Transfer Conference, Pittsburgh, PA, July 2000.
- Davis, G.W., **Hoff, C.J.**, “Evaluation of an Electro-Hydraulically Controlled, Manual Transmission for a Hybrid Electric Vehicle,” 33rd Intersociety Energy Conversion Engineering Conference, 1999.
- Davis, G.W., **Hoff, C.J.**, “Evaluation of an Electro-Hydraulically Controlled, Manual Transmission for a Hybrid Electric Vehicle,” Global Powertrain Congress, Detroit, MI, 1998.

- **Hoff, C.J.**, Brancik, N., Michelini, J., Grabowski, A., Madar, G., "Design and Development of Lawrence Technological University's Parallel Hybrid Electric Vehicle for the 1998 FutureCar Challenge," 17th Congress of the World Energy Council, Houston, TX, 1998.
- **Hoff, C.J.** and Yang, W.J., "Distributed Flow Leakage in Viscoelastic Tubes: An Experimental Study," 10th International Conference on Mechanics in Medicine and Biology, Honolulu, HI, 1998.
- Anneberg, L., **Hoff, C.J.**, Yaprak, E., "Use of AutoCad in an Electrical Engineering Curriculum," ASEE Annual Conference and Exposition, Milwaukee, WI, 1997.
- Hideg, L., **Hoff, C.J.**, Crist, J., Mioduszewski, D., Sverdlik, W., "Summer Science Institute," Proceeding: Engineering and Technology Education for the Future, ASEE North Central Section Spring Conference, 1996.
- **Hoff, C.J.** and Yang, W.J., "An In-Vitro Study of Distributed Flow Leakage on Pulse Propagation in the Aorta," Second World Congress of Biomechanics, Amsterdam, the Netherlands, 1994.
- **Hoff, C.J.** and Yang, W.J., "A Transmission Line Model For Pressure and Flow Waves in Viscoelastic Arteries with Distributed Leakage," Second World Congress of Biomechanics, Amsterdam, the Netherlands, 1994.
- **Hoff, C.J.**, Yang, W.J., "A Transmission Line Model for Pressure and Flow Waves in Viscoelastic Arteries with Distributed Flow Leakage," in Topics on Biomathematics, World Scientific, 1992.

Other Technical Publications

- Davis, G.W., **Hoff, C.J.**, Borton, Z., and Ratcliff, M.A., "Legacy Vehicle Fuel System Testing with Intermediate Ethanol Blends," Technical Report, NREL/TP-5400-53606, March 2012.
- Stein, J.A. and **Hoff, C.J.**, "Safe at the Pump?" Hagerty's, Volume 4, Issue 3, Fall 2009.
- **Hoff, C.J.**, "Final Report: Hydrogen Hybrid Internal Combustion Engine (H2ICE) Data Acquisition Equipment," US Army TARDEC, DESPII Contractual Engineering Task (CET), Contract No. FA8222-05-D-0001-0029, June 2009.
- Stein, J.A., and **Hoff, C.J.**, "Ethanol: Demonic or Devine. Is E10 an enemy of your collector car fuel system?" Hagerty's, Volume 4, Issue 1, Spring 2009.
- Lynch-Caris, T.M., Harding, T., Borchers, A., Redekop, B., El-Sayed, J., **Hoff, C.J.**, "Final Report: Development of a Course on Environmentally Benign Design and Manufacturing," National Science Foundation, DUE #0511322, December 2008.
- **Hoff, C.J.**, and Kane, J., "Final Report: Conversion and Testing of a Fuel-cell Powered Harlan Tow Tractor," US Army TARDEC, Department of Defense Report, June 2008.
- **Hoff, C.J.**, "Final Report: Testing and Modeling of the Baseline Harlan HTH Tow Tractor," US Army TARDEC, Department of Defense Report, March 2008.
- Lynch-Caris, T., and **Hoff, C.J.**, "Final Report: Innovative Emulsion Recycling Technology for the Metal Working Process," Michigan Pollution Prevention Research Grant Program, October 2007.
- **Hoff, C.J.** and Davis, G.W., "Introduction to Automotive Powertrains," Self-published 2003.

- **Hoff, C.J.**, "Final Report: Evaluation of Capillary Pump Loops for Electronics Thermal Management in Combat Vehicles," Battelle Scientific Services Program, Contract No. DAAHO4-96-C-0086 TCN 98-012, February 2000.
- Frasch, L.G. and **Hoff, C.J.**, "Evaluation of the State-of-the-Art in Vehicle HVAC Systems for Application of Combat Vehicles," U.S. Army TACOM, February 2000.
- **Hoff, C.J.**, Rogers, P., "Two-Phase Heat Transfer Devices for Electronics Cooling," U.S. Army TARDEC Advanced Technology Assessment Report, 1999.
- **Hoff, C.J.**, "Thermal Control Techniques for Electronics Equipment," Internal Report: U.S. Army Tank and Automotive Command, Warren, MI, 1997.
- **Hoff, C.J.**, "Thermal Modeling Software for Electronics," Internal Report: U.S. Army Tank and Automotive Command, Warren, MI, 1997.
- **Hoff, C.J.**, "Engineering Computer Applications Laboratory User Manual," Lawrence Technological University, 1996.
- **Hoff, C.J.**, "The Effects of Distributed Leakage on Pulse Propagation in Viscoelastic Arteries," Doctoral Presentation, University of Michigan, Ann Arbor, MI 1992.
- **Hoff, C.J.**, "An Analytical and Numerical Study of the Thermodilution Method of Measuring Cardiac Output," Master Thesis, Michigan State University, East Lansing, MI 1981

PRESENTATIONS

Invited Talks

- **American Petroleum Institute: Mid-Level Ethanol Blends Research Coordination Group Meeting**, "The Effect of Ethanol-blended Gasoline on the Fuel Delivery Systems in Classic Automobiles," October 2010.
- **SAE India**, TOPEC: Powertrain Selection for Acceleration and Fuel Economy, Chennai, India, October, 2005.

Conference Presentations

- Hoff, K.L., **Hoff, C.J.**, and Davis, G.W., "A Peer-Tutor's Perspective on Peer-Tutoring in Thermodynamics," ASEE Annual Conference, San Antonio, TX, June 2012.
- Davis, G.W., and **Hoff, C.J.**, "Incorporating Entrepreneurship into Mechanical Engineering Automotive Courses: Two Case Studies," ASEE Annual Conference, Vancouver, BC, June 2011.
- **Hoff, C. J.** and Davis, G. W., "Using Professional Engineering Standards as a Resource for Improving Undergraduate Education," 8th ASEE Global Colloquium on Engineering Education, Budapest, Hungary, October 2009.
- **Hoff, C. J.** and Davis, G. W., "Promoting Professional Development in Undergraduate Engineering Using Laboratory Team Projects: A Case Study," 7th ASEE Global Colloquium on Engineering Education, Cape Town, South Africa, October 2008.
- **Hoff, C. J.** and Davis, G. W., "Promoting Professional Development in Undergraduate Engineering Using Laboratory Team Projects: A Case Study," ASEE Annual Conference, Pittsburgh, PA, June 2008.

- Lemke, B. and **Hoff, C. J.**, “Fuel Cell Education at the College Level,” Fuel Cell Magazine Conference and Expo, Long Beach, CA, May 2008.
- Lovria, N., **Hoff, C. J.**, “Utilizing a Fuel Cell to Extend the Range of a Global Electric Motorcar,” Fuel Cell Seminar, Honolulu, HI, November 2006.
- **Hoff, C. J.** and Davis, G.W., “Using the SAE Collegiate Design Series to Provide Hands-on Team Project Experience for Undergraduates,” ASEE Annual Conference, Chicago, IL, June 2006.
- **Hoff, C. J.** and Davis, G.W., “The Integration of Hands-on Team Projects into an Engineering Course to Help Students Make the Transition from Student to Professional Engineer,” ASEE Annual Conference, Portland, OR, 2005-2130, June 2005.
- Van Tiem, R., **Hoff, C.J.**, Berry, K.J., “Modeling of a Fuel Cell Hybrid Vehicle, ASME Annual Fuel Cell Conference, Ypsilanti, MI, May 2005.
- **Hoff, C.J.**, “Using CAE Tools for University SAE Vehicle Competitions,” PLM World Annual Users Conference, Dallas, TX, May 2005.
- **Hoff, C.J.**, “MECH545 Hybrid Vehicle Propulsion,” NextEnergy Alternative Energy Curriculum Implementation Workshop, November 2004.
- White, C.V., Dippery, R.E., and **Hoff, C.J.**, “Using Failure Analysis as a Capstone Design Tool,” Integrating Practice into Engineering Education Conference, University of Michigan–Dearborn, October 2004.
- **Hoff, C.J.**, Slagle, T., Lo, A., Zang, P., “Early Introduction of CAE Tools Enhances Success in Student Design Competitions,” ASEE/IEEE Frontiers in Education Conference, Savannah, GA, October 2004.
- Block, C., Carrick, N., Maurer, J., Davis, G., **Hoff, C.J.**, “The Development of a Clean Snowmobile for the 2004 SAE Clean Snowmobile Challenge,” SAE Paper 04SETC-83, SAE Small Engine Technology Conference, Gratz, Austria, September 2004.
- Anzieck, J., Berry, K.J., **Hoff, C.J.**, et al., “Fuel Cell Hybrid Vehicle Development at Kettering University,” Electrical Manufacturing and Coil Winding Association: Electrical Manufacturing Expo 2004 Conference, September 2004.
- Waldron, W.K., Echempati, R., **Hoff, C.J.**, and Zang, P., “Learning Module for using Dynaform to Study the Effects of Die-Entry and Punch-Nose Radii on Drawing Cups,” 8th International LS-DYNA Users Conference, May 2004.
- **Hoff, C.J.**, Dippery, R.E., Knapp, J., “Stress Evaluation of a Bicycle Crank Arm Connection Using BEM,” 15th International Conference on Boundary Element Technology, Detroit, MI, 2003.
- **Hoff, C.J.** and Rogers, P.D., “Correlation of a Sinda/Fluint Model for a Switchbox Loop Heat Pipe,” ASME Paper No. NHTC2000-12160, National Heat Transfer Conference, Pittsburgh, PA, July 2000.
- Rogers, P.D., Ku, J., **Hoff, C.J.**, and Nelson, D., “Evaluation of Loop Heat Pipe Technology for Vehicle Thermal Management,” U.S. Army TACOM, FY99 In-house Laboratory Innovation Research, Review, January, 2000.
- Rogers, P., Ku, J., **Hoff, C.J.**, and Nelson, D., “Loop Heat Pipe Technology,” U.S. Department of Energy Workshop on Thermal Management for Heavy Vehicles (Class 7-8 Trucks), October 1999.

- Rogers, P. and **Hoff, C.J.**, "Electronics Thermal Management in Ground Combat Vehicles," NASA Two Phase Technology '99 Workshop, Greenbelt, MD, May 1999.
- Davis, G.W., **Hoff, C.J.**, "Evaluation of an Electro-Hydraulically Controlled, Manual Transmission for a Hybrid Electric Vehicle," Global Powertrain Congress, Detroit, MI, October 1998.
- Davis, G.W., Hoff, C.J., "The Design of an Electro-Hydraulically Controlled, Manual Transmission for a Hybrid Electric Vehicle," 33rd Intersociety Energy Conversion Engineering Conference, Colorado Springs, CO, August 1998.
- Davis, G.W., **Hoff, C.J.**, "Evaluation of an Electro-Hydraulically Controlled, Manual Transmission for a Hybrid Electric Vehicle," 1998 SAE International Congress and Exposition, February, 1998.
- **Hoff, C.J.** and Yang, W.J., "Distributed Flow Leakage in Viscoelastic Tubes: An Experimental Study," 10th International Conference on Mechanics in Medicine and Biology, Honolulu, HI, 1998.
- **Hoff, C.J.**, Davis, G., Anneberg, L., "Technology Transfer from Industry to Academia through Student Competition Projects," ASEE Annual Conference and Exposition, Milwaukee, WI, 1997.
- **Hoff, C.J.** and Yang, W.J., "An In-Vitro Study of Distributed Flow Leakage on Pulse Propagation in the Aorta," Second World Congress of Biomechanics, Amsterdam, the Netherlands, 1994.

Workshops

- Creating a Multi-Disciplinary Course in Environmentally Conscious Design and Manufacturing Workshop, ASEE Annual Conference, Pittsburgh, PA, (June 2008).

Other Technical Presentations

- Hoff, C.J., and Davis, G.W., "Kettering University/Anuvu Corporation – Potential Strategic Partnership, at Anuvu Corporation, Sacramento, CA (2003).
- Hoff, C.J., "Solar Powered Cars," Grand Blanc Middle School, (2000).
- TV Interviews/Newspaper/Newsletters: Regularly interviewed as a technical expert on automotive and energy technology.

Campus Presentations

- "CAE Tool Use by Kettering Formula SAE Team," Invited Presentation to Kettering University Mechanical Engineering Industrial Advisory Board, (November 2004).
- "CAE Tools in Automotive Engineering," Presentation to High School and Community College Counselors for KU Admissions Department, (October 2004).
- "Hybrid Electric Vehicles," Invited Speaker, Kettering University Tau Beta Pi Initiation Banquet, (May 2000).
- "Distributed Flow Leak in Viscoelastic Tubes: An Experimental Study," Presented to the Faculty of the Mechanical Engineering Department, (February 1999).

FUNDING

External Grants

- **U.S. Department of Energy**, Co-PI: "Legacy Vehicle Fuel System Testing with Intermediate Ethanol Fuel Blends." Testing fuel system compatibility to E17 with mid-1990 vintage vehicles, with Dr. Gregory Davis (ME) (\$125,000, 2010-2011).
- **U.S. Department of Energy**, Co-PI: "Development of a Green Mobility Laboratory." Designed and built three electric vehicle simulation stations consisting of a 15 kW electric motor, a DC power supply, Infineon inverter, Yokagawa power analyzer and eddy current dynamometer, with Dr. Jim Gover (EE) and Dr. Mark Thompson (EE) (\$500,000, 2010-2011).
- **PAICE, LLC**, Bonita Springs, FL, Co-PI: "Analytical and Simulation Study of Advantages of High Voltage (≥ 600 V) versus Low Voltage (≤ 300 V) Hybrid System Operation," with Dr. Mark Thompson (EE) and Dr. Jim Gover (EE) (\$40,000, 2010).
- **Society of Automotive Engineers Formula SAE Rules Committee** –Conducted a series of impact tests to ensure the safety of student-built Formula SAE vehicle. To date the work has resulted in 6 rule changes to improve safety. (unfunded, 2006 – 2009)
- **Hagerty Insurance Company**, Traverse City, MI, Co-PI: "Effect of Low-Blend Ethanol and the Fuel Systems of Classic Cars." Tested fuel system compatibility to E10 in pre-1970 vehicles, with Dr. Gregory Davis (\$50,000, 2008-2009).
- **Michigan Department of Environmental Quality/Crystal Filtration**, Co-PI: "Innovative Emulsion Recycling Technology for the Metal Working Process." Evaluated process for removing metal shavings from lubricant in stamping plant, with Dr. Terri Lynch-Caris (IME) (\$50,000, 2007).
- **National Science Foundation**, Washington, DC, Co: PI: "Development of a Course on Environmentally Benign Design and Manufacturing," DUE #0511322, with Dr. Terri Lynch-Caris (IME), Dr. Andy Borchers (BUS), Dr. Jenifer Aurandt (CHEM), Dr. Ben Redekop (LS), and Dr. Jackie El-Sayed (ME) (\$300,000, 2006-2008).
- **NextEnergy Corporation**, Detroit, MI. PI: Development of a chassis dynamometer to support a Hybrid Electric Vehicle Course (\$88,000, 2005).
- **Partners for the Advancement of Collaborative Engineering Education (PACE)**, Warren, MI. PI: Development of a Fluent tutorial for designing induction systems for Formula SAE vehicles (\$10,000, 2005).
- **NextEnergy Corporation**, Detroit, MI Co-PI: "Development of a fuel cell curriculum," with Dr. K. Joel Berry (ME), Dr. Etim Ubong (ME) (\$100,000, 2004).
- **U.S. Army Tank and Automotive Command (TACOM)**, Warren, MI Co-PI: Worked with a team from Kettering University to develop a fuel-cell hybrid system for a GEM electric vehicle, with Prof. Brenda Lemke. (\$150,000, 2004)
- **Anuvu Corporation**, Sacramento, PA. PI: Development of fuel cells for automotive applications. (\$10,000, 2003)
- **Magna Mirror Systems**, Grand Rapids, MI. Conducted analysis of quality control issues with respect to MMS's side-view mirror business (\$50,000, October 2001 – June 2002).

- **General Motors EV1 Research Donation Program**, Warren, MI. Donation of a Saturn EV1 (\$40,000 – 2001).
- **U.S. Army Tank and Automotive Command (TACOM)**, Warren, MI. Co-PI: FY2000 In-house Laboratory Innovation Research (ILIR) Grant, “Evaluation of Loop Heat Pipe Technology for Vehicle Thermal Management,” with Paul Rodgers (\$146,100, 2000).
- **U.S. Army Tank and Automotive Command (TACOM)**, Warren, MI. Co-PI: FY1999 In-house Laboratory Innovation Research (ILIR) Grant, “Evaluation of Loop Heat Pipe Technology for Electronics Thermal Management,” with Paul Rodgers (\$216,100, 1998).
- **U.S. Army Tank and Automotive Command (TACOM)**, Warren, MI. Co-PI: FY1998 In-house Laboratory Innovation Research (ILIR) Grant, “Theoretical Evaluation of Capillary Pumped Loops for Electronics Thermal Management,” with Paul Rodgers (\$110,000, 1998).
- **Society of Manufacturing Engineers – Education Foundation**, Dearborn, MI. PI, “Establishing a Design and Manufacturing Integration Center at Lawrence Technological University,” (\$1,000,000 – 1998).
- **U.S. Department of Energy - FutureCar Challenge**, PI: Lead a student team that developed a hybrid electric version of a Ford Taurus, (\$10,000, 1998).
- **U.S. Department of Energy - FutureCar Challenge**, PI: Lead a student team that developed a hybrid electric version of a Ford Taurus, (\$10,000, 1997).

Other External Cash Grants

Year	Project	Grantor/Donor	Amt/Value
2014	SAE Motorsports	GM Foundation	\$30,000
2014	SAE Motorsports	Denso Foundation	\$20,000
2014	SAE Motorsports	Chrysler Foundation	\$6,000
2014	SAE Motorsports	Ford Foundation	\$50,000
2013	SAE Motorsports	GM Foundation	\$30,000
2013	SAE Motorsports	Denso Foundation	\$20,000
2013	SAE Motorsports	GM Foundation	\$30,000
2012	SAE Motorsports	Denso Foundation	\$20,000
2012	AVL Fire Software	AVL	\$50,000
2012	SAE Motorsports	Meritor	\$6,000
2011	SAE Motorsports	GM Foundation	\$30,000
2011	SAE Motorsports	Denso Foundation	\$20,000
2011	AVL Cruise Software	AVL	\$50,000
2010	SAE Motorsports	GM Foundation	\$30,000
2010	SAE Motorsports	Denso Foundation	\$20,000
2009	SAE Motorsports	GM Foundation	\$30,000
2009	SAE Motorsports	Denso Foundation	\$20,000
2008	SAE Formula Car	Denso Foundation	\$20,000
2005	Fluent Tutorial	PACE	\$10,000
2005	SAE Formula Car	American Axle & Manufacturing	\$5,000

Year	Project	Grantor/Donor	Amt/Value
2014	SAE Motorsports	GM Foundation	\$30,000
2014	SAE Motorsports	Denso Foundation	\$20,000
2014	SAE Motorsports	Chrysler Foundation	\$6,000
2014	SAE Motorsports	Ford Foundation	\$50,000
2013	SAE Motorsports	GM Foundation	\$30,000
2013	SAE Motorsports	Denso Foundation	\$20,000
2013	SAE Motorsports	GM Foundation	\$30,000
2012	SAE Motorsports	Denso Foundation	\$20,000
2012	AVL Fire Software	AVL	\$50,000
2012	SAE Motorsports	Meritor	\$6,000
2011	SAE Motorsports	GM Foundation	\$30,000
2011	SAE Motorsports	Denso Foundation	\$20,000
2011	AVL Cruise Software	AVL	\$50,000
2010	SAE Motorsports	GM Foundation	\$30,000
2010	SAE Motorsports	Denso Foundation	\$20,000
2009	SAE Motorsports	GM Foundation	\$30,000
2009	SAE Motorsports	Denso Foundation	\$20,000
2005	SAE Formula Car	National Automotive Test Center	\$1,500
2004	SAE Formula Car	American Axle & Manufacturing	\$15,000
2004	SAE Formula Car	National Automotive Test Center	\$1,000
2003	SAE Formula Car	American Axle & Manufacturing	\$12,000
2002	SAE Formula Car	American Axle & Manufacturing	\$10,000
2001	SAE Formula Car	American Axle & Manufacturing	\$5,000

External Gifts in Kind

Year	Item	Grantor/Donor	Amt/Value
2014	Tooling	Kennametal	\$10,000
2013	Tooling	Kennametal	\$10,000
2012	Tooling	Kennametal	\$10,000
2012	Transmission cutaways	Borg Warner	\$2,000
2008	PSAT Software	Argonne National Lab	\$10,000
2005	Transmission #1	Ford	\$1000
2005	Transmission #2	Ford	\$1000
2005	SAE Formula Car	Various	\$15,000
2004	ADVISOR Software	AVL	\$12,000
2004	CVT Transmission	Jasco	\$2000
2004	SAE Formula Car	Various	\$15,000
2003	Transmissions (3)	BorgWarner	\$1500
2003	Fuel Cell	Anuvu	\$10,000
2004	SAE Formula Car	Various	\$15,000
2003	SAE Formula Car	Various	\$15,000

Year	Item	Grantor/Donor	Amt/Value
2002	Transmission Cut-away	Federal Mogul	\$10,000
2002	GT Power Software	Gamma Technologies	\$10,000
2002	SAE Formula Car	Various	\$23,200
2002	SAE Formula Car–Cash	American Axle & Mfg	\$10,000
2001	Cruise Software	AVL	\$10,000
2001	SAE Formula Car	Various	\$18,000
1998	Coordinate Measuring Machine and metrology equip.	Mitutoyo	\$48,000
1998	Programmable Controllers	Siemmen Electric	\$15,000
1997	Ford Taurus	Ford Motor Company	\$22,000
1997	VW Jettas (3) for FutureCar	Volkswagen of America	\$54,000
1997	Personal Computers (20)	Ford Motor Company	\$10,000
1996	Horiba Chasis Dynamometer (1)	General Motors Corp.	\$200,000
1996	Autocad Mechanical Desktop (2)	Autocad	\$6,000
1996	SGI Workstations (5)	Chrysler	\$10,000
1995	DaDisp Software	DaDisp	\$10,000
1995	Aries Software	SME Foundation	\$75,000
1994	MasterCam Software	SME Foundation	\$10,000
1993	Apollo Workstations (8)	Easi Engineering	\$10,000

Internal Grants

- **LTU Internal Grant – FutureCar Challenge**, PI: Led student team that developed a hybrid electric version of a Ford Taurus. (\$50,000, 1998)
- **LTU Internal Grant – FutureCar Challenge**, PI: Led student team that developed a hybrid electric version of a Ford Taurus. (\$10,000, 1997)

Proposals – Unfunded

- **U.S. Department of Energy, EcoCAR 2 Competition**, Co-PI with Dr. Mark Thompson. (165,000, 2011)
- **Nation Science Foundation, DUE–CCLI–Adaptation and Implementation Program**, Co-PI, “Development of a Course in Environmentally Conscious Design and Manufacturing for Undergraduates–Part 2,” (\$500,000, 2009).
- **National Science Foundation, EEC–Partnerships for Innovation Program**, Co-PI, “Partnership for Hybrid Energy Systems Innovations, Research and Commercialization,” (\$600,000, 2005).
- **Department of Education - FIPSE Program**, Co-PI, “Use of FM Sound-Field Systems for Improved Knowledge Transfer and as an Intervention Toward ADA Compliance,” (\$534,183 – 2005).
- **Department of Defense**, Co-PI, “Hybrid Propulsion Systems for Undersea Weapons Technical Proposal,” N054-024-0219 (2005).

- **Partners for the Advancement of Collaborative Engineering Education (PACE)**, Warren, MI. PI, "Development of a MSC.ADAMS for FSAE Teams," (\$10,000, 2005).
- **National Science Foundation – EEC Engineering Education**, PI, "Fear Factors: Overcoming Obstacles to the Integration of Product Design and Realization Tools into the Mechanical Engineering Curriculum, (\$100,000 – 2004).
- **Partners for the Advancement of Collaborative Engineering Education (PACE)**, Warren, MI. PI, "Computers for FSAE Teams," (\$20,000, 2004).
- **Partners for the Advancement of Collaborative Engineering Education (PACE)**, Warren, MI. PI, "Development of CAE Toolkits," (\$15,000, 2004).
- **National Science Foundation – EIA – ITR Medium (Group) Grant**, Co-PI, "ITR Collaborative Proposal: A Distributed Vehicle Open System Architecture," (\$1,428,170 – 2003).
- **Kettering University Research Initiation/Improvement Grant Program**, PI, "Development of a Fog Detection System," (\$6960 – 2001).
- **Kettering University Research Initiation/Improvement Grant Program**, PI, "A Mobile Climate Control/Engine Cooling Laboratory," (\$14,861 – 2000).
- **National Science Foundation – DUE – ILI-IP**, PI, "Automotive Sensor and Measurement Laboratory," (\$88,400 – 1997).

PROFESSIONAL SOCIETY MEMBERSHIP

- American Society of Engineering Educators (ASEE)
- American Society of Mechanical Engineers (ASME)
- Society of Automotive Engineers (SAE)

PROFESSIONAL SERVICE

Review Committees

- External Reviewer, Graduate Program in Automotive Systems Engineering, University of Michigan Dearborn (2012).
- External Reviewer, Graduate Program in Manufacturing Systems Engineering, University of Michigan Dearborn (2012).

Society Committees

- Chair, SAE International – Scholarship Committee (2002 - 2008)
- Member, SAE International – Scholarship Committee (2000 – present)
- Member, SAE International – Engineering Education Board (2002 – present)
- Member, SAE International – FSAE Rules Committee (2004 – present)
- Member, SAE International – Faculty Advisors Committee (2000 – present)
- Member, SAE International – FSAE Education Committee (2004 – present)
- Member, SAE International – Powertrain Certificate Advisory Panel (2003)
- Member, SAE International/Kettering University Partnership (2003 – present)
- Member, NextEnergy Alternative Energy Education Board (2004 – present)
- Director of Industrial Representatives, SAE Detroit Section (1997-1999)

Conference Organization

- Organizer and Chair, SAE International Congress Engineering Education Session (2006-2010)
- Organizer and Co-Chair (w/Barb Mizdail, Penn State), SAE International Congress Engineering Education Session (2005)
- Organizer, ASME Power, Transmission and Gearing Technical Meeting, Chicago, IL (2003)
- Session Chair, 15th International Conference Boundary Element Technology, Detroit, MI, (2003)
- Organizer, and Proceedings Editor, 11th International Conference on Mechanics in Medicine and Biology. Kettering University was a sponsoring organization. (Maui, 2000)
- Organizer and Session Chair, 10th International Conference on Mechanics in Medicine and Biology. University of Michigan was a sponsoring organization. (Honolulu, 1998)

Publications Reviewed

- Executive Editor, Advances in Automotive Engineering Journal (2012 – present)
- Member, Editorial Advisory Board for Journal of Mechanics in Medicine and Biology (2002 – present)
- SAE – Regularly review conference papers (2000 – present)
- ASEE Frontiers in Education (2004) – Reviewed several papers.
- United Kingdom – Natural Environment Research Council: Research Grant Assessment, “From Technology to Market: Accelerating the Introduction of Fuel Cells Through Increasing Returns. (2004)
- American Society of Mechanical Engineers - International Gas Turbine Institute – Reviewed: “Trends in Engine Bearing Design and Bearing Material Development under Consideration of Environmental Protection,” (2003).
- ASME Power, Transmission and Gearing Technical Committee (2003) reviewed 10 papers.
- Introduction to Fluid Mechanics, 6th Edition, R. Fox and A. McDonald, John Wiley & Sons, New York, (1998).
- U.S. Army TACOM, “Advanced Conversion Technology Review Panel Report,” (1997).
- ASME-IGTI Turbo Asia Conference, “A Practical Method for Predicting Windmilling Characteristics of Simple Turbo Jet Engine,” (1996).

Other Professional Service

- Design Judge, SAE MiniBaja 100 Competition (Tuscon, 2005)
- National Defense Science and Engineering Graduate Fellowship Program (Research Triangle Park, NC, 1999).

UNIVERSITY SERVICE

Kettering University – Committees

- Provost Search Committee (2013-14)
- Member, Entrepreneurship Across the Curriculum Committee (2009 – Current)

- Member, Kettering Industrial Ecology Team (2004 – Current)
- Member, University Promotion Tenure and Ethics Committee (2008 – Current)
- Member, University Promotion and Tenure Committee (2007 – 2009)
- Chair, ME Department Promotion and Tenure Committee (2008 – 2009)
- Vice-Chair, ME Department Promotion and Tenure Committee (2007 – 2008)
- Chair, Recruitment, Admission and Retention (RADAR) Committee (1999 – 2004)
- Chair, Academic Review Committee (1999 – 2004)
- Member, Faculty Senate (2005 – 2008)
- Member, University Strategic Planning Committee – Teaching & Learning (2002)
- Member, University Honorary Degree Committee (2003 – present)
- Member, University President’s Medal Committee (2003 – present)

Kettering University – Other

- Advisor, Kettering University’s Formula SAE Team
- Co-Advisor, Kettering University’s SAE Student Section (w/Dr. Greg Davis)
- Presentations to alumni at Detroit Athletic Club during SAE Congress (Annually)
- Presentations of SAE Motorsports vehicles for Board of Trustees picnic (Annually)
- Organized SAE Motorsports vehicle presentations for Discover Kettering (Annually)
- Organized SAE Motorsports vehicle presentations for SAE Foundation Banquet (Annually)
- Organized SAE Motorsports vehicle presentations for SAE Congress (Annually)
- Parent Night for Admissions
- Presentations to community college counselors
- Presentations to M.E. Industrial Advisory Board

Lawrence Technological University

- Chair, Engineering Faculty Council (1993 – 1995)
- Chair, Promotion and Tenure Committee (1991 – 1992)
- Vice Chair, Engineering Faculty Council (1992 – 1993)
- Member, Computer Lab Directors Committee (1991–1999)
- Member, Master Automotive Engineering Admissions Committee (1995 – 1999)
- Member, Teaching Learning Technology Roundtable (1997 – 1999)
- Member, Capital Campaign Committee (1997 – 1999)
- Member, Dean Search Committee (1994 – 1996)
- Member, Promotion and Tenure Committee (1989 – 1991)

DEPARTMENTAL SERVICE

Kettering University - Committees

- Provost’s Council (2012 – present)
- Chair, Mechanical Engineering Automotive Group (2005 – 2012)
- Representative to Faculty Senate (2005 – present)
- Member, Mechanical Engineering Assessment Team (1999 – present)
- Member, Mechanical Engineering Transfer Credit Team (2001 – present)

- Member, Mechanical Engineering Energy Systems Group (1999 – present)
- Member, Fuel Cell Educational & Research groups (2004 – present)
- Chair, Mechanical Engineering Department Promotion and Tenure Committee (2008-2009)
- Vice-Chair, Mechanical Engineering Department Promotion and Tenure Committee (2007-2008)
- Member, Mechanical Engineering Graduate Committee (2001 – 2004)
- Member, Mechanical Engineering Curriculum Reform Committee (1999-2001)
- Member, Mechanical Engineering Curriculum Committee (2001-2004)
- Member, Mechanical Engineering Strategic Planning Committee (2002)

Lawrence Technological University

- Chair, Mechanical Engineering (1995-1999)
- Advisor, Pi Tau Sigma Honor Society (1982 – 1999)
- Advisor, Formula SAE Team (1983 – 1986)
- M.E. Representative, Engineering Faculty Council (1990 – 1992)
- Member, Master Automotive Engineering Admissions Committee (1995 – 1999)
- Member, Teaching Learning Technology Roundtable (1997 – 1999)

COMMUNITY SERVICE

- **Precinct Observer, LWV of the Flint Area**, Flint, Michigan. Volunteered to serve as a precinct observer to act as a presence to help ensure fair access to voting; also gathered data to be used in election reform. (2012, 2014)
- **Future City Mentor, Grand Blanc Middle School**. Advised 7th-8th graders on the engineering aspects of their Future City Project. Placed 2nd in Michigan region in 2002, 3rd in 2003, and 3rd in 2004. (2001 - 2004)
- **District Technology Steering Committee, Livonia Public Schools**. Advised the district on how to carry out a \$60 million bond improvement program to implement computer usage in the K-12 curriculum (1993 - 1999)
- Frequent speaker to School groups on “Mechanical Engineering as a Profession.” (1995 – 1999)
- **DAPCEP**, Outreach program for inner-city teenagers. Taught a program on “Computers in Engineering.” (1991 - 1995)
- **Girl Scouts of America**, Michigan Metro Council & Fair Winds Council program assistant and camp first-aider. (1988 - 2004)
- **Olympics of the Mind Mentor, Clarkston Public Schools**, Acted as advisor for 5/6th grade students. (1984 -1986)

HONORS AND AWARDS

- Carroll Smith Mentor's Cup, Sports Car Club of American (2015)
- Outstanding Educational Scholar, Kettering University Center for Education, Teaching and Learning (2007).
- SAE Forest R. McFarland Award – For outstanding contributions in the planning, development, and dissemination of technical information.
- Nominee, Kettering University Tau Beta Pi Teacher of the Year (2004)
- SAE Ralph R. Teetor Award (2002) – In recognition of significant contribution to teaching, research and student development in automotive engineering
- Tau Beta Pi (1991) - National Engineering Honor Fraternity, Gamma of Michigan Chapter
- Teacher of the Year (1984) - LTU Chapter of Michigan Society of Professional Engineers
- Pi Tau Sigma (1979) - National Mechanical Engineering Honor Fraternity, Tau Epsilon Chapter
- Michigan State University (1976-1979) - Community College Transfer Scholarship

COURSES TAUGHT

Kettering University

- Introduction to Engineering (ENG100)
- Statics (MECH210)
- Mechanics of Materials (MECH212)
- Design of Machine Elements (MECH312)
- Thermodynamics (MECH 320)
- Fluid Mechanics (MECH 322)
- Heat Transfer (MECH 420)
- Energy Systems Laboratory (MECH422)
- Automotive Capstone Design Project (MECH 448)
- Introduction to Automotive Powertrains (MECH544)
- Hybrid Electric Vehicle Propulsion (MECH545)
- Independent Study (MECH599)
- Automotive HVAC & Engine Cooling (MECH6xx)
- Environmentally Benign Design and Manufacturing (IME540)

Lawrence Technological University

- Introduction to Electrical Circuits
- Engineering Cost Analysis
- Engineering Design Graphics
- Manufacturing Processes
- Engineering Computer Applications Lab
- Computer Aided Engineering
- Statics

- Dynamics
- Mechanics of Materials
- Mechanics of Materials Lab
- Design of Machine Elements
- Kinematics of Machines
- Thermodynamics I
- Thermodynamics II
- Fluid Mechanics
- Heat Transfer
- Thermal Science Lab
- Engineering Solar Systems
- Internal Combustion Engines
- Senior Design Project
- Independent Study

Michigan State University

- Drafting I & II
- Fluid Mechanics Laboratory
- System Dynamics

OTHER ASSIGNED DUTIES

Co-Advisor (w/Greg Davis) SAE Student Section,

- Provided supervision and leadership for the activities of the student members
- Helped to develop the 6500 sq. ft. Student Design Center (a.k.a. the Garage)
- Supported university recruiting activities by organizing tours of the lab

Advisor, Kettering University Formula SAE Team

- Provided supervision and technical advice to a team of students designing and building a small open-wheel race car.
- Supervised students while traveling to competitions (Including two trips to compete in England)
- Assisted with funding raising

Course Coordination (Current)

- MECH544 Automotive Powertrains (w/Greg Davis)
- MECH545 Hybrid Electric Vehicle Propulsion

Graduate Student – Master Thesis Advising

- Zackery Borton, “Legacy Vehicle Fuel System Testing with Intermediate Ethanol Fuel Blends.” (2011-pending)
- Jason Fahland, “Evaluating Impact Attenuator Performance for a Formula SAE Vehicle” (2010)
- Jason Kane, “Development of a Fuel Cell Tow Tractor” (2009)

- Nick Lovria, "Data Acquisition and Modeling of a Fuel-Cell Equipped GEM Vehicle" (2009)
- Seth Lerner, "Characterization of an ANUVU Fuel Cell Stack" (2008)
- Rob Lillicrap, "Development of a Fuel Cell Test Bench" (2005)

Graduate Student – Master Thesis Committee Member

- Allan Taylor, "Development of a Green Mobility Laboratory," (2011).
- Abdrahamane Traore, "Power Electronics & Controls for a Fuel Cell Hybrid Electric Vehicle," (2010).
- Philip Lundberg, "A Computational Study of Flow Maldistribution and Pressure Drop in Catalytic Converters," (2007).
- Amit Khamkar, "A Numerical study of In-cylinder Mixture Preparation, Combustion and Emissions Using Multiple Injection Points in Diesel Engine," (2007).
- Sumit Kaul, "Effect of Biodiesel Blended Fuels on the Emissions and Performance of an Unmodified Medium Duty Diesel Engine" (2007).
- Arvind Jujare "A Numerical Study of an Automotive Catalytic Converter Internal Flow," (2005).
- Prashant Ahire, "CFD Simulations for the Development of Problem Based Learning Modules in Engineering Thermodynamics," (2005).
- Claude Pilger, "Small Engine Development" (2005).
- Ed Heil, "The Design and Development of a Hydrogen Reformation System," (2003).
- Deepak Sathyanarayana, "External Knee Geometry Surface Variation as a Function of Subject Anthropometry and Flexion Angle for Human and Surrogate Subjects," (2003).
- Yubo Zhang, "Minimum Supplementation to Achieve Acceptable Cold Start Performance in Ethanol Fueled Vehicles," (2002).
- Jason Cartwright, "Design and Development of a Windshield Fog Test Chamber," (2001).
- Sanjay Singh, "Hydrogen Supplemented E85 for Cold Start Improvement," (2000).

PROFESSIONAL DEVELOPMENT

Training

- Mustang Dynamometer operation (2005)
- ISO1705 Laboratory Assessment (2004)
- "A Familiarization of Drivetrain Components," SAE Seminar, Troy, MI (2003)
- BlackBoard User's Training (2002) and continuous self-instruction
- ABET 2000 Workshop at Rose-Hulman University, Terre Haute, IN (1998)

Conferences Attended

- SAE International Congress & Exposition (Annually)
- ASEE Annual Conference, Portland, OR (2005)
- **Invited Speaker**, PLM World Conference, Dallas, TX (2005)
- SAE Small Engine Technology Conference, Gratz, Austria (2004)
- Frontiers in Education, Savannah, GA (2004)

- Electrical Manufacturing and Coil Winding Association: Electrical Manufacturing Expo 2004 Conference, Indianapolis, IN (2004)
- MSC Users Conference, Dearborn, MI (2003)
- 15th International Conference on Boundary Element Technology, Dearborn, MI (2003)
- ASME Power, Transmission and Gearing Technical Meeting, Chicago, IL (2003)
- **Invited Participant**, ABET Colloquy on Laboratory Experiences, San Diego, CA (2002)
- 11th International Conference on Mechanics in Medicine and Biology, Maui, HI (2000)
- ASME National Heat Transfer Conference, Pittsburgh, PA (2000)
- FutureCar Congress, Ypsilanti, MI (1999)
- U.S. Department of Energy Workshop on Thermal Management for Heavy Vehicles (Class 7-8 Trucks), Washington, DC (1999)
- NASA Two Phase Technology '99 Workshop, Greenbelt, MD (1999)
- 10th International Conference on Mechanics in Medicine and Biology, Honolulu, HI (1998)
- Space Technology and Applications International Forum, Institute for Space and Nuclear Power Studies, Albuquerque, NM (1998)
- Engineering Society of Detroit HEV Ride and Drive, Ypsilanti, MI (1998)
- U.S. Representative to World Energy Congress, Houston, TX (1998)
- Global Powertrain Congress, Detroit, MI (1998)
- 9th International Conference on Mechanics in Medicine and Biology and Second World Congress of Biomechanics, Amsterdam, Netherlands (1998)
- **Invited Participant**, Ford Global Dean's Conference, Detroit, MI (1996)
- ASEE Annual Conference, Milwaukee, WI (1997)
- ASEE Annual Conference, Washington, DC (1996)

Computer Software

- Adams – Training (1996)
- Algor – Training (1995)
- Ansys – Training (1995) and continuous self-instruction
- BEASY – Self-instruction (2003)
- CANalyzer – Self-instruction (2004)
- Fortran – Continuous self-instruction
- HyperMesh – Training (1994)
- Labview – Self-instruction and training (2004)
- Mathcad – Continuous self-instruction
- Matlab/SIMULINK – Continuous self-instruction
- Nastran – Training (1994)
- Powertrain Simulation and Analysis Toolkit (PSAT) – Continuous self-instruction