

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

TESLA, INC.,
Petitioner

v.

CHARGELOGIC LLC,
Patent Owner

Case IPR2026-00379
U.S. Patent 11,508,996

DECLARATION OF SAMUEL RUSS, PH.D.

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I. INTRODUCTION

1. I have been retained as a technical expert by ChargeLogic LLC (“ChargeLogic” or “Patent Owner”) and asked to provide my objective and unbiased opinions concerning the patentability of U.S. Patent No. 11,508,996 (“the ’996 Patent”). Specifically, I have been asked to provide my opinions on the patentability of the challenged claims of the ’996 Patent in view of the grounds advanced in the pending Petition for Inter Partes Review filed by Tesla, Inc. (“Tesla” or “Petitioner”) against the ’996 Patent (IPR2026-00379), the state of the art at the time of the claimed inventions, and the knowledge of a person of ordinary skill in the art at the time of the claimed inventions.

II. BACKGROUND AND QUALIFICATIONS

2. My Curriculum Vitae is attached hereto as Appendix A.
3. In forming the opinions expressed in this Declaration, I have considered and relied upon my education, background, and experience. In addition, I have reviewed and relied upon materials in preparation of this Declaration, as described herein.
4. I received a Bachelor’s degree in Electrical Engineering from the Georgia Institute of Technology (“Georgia Tech”) in 1986 and a Ph.D. in Electrical Engineering from Georgia Tech in 1991.
5. From 2007 to the present, I have been a member of the faculty of the University of South Alabama as an Assistant and Associate Professor in the Department

of Electrical and Computer Engineering. During that time, I have won awards for excellent teaching.

6. I am active in the Institute of Electrical and Electronic Engineers (IEEE) and am a Distinguished Lecturer for the IEEE Consumer Electronics Society. As a consultant, I have conducted briefings for members of the financial community on technology trends in the cable, satellite, and IPTV sectors.

7. I also served on the faculty of Mississippi State University from 1994 to 1999 as an Assistant Professor in the Department of Electrical & Computer Engineering, where I taught circuit board design and two-way interactive video classes, among other things.

8. I have also authored at least 15 journal articles and at least 31 conference papers.

9. With regards to batteries and battery charging, subject matter associated with the '996 Patent, I have actively developed numerous systems that used batteries and battery chargers.

10. From 1999 to 2000, I developed a portable version of a payment terminal. To complete the design based on Nickel Metal Hydride (NiMH) batteries, I had to consider thermal issues, charge management, and charge memory associated with incomplete discharging.

11. From 2016 to 2022, I managed the design of a fully functional satellite that was successfully deployed on orbit in 2022. The satellite included a maximum power-point tracking solar battery charger and Lithium-Ion batteries. The batteries required a special safety rating for safe storage on the International Space Station, and I architected the software specifically for very low power consumption. I overhauled the EE 457 Embedded Systems course to include components of safety and ethics, and I use batteries and battery chargers as examples of systems with significant safety risks. I also teach specifically on battery charging and battery chemistry so that students can be prepared for battery-equipped systems.

12. I have no financial interest in ChargeLogic or the '996 Patent. I am being compensated for my time spent in connection with these proceedings at an hourly rate. I am also being reimbursed for reasonable expenses, such as travel expenses. My compensation is not contingent on my opinions, on the outcome of any matter, or on any of the technical positions I explain in this declaration.

III. LEGAL STANDARDS

13. I am not an attorney. For purposes of this Declaration, I have been informed about certain aspects of the law that are relevant to my opinions, as set forth below.

A. Patentability

14. I understand that for an invention claimed in a patent to be valid and patentable, it must be, among other things, new and not obvious in light of what was known and came before it. That which was known or came before the invention claimed is generally referred to as “prior art.”

15. I understand that there are two ways in which prior art may render a patent claim unpatentable. First, the prior art can be shown to “anticipate” the claim. Second, the prior art can show that the claim was obvious to a person of ordinary skill in the field of the invention at the time the invention was made.

16. I understand that, for a patent claim to be “anticipated” by the prior art, each and every element or requirement of the claim must be found, expressly or inherently, in a single prior art reference. Further, I understand that anticipation requires that the single prior art reference must disclose the elements of the claim arranged or combined in the same way as in the claim. It is my understanding that whether a claimed invention is obvious is a question of law, with underlying factual inquiries that are determined from the perspective of a person of ordinary skill in the art at the time of the claimed invention.

17. It is my understanding that a claimed invention is obvious if the differences between the claimed invention and the prior art are such that the claimed invention as

a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art (a “POSITA”).

18. It is my understanding that obviousness requires consideration of the following underlying factual inquiries:

- determining the scope and content of the prior art
- ascertaining the differences between the claimed invention and the prior art;
- resolving the level of ordinary skill in the art; and
- evaluating objective evidence or “secondary considerations” of non-obviousness, such as experimental results, commercial success, long-felt but unresolved needs, failure of others, industry praise, and unexpected results.

19. It is my understanding that a reference must be analogous art to the claimed invention in order to be properly considered for use in an obviousness inquiry. It is my understanding that a reference is analogous art to the claimed invention if:

- The reference is from the same field of endeavor as the claimed invention (even if it addresses a different problem); or
- The reference is reasonably pertinent to the problem faced by the inventor (even if it is not in the same field of endeavor as the claimed invention).

20. It is my understanding that whether a reference is reasonably pertinent depends on how the problem faced by the inventor is reflected, either explicitly or implicitly, in the specification.

21. It is my understanding that the following are exemplary rationales that may support a conclusion of obviousness:

- Combining prior art elements according to known methods to yield predictable results;
- Simple substitution of one known element for another to obtain predictable results;
- Use of known techniques to improve a similar method or product in the same way;
- Applying a known technique to a known method or product ready for improvement to yield predictable results;
- Obvious to try – choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success;
- Known work in one field of endeavor may prompt variations of it for use in either the same field or a different one based on design incentives or other market forces if the variations are predictable to one of ordinary skill in the art; and
- Some teaching, suggestion, or motivation in the prior art that would have led one of ordinary skill to modify the prior art reference or to combine prior art reference teachings to arrive at the claimed invention.

22. In addition to the above, I understand that a person of ordinary skill in the art may resort to logic, judgment and common sense available to him or her at the time of the invention or prior to the invention to find a claim feature obvious, even if the prior art relied on does not explicitly state or teach that feature. I understand that when common sense is relied on to find a feature obvious, the reasoning for that conclusion must be articulated with sufficient clarity.

23. I also understand that a patent claim is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art. An obviousness determination requires finding both that a skilled artisan would have been motivated to combine the teachings of the prior art references to achieve the claimed invention, and that the skilled artisan would have had a reasonable expectation of success in doing so. I understand that it is important to be careful not to allow hindsight reconstruction of references to produce the claimed invention, without any explanation as to how or why the references would be combined to produce the claimed invention.

24. Regarding “objective evidence” or “secondary considerations,” I understand that for such evidence to be relevant to the obviousness of a claim, there must be a causal relationship (called a “nexus”) between the claim and the evidence. I also understand that such objective evidence may include: commercial success of products covered by the patent claims; long-felt need for the invention; failed attempts by others to solve the problem addressed by the invention; copying of the invention by

others in the field; unexpected results achieved by the invention; praise of the invention; the taking of licenses under the patent by others; expressions of surprise by experts and those skilled in the art at the making or use of the invention; and that the patentee proceeded contrary to the accepted wisdom of the prior art.

25. I understand that a person of ordinary skill is also a person of ordinary creativity. I further understand that the obviousness analysis need not seek out precise teachings directed to the specific subject matter of the challenged claim, but instead can take into account “ordinary innovation” that does no more than yield predictable results, which are inferences and creative steps that a person of ordinary skill in the art would be understood to employ.

26. I understand that sometimes it will be necessary to look to interrelated teachings of multiple patents and publications; the effects of demands known to the relevant field or present in the marketplace; and the background knowledge possessed by a person having ordinary skill in the art. I understand that all these issues may be considered to determine whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue.

B. Prior Art

27. I understand that for purposes of this proceeding, prior art includes patents and printed publications (e.g., journal articles) in or outside the United States before the effective filing date of the claimed invention. I also understand that prior art includes

U.S. patents, published U.S. patent applications, and published international applications (pursuant to the Patent Cooperation Treaty) that themselves have an effective filing date before the effective filing date of the claimed invention, as long as they name another inventor.

C. Inherency

28. I understand that if a prior art reference does not expressly set forth a particular claim element, the prior art may still disclose that element if it is “inherent” in its disclosure. To establish inherency, it is my understanding that evidence must make clear that the missing descriptive matter is necessarily present in the thing described in the reference. It is my understanding that inherency may not be established by probabilities or possibilities. In other words, it is my understanding that the mere fact that a certain thing may result from a given set of circumstances is not sufficient to establish inherency.

29. I understand that under the principles of inherency, if a prior art device, in its normal and usual operation, would necessarily perform a claimed method, then the method will be considered to be anticipated by the prior art device. I also understand that when the prior art device is the same as a device described in the specification for carrying out the claimed method, it can be assumed that the device will inherently perform the claimed process.

D. Person of Ordinary Skill In The Art

30. I understand that “a person of ordinary skill in the art” or POSITA is a hypothetical person who is presumed to have known the relevant art at the time of the invention. Such a person would necessarily have the capability of understanding any scientific and engineering principles applicable to the pertinent art.

31. I understand that factors that may be considered in determining the level of ordinary skill in the art include, but are not limited to, the following:

- the educational level of the inventor;
- the type of problems encountered in the art;
- prior art solutions to those problems;
- the rapidity with which innovations are made;
- the sophistication of the technology; and
- the educational level of active workers in the field.

32. I understand that a person of ordinary skill in the art is not a real person, but rather is a hypothetical individual having the qualities reflected by the factors above. This hypothetical person has knowledge of all prior art in the relevant field as if it were arranged on a workshop wall and takes from each reference what it would teach to a person of ordinary skill in the art.

33. I understand that a person of ordinary skill in the art is a person of ordinary creativity, not an automaton. In many cases a person of ordinary skill will be able to fit the teachings of multiple prior art references together like pieces of a puzzle.

34. I understand that a person of ordinary skill in the art can collaborate with one or more other persons of ordinary skill in the art for one or more aspects with which the other person may have superior expertise, experience, and/or knowledge.

E. Claim Construction

35. It is my understanding that claim construction, or the interpretation of the claims of a patent, is ultimately a question of law. I have been informed that claim terms are generally presumed to carry their ordinary and customary meaning. However, I understand that a patent applicant is his own lexicographer and is entitled to provide alternate definitions of words in common usage, but if the patent applicant uses a term that is in common usage without providing an alternate definition, then that term should generally be understood as having its common meaning.

36. I understand that a person of ordinary skill in the art is deemed to read a claim term not only in the context of the particular claim in which the disputed term appears, but in the context of the entire patent specification and the “file history” of the patent developed during examination by the Patent Office.

37. I understand that the claims, the specification, and the file history are referred to as “intrinsic evidence,” and are to be read as a person of ordinary skill in the art at the time of the invention would have done at the time of the alleged invention.

38. In addition to the intrinsic evidence, I understand that the court or tribunal may also consider other relevant evidence, which is called “extrinsic evidence,” concerning relevant scientific principles, the meaning of technical terms, and the state of the art. Such evidence includes the testimony of qualified expert witnesses. Although extrinsic evidence may be used to resolve ambiguities that may exist after reviewing the intrinsic evidence, I understand that extrinsic evidence cannot be used to contradict a claim construction that is clear from the intrinsic evidence.

39. I understand that some claims are independent, and that those independent claims are complete by themselves. Other claims refer to these independent claims, or other dependent claims, and are “dependent” on those claims. The dependent claims include all of the limitations of the claims on which they depend.

IV. BASES FOR OPINIONS

40. The opinions set forth in this Declaration are my own. In forming the opinions herein, I have considered the Petition for Inter Partes Review filed in the IPR proceedings referenced above and exhibits thereto, as well as the additional materials cited in this Declaration (including the exhibits to the Patent Owner’s Response cited herein), and my education, training, and experience.

41. My analysis of the materials relating to this matter is ongoing and I will continue to review any new material that is provided to me. This Declaration represents certain opinions that I have formed to date and the bases for those opinions. I reserve the right to revise, supplement, and/or amend my opinions based on new information presented to me and on my continuing analysis of the materials cited herein or later provided to me.

V. LEVEL OF ORDINARY SKILL IN THE ART

42. I understand that the Petition asserts the following level of skill of a POSITA at the time of the '996 Patent:

A POSITA at the time of the '996 Patent would have had at least a bachelor's degree in electrical or mechanical engineering (or an equivalent field) and at least two years of work experience involving automotive systems, including electric vehicle battery charging systems. EX 1003-Dec., ¶¶ 28-30. Additional industry experience or technical training may offset less formal education, while advanced degrees or additional formal education may offset lesser levels of industry experience. *Id.*

Petition, 2.

43. I understand that Petitioner's expert, Dr. Andrews, provides the following opinion on the level of a POSITA as of August 18, 2008:

[A] POSITA at the time of the '996 Patent would have been knowledgeable regarding the field of automotive systems, including

electric vehicle battery charging systems. In my experience working in this field, most workers of ordinary skill in the art as of the earliest possible priority date of August 18, 2008, would have had at least a bachelor's degree in electrical or mechanical engineering, or a similar technical field and at least two years of experience involving automotive systems, including electric vehicle battery charging systems. Additional industry experience or technical training may offset less formal education, while advanced degrees or additional formal education may offset lesser levels of industry experience.

Ex. 1003 ¶ 28.

44. For purposes of this Declaration only, I have applied the definition of a person having ordinary skill in the art ("POSITA") proposed by Dr. Andrews and Petitioner, with one modification. Specifically, the proposed definition should not require "automotive systems" experience generally, which encompasses experience with systems unrelated to the technology at issue, such as transmissions, cooling systems, and the like. Likewise, although the '996 Patent focuses on electric vehicle battery chargers, a POSITA would not require specific experience with such chargers if they have sufficient experience with other types of chargers. For example, I have considerable experience with battery chargers for satellite systems and for portable payment terminals, which are not meaningfully different in terms of technical complexity or complexity of operation as compared to vehicle chargers.

45. My education and experience exceed that of a POSITA as described above and qualify me to testify as to the knowledge of a POSITA under any reasonable definition. *Supra* Section II (“Background and Qualifications”). Moreover, even under Petitioner’s proposed level of ordinary skill in the art, I qualify based on my significantly higher level of education, which offsets the requirement of any specific industry experience.

46. All references to a POSITA here are made pursuant to this modified definition. However, my application of that definition is not a reflection of my agreement or disagreement with it. I reserve the right to provide my own opinion on the level of ordinary skill should there be further proceedings.

47. With these understandings, my testimony herein relates to the knowledge and understanding of a POSITA as of August 18, 2008. I understand this is the priority date applied by Petitioner, and I have been asked to use this date for the purposes of my testimony. I have formed no opinion on whether this date is the appropriate date, nor have I been asked to do so.

VI. CLAIM CONSTRUCTION

48. I understand that the Petition asserts that it is applying the “ordinary and customary meaning of all claim terms,” but does not provide any explanation of any such meanings. Petition, 4.

49. At this stage, I have not identified any claim terms that require construction to resolve the challenges presented in the Petition. I may undertake additional analysis of the asserted grounds and the associated challenges to the patentability of the claims to the extent this proceeding continues to a later stage. Therefore, I reserve the right to identify and provide my opinion as to the construction of any claim terms that I later recognize are material to resolving the challenges presented in the Petition.

VII. OPINIONS REGARDING GROUND 1

50. The Petition asserts that the combination of Izuno, Minoshima, Canedy, and Yokota renders obvious claim 1 of the '996 Patent. Petition, 3. Based on my analysis, I have concluded that this combination would not have rendered any of these claims obvious to a POSITA for the reasons explained below.

A. Claim 1[Pre]: A vehicle alignment system for an inductive vehicular battery charger having a first core movable with respect to a second core to charge a battery of a vehicle, the vehicle alignment system comprising:

51. The Petition asserts that Izuno discloses element 1[Pre]. Petition, 7. The Petition acknowledges that Izuno discloses inductive battery charging which is enabled “only after the vehicle is parked in a predetermined position in a charging space.” *Id.*, 9. However, the Petition asserts that Izuno teaches a “vehicle alignment system” because in Izuno the user is informed of correct or incorrect alignment by whether charging is able to be performed. *Id.*; *see also* EX 1003 ¶ 115. I disagree. Nothing in

Izuno discloses any system for vehicle alignment or any assistance to a driver in achieving appropriate alignment for charging. Rather, whether charging is performed is premised on parking in a predetermined position. EX 1004 [0019]-[0020]. Izuno does not disclose any details of vehicle alignment, but its system only checks as to whether the vehicle is parked in the predetermined position. *Id.* [0037]. Dr. Andrews appears to admit that Izuno does not disclose a vehicle alignment system, because he states that Izuno “does not provide any specific guidance to the user to help them determine how to move the vehicle when it is not aligned, so that charging can begin.” EX 1003 ¶ 117. I agree that Izuno does not provide any guidance on appropriate alignment, which is instead preestablished based on the predetermined position. Izuno does not disclose a “vehicle alignment system for an inductive vehicular battery charger” as required by Claim 1[Pre].

B. Claim 1[a]: a controller; and

52. The Petition maps Izuno’s ECU 11 to the claimed controller, required by element 1[a] and 1[c], and configured to perform the actions listed in claims 1[c][i]-[vii]. Petition, 12, 18. The Petition asserts that the ECU alone is configured to perform the claimed functions. *Id.*, 12. However, it does not at any point explain how the ECU alone performs the functions of elements 1[c][i]-[vii], and instead states that the ECU is modified to perform those functions through incorporation of isolated elements extracted from Minoshima, Canedy, and Yokota. *Id.*, 18, 28, 33, 38, 43, 48, 52, 58.

Therefore, I disagree, based on the Petition itself, that Izuno alone discloses the claimed controller.

53. In addition, Izuno does not teach that its ECU controls any charging-related functionality, but rather that such functions are controlled and determined by Izuno's service system server 100. Thus, the vehicle system's ECU controls the vehicle motor (during driving), and manages the battery by monitoring its status and transmits that information (voltage, remaining capacity, fault data) to the server. Izuno expressly teaches that:

The ECU 11 is a **control device that primarily controls the motor 20 via the inverter 13 and manages the battery 12**. In FIG. 2, this is shown as a single unit that oversees the entire system, and it includes a communication module 11a that serves as a means of communication capable of transmitting battery 12 charging information to an outside unit.

When the ECU 11 controls the motor, the ECU 11 calculates the driving force requested by the driver based on signals from a sensor (not shown) that detects the amount by which the accelerator pedal has been depressed, and controls the inverter 13 so that output from the motor 20 matches the driving force requested by the driver, based on information such as the rotational speed, voltage, and current of the motor 20. **When ECU 11 manages the battery**, the ECU 11 monitors the battery status based on factors such as the remaining capacity indicated by the State of Charge (SOC) of the

battery 12 and the 50 degree of degradation by the battery 12. **Based on the battery status**, the ECU 11 **performs functions such as cooling** the battery 12, **monitoring the charging status** at the charging station 60 via the service system, detecting abnormalities, and performing protective actions when abnormalities are detected.

In particular, **when charging the battery 12, the ECU 11 communicates with the service system server 100** via the communication module 11a provided in the unit, and **transmits battery information**, such as the voltage and remaining capacity of the battery 12 as well as fault information, **to the service system server 100**. **The service system server 100 sets** an optimal charging schedule based on the battery information received from the vehicle system 10 (the ECU 11) and the information stored in the service system server 100, **and controls charging of the battery** by transmitting charging start/end signals to the charging station 60 in response to instructions from the user.

EX 1004 [0016]-[0018]. It is thus the server which controls charging operations—setting the charging schedule based on the transmitted battery information, and controlling the charging station 60 before and during charging. *Id.* [0018].

54. While the Petition proposes various modifications to the ECU to add certain connections and functions to the ECU with respect to claims 1[b] and 1[c][i]-1[c][vii], it never modifies the ECU to perform any of the functions of Izuno's system server. As detailed with respect to certain of these claim limitations below, the Petition maps some of the system server's functionality to the ECU. Because the ECU cannot

perform those functions, either in the unmodified Izuno or in the asserted combination(s) (because the Petition does not propose modifying the ECU to perform those functions), the ECU cannot satisfy all the limitations required of the claimed controller. *See* Sections VII.C., VII.H.. Accordingly, for these reasons, Ground 1 does not teach or suggest the claimed controller.

C. 1[b]: a display mounted within the vehicle, oriented for view by a user seated in the vehicle, and coupled to the controller;

1. Izuno display and ECU.

55. The Petition maps Izuno's communication terminal 50 as the claimed display. Petition, 13-14. The Petition argues that Izuno's display is coupled to ECU 11 (the mapped controller), because both it and the display are part of the vehicle system, and the ECU transmits battery information to a service system server which in turn calculates charging variables and then transmits them to the user's communication terminal. *Id.*, 14 (citing EX 1004 [0018], [0022]).

56. Contrary to the Petition, Izuno does not teach that ECU 11 is coupled to the display. While Izuno teaches that ECU 11 transmits information to the service system server, it is the system server—not the ECU—that sets a charging schedule based on that information and controls charging by transmitting charging start/end signals to the charging station. EX 1004 [0018], [0022]. The server, not the ECU, then transmits that information to the communication terminal/display. *Id.* [0022]. Izuno

describes no information transferred from the ECU to the display without first being received and processed by the system server.

57. The Petition apparently asserts that the ECU and display are coupled because the display presents information “originally provided by ECU 11 via service system server 100.” Petition, 15. Even if this were true, the Petition does not explain why this satisfies the claim language—that is, the Petition does not explain why the server transmitting to the display the same information received from the ECU comprises the claimed coupling. It is not apparent why this qualifies as coupled, and merely because two components provide the same information does not, to my understanding of the ordinary meaning, mean that they are coupled.

58. However, even if this were within the meaning of the claimed coupling, Izuno does not teach that the server provides the same information to the display that was originally provided to the server by the ECU. As noted in the Petition, the ECU provides battery status information to the server, and the server does not merely transmit this same information to the display but uses that information to perform various charging operation calculations, and it then transmits the results of those calculations to the display. *See id.*, 14-15; EX 1004 [0018], [0022]. Therefore, even using the apparent construction of “coupled” applied in the Petition, Izuno does not disclose the claimed display coupled to the controller.

2. Izuno-Canedy.

59. The Petition next states that, “[t]o the extent it is argued Izuno’s display is not explicitly *coupled to the controller*, Canedy teaches this.” Petition, 15. The Petition asserts that Canedy’s “electronic circuitry,” including microprocessor 100 and displays 104 and 112/114, which are connected via buses, comprise the claimed display and controller. Petition, 15-16.

60. The Petition asserts a motivation to combine to improve Izuno’s vehicle in the same way as Canedy’s vehicle, and that a POSITA would have modified Izuno’s display to couple it to ECU 11 for display to the user. *Id.*, 16. The Petition asserts that this would have allowed Izuno’s ECU to “advantageously allow[] the ECU to output information for viewing by the user (e.g., related to charging, sensor data, proximity).” *Id.*, 16-17. The Petition asserts that this would “have assisted the user in parking the vehicle, thereby improving accuracy and efficiency of parking in a predetermined position.” *Id.*, 17. In his declaration, Dr. Andrews asserts as an example that “providing information regarding amount of battery left would have benefited Izuno so the driver would know when the vehicle needs to be charged again.” EX 1003 ¶ 127.

61. The combination of Izuno and Canedy fails for at least the following reasons: [a] Izuno’s ECU does not possess the charging information, and therefore cannot transmit it to the display; [b] the Petition does not address or explain why a POSITA would be motivated to add these functions to the ECU, as opposed to Izuno’s

server; [c] the Petition does not explain why a POSITA would be motivated to add Canedy's system, nor why it would be expected to work in aligning charging couplers in Izuno.

(a) Izuno's ECU does not possess the charging information, and therefore cannot transmit it to the display.

62. As previously discussed, in Izuno, the system server 100 possesses the charging information and information about remaining battery capacity—not the ECU. The server, not the ECU, performs all charging analysis functions, including checking vehicle parking alignment. The ECU's only function related to charging operations, including parking, was to transmit battery status information (remaining capacity, voltage, fault data) to system server 100, transmit the selected charge mode, and monitor the charging status at the charging station. EX 1004 [0015]-[0018], [0027].

63. Izuno's server received the information from the ECU, and based on that information, determined an optimal charging schedule and controlled charging of the battery via signal to charging station 60. *Id.* [0018], [0032]. Based on the information from the ECU, the server calculates the amount of charge required, the charging time and the estimated driving range before and after charging, and transmits that information to the vehicle display. *Id.* [0022], [0034]-[0035]. The server also determines whether the vehicle is properly parked in the predetermined position that allows for charging. *Id.* [0030]. Thus, Izuno's server—not the ECU—conducted all

calculations relating to charging before transmitting it to the display, including alignment evaluation.

64. Therefore, even if the ECU were coupled to the display per Canedy as proposed, the ECU could not output charging information to the display which it did not have. This information is on the system server, not resident at the ECU. Further, the Petition does not propose modifying the ECU so that it would have or determine information related to charging operations, or estimated range—these remain with the system server. *See* Petition, 13-15; *see* Sections VII.C.2.(b), VII.H. Further, a POSITA would understand that merely adding these charging functions to the ECU (e.g., estimating the charge time) would require detailed information from the server or charger, such as the currents and voltages being applied. Because the charging coil is remote from the vehicle, detailed planning and design are required to add such capabilities to the ECU. The Petition presents no evidence supporting its implicit conclusion that the ECU had such information. Thus, a POSITA would not have recognized any advantage to the ECU outputting information to the display, because even if “allowed” to do so, it had no information to send.

(b) The Petition does not address or explain why a POSITA would be motivated to add these functions to the ECU, as opposed to Izuno’s server.

65. Although I have not identified any such proposed modifications, assuming that the Petition did propose modifying the ECU so that it would actually have the

charging information that allegedly motivates the combination (Petition, 16-17), neither the Petition nor Dr. Andrews explains why a POSITA would have modified Izuno's system so that this information would be transmitted directly from the ECU, instead of the system server.

66. In Izuno, all of the charging information that the Petition and Dr. Andrews identify is already displayed, but it is transmitted from the server (not the ECU). Because Izuno would have already displayed this information from the server without modification, there would be no advantage to the driver in modifying Izuno's ECU so that the ECU instead of the server, transmitted this information for display.

67. Further, with regard to the "sensor data" and "proximity" information that the Petition asserts would also motivate this combination (Petition, 16-17), I note that Izuno also teaches that its alignment evaluation processing resides at the system server, not the ECU. EX 1004 [0030] ("The processing performed by the service system server 100 begins when a vehicle enters the charging parking space of the charging station 60. Step S21 is executed from the system standby state. In step S21, the system checks whether the vehicle has been parked at the predetermined position in the charging parking space."). Although the Petition asserts that displaying sensor and proximity data would assist the user in parking in the predetermined position, the Petition does not explain why a POSITA would have modified Izuno's system to transfer the alignment evaluation from the server to the ECU, before transmitting this information

to the display. Because the server was already doing this analysis, there is no apparent reason to transfer these functions to the ECU, rather than simply having the system server transmit this information to the display per the existing configuration of Izuno. Thus, even if the Petition proposed modifying the ECU to possess this information so that it would have it to transmit to the display, the motivation is not reasonable. There is no reason to modify Izuno's existing architecture, where the charging management and alignment operations resided on the system server, simply so that the ECU instead of the server can transmit such information to the display.

(c) The Petition never explains why a POSITA would be motivated to add Canedy's system, nor why it would be expected to work in aligning charging couplers in Izuno.

68. The Petition does not detail why importing Canedy's "electronic circuitry," including its microprocessor and displays, would be expected to work with the modified Izuno system. The Petition does explain that connecting components in vehicles via buses was well known, and that off-the-shelf components might be used to modify software, or a commercially available product could be used. Petition, 17. This explanation does not address the underlying issue of why a POSITA would have reasonably expected Canedy's particular system to successfully impart the functionality required by the claim. This is discussed in detail for claim 1[c][ii] below, but generally, Canedy described what I would call a basic "curb feeler" system. *See* Section VII.D.2. For the reasons discussed there, I would not be expect the addition of Canedy's system

to enable the claimed functionality (or assist in implementation of Minoshima's system as the Petition asserts for claim 1[c][i]) requiring alignment of a vehicle with a pad-mounted inductive charging coupler. *See* Section VII.D.2; *see also* Petition, 65 (Izuno's charging setup is a charging *pad* because a vehicle drives over the charger to perform inductive charging.”).

3. Conclusion for Claim 1[b]

69. Because Izuno does not teach a display coupled to its ECU, it cannot alone teach this claim limitation. The Petition's analysis of the motivation to combine Canedy with Izuno to create a combination that does teach this limitation is defective. There was no motivation to couple the ECU and display (via modification with Canedy) to display charging information as the Petition asserts, because the charging information was not available at the ECU to be sent for display. Even if it were, there was no motivation to add Canedy because the charging information was already being displayed from Izuno's server system. Finally, the Petition fails to show that a POSITA would have had a reasonable expectation that modifying Izuno's system based on Canedy's teaching would have been expected to yield a system configured to perform the claimed functions. Therefore, Ground 1 fails to establish that this claim limitation was present in or obvious in view of the asserted prior art.

- D. 1[c][i]-[ii] [wherein the controller is configured to:] detect a first positional relationship between the first core and the second core at a first time, detect a misalignment of the first core with respect to the second core based at least in part on the first positional relationship between the first core and the second core,**

70. I note that the Petition asserts that Izuno's ECU "controls the charging of the battery." Petition, 18. As discussed for claim 1[b] above, Izuno's server controls the charging of the battery, not its ECU, nor does the Petition propose transferring that control to the ECU. *See* Section VII.C.; *see also* Section VII.H. Accordingly, the ECU does not control the charging of the battery, either in Izuno or in the proposed combination(s).

1. Certain Issues with Implementation of the Izuno-Minoshima Combination

71. Generally, the Petition proposes combining Izuno with Minoshima by importing only one part of Minoshima's inductive charging alignment system; specifically, importing proximity detection sensors used in that system, but not the power-transmitting coupler attached to a support arm on Minoshima's ground-side charging device that is integrated with those sensors. Petition, 19. Further, the proposed modification is based on an embodiment suggested but not detailed in Minoshima, where the proximity sensors are placed on the vehicle and not the ground-level charging device 9 (which is Minoshima's detailed embodiment). *Id.*, 20-21. Thus, in the proposed combination, ECU 11 (the mapped controller) "performs processing for

positional relationships based on sensor data from proximity sensors installed on the vehicle and provides feedback to the driver via a display ... located within the Izuno-Canedy-Minoshima vehicle. *Id.*

72. As discussed in detail below (Section VII.D.3.), a fundamental difference between Minoshima and Izuno is that Minoshima teaches a moveable charger—its support arm moves to align the charging station’s coupler with the coupler on the vehicle. Section VII.D.3. The Petition does not explain why a POSITA would consider Minoshima’s moveable-charger system to improve Izuno’s stationary pad-based inductive charger. This is because Minoshima teaches a POSITA nothing about how to align a system in which the charging coupler is stationary. This is an intrinsic incompatibility between the two systems that is never addressed.

73. The Petition asserts that Izuno’s ECU 11 (the mapped controller) is modified to “extend the ECU’s wireless control to include Minoshima’s proximity detection to allow the system to more effectively detect and confirm the required positional relationship (e.g., within the predetermined distance) is satisfied before issuing start charging signals.” Petition, 25. The Petition asserts that the modification would “simply be a matter of including proximity sensors and detected component ... and related programming instructions to provide positional relationship information to help the user properly align the couplers.” *Id.* The Petition’s reasonable expectation of success analysis generally asserts that connecting components in vehicles via buses,

such as a controller and display, was well known in the prior art, and that implementing sensors and a processor in a vehicle would have required only straightforward and routine changes to programming instructions and known, off-the-shelf solutions. *Id.*, 27-28, 32-33. However, the Petition does not explain how a POSITA would actually modify Izuno's ECU to implement Minoshima's teachings. *Id.*, 27-28; *see also* EX 1003 ¶¶ 156-157 (asserting that the modification would be "straightforward and routine" and "a natural and logical consequence of utilizing proximity sensors").

74. The Petition also asserts that Minoshima "provides implementation details for achieving proper alignment, including by utilizing proximity sensors in a vehicle and a detected component in the charging station." Petition, 27. Dr. Andrews includes the same statement in his declaration. EX 1003 ¶ 156. However, I note that the Petition and Dr. Andrews later state that this is not the case. Petition, 32 ("Minoshima lacks implementation details for how sensor data is processed for its embodiment where proximity sensors are located in/on the vehicle."); EX 1003 ¶ 165 ("Minoshima simply lacks implementation details for how sensor data is processed when proximity sensors are located in/on the vehicle.").

75. I agree with the Petition and Dr. Andrews' second statement—Minoshima lacks implementation details for how sensor data is processed for its embodiment where proximity sensors are located in/on the vehicle. Therefore, absent such implementation details, I disagree that there is a reasonable expectation of success in combining

Minoshima's vehicle-side proximity sensors into Izuno's system. Because Minoshima's detailed disclosure does not describe how a vehicle-side controller would receive and process proximity-sensor signals originating from vehicle-mounted sensors (since, in Minoshima's detailed embodiment, the sensors are on the charging device and the controller receiving their signals is likewise on the charging device), the assertion that this modification would have had a reasonable expectation of success rests on an unstated assumption that transplanting the sensing function to the opposite side of the system, together with an entirely different signal-processing architecture, would work exactly the same way. This is an assumption the Petition does not test against Minoshima's disclosed control logic, which is built around signals arriving at the ground-station controller 20 together with a "P range signal" and "ID identification signal" transmitted wirelessly from the vehicle. EX 1005 [0034]-[0035].

76. Thus, Petitioner's combination of Izuno-Minoshima cannot have a reasonable expectation of success absent additional guidance on how to implement Minoshima's vehicle-side proximity sensor embodiment.

2. Canedy's processor configuration and purpose.

77. Presumably because of this problem, the Petition proposes an additional modification to the Izuno-Minoshima combination by implementing certain teachings in Canedy. Petition, 28 ("To the extent it is argued Izuno-Minoshima is insufficient to teach a *controller configured to detect a positional relationship*, Canedy teaches this.").

In this combination, the Petition maps Canedy's microprocessor 100 to the claimed controller. Petition, 28, 30 ("Thus, the display and proximity sensors are coupled to the microprocessor (*controller*)"). The Petition proposes adding "Canedy's well-known circuitry arrangement where a vehicle microprocessor is coupled to vehicle proximity sensors and display via buses." *Id.*, 31. The Petition asserts a reasonable expectation of success because "a setup such as Canedy's was known ... and would have been a straightforward, off-the-shelf solution." *Id.*, 32. In the combination, Canedy purportedly provides Minoshima's missing implementation details via "teaching a microprocessor and communication bus within a vehicle for processing sensor data." *Id.* The modification is again described as requiring "merely straightforward and routine changes to programming instructions." *Id.*, 32-33. Dr. Andrews testifies that this includes modifying Izuno's processor to utilize proximity sensors by "swapping [Izuno's] processor for a commercially available, off-the-shelf processor (e.g., such as Canedy's processor)" EX 1003 ¶ 166. However, citing the ubiquity of communications buses and sensors is not dispositive—it merely means that a POSITA would understand ways to carry out embedded design generally. Dr. Andrews' proposals are not sufficient for a POSITA to design a working system in this context.

78. However, Canedy is unrelated to battery charging and appropriate alignment of power cores for inductive charging. Rather, Canedy's system is what I would describe as a simple "curb feeler" system, which addresses the problem of

indicating the distance from a car's bumper or spoiler to an object such as a curb while parking. EX 1006, 2:15-34 ("In the present invention, the operator of the car is given varying ... information as to the location and exact distance of a solid object in the proximity of the front spoiler, bumper, or finder [sic] during parking. Accordingly, it is a principal object of the invention to provide an indication of the distance between a solid object and the front bumper or spoiler to the operator of the vehicle in inches. ... It is another object of the invention to provide the operator with an accurate determination of the location of a potentially dangerous solid object."). Canedy teaches providing both audio and visual warnings along with a digital readout of exact distance. *Id.*, 1:10-16, 1:28-34. Canedy discloses optical sensor units (transmitter and detector) on the vehicle which detect the distance to a solid object (a curb or divider) extending above the ground. *Id.*, 3:6-22, 5:33-36 ("Generally, the divider or wall in front of a parking space has solid surfaces perpendicular to the direction a car would enter the parking space"), Fig. 1. Canedy's microprocessor controls the detection process, which involves lighting sensors on a displayed silhouette, and control of a display array indicating distance from the object to the vehicle. *Id.*, 3:58-4:23. Thus, Canedy's microprocessor and display shows parking-distance information along a single axis (the "x-axis"). This is different from Minoshima's described proximity detection system required to position a vehicle for inductive charging, which requires and relies on two-dimensional alignment data (both lengthwise and widthwise, both the "x-axis" and "y-

axis”). EX 1005 [0021]-[0023], [0036]-[0038], Figs. 3(a)-3(c). Minoshima’s system also relies on its moveable support arm to provide further fine-tuned alignment of the charging couplers along the “x-axis” as well as a third axis, the vertical “z-axis.” *Id.* [0018], [0020]. Additionally, the motivation for Canedy’s system is to prevent a car’s running over or colliding with a solid object. In other words, it is primarily designed to detect when a car is too close. A charging system requires accurate positioning in at least two axes, and being “too far” (having not pulled up far enough) is as useless as being “too close” (having pulled up too far). A POSITA would therefore have concluded that Canedy’s processor, sensors, and display were not configured to provide the necessary three-dimensional alignment data required to position a vehicle for inductive charging using Minoshima’s system.

79. The Petition’s motivation and reasonable expectation of success analyses assert that they use “Canedy’s known technique” to improve Izuno-Minoshima in the same way. Petition, 31. The Petition asserts this yields a predictable result of a functional proximity sensor system "where the vehicle's processor processes sensor data to determine proximity of the vehicle to an object.” *Id.* This statement, which describes detection along a single axis (proximity of the vehicle to an object), shows the difference between Canedy and Minoshima—Canedy teaches the use of sensors to detect the single-axis proximity to a solid object extending above ground. This is not the same as using proximity sensors to detect a component along two axes as detailed

in Minoshima. There is no discussion in Canedy of any capability of guiding a driver to precisely align a vehicle with any object (including a stationary inductive power core), only of notifying and alerting a driver of the proximity to an object (that is, closeness and not actual position), and one that extends above the ground. Because of these differences, a POSITA would not have considered Canedy, absent significant modifications which are not explained in the Petition, to be useful when used with proximity sensors detecting the distance from, and relative location to, a specific detected component such as in Minoshima.

3. The Petition's analysis of motivation to combine and reasonable expectation of success with respect to Minoshima's integrated positioning system.

(a) Izuno's system

80. Izuno discloses a charging station 60 having a charging coupler 15b installed in the predetermined charging parking space and arranged, for example, beneath the vehicle body. EX 1004 [0015], [0020]. When a vehicle with a charging coupler 15a mounted thereon is parked in the predetermined space at the charging station, the two charging couplers will be "positioned opposite each other" enabling inductive charging. *Id.* [0020]. When a vehicle enters the charging parking space, the service system server checks whether the vehicle is parked at the predetermined position for charging. *Id.* [0030]. If the vehicle is not parked in the predetermined position, the server's processing ends; if it is parked in the predetermined position,

processing continues to either complete charging, or not, based on other variables. *Id.* [0030]-[0034]. Thus, Izuno discloses that its system relies on the appropriate positioning of the vehicle charging coupler with the charging station's stationary charging coupler, and this depends solely on the correct position of the vehicle in the predetermined parking space. That is, Izuno does not provide any details regarding appropriate alignment for charging; the vehicle is either correctly parked for charging or it is not.

(b) Minoshima's system

81. Minoshima also discloses an automatic charging device for an electric vehicle, but addresses the specific problem of notifying the driver, while still inside the vehicle, whether the vehicle has been parked correctly for charging. EX 1005, [Abstract], [0007]. Minoshima's only detailed embodiment describes an automatic inductive charging system, where an electric vehicle has a power receiving coupler on its bottom surface, and a "ground-level charging device" in a garage has a power transmitting coupler. *Id.* [0017]-[0018]. The power transmitting coupler is mounted on the end of a support arm which rotates outward from the charging device, and which is moveable both side-to-side (across the width of the vehicle) and vertically. *Id.* A detected component is mounted on the vehicle, and two proximity sensors are provided on the charging device. *Id.* [0021]. When the vehicle is properly aligned, both sensors detect the detected component, and a vehicle-mounted wireless transceiver transmits a

“P range signal” to a transceiver in the charging station, whereupon a display mounted either on the charging station or alternatively in the vehicle displays a “Parking Position OK” message and automatic charging may begin. *Id.* [0027]-[0028], [0033]-[0035], [0040], [0052]-[0053]. When the vehicle is not properly aligned, such that either sensor is not activated, the message “Parking Position NG” is displayed for the driver, indicating that the vehicle must be repositioned. *Id.* [0038]-[0039]. Additionally, the specific direction of misalignment may be indicated, thus notifying the driver of exactly how the vehicle must be repositioned. *Id.* [0056].

82. If the parking position allows for charging, the charging operation begins and the controller rotates the support arm to its extended state, whereupon the support arm traverses width-wise and, and via an electromagnetic induction effect between the arm’s power-transmitting coupler and the vehicle’s power receiving coupler, the controller detects and determines the appropriate width-wise position for the support arm such that the two couplers are aligned for inductive charging. *Id.* [0041]-[0044]. The support arm is then positioned vertically near the power-receiving coupler and charging may begin. *Id.* [0044]. If no charging current is detected, a message is displayed to repeat parking. *Id.* [0045]. The moveability of the support arm provides Minoshima’s system with a fine-positioning ability that accommodates limited vehicle misalignment. *Id.* [0020], [0024]. Stated differently, the system is designed so that the

car is placed in roughly the correct position and the movable arm hones in on exactly the correct position.

83. Minoshima states that an alternative embodiment may include using proximity sensors on the vehicle instead of the charging station, with the detected component on the charging station. *Id.* [0059]. This embodiment is not further described. *Id.* Thus, Minoshima provides implementation details for only the primary embodiment where the sensors are located on the charging station. Importantly, even this embodiment relies on a moveable charging coupler—no embodiment is described which does not include the support arm.

(c) The Petition does not explain why a POSITA would have expected the combined system to function absent inclusion of Minoshima’s integrated positioning system.

84. The Petition’s proposed Izuno-Minoshima combination asserts that “the power transfer core is stationary as in Izuno’s native arrangement,” but relies on Minoshima’s proximity sensors for alignment of the cores. Petition, 19. The Petition’s justification for not including Minoshima’s movable power-transmitting coupler (on the support arm) is that, “[w]hile Minoshima’s setup allows more flexibility in the allowable position for ‘correctly’ parking the vehicle ... Izuno’s setup is simpler, less expensive, and requires fewer moving parts.” *Id.* Dr. Andrews testifies that Izuno’s setup “avoids the use of complicated mechanical systems that require maintenance or are prone to error or breaking down and additionally are not susceptible to driver error,”

i.e., “running into the charging stations.” EX 1003 ¶ 138. The Petition characterizes this selection as “simply a design choice.” *Id.*, 19-20.

85. There is a fundamental problem with the analysis presented in both the Petition and Dr. Andrews’ declaration. Specifically, it breaks Minoshima’s positioning system into its component parts (proximity sensors and moveable support arm used to position the power transmitting coupler), and only applies one piece of that system—the proximity sensors. Further, it proposes placing the proximity sensors on the vehicle, which Minoshima suggests but never details, as its only describes implementation of a system utilizing proximity sensors on its ground-level charging device.

86. However, even if Minoshima fully explained how its vehicle-side sensor embodiment would function, that embodiment still requires integration with the moveable support arm to yield a functioning alignment system. Minoshima specifically explains that its system relies on a “permissible misalignment range for charging,” and that its proximity sensors will detect the detected component when there is a misalignment only “as long as the misalignment is within the range that allows for charging.” EX 1005 [0033], [0035]. This permissible misalignment range is derived from the integrated moveable support arm, which Minoshima specifically states allows for widthwise parking offsets (300-400 mm) as well as angular parking misalignments (2° - 3°) accommodated by the pivoting support arm plate. *Id.* [0020], [0024]-[0025], Abstract (“A charging parking space ... is configured so that a power receiving coupler

3, located on the front underside of the electric vehicle 1, is positioned within the acceptable range of movement of a power transmitting coupler 10 on the charging device 9.”). The moveable support arm is thus an indispensable structural element in Minoshima that directly defines and enables the permissible misalignment range which allow the entire positioning system to correctly function. That is, Minoshima tolerates misalignment—an error in positioning—precisely because it has a moveable arm. Minoshima’s alignment-detection scheme (proximity sensors and detected component) and its automated fine-positioning scheme (motorized support arm 11 that moves in the X and Z directions via an actuator, guided by current-detection circuitry) are two interlocking parts of an integrated positioning system.

87. If one were to attempt to implement a system utilizing only Minoshima’s proximity sensors and detected component aspect (without the support arm), as proposed in the Petition, it would require analysis and explanation detailing why and how the system would still achieve appropriate alignment. There is no such explanation in either the Petition or Dr. Andrews’ declaration explaining this, or detailing how Minoshima’s sensor setup absent the moveable support arm will be modified to add the greater precision needed absent the support arm. It would be clear to a POSITA that the sensors provided some level of alignment, but Minoshima added the mobility of the arm on purpose, to provide a final, more detailed level of alignment. It would thus be clear to a POSITA that Minoshima’s sensor, divorced from the moveable arm, would

not offer a sufficient level of positioning accuracy. The fact that the arm in Minoshima is moveable cannot be overlooked. It is well known that alignment is absolutely critical for wireless power transfer. Indeed, this is why the modern Apple “MagSafe” charging system has permanent magnets in the phone; it “snaps” the phone into the optimal alignment. I have worked with numerous senior projects at South Alabama, and the alignment issue is always critical. For example, a student-project drone charger used a conical arrangement to center the drone on the charger. It is clear to a POSITA that the moveable arm of Minoshima enables the charger to fine-tune its position for maximum efficiency. For these reasons, removing this capability in the proposed combination would strike a POSITA as counter-productive and, indeed, as likely rendering the combined system inoperable.

88. Because Minoshima details an integrated system utilizing a moveable support arm for achieving acceptable alignment using its proximity sensors, in my opinion a POSITA considering it for combination with Izuno would only find it to suggest using Minoshima’s entire system. That is, a POSITA would not look to Minoshima and consider extracting and applying only the proximity sensors without the moveable support arm to Izuno’s system, because Izuno teaches a stationary power transmitting coupler. There is no indication in Minoshima that its alignment system would be suitable for such a system.

89. The Petition asserts that using only part of Minoshima's system (the proximity sensors without the support arm) was "simply a design choice." Petition, 19-20. This is characterized as merely a "tradeoff" between "Izuno's simplicity" and "Minoshima's flexibility," based on Izuno's system having fewer moving parts. *Id.*, 19-20. However, neither the Petition nor Dr. Andrews' declaration provide any technical reasoning explaining how or why a POSITA would expect that using only one part of Minoshima's system would function without the fine positioning enabled by the integrated support arm. Thus, even if a POSITA was motivated to use only Minoshima's sensor system with Izuno, the Petition provides no reasoned technical explanation for why a POSITA would believe the combination, without the benefit of Minoshima's support arm, would be able to successfully achieve the proper positioning required to enable inductive charging.

90. A review of the Petition's motivations to combine the two references further supports this analysis. The Petition asserts that the combination is merely applying "Minoshima's known method" for positioning to Izuno's system to yield "predictable results." Petition, 26; *see also* EX 1003 ¶ 153. As shown, however, Petitioner is not using Minoshima's method, but rather only applies one aspect of that system, and does not explain why the resulting combination would be expected to achieve any of the benefits the Petition claims, or even to actually function to achieve appropriate alignment for inductive charging.

91. The Petition asserts as specific motivations to combine: [a] “to improve operational reliability and efficiency”; [b] “to more effectively detect and confirm the required positional relationship ... is satisfied before issuing start charging signals”; [c] to “prevent inefficient charging conditions”; [d] “while providing a centralized control system for the user”; [e] to ensure “the required positional condition is satisfied prior to charging to improve the efficiency and reliability of the charging system”; [f] to “prevent a vehicle from being uncharged due to being improperly parked, as taught by Minoshima”, [g] “to allow for more reliable, efficient, and faster inductive charging; and [h] to avoid “the situation of being parked in a position in which it will not be charged.” Petition, 24-26 (citing EX 1003 ¶¶ 149-155).

92. Although these are asserted as separate motivations, in reality these are the same general motivations, restated in different ways. Motivations [a] (“to improve operational reliability and efficiency”), [c] (“to “prevent inefficient charging conditions”), and [g] (“to allow for more reliable, efficient, and faster inductive charging”) are merely different ways of stating a single general motivation of improving reliability and efficiency. Likewise, motivations [b] (“to more effectively detect and confirm the required positional relationship ... is satisfied before issuing start charging signals”), [e] (to ensure “the required positional condition is satisfied prior to charging to improve the efficiency and reliability of the charging system”), [f] (to “prevent a vehicle from being uncharged due to being improperly parked, as taught by

Minoshima”), and [h] (to avoid “the situation of being parked in a position in which it will not be charged”) are simply different ways of stating a single general motivation to improve positional alignment for effective charging.

93. Fundamentally, the problem with all of these asserted motivations is that the Petition does not explain why a POSITA would expect Minoshima’s positioning system, without the integrated support arm, would be effective in Izuno’s system to actually achieve proper positioning for charging and thus achieve any of the purported benefits of the combinations. Nor does Dr. Andrews, who simply assumes that implementing one aspect of Minoshima’s integrated positioning system would result in a functioning alignment system. EX 1003 ¶ 153 (“[Minoshima’s positioning method] would have ensured the required positional condition is satisfied prior to charging ...”). However, there is no evidence supporting this assumption, and a POSITA would have understood that Minoshima’s positioning system would only effectively function within its permissible misalignment range allowed due to the support arm’s movement, as discussed above. A POSITA would not have expected the system as applied in the proposed combination to enable proper charging positioning of Izuno’s cores absent the permissible misalignment range provided by Minoshima’s integrated system.

94. In addition, the Petition also overlooks the plain fact that the part of the system best equipped to measure alignment is the fixture to which the car is being aligned. By way of analogy, when aligning the tires of a car, technicians use an

alignment system, not sensors on the car. Placing the sensors on the charging station, as in Izuno's detailed embodiment, also allows charging stations of different sizes and shapes to be constructed and may enable the fixture to measure partial alignment with greater ease because the sensors can be spread out or be more sophisticated or even more expensive since the cost can be amortized over multiple cars. The point is that a POSITA is not automatically motivated to move the sensors onto the car and indeed would see many reasons not to. A POSITA would not regard having the sensors on the fixture, connected to the server of Izuno, as a shortcoming that needs to be addressed. Accordingly, for the foregoing reasons, the Petition does not show that the asserted combination would actually be configured to successfully execute the functions related to detecting alignment and misalignment of the power cores for charging (claims 1[c][i]-1[c][vi]).

4. Izuno-Minoshima-Canedy

95. As discussed above, Canedy's proximity sensors and related displays are devoted to its goal of assisting a user in knowing how far the vehicle is from a solid object (one extending above the surface of the ground), such as a curb. *See* EX 1006, Fig. 1, 5:33-36; Section VII.D.2. However, the Petition does not provide any analysis or reasoning showing that Canedy's system would function with respect to aligning the vehicle's charging coupler (mounted on its underside) and Izuno's charging station charging coupler, which the Petition identifies as being in a charging pad that must be

driven over to align the couplers. EX 1004 [0020]; Petition, 65 (“Izuno’s charging setup is a charging *pad* because a vehicle drives over the charger to perform inductive charging.”). A POSITA would not have been motivated to incorporate Canedy’s system into Izuno-Minoshima, nor would a POSITA have had a reasonable expectation of success in doing so, given that Izuno-Minoshima’s charging station coupler, unlike Canedy’s curb/divider or Minoshima’s ground-level charging device, does not extend above the ground.

E. 1[c][iii]: [wherein the controller is configured to:] in response to detecting the misalignment, disable at least one user control on the display usable to control the inductive charging of the battery,

96. For claim 1[c][iii], the Petition combines Yokota with the previously combined Izuno-Minoshima-Canedy combination. Petition, 38. The Petition relies on Izuno’s disclosure that charging begins after a command to start charging is issued by the user after correct vehicle positioning. *Id.*, 39. The Petition asserts that Izuno-Minoshima-Canedy teaches a controller configured to detect misalignment. *Id.* The Petition adds Yokota to this combination, specifically Yokota’s teaching of “determining whether a function corresponding to a menu item displayed on a screen can be executed,” and if not, “disabling the menu item corresponding to that function.” *Id.*, 40. In the resulting Izuno-Minoshima-Canedy-Yokota combination, the user-selectable control for initiating charging (the “‘start charging’ command”) on the display is disabled when the vehicle-side core and the charging station core are

misaligned per Minoshima's detection determination. Petition, 42; EX 1003 ¶¶ 183-184.

97. The Petition asserts the following motivations to modify Izuno-Minoshima-Canedy with Yokota: [a] to “prevent initiating charging while the coils are misaligned” because misaligned coils prevent or lessen charging efficiency; [b] to “allow the system to disable the user control for initiating charging when misalignment is detected”; [c] to provide “clear feedback and control to the user and prevent[] inefficient operation of the contactless charger”; and [d] to “prevent[] a user thinking it started charging, but did not because the coils are not properly aligned.” Petition, 41-42. The Petition summarizes the change as “a straightforward method for informing a user ... that misalignment ... has been detected and need [sic] to be correctly aligned before charging can be initiated.” *Id.*, 42. Similar to the Petition's proposed motivations to combine Izuno and Minoshima, these motivations overlap and essentially are different ways of stating two general motivations: (1) preventing failed charging or inefficient charging by disabling charging initiation during misalignment (motivations [a], [b]) and (2) providing clear feedback and control to the user regarding a misalignment that impacted charging (motivations [c], [d]).

98. However, incorporating Yokota as proposed would disable Izuno's “start charging” command when there is a misalignment affecting charging. Petition, 41. But a POSITA would not have been motivated to make this change to Izuno-Minoshima-

Canedy because those references already provided, more so than Yokota suggests, the supposed benefits advanced in the Petition.

99. This is first because, in the advanced Izuno-Minoshima-Canedy combination, there is no need to disable a charging command to prevent failed charging due to a misalignment. A misalignment that prevents charging in either Izuno or Minoshima, charging will not occur, regardless of whether the command is disabled. EX 1004 [0030]; EX 1005 [0038]-[0039]. Disabling the command as Petitioner suggests from Yokota does not prevent failed charging.

100. Similarly, there is nothing in Izuno or Minoshima allowing for inefficient charging when there is a misalignment. Both references teach that charging occurs only when their cores are aligned opposite one another. EX 1004 [0020]; EX 1005 [0027]. If they are, charging proceeds; if not, it cannot. EX 1004 [0020], [0030]; EX 1005 [0035], [0038]-[0039]. There is no suggestion that the cores can be sufficiently aligned to allow charging but still misaligned such that charging will be “inefficient.” Because inefficient charging cannot happen in either reference, disabling Izuno’s “start charging” command does not prevent it.

101. Disabling the command thus actually serves one of the purposes presented in the Petition’s asserted motivations to combine: notifying the user of a misalignment when charging cannot be initiated. However, merely disabling the charging command alone does not actually provide any information about misalignment; it merely disables

an existing command. If anything, the combination presented in the Petition is merely annoying, because the user interface blanks out the option until the driver stumbles across the correct positioning. But assuming that the combination provided information about misalignment, or that the Petition proposes a modification which would also state the reason (which to my understanding is not detailed), this is already present in Izuno-Minoshima-Canedy. In fact, that combination provides even more detailed notification to the user than contemplated in Yokota. Minoshima's disclosure is about notifying a driver as to whether the vehicle is properly aligned for charging. EX 1005, Abstract, [0007]. Minoshima already displays the "Parking Position NG" message for the driver during misalignment, and teaches also providing the specific direction of misalignment via detailed messages indicating the precise reason for the misalignment and how to reposition the vehicle. *Id.* [0038]-[0039], [0056]. I note that the Petition explicitly includes this functionality in the Izuno-Minoshima combination. Petition, 28 ("Thus, when modifying Izuno [with Minoshima], positional information would also have been provided to the driver on a display to help correctly position the vehicle to enable inductive charging."). Similarly, Canedy discloses delivering precise (single-axis) distance information, as well as visible indicators on a displayed vehicle silhouette to inform the driver of how far the vehicle is away from an object. EX 1006, 2:15-22, 4:52-5:6, 5:24-30. All of these methods do more than disable a charging command, which at best provides a passive indication to the user that something is wrong, but does

not provide any specific notice that there is a misalignment or how to correct it. They instead affirmatively notify the user that the vehicle is misaligned and requires repositioning, with directions on how to do so, and/or provide detailed distance information. A POSITA would therefore not consider merely disabling a menu command to be necessary or provide anything useful over the existing combination.

102. Thus, none of the proposed motivations to combine would prompt a POSITA to implement Yokota's functionality into the proposed Izuno-Minoshima-Canedy combination.

- F. 1[c][iv]-[v]: [wherein the controller is configured to:] detect a second positional relationship between the first core and the second core at a second time occurring after movement of the vehicle, detect an alignment of the first core with respect to the second core within a threshold based at least in part on the second positional relationship between the first core and the second core,**

103. For the reasons discussed for claim 1[c][i]-[ii] above, the Petition fails to show that the proposed combination would achieve the claimed functionality of detecting a second positional relationship or an alignment between the cores, within a threshold based on a positional relationship between them, as required by claims 1[c][iv]-[v]. *See* Section VII.D.

- G. 1[c][vi]: [wherein the controller is configured to:] in response to detecting the alignment, enable the user control on the display, and**

104. The Petition asserts that Izuno-Minoshima-Canedy-Yokota teaches claim 1[c][vi]. Petition, 52. The Petition asserts, based on its analysis of claim 1[c][iii], that

control for initiating charging would be disabled when the charging cores are misaligned, and that the combination's "user control for initiating charging would be *enabled* per Yokota only after repositioning the vehicle and detecting proper alignment." *Id.*

105. The Petition asserts that Yokota "performs a determination step that results in disabling or enabling a menu item." *Id.*, 53. Specifically, the Petition asserts that Yokota enables a function because Yokota's menu item displaying method "includes the steps of determining whether a function corresponding to a menu item displayed on the screen can be executed." *Id.* (quoting EX 1007 [0030]). However, Yokota does not teach enabling a menu item; but (as stated in the Petition) only executing a function corresponding to a selected menu item when the system initially determines that it can be executed. Petition, 54 (citing EX 1007 [0030]-[0031], [0052], [0069], [0075]-[0076], [0083]). This is confirmed by the Petition's analysis of Yokota's Fig. 6, where the system initially evaluates whether a function is available (Step 205). Once the system determines that it is not, the menu item is disabled preventing user selection (Step 207). Petition, 55; EX 1007 [0076]-[0077].

106. Neither the Petition nor Dr. Andrews' declaration provides any analysis showing the claimed functionality, which requires disabling a user charging control on the display due to a misalignment (claim 1[c][iii]), then, after movement of the vehicle, detecting an appropriate alignment (claim 1[c][v]), and "in response to detecting the

alignment, enable the user control on the display” (claim 1[c][vi]). Thus, while Yokota teaches initially determining whether a function can be executed, and if so leaving that function in its default enabled state, it does not address [1] first disabling a user control after determining a condition is unsatisfied (here, the unsatisfied condition is correct alignment, or conversely detection of misalignment), then [2] detecting a change in that condition (here, proper alignment after vehicle movement that now permits charging), and then [3] affirmatively enabling the previously-disabled user control to permit a user selection. That is, Yokota does not discuss or address re-evaluating a previously-disabled menu item and then re-enabling it once the corresponding functionality is restored. Therefore, even if the combination were made, it would not possess the limitation required by claim 1[c][vi].

107. The Petition’s motivation to combine analysis for claim 1[c][vi] is essentially the same as its analysis for Claim 1[c][iii], with changes only in whether the motivation is tied to detecting alignment or misalignment or enabling or disabling a menu item. *Compare, e.g.,* Petition, 56-57 *with* Petition, 41-42 (changing “detecting misalignment” to “detecting alignment” and “disabling a menu item” to “enabling a menu item”). I note that the Petition asserts that the combination for claim 1[c][vi], which requires enabling user control, would “prevent inefficient operation” “by **disabling** the initiating charge functionality when coil misalignment is detected.” Petition, 56. It is not clear why a modification that enables the user control for initiating

charging would result in disabling the user control for charge functionality, and this appears to be a motivation applicable to claim 1[c][iii] rather than 1[c][vi]. Nevertheless, because the asserted motivations are actually the same as those proposed for claim 1[c][iii], the asserted motivations are deficient for the same reasons discussed for that claim. Section VII.E.

108. The Petition asserts that there was a reasonable expectation of success in the combination because “[e]nabling menu items when conditions are appropriate was a known technique in human machine interfaces,” and “if a menu item is not disabled, it would have been enabled for user selection to execute the particular function associated with the menu item.” Petition, 57; EX 1003 ¶ 235. These positions actually support the conclusion that Yokota does not teach enabling a disabled user control. The Petition’s statement that “if a menu item is not disabled, it would have been enabled” effectively states that a menu item that is enabled has not yet been disabled, and does not require or suggest that a menu item that has been disabled will be reenabled. As discussed, there is no teaching in Yokota about any process for reevaluating functionality and then enabling the disabled menu item, as required by the claim. Neither the Petition nor Dr. Andrews provides any explanation for how to do so, relying instead on generalized assertions of “straightforward and routine changes” and general knowledge (“context based/context-aware menu design”), outside the asserted references. Petition, 57-58; EX 1003 ¶ 236.

109. Therefore, this limitation is not taught or suggested in Yokota. Even if it were suggested (which I do not understand to be the case), the Petition does not provide any technical reasoning explaining how the combination would implement such functionality, which is not detailed at all in Yokota. In my opinion, this limitation is not taught or suggested by any of the asserted references, nor does the Petition provide a sufficient analysis of any motivation to combine, or any reasonable expectation of success. Therefore, Ground 1 does not teach or suggest this claim element.

H. 1[c][vii]: [wherein the controller is configured to:] in response to receiving a selection of the user control, initiate inductive charging via the first core and the second core.

110. The Petition asserts that Izuno-Minoshima-Canedy-Yokota teaches this element, citing user selection of a “charging start instruction” via the vehicle display, and Izuno’s step S28, which as described in Izuno, “the system checks whether a charging start instruction has been received from the user.” Petition, 58 (citing EX 1004 [0027], [0034]).

111. I note that the “system” as used in the cited passage from Izuno (paragraph [0034]) refers to the service system server 100. This is clear based on the division of functions between the ECU, the server, and the charging station. EX 1004 [0023] (“The processing related to controlling charging of the battery 12 will now be explained using flowcharts divided into the processing performed by the vehicle system 10 shown in FIG. 3, the processing performed by the service system server 100 shown in FIG. 4,

and the processing performed by the 40 charging station 60 shown in FIG. 5.”). The discussion of the processing performed by the vehicle system (the ECU) is discussed in paragraphs [0024]-[0028]. *Id.* [0024]-[0028], Fig. 3. The processing performed by the service system server 100 is explained in paragraphs [0029]-[0035]. *Id.* [0029]-[0035], Fig. 4. This includes the cited paragraph [0034]; thus, “the system” performing step S28 in Figure 4 is the system server 100.

112. Returning to the Petition, it traces the signal sent to the server 100, and the server’s subsequent charging schedule determination and signal to start charging sent to the charging station. Petition, (citing EX 1004 [0018], [0022]. Based on this analysis, the Petition concludes that the modified “ECU/processor/controller” of the combination (the mapped controller) is configured to initiate inductive charging via the first and second cores, as required by the claim limitation. *Id.*, 59. Dr. Andrews testifies that “[t]his is because ... when a user selects the [enabled] menu item for start charging, the inductive charging process occurs.” EX 1003 ¶ 238.

113. As previously discussed, Izuno’s ECU is not responsible for charging control in Izuno, nor does the Petition propose any modification or combination whereby such charging control is added to the ECU. *See* Section VII.C. above. The ECU sends battery status information to the server for the server’s use in planning and controlling charging operations. *Id.*; EX 1004 [0016]-[00018]. The ECU is responsible, as the Petition identifies, for checking the user’s selected charge mode (automatic or

not) and transmitting that information to the system server. EX 1004 [0027]. When automatic charging is selected, “the processing proceeds from step S8 to step S9 [in Figure 3], in which a charging mode selection signal indicating automatic charging is sent to the service system server 100, and the processing is then exited.” *Id.* “[T]he processing” that is exited here refers to the processing discussed in Izuno Figure 3, which as previously explained reflects the processing performed by the vehicle system 10, which is done by the ECU. EX 1004 [0023], Fig. 2. Thus, the ECU’s involvement in charging control is sending a signal to the system server noting that the user has selected the automatic charging mode. But this signal does not initiate charging as required by the claim.

114. This is because the system server 100 in Izuno checks “whether a charging start instruction has been received from the user.” *Id.* [0034]. This is shown step S28 in Figure 4, and is the same signal sent by the ECU in S9. But receipt of this signal does not result in an automatic initiation of charging or even an automatic charging signal. Instead, the system server first checks “whether the elapsed time since receiving the charging start instruction was less than a threshold value.” *Id.* If the time since receiving the start charging instruction is over a threshold value, charging is not initiated and the unit goes into standby. *Id.* If the time is less than a threshold value, the sever transmits a charging signal to the charging station and initiates charging. *Id.*

115. Because the system server must perform a comparison with the threshold time after receiving the ECU's charging signal, and only transmits its own charging initiation signal when the appropriate conditions are met, the ECU's charging signal does not itself initiate charging. That is, even if a user selects the enabled menu item to initiate charging, charging may not be initiated because the system server may not find all conditions allowing charging to begin have been met. Thus, contrary to Dr. Andrews' assertion that "when the user selects 'start charging,' inductive charging via the first and second cores initiates," user selection of an enabled menu item will not necessarily result in starting the charging process. *See* EX 1003 ¶ 238. Accordingly, the ECU, the mapped controller in the asserted combination, is not "configured to ... in response to receiving a selection of the user control, initiate inductive charging via the first core and the second core."

116. The Petition does not propose to change this functionality in the proposed modification. The Petition, in analyzing this limitation, explicitly relies on Izuno's identification of the server (not the ECU) as the ultimate control for initiating charging, explaining that "when the user presses the start control, a signal is transmitted to server 100, server 100 calculates a charging schedule, and server 100 transmits the charging start signal to charging station 60." Petition, 58. Petitioner's proposed modifications to Izuno consistently accept the server's processing role for charging operations as-is, and never propose relocating them for performance at the ECU. *See* Petition, 14-15.

117. Therefore, Izuno-Minoshima-Canedy-Yokota does not teach or suggest Claim 1[c][vii].

I. Conclusion as to Ground 1

118. For the reasons explained above, Ground 1 does not render claim 1 unpatentable. To summarize, and without intending to limit the analysis presented above, there are multiple problems with the proposed combination(s). The proposed combination of Izuno-Minoshima isolates and extracts only one part of Minoshima's integrated positioning system, eliminating the moveable support arm that is critical to the system's functionality. The Petition does not provide any explanation as to why a POSITA would have expected this combination to be able to achieve proper alignment for inductive charging, without the support arm required by Minoshima's system. The proposed combination of Izuno-Minoshima-Canedy-Yokota also does not teach or suggest an initial disabling of a user control due to misalignment and then reenabling it to allow charging once alignment is corrected. Further, as discussed, there are multiple deficiencies in the Petition's asserted motivations to combine and reasonable expectations of success. Therefore, in my opinion the Petition does not show that the asserted combination(s) teach or suggest all limitations of independent claim 1, nor does it support a conclusion that the claim as a whole was obvious.

VIII. OPINIONS REGARDING GROUND 2

119. In Ground 2, the Petition maps all elements of independent claim 7 to corresponding elements of Claim 1. Petition, 59-60. Likewise, the Petition maps independent claim 15 to corresponding elements of Claim 1, but cites only to the combinations of Izuno, Minoshima, and/or Yokota (that is, excluding Canedy). *Id.*, 61-62. Petitioner's challenges to dependent claims 12-14 and 16-20 all incorporate Petitioner's analysis of either claim 1, claim 7, or claim 15. *Id.*, 60-64. Because they all ultimately depend on Ground 1, the Ground 2 combinations fail for the same reasons discussed for Ground 1 above. *See* Section VII above. Because of this, I have not at this time analyzed the specific analysis set forth in the Petition for these claims. I will do so should a trial on the Petition be instituted.

120. I also note that the Petition acknowledges that Minoshima's primary embodiment relies on charge station mounted proximity sensors, and relies on the alternative embodiment "where the proximity sensors are located within the electric vehicle." *Id.*, 20. The Petition asserts that Minoshima teaches "vehicle proximity sensors 17 detect the vehicle's deviation in the width and longitudinal directions relative to a predetermined distance from the ground-level charging device." *Id.*, 21. In support, however, the Petition cites only to Minoshima's implementation of its charger-side sensor embodiment. *Id.* The Petition constructs modified versions of Minoshima's

figures showing how it believes Minoshima's vehicle-based sensor embodiment would be implemented. *Id.*, 22-23.

121. However, as previously noted the Petition and Dr. Andrews admit that Minoshima "simply lacks implementation details" for its vehicle-based sensor embodiment. *See* Section VII.D.1. This is an acknowledgement that there is no reasonable expectation of success in combining Minoshima with Izuno absent additional guidance on this implementation. For Ground 1, the Petition relies on Canedy to supply these details. *See* Section VII.D.2. However, for Ground 2, the Petition does not include Canedy, reasoning that it is unnecessary because the claims do not recite a controller. Petition, 59. But even without a controller, the asserted combination still requires Izuno and Minoshima to be successfully combined to implement Minoshima's vehicle-side proximity sensors. *See id.*, 60-62 (relying on combination of Izuno-Minoshima for independent claims 7 and 15). The Petition's acknowledgement that Minoshima lacks the necessary implementation details for its vehicle-side sensor embodiment thus effectively admits that there is no reasonable expectation of success for the Ground 2 combination. For this additional reason, the Petition does not support the conclusion that any of the challenged claims are obvious in view of Ground 2.

IX. OPINIONS REGARDING GROUNDS 3-7

122. Grounds 3-5 are directed at dependent claims 2-6, all of which depend from Claim 1. Petition, 64-78. Grounds 6-7 are directed at claims 8-11, which depend

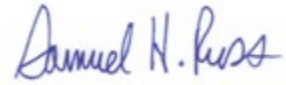
from Claim 7. *Id.*, 78-79. In its analysis of these grounds, the Petition does not separately address the limitations of the independent claims from which these claims depend. Petition, 64-79. I will assume the Petition intended to incorporate for Grounds 2-5 the same Ground 1 combinations (of Izuno, Minoshima, Canedy, and Yokota), and for Grounds 6-7 the same Ground 2 combinations (of Izuno, Minoshima, and Yokota), while merely combining them with the additional references identified for the challenged dependent claims. Petition, 59-79. Assuming this is the case, Grounds 3-7 assert the same combinations asserted in either Ground 1 or Ground 2 directed to the independent claims. Further, the Petition does not contend that any of the additional references cited in Grounds 3-7 (Ross, Kuki, Shimizu) address the deficiencies identified for Grounds 1 or 2. Therefore, these Grounds cannot demonstrate that any of the challenged claims are obvious for the same reasons as the grounds directed to the independent claims. *See* Sections VII.-VIII. Because of this, I have not at this time analyzed the specific analysis set forth in the Petition for these claims. I will do so should a trial on the Petition be instituted.

X. CONCLUSION

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

of the United States Code. I further declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct.

Dated: September 23, 2026



Samuel Russ, PhD.

APPENDIX A

Curriculum Vitae of Dr. Samuel H. Russ

Personal

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Phone: (251) 461-1378
e-mail: sruss@southalabama.edu
Citizenship: U.S.

Education

Ph.D. in Electrical Engineering, Georgia Institute of Technology, 1991.
Thesis Title: *An Information-Theoretic Approach to Analysis of Computer Architectures and Compression of Instruction Memory Usage*
Thesis Advisor: Dr. Cecil O. Alford
Bachelor's of Electrical Engineering (with Highest Honor), Georgia Institute of Technology, 1986.

Employment

Aspect Aerospace

2023 – Present

Co-Founder and CTO: Pursue venture capital investments, work with potential customers, develop engineering plan for the company, write grant proposals, supervise patenting process. Write and obtain grant funding. Develop satellite architectures and products including power system and battery charging.

University of South Alabama

2007 – Present

Interim Chair, Department of Electrical and Computer Engineering (2015-2016)

Associate Professor, Department of Electrical and Computer Engineering (2011-present)

Assistant Professor, Department of Electrical and Computer Engineering

Developing new class in signal integrity, developing cross-disciplinary collaborative research efforts, updating labs and class materials, teaching both undergraduate and graduate classes. Pioneering coursework in embedded-system safety includes battery chemistries, chargers, and safety issues. Developed and launched a fully functional CubeSat satellite that included a power system with solar power and a battery charger, and optimized the software for minimal power consumption.

Scientific-Atlanta (Later Cisco, Now Technicolor)

2000 - 2007

Manager, Advanced Technologies R&D, Explored major new technologies including home networking and multi-room video distribution; oversaw construction of prototypes and demonstrations; demonstrated technologies at trade shows and to stock analysts; managed group of approximately 10 designing set-top boxes for the cable television industry including all phases of high-volume electronic design including layout, high-speed digital design, emissions considerations, gate array conversion, and designing with custom ASICs; supervised cross-functional team to increase hard drive reliability; wrote numerous patent applications. Products deployed widely, including Time Warner Cable and Cablevision.

IVI Checkmate (Now Ingenico)

1999 – 2000

Matrix Manager, Electrical Engineering, Supervised staff of approximately 6 electrical engineers, oversaw assignments, allocated time across multiple projects, worked to coordinate project schedules with priorities, assisted in sales and other customer communications.

Staff Electrical Engineer, Oversaw major design overhaul of touch-pad payment system including embedded-systems design, power-system design, battery-powered operation, optimization of charging including thermal issues, and system layout and schematic capture. System deployed widely at Wal-Mart, Home Depot, and others.

Mississippi State University

1994 - 1999

Thrust Leader, Computing Systems Research Thrust and Systems Integration Group, NSF Engineering Research Center -- Coordinate research plans and NSF reporting for 6 faculty and 3 full-time staff, assist in development of strategic plans and pursuit of funding opportunities, oversight of development of the ERC-wide integrated testbed. Managed multi-year research project in distributed computing that included 11 students and 5 faculty.

Assistant Professor, Department of Electrical & Computer Engineering -- Developed all-new graduate class in circuit board design, authored textbook chapter, developing new undergraduate lab, pioneered teaching classes over 2-way interactive video.

Dickerson Vision Technologies (Now Cognex)

1992 - 1994

Director of Manufacturing--Oversaw the development and implementation of a manufacturing plan for the company.

Senior Applications Engineer--Developed firmware and user-interface software for the company's proprietary hardware, Assisted in development of machine vision system hardware, Assisted in sales duties.

Georgia Institute of Technology

1987 - 1991

Graduate Research Assistant--Helped design five VLSI chips while developing two custom CPU's, Silicon-compiler-based computer chip design, including initial design, full functional simulation, size and timing optimization, and manufacturing test development.

Publications

Books

1. Samuel H. Russ, *Signal Integrity: Applied Electromagnetics and Professional Practice*, Springer, 2016. (Textbook)
2. Samuel H. Russ, *Signal Integrity: Applied Electromagnetics and Professional Practice*, Second Edition, Springer, 2022. (Textbook)

Book Chapters

1. Samuel H. Russ, "High-Speed Digital Effects", Chapter 10 of John Kraus and Daniel Fleisch, *Electromagnetics with Applications, Fifth Edition*, McGraw-Hill, 1998. (Textbook)
2. Samuel Russ, Bret Webb, Jonathan Holifield and Justin Walker (2011). "PILS: Low-Cost Water-Level Monitoring, Environmental Monitoring", Dr. E.O. Ekundayo, Ph.D., (Ed.), pp. 137-156, ISBN: 978-953-307-724-6, InTech, (Peer-reviewed)

Journal and Magazine Articles

1. Samuel Russ, "The Threat of Malicious Circuit-Board Alteration: Attack Taxonomy and Examples," *Electronic Device Failure Analysis*, Vol. 23, Issue 3, August 2021, pp. 13-22.
2. Mink DM, McDonald J, Bagui S, Glisson WB, Shropshire J, Benton R, Russ S. Near-Real-Time IDS for the U.S. FAA's NextGen ADS-B. *Big Data and Cognitive Computing*. 2021; 5(2):27. <https://doi.org/10.3390/bdcc5020027>
3. S. H. Russ and J. Gatlin, "Ways to hack a printed circuit board: PCB production is an underappreciated vulnerability in the global supply chain," *IEEE Spectrum*, vol. 57, no. 9, pp. 38-43, Sept. 2020.
4. Samuel H. Russ, Cade C. Cashen, Thomas Thomas, and Roma Hanks, "Smart Grid Architecture for Unobtrusive Home Health Monitoring," *National Social Science Journal*, Vol. 44, No. 1, 2015, pp. 62-68.
5. Samuel H. Russ, Tho D. Ha, and Jonathan H. Shapiro, "Simulation-based Optimization of Wear Leveling for Solid-State Disk Digital Video Recording," *IEEE Transactions on Consumer Electronics*, Vol. 60, No. 3, Nov. 2014, pp. 363-367.

6. Samuel H. Russ and Salim Alsharif, "Packet Loss Behavior of HomePlug AV Traffic at Video Bit Rates", *IEEE Transactions on Consumer Electronics*, Vol. 57, No. 2, May 2011, pp. 823-826.
7. Samuel H. Russ and Ramesh Nallur, "Digital Video Recording onto Solid-State Disks: Feasibility and Lifetime Estimation", *IEEE Transactions on Consumer Electronics*, Vol. 57, No. 2, May 2011, pp. 558-563.
8. Samuel H. Russ and Sasan Haghani, "802.11g Packet-Loss Behavior at High Sustained Bit Rates in the Home", *IEEE Transactions on Consumer Electronics*, Vol. 55, No. 2, May 2009, pp. 788-791.
9. Samuel H. Russ, and Ramesh Nallur, "A Framework for Calculating Fundamental DVR Performance Limits", *IEEE Transactions on Consumer Electronics*, Vol. 55, No. 1, Feb. 2009, pp. 132-138.
10. Ioana Banicescu, Sheikh Ghafoor, Vijay Velusamy, Samuel H. Russ, Mark Bilderback, "Experiences from integrating algorithmic and systemic load balancing strategies", *Concurrency and Computation: Practice and Experience*, Volume 13, Number 2, pp. 121-139 (2001).
11. Roger L. King, Samuel H. Russ, Aric B. Lambert, Donna S. Reese, "An artificial immune system model for intelligent agents", *Future Generation Computer Systems*, Volume 17, Issue 4, pp. 335 - 343 (January 2001).
12. Dr. Samuel H. Russ, Jonathan Robinson, Matt Gleeson, Brad Meyers, and Chun-Heong Tan, "Using Hector to Run MPI Programs over Networked Workstations", *Concurrency - Practice and Experience*, Vol. 11, No. 4, pp. 189-204 (1999).
13. Russ, S.H. Reece, K. Robinson, J. Meyers, B. Rajan, D. Rajagopalan, L. Chun-Heong Tan, "Hector: an agent based architecture for dynamic resource management", *IEEE Concurrency*, Vol. 7, No. 2, pp. 47-55, Apr-Jun 1999.
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U.S. Patents

1. U.S. Patent Number 6,748,080, "Apparatus for entitling remote client devices", Samuel Russ, Michael Gaul, Anthony Wasilewski, and Howard Pinder, June 8, 2004.
2. U.S. Patent Number 7,181,010, "Apparatus for entitling remote client devices", Samuel Russ, Michael Gaul, Anthony Wasilewski, and Howard Pinder, February 20, 2007.
3. U.S. Patent Number 7,360,233, "Broadcast carousel system access for remote home communication terminal", Samuel Russ, Michael Gaul, and Anthony Wasilewski, April 15, 2008.
4. U.S. Patent Number 7,360,235, "Systems and methods for operating a peripheral record/playback device in a networked multimedia system", David Davies, Samuel Russ, and Irvan Krantzler, April 15, 2008.
5. U.S. Patent Number 7,499,822, "Analog set-top calibration patterns in manufacturing", Leo Montreuil, Wayne B. Williams, Samuel H. Russ, and Robert Kriete, March 3, 2009
6. U.S. Patent Number 7,505,592, "Apparatus for entitling and transmitting service instances to remote client devices", Samuel H. Russ, Michael Gaul, Anthony Wasilewski, and Howard Pinder, March 17, 2009
7. U.S. Patent Number 7,516,470, "Locally-updated interactive program guide", Samuel H. Russ and Michael Gaul, April 7, 2009
8. U.S. Patent Number 7,826,711, "Digital Video Disc (DVD) Player or Digital Video Recorder (DVR) Playback with Memory", Samuel H. Russ, Nov. 2, 2010.
9. U.S. Patent Number 7,849,486, "Networked subscriber television distribution", Samuel H. Russ, David Lett, Jonathan Robinson, and Michael Gaul, Dec. 7, 2010.

10. U.S. Patent Number 7,860,250, "Apparatus for entitling and transmitting service instances to remote client devices", Samuel H. Russ, Michael Gaul, Anthony Wasilewski, and Howard Pinder, Dec. 28, 2010.
11. U.S. Patent Number 7,861,272, "Networked subscriber television distribution", Samuel H. Russ, David Lett, Jonathan Robinson, and Michael Gaul, Dec. 28, 2010.
12. U.S. Patent Number 7,870,584, "Interactive program guide with selectable updating", Samuel H. Russ and Michael Gaul, Jan. 11, 2011.
13. U.S. Patent Number 7,876,998, "DVD playback over multi-room by copying to HDD", William Wall and Samuel H. Russ, Jan. 25, 2011.
14. U.S. Patent Number 7,908,625, "Networked multimedia system", Neil C. Robertson, David B. Lett, Samuel H. Russ, Bohdan S. Prus, Michael A. Gaul, and Ajith N. Nair, March 15, 2011.
15. U.S. Patent Number 7,937,737, "Field qualification of disk drives in consumer electronics devices", Samuel H. Russ and Mark R. Murray, May 3, 2011.
16. U.S. Patent Number 7,961,780, "Generated set top calibration patterns in manufacturing", Leo Montreuil, Wayne B. Williams, Samuel H. Russ, and Robert Kriete, Jun. 14, 2011.
17. U.S. Patent Number 7,978,720, "Digital media device having media content transfer capability", Samuel H. Russ, Christopher L. Stallings, July 12, 2011.
18. U.S. Patent Number 8,046,806, "Multiroom point of deployment module", William E. Wall, Samuel H. Russ, Oct. 25, 2011.
19. U.S. Patent Number 8,127,236, "Proximity detection using wireless connectivity in a communications system", Paul J. Claussen, Ajith N. Nair, and Samuel H. Russ, Feb. 28, 2012.
20. U.S. Patent Number 8,181,205, "PVR Channel and PVR IPG Information", Samuel H. Russ, Michael A. Gaul, and Dariusz S. Kaminski, May 15, 2012.
21. U.S. Patent Number 8,208,796, "Systems and methods for prioritizing the storage location of media data", Bohdan Prus and Samuel H. Russ, June 26, 2012.
22. U.S. Patent Number 8,280,229, "DVD playback over multi-room by copying to HDD", William E. Wall and Samuel H. Russ, October 2, 2012.
23. U.S. Patent Number 8,295,338, "Generated set top calibration patterns in manufacturing", Leo Montreuil, Wayne B. Williams, Samuel H. Russ, and Robert A. Kriete, October 23, 2012.
24. U.S. Patent Number 8,364,015, "Stretch and zoom bar for displaying information", Samuel H. Russ and Gary Hibbard, January 29, 2013.
25. U.S. Patent Number 8,549,567, "Media content sharing over a home network", Samuel H. Russ, David B. Lett, Jonathan Robinson, Michael A. Gaul, October 1, 2013.
26. U.S. Patent Number 8,627,385, "Systems and methods for operating a peripheral record playback device in a networked multimedia system", David B. Davies, Samuel H. Russ, Irvan J. Krantzler, January 7, 2014.
27. U.S. Patent Number 8,966,550, "Home communication systems," David B. Davies, Samuel H. Russ, Irvan J. Krantzler, February 24, 2015.
28. U.S. Patent Number 9,762,970, "Access of stored video from peer devices in a local network," David B. Davies, Samuel H. Russ, and Irvan J. Krantzler, September 12, 2017.
29. U.S. Patent Number 10,412,439, "PVR Channel and PVR IPG Information", Samuel H. Russ, Michael A. Gaul, and Dariusz S. Kaminski, Sep. 10, 2019.

European Patents

1. European Patent Number EP1543680B1, "Locally-updated interactive program guide", Samuel Russ and Michael Gaul, Feb. 17, 2010.
2. European Patent Number EP1673937B1, "Proximity detection using wireless connectivity in a communications system", Paul Claussen, Ajith Nair, and Samuel Russ, April 21, 2010.
3. European Patent Number EP1604523B1, "Method for determining the encryption of a service content depending on the fidelity of the reformatting of said content", Samuel Russ, Michael Gaul, Anthony Wasilewski, and Howard Pinder, Nov. 21, 2012.

4. European Patent Number EP1552699B1, "Networked multimedia system", Neil Robertson, David Lett, Samuel Russ, Bohdan Prus, Michael Gaul, and Ajith Nair, Dec. 18, 2013.
5. European Patent Number EP1334617B1, "Networked Subscriber Television Distribution", Samuel Russ, David Lett, Jonathan Robinson, and Michael Gaul, April 1, 2015.
6. European Patent Number EP1920601B1, "Multiroom Point of Deployment Module," William Wall and Samuel Russ, May 4, 2016.
7. European Patent Number EP1510033B1, "Apparatus for Entitling Remote Client Devices," Samuel H. Russ, Michael Gaul, Anthony Wasilewski, and Howard Pinder, April 26, 2017.
8. European Patent Number EP1540946B1, "Broadcast Carousel System Access for Remote Home Communications Terminal via a Gateway Device," Samuel Russ, Michael Gaul, and Anthony Wasilewski, April 18, 2018.
9. European Patent Number EP2008280B1, "Method and Device for Prioritizing the Storage Location of Media Data," Bohdan Prus and Samuel Russ, September 26, 2018.

Conference Papers

1. J. E. S. Dalgety and S. Russ, "Design, Implementation, and Verification of a DC-Powered Solar Cell Test Bench," *SoutheastCon 2025*, Concord, NC, USA, 2025, pp. 1328-132
2. McDonald, Jeffrey Todd, Jennifer Parnell, Todd R. Andel, and Samuel H. Russ. "Effectiveness of Adversarial Component Recovery in Protected Netlist Circuit Designs." In *SECURITY*, pp. 181-192. 2022.
3. S.H. Russ, M. Khan, S. Latif, "Surreptitiously Adding a WLAN Antenna to a Printed Circuit Board" 2022 IEEE Physical Assurance and Inspection of Electronics (PAINE), Huntsville, AL, USA, 2022.
4. J. Todd McDonald, Rebecca C. Clark, Lee M. Hively, and Samuel H. Russ. 2022. "Phase space power analysis for PC-based rootkit detection." In *Proceedings of the 2022 ACM Southeast Conference (ACM SE '22)*. Association for Computing Machinery, New York, NY, USA, 82–90. <https://doi.org/10.1145/3476883.3520212>
5. S. H. Russ, "Surreptitiously Adding a Microcontroller to a Printed Circuit Board," 2021 IEEE Physical Assurance and Inspection of Electronics (PAINE), Washington, DC, USA, 2021.
6. S.H. Russ, "Circuit Board Security Vulnerabilities and Counteractions", IPC APEX EXPO 2021.
7. S. H. Russ, "Techniques to Thwart Surreptitiously Altered PCBs," 2020 IEEE Physical Assurance and Inspection of Electronics (PAINE), Washington, DC, USA, 2020, pp. 1-4.
8. S. H. Russ, E. Spencer, T. Scroggins, and S. Latif, "Power-Efficient Software Architecture for a CubeSat System", *2020 SoutheastCon*, Raleigh, NC, USA, 2020, pp. 1-6.
9. A. Russ, S. H. Russ, E. Spencer and M. Frank, "Motor Controller and Reaction Wheel for CubeSat," *2019 SoutheastCon*, Huntsville, AL, USA, 2019, pp. 1-3.
10. F. Lorenzo, J. T. McDonald, T. R. Andel, W. B. Glisson and S. Russ, "Evaluating Side Channel Resilience in iPhone 5c Unlock Scenarios," *2019 SoutheastCon*, Huntsville, AL, USA, 2019, pp. 1-7
11. E. Spencer, D. Clark, S. Russ, *et al.*, "First results from a time domain impedance probe for measuring plasma properties in the ionosphere," 2017 IEEE 60th International Midwest Symposium on Circuits and Systems (MWSCAS), Boston, MA, 2017, pp. 1284-1287.
12. E. Spencer, D. Clark, R. Gollapalli, S. Russ and B. Kerrigan, "A System On Chip design for fast time domain impedance spectroscopy," 2017 IEEE 60th International Midwest Symposium on Circuits and Systems (MWSCAS), Boston, MA, 2017, pp. 124-127.
13. Ramya Manikyam, J. Todd McDonald, William R. Mahoney, Todd R. Andel, and Samuel H. Russ, "Comparing the effectiveness of commercial obfuscators against MATE attacks," *Proceedings of the 6th Workshop on Software Security, Protection, and Reverse Engineering (SSPREW '16)*, 2016, Article 8. DOI: <https://doi.org/10.1145/3015135.3015143>
14. Samuel Russ, Tho Ha, and Jonathan Shapiro, "Simulation of Digital Video Recording to

- Maximize Solid-State Disk Lifetime,” *Proceedings of the 2014 International Conference on Consumer Electronics*, Jan. 10-13, 2014, pp. 562-563.
15. Thomas Thomas, Cade Cashen, and Samuel Russ, “Leveraging Smart Grid Technology for Home Health Care”, *Proceedings of the 2013 International Conference on Consumer Electronics*, Jan. 11-14, 2013, pp. 276-277.
 16. Cade Cashen, Samuel Russ, and Thomas Thomas, “Using a Wireless LAN to Perform Motion Detection”, *Proceedings of the 2013 International Conference on Consumer Electronics*, Jan. 11-14, 2013, pp. 63-64.
 17. Nicklaus Thomas, David Evans, and Samuel Russ, “A Markovian Algorithm for Creating Immersive Public-Speaking Audiences”, *Proceedings of the 2013 International Conference on Consumer Electronics*, Jan. 11-14, 2013, pp. 384-385.
 18. Samuel H. Russ, “Podcasting to Improve Software Usage”, *Proceedings of the 2012 ASEE Southeastern Section Conference*, April 1-3 2012, Starkville, MS, Paper ID 605.
 19. Samuel H. Russ, “Using Student ID Numbers to Create Customized Homework Problems”, *Proceedings of the 2012 ASEE Southeastern Section Conference*, April 1-3 2012, Starkville, MS, Paper ID 606.
 20. Samuel H. Russ and Ramesh Nallur, “Digital Video Recording Onto Solid-State Disks”, *2011 Digest of Technical Papers, 2011 International Conference on Consumer Electronics*, pp. 495-496. (2nd place in best paper contest, 2011.)
 21. Mohammad Mushtaq, Samuel H. Russ, and Mohammad S. Alam, “Variable FEC to Reduce ECC Overhead in Digital Video Transmission”, *2011 Digest of Technical Papers, 2011 International Conference on Consumer Electronics*, pp. 215-216.
 22. Samuel H. Russ and Salim Alsharif, “Behavior of HomePlug AV Traffic At High Sustained Bit Rates in the Home”, *2011 Digest of Technical Papers, 2011 International Conference on Consumer Electronics*, pp. 682-683.
 23. Samuel H. Russ, Viswakalyan Perepa, Silas Leavesly, and Bret Webb, “Novel Low-Cost Salinity Sensor for Embedded Environmental Monitoring”, *Proceedings of IEEE Southeastcon 2010*, March 18-21, 2010, pp. 53-56.
 24. Samuel H. Russ and Kung-Hsien Chen, “Thermally Conductive Circuit Boards”, *Proceedings of the 59th Electronic Components and Technology Conference (ECTC 2009)*, May 2009, pp. 465-468.
 25. Samuel H. Russ and Sasan Haghani, “Behavior of 802.11g Traffic at High Sustained Bit Rates in the Home”, *2009 Digest of Technical Papers, 2009 International Conference on Consumer Electronics, Jan. 2009*, pp. 423-424.
 26. Samuel H. Russ, and Ramesh Nallur, “A Framework for Calculating Fundamental DVR Performance Limits”, *2009 Digest of Technical Papers, 2009 International Conference on Consumer Electronics, Jan. 2009*, pp. 51-52.
 27. Samuel H. Russ, “Home Networking: Extending Cable’s Reach”, *The Complete Technical Paper Proceedings from NCTA*, 2001, pp. 160-165.
 28. Samuel H. Russ, Rashid Jean-Baptiste, Tangirala Shailendra Krishna Kumar, and Marion G. Harmon, “Transparent Real-Time Monitoring in MPI”, *IPPS/SPDP Workshops 1999*, in *Parallel and Distributed Processing*, Lecture Notes in Computer Science, vol. 1586, Springer-Verlag, 1999, pp. 1327-1334.
 29. Roger L. King, Aric B. Lambert, Samuel H. Russ, and Donna S. Reese, “The Biological Basis of the Immune System as a Model for Intelligent Agents”, *IPPS/SPDP Workshops 1999*, in *Parallel and Distributed Processing*, Lecture Notes in Computer Science, vol. 1586, Springer-Verlag, 1999, pp. 156-164.
 30. Aric Lambert, Roger King, Sam Russ, and Donna Reese, “Intelligent Control Agents for Resource Management of Heterogeneous Parallel Computing”, *Computational Intelligence for*

Modeling, Control, and Automation (CIMCA 98) in Concurrent Systems Series, vol. 55, IOS Press, 1999, pp. 116-121.

31. Samuel H. Russ and Adam Gaither, “Developing An Integrated Environment for Computational Field Simulation”, *Object-Oriented Methods for Inter-Operable Scientific and Engineering Computing: Proceedings of the 1998 SIAM Workshop*, pp. 50-57.
32. Samuel H. Russ, Ioana Banicescu, Sheikh Ghafoor, Bharathi Janapareddi, Jonathan Robinson, and Rong Lu, “Hectiling: An Integration of Fine and Coarse-Grained Load-Balancing Strategies”, *Proceedings of the Seventh International Symposium on High Performance Distributed Computing*, August 1998, IEEE Computer Society, pp. 106-113.
33. Samuel H. Russ, “An Architecture for Rapid Distributed Fault Tolerance”, 3rd International Workshop on Embedded High-Performance Computing, in J. Rolim, Editor, *Parallel and Distributed Processing*, Lecture Notes in Computer Science, vol. 1388, Springer-Verlag, 1998, pp. 925-930.
34. Dr. Samuel H. Russ, Brad Meyers, Jonathan Robinson, Matt Gleeson, Laxman Rajagopalan, Chun-Heong Tan, and Bjørn Heckel, “User-Transparent Run-Time Performance Optimization”, *Proceedings of the 2nd International Workshop on Embedded HPC Systems and Applications*, Geneva, April 1997.
35. J. Robinson, S.H. Russ, B. Flachs, and B. Heckel, “A Task Migration Implementation of the Message-Passing Interface”, *Proceedings of the 5th High Performance Distributed Computing Conference (HPDC-5)*, August 1996, IEEE Computer Society, pp. 61-68.
36. S.H. Russ, B. Flachs, J. Robinson, and B. Heckel, “Hector: Automated Task Allocation for MPI”, *Proceedings of the 10th International Parallel Processing Symposium*, April, 1996, IEEE Computer Society, pp. 344-348.
37. W.S. Tan, C.O. Alford, and S.H. Russ, “GT-EP: A Novel High-Performance Real-Time Architecture”, *Proceedings of the 18th International Symposium on Computer Architecture*, May 1991, pp. 12-21.

Reports

1. Aric B. Lambert, Roger L. King, Samuel H. Russ, Donna S. Reese, “Adaptive Analysis for the Design of Hardware Agents Using the Artificial Immune System Model for Resource Management of Heterogeneous Systems”, Miss. State Technical Report No. MSSU-COE-ERC-98-10, Aug. 1998.
2. Daniel H. Linder, Robert B. Reese, Jon Robinson, and Samuel H. Russ, “JavaCADD: A Java-based Server and GUI for Providing Distributed ECAD Services”, Mississippi State University Technical Report No. MSSU-COE-ERC-98-07, May 1998.
3. Samuel H. Russ, “Using Hector in an Architecture for Rapid Distributed Fault Tolerance”, Mississippi State Technical Report No. MSSU-EIRS-ERC-97-17, December 1997.
4. Samuel H. Russ, Jonathan Robinson, Matt Gleeson, and Jose Figueroa, “Dynamic Communication Mechanism Switching in Hector”, Mississippi State Technical Report No. MSSU-EIRS-ERC-97-8, September 1997.
5. Samuel H. Russ, Brian Flachs, Jonathan Robinson, and Bjorn Heckel, “Hector: Automated Task Allocation for MPI”, Mississippi State Technical Report No. MSSU-EIRS-ERC-95-6, September, 1995.

Funded Grants and Contracts

University of South Alabama

1. National Space Grant Foundation, Aug. 2018-May 2019, “Automation Infrastructure for Gateway Biological Laboratory,” PI, \$28,062.
2. Nfina (Local Mobile Company), March 2018 – March 2019, “Redhawk”, PI, \$119,881.

3. NASA, May 2016 – Present, “Spatially Resolved Measurements Of Plasma Density Irregularities In The Ionosphere F Region For Scintillation Studies”, Co-I, \$100,000.
4. Marine Environmental Science Consortium (GRI), Jan. 2011-Dec. 2011, “Conductivity Based In-Situ Hydrocarbon Sensor”, PI, \$9,338.
5. University of South Alabama Research Council (USARC), Feb. 2008 – Feb. 2009, “Instrumentation of Hurricane Forecast Models for Performance Optimization”, \$5,000 for one year.

Mississippi State University

1. National Science Foundation, April 1998-March 1999, “An ERC-CREST Partnership in Distributed and Computational Systems”, PI, \$100,000/year, renewable for 5 years.
2. Office of Naval Research, Nov. 1996-Nov. 1998, “Distributed Visualization and Virtual Environments for Oceanography and Meteorology”, Co-PI, \$200,000.
3. U.S. Army Waterways Experiment Station, July 1996-July 1999, “Efficient Parallel Wave Modeling”, PI, \$200,000, Funded under CHSSI (Common HPC Scalable Software Initiative) of the DoD. (\$50,000 actually funded.)
4. NSF Engineering Research Center for Computational Field Simulation, April 1995- May 1999, “Heterogeneous Computing Testbed (CA 8)”, PI, By year: \$34,983/\$70,111/\$55,916. Funded through NSF Engineering Research Center.

Dickerson Vision Technology

1. Small Business Innovations Research Program of the NSF, Division of Industrial Interface, September 1993 - February 1994, Award No. III-9260914. (\$50,000 Phase I contract conducted at Dickerson Vision Technologies.)

Technology Transfer and Licensing

Hector Distributed Run-Time Environment licensed by MPI Software Technology, Inc., Starkville, MS in June 1998 (while at Mississippi State University)

Students Advised (Major Professor)

Level	At USA	At MSU
Ph.D.	--	0
Masters	3	9

Courses Created and Enhanced

University of South Alabama

EE 264 Microprocessor Systems and Interfacing – Replaced 68HC11 with Freescale 9S12 architecture and redesigned the entire course, Introduced use of 68HC11 simulator and accompanying podcast to enhance student’s ability to visualize microprocessor operation

EE 268 Digital Logic Design Lab – Updated one lab experiment

EE 368 Microprocessor Systems Lab – Developed all-new sequence to tie EE 368 to senior projects with hands-on experiments like motors, photocells, and servomotors.

EE 401 Introduction to ECE Design – Completely overhauled the first-semester senior project course. Added lectures on professionalism, career development, and legal aspects of engineering. Structured the course so that reports would lead up to their senior-project reports.

EE 404 ECE Design – Completely overhauled the second-semester senior project course by requiring better projects and adding material on giving effective presentations. Obtained very enthusiastic response from the department’s Industrial Advisory Board.

EE 446 – Obtained donation of boards from Freescale and redesigned all of the experiments to develop more interesting demonstrations and to switch from assembly language to C.

EE 457/557 – Developing series of podcasts to augment in-class lectures with materials related to embedded systems and professional development.

EE 469/569 Advanced Digital System Design – Developed all-new course in high-speed circuit board design from an electromagnetics perspective, and authored a textbook for the course. Added a lab experience in 2009.

EE 560 Advanced Computer Architecture – Selected new textbook for the class and developed lecture materials to match

EG 101 – Developed systematic curriculum shared by all sections including “checklists” for instructors, handouts, and lecture materials. Introduced motors project, which has become the most popular EG 101 project.

Mississippi State University

EE 8993 High Speed Digital Design -- Offered on video nationwide, it features pioneering treatment of high-speed circuit board design from an electromagnetics perspective. Material from the class has been included in one of the best-known electromagnetics textbooks, and it continues to be one of the most popular graduate classes in the department.

EE 4743 Computer Aided Digital Design -- Added breakthrough educational technology to permit remote access to logic synthesis capabilities. Offered on live two-way video starting Fall 1998.

Courses Taught

University of South Alabama

EE 220, Circuit Analysis I, 1 course.

EE 263, Digital Logic Design, 2 courses.

EE 264, Microprocessor Sys-Interfacing, 4 courses.

EE 268, Digital Logic Design Lab, 1 course.

EE 368, Microprocessor Sys Interf Lab, 14 courses.

EE 401, Intro Elec and CpE Design - W, 7 courses.

EE 404, Elec and Comp Eng Designs-W, 7 courses.

EE 440, HDL Logic Synthesis, 1 course.

EE 446, Embedded System Design Lab, 2 courses.

EE 457, Embedded System Design, 10 courses.

EE 469, Signal Integrity, 5 courses.

EE 534, VLSI Design Systems, 1 course.

EE 540, HDL Logic Synthesis, 1 course.

EE 548, Computer-Network Security, 5 courses.

EE 557, Adv. Embedded System Design, 8 courses.

EE 560, Adv Computer Architecture, 3 courses.

EE 569, Signal Integrity, 5 courses.

EG 101, Intro to Engineering & Design, 5 courses.

EG 231, Intro to Ethics and Economics, 2 courses.

Mississippi State University

Number Description

EE 2111 Electrical Lab I

Class Description

Accompanies introductory digital class

EE 2713 Digital Devices
 EE 4723 Microcomputers II
 EE 4743 Computer Aided Digital Design
 EE 8993 High-Speed Digital Design

Introductory digital class
 Microcontroller interfacing
 VHDL, logic design, and synthesis
 Signal integrity and high-speed design

Honors and Awards

University of South Alabama College of Engineering “Teacher of the Year” 2015

Mobile Area Council on Engineering “Engineering Educator of the Year” 2015

Technology and Engineering Emmy® Award, 2012, for “Pioneering Development of Multi-Room DVR.” Awarded to Cisco. I managed the groups that built the first prototypes, gave public demonstrations, wrote numerous patent applications, and developed the first mass-production set-top containing Multi-Room DVR.

2nd Place in “Best Paper – Storage Category” at ICCE 2011. The paper is “Digital Video Recording Onto Solid-State Disks” as noted in Conference publications above.

Attendee, “Top Prof” Banquet – University of South Alabama chapter of Mortar Board, 2009,2010

Tau Beta Pi Engineering Professor of the Year – University of South Alabama chapter of Tau Beta Pi, 2008. One of two highest awards in the College of Engineering for teaching, and the only award voted on by honor students in the College.

Finalist, 53rd International Science and Engineering Fair, 1983, Albuquerque, NM.

Professional Activities

Expert Witness Engagements

Case	Jurisdiction and Case Number	Year(s)	Witness for	Expert Reports	Dep.	Trial	IPR* Rep.
WNE Holdings v. Rockwell Automat.	Southern District of Alabama	2011	Plaintiff	1	0	0	0
Personalized Media Corp. (PMC) v. Echostar	Eastern District of Texas	2010-2015	Plaintiff	2	3	0	0
Pegasus v. DirecTV et al.	Delaware	2011-13	Plaintiff	1	0	0	0
Apple v. Samsung	Int’l Trade Commission 337-TA-796	2012	Respondent	4	1	1	0
EON v. MobiTV et al.	Delaware	2013	Defendant	1	1	0	0
PMC v. Zynga	Eastern District of Texas	2013	Plaintiff	1	5	0	4
OpenTV v. Netflix	Delaware	2014	Defendant	0	0	0	0
Kaplan v. OnForce	N.D. California	2014	Defendant	0	0	0	1
Intellectual Ventures v. J.P. Morgan Chase	Southern District of New York	2013-2019	Defendant	2	2	0	0
PMC v. Amazon	Delaware	2014-2015	Plaintiff	1	9	0	5
Better Mouse Corp. v. Steelseries et al.	Eastern District of Texas	2015-2016	Plaintiff	2	0	1	0

Case	Jurisdiction and Case Number	Year(s)	Witness for	Expert Reports	Dep.	Trial	IPR* Rep.
SyncPoint v. Nintendo et al.	Eastern District of Texas	2015	Plaintiff	2	1	0	0
TQ Beta v. Dish	USPTO (IPR)	2016	Defendant	1	1	0	0
Script v. ADT et al.	Eastern District of Texas	2016	Plaintiff	2	2	0	0
Sony v. Pace	USPTO (IPR)	2016	Defendant	0	1	0	4
PMC v. Apple	EDTX and USPTO (IPR)	2016-2021	Patent Owner	2	1	1	2
PMC v. Samsung	Eastern District of Texas	2016	Patent Owner	2	0	0	0
Music Choice v. Stingray	Eastern District of Texas	2016-2019	Plaintiff	2	2	0	4
Broadcom v. AMD	USPTO (IPR)	2016	Petitioner	0	0	0	1
Tech Pharmacy v. Alixa et al.	Eastern District of Texas	2017	Plaintiff	2	2	1	0
Rovi v. PMC	Eastern District of Texas, Arbitration	2017	Defendant	0	1	0	0
Implicit v. Trend Micro	Eastern District of Texas	2017	Defendant	2	1	0	0
Implicit v. Palo Alto	Eastern District of Texas	2018	Defendant	1	1	0	0
Invensas v. Samsung	Eastern District of Texas	2018	Plaintiff	2	1	0	0
Selective Signals v. Palo Alto	USPTO (IPR)	2018	Petitioner	0	1	0	1
Rovi Tivo v. Various	Canada	2018	Plaintiff	0	0	0	0
Implicit v. Netscout	Eastern District of Texas	2018	Defendant	0	0	0	0
Rovi Tivo v. Comcast	USPTO (IPR)	2019-2020	Plaintiff	0	4	0	5
Rovi Tivo v. Comcast	ITC	2019-2020	Petitioner	2	1	1	0
BBiTV v. OpenTV	California	2019	Defendant	0	0	0	0
Roku v UEI	USPTO (IPR)	2019-Now	Petitioner	0	6	0	8
MV3 v Roku	Western District of Texas	2019-2020	Defendant	2	2	1	0
BBiTV v Dish	USPTO (IPR)	2019-2020	Petitioner	0	3	0	6
PMC v Google	Eastern District of Texas	2020	Plaintiff	1	1	0	0
PMC v Netflix	Southern District of New York	2020	Plaintiff	2	0	0	0
UEI v Roku <i>et al.</i>	ITC	2020-2021	Respondent	1	1	1	0
BBiTV v Dish	Western District of	2020-	Defendant	1	5	0	6

Case	Jurisdiction and Case Number	Year(s)	Witness for	Expert Reports	Dep.	Trial	IPR* Rep.
	Texas	2021					
Flexiworld v Amazon <i>et al.</i>	Western District of Texas	2020-Now	Defendant	0	0	0	0
Flexiworld v Roku	Western District of Texas	2021-2022	Defendant	2	0	0	0
Roku v UEI <i>et al.</i>	ITC	2021-2022	Complain.	1	0	1	0
Roku v DivX	USPTO (IPR)	2021	Petitioner	0	0	0	1
Apple v Identity	USPTO (IPR), Ex Parte Re-Exam, Western District of Texas	2022-2024	Patent Owner	2	1	1	6
Audi v Aprese	USPTO (IPR)	2022	Petitioner	0	0	0	2
paSafeShare	Ex Parte Re-Exam, Western District of Texas	2021-Now	Patent Owner, Plaintiff	1	0	0	3
PerfectVision v PPC Broadband	USPTO (IPR)	2022-Now	Petitioner	0	0	0	1
Google v Nobots	USPTO (IPR)	2022	Patent Owner	0	2	0	4
Fall Line v Various	Eastern District of Texas	2022-Now	Plaintiff	6	2	1	0
Assa Abloy v CPC	USPTO (IPR)	2023-2024	Patent Owner	0	2	0	4
IOENGINE v Roku	Western District of Texas	2023-2024	Defendant	5	2	1	0
Gratuity v Toast	USPTO (IPR)	2023-2024	Petitioner	0	1	0	1
Lexos v Ebay	USPTO (IPR)	2024	Patent Owner	0	1	0	1
Entropic v Various	USPTO (IPR) Eastern District of Texas	2024-Now	Patent Owner / Plaintiff	3	6	0	7
Roku v Anonymous	USPTO (IPR)	2024	Petitioner	0	0	0	6
Adeia v Videotron	Fed. Court of Canada	2024-2025	Plaintiff	2	0	1	0
AMD v Concurrent	USPTO (IPR)	2024-Now	Petitioner	1	0	0	0
TrueSight v Samsung	Eastern District of Texas	2025	Defendant	2	1	0	0
Sandpiper v Various	USPTO (IPR)	2025-Now	Patent Owner	0	0	0	1
Mood v Eglä	USPTO (EPR)	2026	Petitioner	0	0	0	1

* Includes reports submitted for IPRs, CBMRs, and Re-Exams

Invited Lectures

“Real-time Monitoring in MPI”, Florida A&M University, Tallahassee, FL, August 1998

Consulting

Consulted with various investment firms concerning telecommunications market, 2007 – 2011.
Cox Communications – DVR Reliability – 2015

Society Memberships

Institute of Electrical and Electronic Engineers (Senior Member), IEEE Consumer Electronics Society, IEEE Computer Society, Eta Kappa Nu, Tau Beta Pi, Phi Kappa Phi, Gamma Beta Phi
Secretary, Northeast Mississippi Subsection of the IEEE, 1994-95

Article Reviewer

Computers and Electrical Engineering, Supercomputing '94, IEE Transactions, Concurrency: Practice and Experience, International Parallel Processing Symposium, IEEE Transactions on Education, IEEE Transactions on Parallel and Distributed Systems, ICT 2012, ICAEE 2012

Proposal Reviewer

Army Research Office, National Science Foundation, U.S. Department of Energy

University Service

Chair, Search Committee, ECE Department – Search for Assistant Professor positions, 2008-now (chair since 2011)

Member, ECE Department Undergraduate Affairs Committee, 2015-now

Member, College of Engineering Academic Standards Committee, 2016-now

Member, Search Committee, College of Engineering – Search for 2 Associate Dean positions, 2015

Member, Search Committee, College of Engineering – Search for Associate Dean positions, 2008-09

Member, University of South Alabama Council on International Education, 2008-15

Chairman, ECE Department “Open House” Committee, 2008-09

Conducted open house and other demonstrations for the department, 2008-now

Chairman, ECE Department Recruiting and Retention Committee, 2007-08

Updated and conducted experiment for ACE program, 2007

Member, Hearin Undergraduate Committee, 1998

Department Coordinator, United Way Campaign, 1995

Award Referee, 1995 Instructional Paper Award, MSU College of Engineering