

U.S. Patent No. 9,651,533
IPR2025-01250

Declaration of Igor Efimov, Ph.D.

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SAMSUNG ELECTRONICS CO., LTD., SAMSUNG ELECTRONICS
AMERICA, INC., FOSSIL GROUP, INC., FOSSIL STORES I, INC., FOSSIL
PARTNERS, L.P., OURA HEALTH OY, AND ONEPLUS TECHNOLOGY
(SHENZHEN) CO., LTD.,

Petitioners,

v.

OMNI MEDSCI, INC.,
Patent Owner.

U.S. Patent No. 9,651,533

Case No. IPR2025-01250

DECLARATION OF IGOR EFIMOV, PH.D.

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I, Igor Efimov, declare as follows:

1. I make this declaration based upon my own personal knowledge and, if called upon to testify, would testify competently to the matters stated herein.

2. I have been retained on behalf of Omni MedSci, Inc., ("Omni" or "Patent Owner") as an independent expert to provide this declaration concerning the technical subject matter relevant to U.S. Patent No. 9,651,533 ("the '533 Patent") (Ex. 1001) in connection with an *inter partes* review ("IPR") petition filed by Samsung Electronics Co. Ltd., Samsung Electronics America Inc., Fossil Group, Inc., Fossil Stores I, Inc., Fossil Partners, L.P., Oura Health Oy, and OnePlus Technology (Shenzhen) Co., Ltd. ("Petitioners").

3. I am being compensated at my standard hourly rate of \$700 per hour for the time I spend on this matter. My compensation is not based on the content of my opinions or the resolution of this matter, and I have no financial or other interest in this proceeding.

4. I understand that Omni is asserting the '533 Patent against Samsung Electronics Co., Ltd., and others, in a related matter currently pending in the United States District Court for the Eastern District of Texas ("the Texas Case").

5. I also understand that Omni is asserting the '533 Patent against Whoop, Inc., in a related matter currently pending in the United States District Court for the District of Delaware ("the Delaware Case").

6. In this declaration, I offer opinions relating to the '533 Patent, claim construction, the references in the Petition, and the declaration of Petitioners' expert Dr. Anthony. The substance and bases of my opinions appear below.

I. BACKGROUND AND QUALIFICATIONS

7. In formulating my opinions, I have relied on my knowledge, training, and experience in the relevant field, which I will summarize briefly herein.

8. I am currently a Professor of Biomedical Engineering and a Professor of Medicine (Division of Cardiology) at Northwestern University, Chicago, Illinois. Prior to my tenure at Northwestern University, I was the Alisann and Terry Collins Professor of Biomedical Engineering at The George Washington University, Washington, D.C., where I also served as Founding Chair of the Department of Biomedical Engineering from 2015 to 2019. Before that, from 2004 to 2015, I served as the Lucy & Stanley Lopata Distinguished Professor of Biomedical Engineering at Washington University in Saint Louis, Missouri. I was also a Professor of Medicine, Professor of Radiology, and Professor of Cell Biology & Physiology at the Washington University School of Medicine. I also served on the faculty of the Department of Cardiology of the Cleveland Clinic Foundation (1994-2000) and the Department of Biomedical Engineering of Case Western Reserve University (2000-2004), Cleveland, Ohio.

9. My research focuses on the physiological mechanisms of

cardiovascular disease and the development of diagnostic and therapeutic bioelectronics for heart rhythm disorders, heart failure, and vascular dysfunction. My laboratory develops implantable, wearable, and optical sensing and imaging systems for real-time physiological diagnostics and device-based therapy. These systems incorporate semiconductor light sources, photodiodes, and spectroscopic analysis.

10. I received my Master of Science degree in experimental nuclear physics from the Moscow Institute of Physics and Technology, USSR, in 1986. In 1992, I received a Ph.D. in Biophysics from the Moscow Institute of Physics and Technology after completing a doctoral study on the mechanisms of sudden cardiac death due to ventricular arrhythmias. I completed my postdoctoral training in 1992-1994 in the fields of fast fluorescent imaging / optical mapping, cardiac electrophysiology, and arrhythmia at the University of Pittsburgh in Pittsburgh, Pennsylvania. Then, I started my independent cardiac research career in the Department of Cardiology at the Cleveland Clinic Foundation (1994-2000), where I established an NIH-funded laboratory. Cleveland Clinic has been consistently ranked the #1 Cardiology program nationwide by U.S. News & World Report since 1994.

11. For the past 25 years, I have taught undergraduate and graduate courses in Biomedical Engineering, including courses relating to quantitative physiology,

applied bioelectricity, biomedical optics, biosignal acquisition and analysis, light-tissue interaction, physiology of the heart, introduction to biomedical engineering, clinical cardiovascular engineering, and cardiovascular engineering and technology. In these and other courses, I taught sections on engineering and physiological principles of cardiac electrophysiology, arrhythmia, and electrocardiography. Many of my trainees are currently working at leading national medical device companies, including Medtronic, Abbott, and Boston Scientific, developing novel cardiac antiarrhythmic therapies, diagnostics, and sensing devices.

12. I have also mentored over 30 clinical fellows and postdoctoral research fellows, many of whom are currently professors, cardiologists, cardiac and vascular surgeons, and clinical engineers throughout the national and world Universities and hospitals, including Harvard University, MA; University of California, CA; Ohio State University, OH; University of Wisconsin, WI; University of Fukuoka, Japan; University of Bordeaux, France; University of Brno, Czech Republic; Imperial College London, UK; etc.

13. I have published a book in 2009 on cardiac bioelectric diagnostics and therapy (Efimov I.R., Kroll, M.W., Tchou, P.J., Eds., Cardiac Bioelectric Therapy: Mechanisms and Practical Implications, Springer, 2009. ISBN 978-0-387-79402- 0), and I have published a second updated edition of this book in 2021 (Efimov I.R., Ng F.S., Laughner J.I., Eds., Cardiac Bioelectric Therapy: Mechanisms and Practical

Implications, Springer, 2nd Edition. 2021. ISBN 978-3-030-63354-7). These volumes address optical imaging technology and electrophysiological principles of diagnosis and therapy, providing novel approaches to the treatment of cardiac arrhythmias using implantable devices, percutaneous ablation therapies, machine learning, and other approaches.

14. Most of my 300+ peer-reviewed publications focus on cardiac electrophysiology, biomedical optics, device development, the physiological mechanisms of cardiac arrhythmias, and their diagnostics and therapy. In collaboration with Professor John A. Rogers from Northwestern University, we have developed a novel implantable, interventional, and wearable electronics platform for monitoring cardiac electrophysiology, optical image mapping, diagnosis of heart rhythm disorders due to brady- and tachyarrhythmias, and antiarrhythmic therapy. Several high-impact publications have been published on that subject recently in leading scientific journals. For example, our recent paper on novel bioresorbable electronics platform (Choi YS, Yin RT, Pfenniger A, Koo H, Avila R, Lee KB, Chen SW, Lee G, Li G, Qiao Y, Murillo-Berlitz A, Kiss A, Han S, Lee SM, Li C, Xie Z, Chen YY, Burrell A, Geist B, Jeong H, Kim J, Yoon HJ, Banks A, Kang SK, Zhang ZJ, Haney CR, Sahakian AV, Johnson D, Efimova T, Huang Y, Trachiotis GD, Knight BP, Arora RK, Efimov IR, Rogers JA. Fully implantable and bioresorbable cardiac pacemakers without leads or batteries. *Nature Biotechnology*, June 28, 2021,

<https://doi.org/10.1038/s41587-021-00948-x>.) was featured by over 150 international news outlets reaching at least 12 million listeners/viewers from 5 continents, including PBS, Guardian, and NIH Research Matters (NIH Director's office online publication).

15. Another 2025 publication in Nature (Zhang Y, Rytkin E, Zeng L, Kim JU, Tang L, Zhang H, Mikhailov A, Zhao K, Wang Y, Ding L, Lu X, Lantsova A, Aprea E, Jiang G, Li SG Seo, Wang T, Wang J, Liu J, Gu J, Liu F, Bailey K, L YFL, Burrell A, Pfenniger A, Ardashev A, Yang T, Liu N, Lyu Z, Purwanto NS, Ying Y, Lu Y, Hoepfner C, Melisova A, Gong J, Jeong J, Choi J, Hou A, Nolander R, Bai W, Jin SH, Ma Z, Torkelson JM, Huang Y, Ouyang W, Arora RK, Efimov IR, Rogers JA. Millimetre-scale, bioresorbable optoelectronic systems for electrotherapy. Nature, 2025, 640 (8057), 77-86.) was recognized among the Best Inventions of 2025 by the Time.

16. I have also delivered 400+ invited lectures at prestigious professional conferences and leading Universities worldwide, most of them on biomedical imaging, semiconductor-based light emission, optical coupling through tissue, wireless control architectures, cardiac arrhythmias, and therapy.

17. In 2021-2025, I served as Editor-in-Chief of Cardiovascular Engineering and Technology, a journal of the Biomedical Engineering Society published by Springer Nature. I was responsible for reviewing and decision-making

of approximately 250-300 manuscripts submitted for publication, including biomedical imaging mapping, cardiac electrophysiology, signal processing, arrhythmia therapy, etc.

18. I have served on the editorial board of the American Journal of Physiology: Heart and Circulatory Physiology and Heart Rhythm Journal, where I manage and make decisions on manuscripts related to biomedical sensing and imaging, cardiac electrophysiology and electrotherapy. I have served or currently am serving on many editorial boards of other leading cardiac journals, where I review papers on biomedical imaging technique, cardiac electrophysiology and arrhythmia. These journals include Circulation Research, Heart Rhythm, Journal of Cardiac Electrophysiology, Journal of Molecular and Cellular Cardiology, American Journal of Physiology, IEEE Transactions in Biomedical Engineering, Experimental Physiology, etc. I regularly review papers on biomedical imaging, cardiovascular physiology and arrhythmia for Nature, Science, Proceedings of the National Academy of Science, Circulation, and other leading journals.

19. I have served on numerous national and international expert panels, which consider grant applications from the leading experts in the field of biomedical optics, diagnostic sensing, cardiac electrophysiology, and defibrillation from many countries, including the USA, the European Union, Canada, the UK, France, Switzerland, Germany, the Netherlands, Russia, Australia, New Zealand, South

Africa, Singapore, etc. From 2009-2013, I served as a chartered member of the leading US panel at the National Institutes of Health, the Electrical Signaling, Transporters and Arrhythmia (ESTA) Study section, which is the major funding source for leading US bioinstrumentation investigators. I have also served on many international panels that consider policy, research, and funding decisions in the field of biomedical sensing, cardiac electrophysiology and therapy in numerous countries from most continents. For example, I served on The Expert Panel on the Medical and Physiological Impacts of Conducted Energy Weapons, the Council of Canadian Academies.

20. My research on biomedical imaging and electronics has been funded by the National Heart, Lung, and Blood Institute of the National Institutes of Health and other federal and private foundations without interruptions since 1998, with an average of approximately \$1M per year during recent years. I am also funded by the American Heart Association, National Science Foundation, Leducq Foundation, etc.

21. I have been designing and developing medical devices and diagnostic systems for more than twenty-five years. My inventions and patent portfolio include methods for low-voltage cardiac defibrillation, optical and electrical biosensors, cardiac and neural stimulators, and hybrid optoelectronic systems for tissue monitoring and physiological diagnostics. Many of these devices integrate semiconductor light sources, photodetectors, and optical mapping technologies. For

example, I am the inventor or co-inventor on several patents and patent applications, including "Systems and Methods for Triple-Parametric Optical Mapping" (U.S. Pat. App. Pub. No. 2023/0085578), "Distributed Neuromorphic Computing for High-Definition Bioelectric Diagnostics and Therapy" (U.S. Patent No. 11,701,002), and "High-Resolution Multi-Function and Conformal Electronics Device for Diagnosis and Treatment of Cardiac Arrhythmias" (PCT/US18/16499). With the support of NIH funding, I have invented a method for low-voltage defibrillation of cardiac arrhythmias by effectively unpinning anatomical reentry (U.S. Patent No. 8,175,702), a method for cardiac pacing using the inferior nodal extension (U.S. Patent No. 8,391,995), and a method and device for low-energy termination of atrial tachyarrhythmias (U.S. Patent No. 8,509,889). I founded Cardialen, Inc. to develop clinical defibrillators based on this method, which received over \$30M in venture and NIH funding. Cardialen was acquired in 2022.

22. I have received many awards in recognition of my research and innovation in the field of bioengineering and diagnostic device development. For example, I was elected to the United States National Academy of Inventors in 2019; and I have received the 2021 Distinguished Scientist Award and the 2025 Ralph Lazzara Lectureship Award from the leading clinical cardiac electrophysiology professional association – the Heart Rhythm Society. In 2025, I was elected to the American Academy of Sciences and Letters.

23. A more detailed listing of my credentials is set forth in my curriculum vitae (Ex. 2044).

II. MATERIALS CONSIDERED

24. In forming the opinions set forth herein, I have considered and relied upon my education, knowledge of the relevant field, and my experience. I have also reviewed and considered the '533 Patent (Ex. 1001), the '533 Patent's file history (Ex. 1002), and at least the following additional materials:

- Petition for *Inter Partes* Review of the '533 Patent (Paper 1) ("Petition");
- Declaration of Brian Anthony in Support of Petition for *Inter Partes* Review of U.S. Patent No. 9,651,533 (Ex. 1003);
- Previous Declaration of Brian Anthony in Support of Petition for *Inter Partes* Review of U.S. Patent No. 9,651,533 (Ex. 1004);
- Final Written Decision in *Apple Inc. v. Omni MedSci, Inc.*, IPR2019-00916, Paper 39 (PTAB Oct. 14, 2020) (Ex. 1008);
- U.S. Patent No. 9,241,676 ("Lisogurski") (Ex. 1025);
- U.S. Pat. App. Pub. No. 2005/0049468 ("Carlson") (Ex. 1028);
- U.S. Patent No. 7,029,628 ("Tam") (Ex. 1030);
- U.S. Patent No. 8,050,730 B2 ("Zhang") (Ex. 1031);
- U.S. Pat. App. Pub. No. 2011/0237911 ("Lamego") (Ex. 1033);

- U.S. Patent No. 5,942,749 ("Takeuchi") (Ex. 1034);
- U.S. Patent No. 5,822,473 ("Magel") (Ex. 1035);
- U.S. Patent 5,592,124 ("Mullins") (Ex. 1036);
- E.F. Schubert, Light-Emitting Diodes (Cambridge Univ. Press, 2nd ed. reprinted 2014) (Ex. 1037);
- "The Biomedical Engineering Handbook," by Joseph D. Bronzino (1995) (Ex. 1038);
- U.S. Patent No. 5,497,769 ("Gratton") (Ex. 1059);
- U.S. Patent No. 5,827,182 ("Raley") (Ex. 1060);
- U.S. Patent No. 7,764,982 ("Dalke") (Ex. 1061);
- U.S. Patent No. 7,005,679 ("Tarsa") (Ex. 1071);
- U.S. Pat. App. Pub. No. 2010/0249550 ("Lovejoy") (Ex. 1072);
- U.S. Pat. App. Pub. No. 2015/0057511 ("Basu") (Ex. 1073);
- U.S. Pat. App. Pub. No. 2013/0327966 ("Fidler") (Ex. 1074);
- U.S. Pat. App. Pub. No. 2011/0267688 ("Kleppe") (Ex. 1075);
- U.S. Pat. App. Pub. No. 2005/0133691 ("Doppke") (Ex. 1076);
- U.S. Pat. App. Pub. No. 2006/0184040 ("Keller") (Ex. 1077);
- U.S. Patent No. 6,339,715 ("Bahr") (Ex. 1079);
- U.S. Patent No. 8,417,307 ("Presura") (Ex. 1080);

- 2026-03-23 - Claim Construction Order, *Omni MedSci, Inc. v. Samsung Electronics Co., Ltd. et al.*, No. 2:24-cv-01070-JRG-RSP (E.D. Tex.) (Ex. 1119);
- Deposition of Brian W. Anthony, Volume I, April 17, 2026 (Ex. 2045);
- Deposition of Brian W. Anthony, Volume II, April 18, 2026 (Ex. 2046);
- 2026-01-30 - Exhibit A to the P.R. 4-5 Joint Claim Construction Chart, *Omni MedSci, Inc. v. Samsung Electronics Co., Ltd. et al.*, No. 2:24-cv-01070-JRG-RSP (E.D. Tex.) (Ex. 2047);
- Declaration of Mohammed N. Islam, Sc.D (Ex. 2100);
- OMS_SAM0031768 (Ex. 2101);
- OMS_SAM0031776 (Ex. 2102);
- OMS_SAM0031782 (Ex. 2103);
- OMS_SAM0031797 (Ex. 2104);
- OMS_SAM0031867 (Ex. 2105);
- OMS_SAM0031851 (Ex. 2106);
- OMS_SAM0031961 (Ex. 2107);

- U.S. Patent No. 5,632,272 to Diab et al. (“Masimo ‘272 Patent”) (Ex. 2108);
- U.S. Patent No. 7,738,935 to Turcott (“Pacesetter ‘935 Patent”) (Ex. 2109);
- U.S. Patent No. 6,126,595 to Amano et al. (Ex. 2110);
- Fitbit ‘854 Publication (Ex. 2111);
- GE Dash 2000 Patient Monitor Operating Manual (Ex. 2112);
- Accuracy in wrist-worn, sensor-based measurements of heart rate and energy expenditure in a diverse cohort (Ex. 2113);
- Are Currently Available Wearable Devices for Activity Tracking and Heart Rate Monitoring Accurate, Precise, and Medically Beneficial? (Ex. 2114);
- A review of wearable sensors and systems with application in rehabilitation (Ex. 2115)
- ‘533 Patent Infringement Contentions Chart for Samsung Smartwatch (Ex. 2116).

25. I have also considered any materials cited in this declaration to the extent they are not expressly listed above. My review of these materials was informed by my education, my work experience, and my experience designing

medical devices.

26. I reserve the right to supplement my opinions or express additional opinions should additional and/or presently unknown information about this matter become known by me at a later date.

III. LEGAL STANDARDS

27. As a technical expert, I am not offering any legal opinions. Rather, I am offering technical assessments and opinions. In rendering my analysis, I have been informed by counsel regarding various legal standards for determining patentability. I have applied those standards in forming my technical opinions expressed in this declaration.

A. Level of Ordinary Skill in the Art

28. I understand that the claims and specification of a patent are addressed to and intended to be read by others of skill in the art to which the patent pertains, or to which the patent is most nearly connected, at the time of the filing of the patent application.

29. I understand that a person of ordinary skill in the art ("POSITA") is a hypothetical person who is presumed to be aware of all of the pertinent art. The person of ordinary skill is not an automaton, and may be able to fit together the teachings of multiple prior art references employing ordinary creativity and the common sense that familiar items may have obvious uses beyond their primary

purposes.

30. I understand that multiple factors should be used to decide the skill of the POSITA, including: the types 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 education level of active workers in the field.

B. Claim Construction

31. The patent claims describe the invention made by the inventor and describe what the patent owner owns and what the owner may prevent others from using. I understand that an independent claim sets forth all the requirements that must be met to be covered by that claim. I further understand that a dependent claim does not itself recite all of the requirements of the claim but refers to another claim and incorporates all of the requirements of the claim to which it refers.

32. I understand that claim construction is the process by which the scope and meaning of terms used in the claims of a patent is determined. I understand that the goal of this process is to give claim terms the ordinary and customary meaning they would have had to a POSITA at the time of the invention, after reading the patent and its prosecution history.

33. I understand that the patent specification may reveal a special definition given to a claim term by the patentee that differs from the plain and ordinary meaning

it would otherwise have to a POSITA. In such cases, I understand that the patentee's definition usually controls.

34. I understand that the prosecution history of a patent can inform the meaning of some claim language and that the prosecution history must be considered when construing the claims.

35. I understand that extrinsic evidence, such as dictionaries, treatises, and expert opinions, may also be considered to understand the technology at issue and the way in which claim terms would be understood by a POSITA in the relevant timeframe.

C. Anticipation

36. I understand that anticipation analysis is a two-step process. The first step is to determine the meaning and scope of the asserted claims. Each claim must be viewed as a whole, and it is improper to ignore any element of the claim. For a claim to be anticipated under U.S. patent law: (1) each and every claim element must be identically disclosed, either explicitly or inherently, in a single prior art reference; (2) the claim elements disclosed in the single prior art reference must be arranged in the same way as in the claim; and (3) the identical invention must be disclosed in the single prior art reference, in as complete detail as set forth in the claim. Where even one element is not disclosed in a reference, the anticipation contention fails. Moreover, to serve as an anticipatory reference, the reference itself must be enabled,

i.e., it must provide enough information so that a person of ordinary skill in the art can practice the subject matter of the reference without undue experimentation.

37. I understand that where a prior art reference fails to explicitly disclose a claim element, the prior art reference inherently discloses the claim element only if the prior art reference must necessarily include the undisclosed claim element. Inherency may not be established by probabilities or possibilities. The fact that an element may result from a given set of circumstances is not sufficient to prove inherency.

D. Obviousness

38. I understand that a patent claim is invalid under 35 U.S.C. § 103 only if the differences between the claimed invention and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person of ordinary skill in that art. An obviousness analysis requires consideration of four factors: (1) scope and content of the prior art relied upon to challenge patentability; (2) differences between the prior art and the claimed invention; (3) the level of ordinary skill in the art at the time of the invention; and (4) the objective evidence of non-obviousness, such as commercial success, unexpected results, the failure of others to achieve the results of the invention, a long-felt need which the invention fills, copying of the invention by competitors, praise for the invention, skepticism for the invention, or independent development.

39. I understand that a prior art reference is proper to use in an obviousness determination if the prior art reference is analogous art to the claimed invention. I understand that a prior art reference is analogous art if at least one of the following two considerations is met. First, a prior art reference is analogous art if it is from the same field of endeavor as the claimed invention, even if the prior art reference addresses a different problem and/or arrives at a different solution. Second, a prior art reference is analogous art if the prior art 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.

40. Furthermore, I understand that a claim may be obvious in view of a single prior art reference, without the need to combine references, if the elements of the claim that are not found in the reference can be supplied by the knowledge or common sense of one of ordinary skill in the relevant art.

41. I further understand that a reconstructive hindsight approach to this analysis, i.e., the improper use of post-invention information to help perform the selection and combination, or the improper use of the listing of elements in a claim as a blueprint to identify selected portions of different prior art references in an attempt to show that the claim is obvious, is not permitted. In other words, one should avoid using the challenged patent as a guide through the prior art references, combining the right references in the right way so as to achieve the result of the

claims at issue. Instead, one must put oneself in the place of a person of ordinary skill at the time the invention was made and consider only what was known before the invention was made and not consider what was only known after the invention was made.

42. I also understand that when considering the obviousness of a patent claim, one must consider whether a teaching, suggestion, or motivation to combine the references exists so as to avoid impermissibly applying hindsight when considering the prior art. I understand that a teaching, suggestion, or motivation may be found explicitly or implicitly: (1) in the prior art; (2) in the knowledge of those of ordinary skill in the art; or (3) from the nature of the problem to be solved. I also understand that the motivation to combine references may include logic, judgment, and common sense, but that any such motivation to combine references must still avoid the improper application of hindsight or reliance on the patentee's disclosure of his invention as found in the patent specification, drawings, and claims.

43. I understand that it must also be shown that one having ordinary skill in the art at the time of the invention would have had a reasonable expectation that a modification or combination of one or more prior art references would have succeeded.

44. I understand that obviousness should be considered in light of the problems known to the person having ordinary skill in the art and the complexity of

the alternatives for solving the problems. That individual elements of the claimed invention are disclosed in the prior art is not alone sufficient to reach a conclusion of obviousness.

45. While certain combinations of the prior art might be "obvious to try," I understand that any obvious to try analysis will not render a patent invalid unless it is shown that the possible combinations are: (1) sufficiently small in number so as to be reasonable to conclude that the combination would have been selected; and (2) such that the combination would have been believed to be one that would produce predictable and well understood results.

46. I understand that each alleged prior art reference in a proposed obviousness combination must be evaluated in its entirety, i.e., including those portions that would argue against obviousness, and must be considered for everything that it teaches, not simply the described invention or a preferred embodiment. I understand that it is impermissible to pick and choose from any one reference only so much of it as will support a given position to the exclusion of other parts necessary to the full appreciation of what such reference fairly suggests to one skilled in the art, or to ignore portions of the reference that argue against obviousness. I also understand that all of the supposed prior art to be combined as proposed must also be evaluated as a whole and should be evaluated for what they teach in combination as well as separately.

47. I also understand that if the teachings of a prior art reference would lead one skilled in the art to make a modification that would render that prior art device, system, or method inoperable, then such a modification would generally not be obvious. I also understand that if a proposed modification would render the prior art device, system, or method unsatisfactory for its intended purpose, then there is strong evidence that no suggestion or motivation existed at the time of the subject invention to make the proposed modification.

48. I understand that it is improper to combine references where the references teach away from their combination. I understand that a reference may be said to teach away when a person of ordinary skill, upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken by the applicant. It is also my understanding that the degree of teaching away will depend on the particular facts; in general, a reference will teach away if it suggests that the line of development flowing from the reference's disclosure is unlikely to be productive of the result sought by the applicant. I understand that a reference teaches away, for example, if (1) the combination would produce a seemingly inoperative device, or (2) the references leave the impression that the product would not have the property sought by the applicant or would no longer achieve the intended purpose(s) of the references being modified or combined.

49. I understand that the law recognizes the importance of certain objective indicia, commonly referred to as secondary considerations of non-obviousness, as an important part of the obviousness inquiry under 35 U.S.C. § 103. It is my understanding, that these secondary considerations include, among other things, commercial success of products practicing the claimed inventions, long-felt but unsolved need in the art, failure of others to arrive at the claimed solutions, industry praise and recognition, copying by competitors, licensing activity, and unexpected results. It is my understanding that evidence of secondary considerations must always when present be considered en route to a determination of obviousness and that such evidence may often be the most probative and cogent evidence in the record.

50. It is my understanding that these secondary considerations serve as a critical check against the hindsight bias that inevitably accompanies any post-hoc reconstruction of the inventive process. I understand that secondary considerations serve to resist the temptation to read into the prior art the teachings of the invention in issue. I also understand that secondary considerations may often establish that an invention appearing to have been obvious in light of the prior art was not.

E. Dependent Claims

51. I understand that a dependent claim incorporates each and every limitation of the claim from which it depends. Thus, my understanding is that if a

prior art reference or combination of prior art references fails to render obvious an independent claim, then that prior art reference or combination of prior art references also necessarily fails to render obvious all dependent claims that depend from the independent claim.

IV. LEVEL OF SKILL IN THE ART

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

53. I have reviewed the definition of the level of ordinary skill in the art proposed in the Petition, which is:

on or before the claimed priority date of 12/31/2012, a person of ordinary skill in the art ("POSITA") "would have [had] a good working knowledge of optical sensing techniques and their applications, and familiarity with optical system design and signal processing techniques." ... A POSITA would have obtained such knowledge through "an undergraduate education in engineering (electrical, mechanical, biomedical, or optical) or a related field of study, along with relevant experience studying or developing physiological monitoring devices...in industry or academia."

Petition at 15-16.

54. For purposes of this declaration, I have applied Petitioners' proposed definition in my analysis. I reserve the right to identify a differing level of skill in the art for the '533 Patent should an IPR be instituted.

55. As of the relevant time period of December 2012, I was at least a person of ordinary skill in the art through my education and experience under the definition Petitioners have proposed. I am also familiar with individuals having this level of skill in the relevant timeframe and am capable of addressing the issues from the perspective of such a person, and I have done so in this declaration.

V. OVERVIEW OF THE '533 PATENT

56. The '533 Patent discloses systems for non-invasive physiological measurements. Ex. 1001 at 8:29-34, 3:66-4:32. The '533 Patent describes using spectroscopy to inspect a bodily sample of a user "by comparing different features, such as wavelength (or frequency), spatial location, transmission, absorption, reflectivity, scattering, fluorescence, refractive index, or opacity." Ex. 1001 at 8:29-34.

57. An exemplary physiological measurement system is depicted in Figure 24:

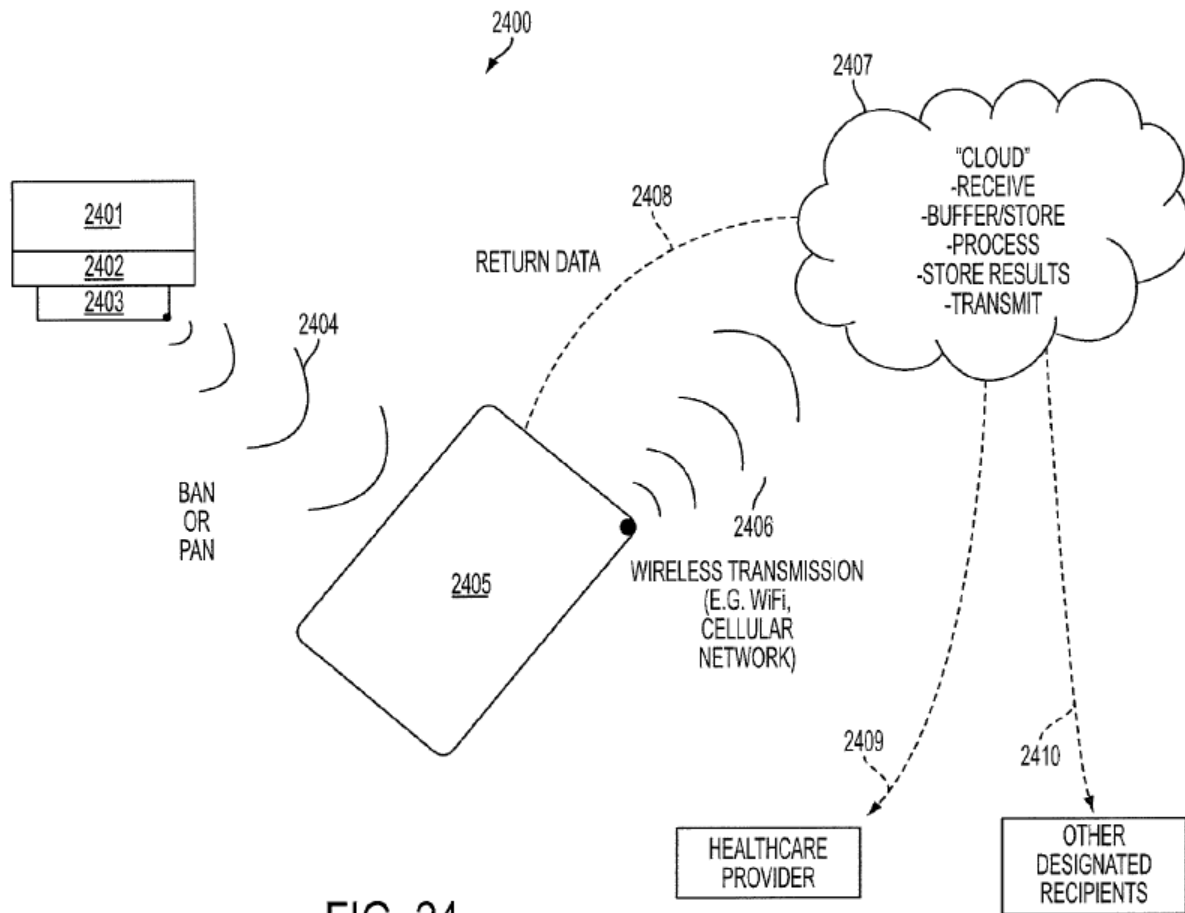


FIG. 24

The system includes a wearable measurement device 2401, a personal device 2405, and a cloud server 2407. Ex. 1001 at 26:49-27:20.

58. The wearable measurement device includes a light source, including light-emitting diodes ("LEDs"), which emit light of particular wavelengths, and a detection system. Ex. 1001 at 19:23-30, 10:18-22. The specification discloses two types of LEDs: (1) those that "emit a wavelength band that is ... between about 20 nm to 40 nm" and (2) "so-called super-luminescent LEDs that may even emit over a much wider wavelength range." Ex. 1001 at 20:2-9. The LEDs may emit light with

a wavelength band that is between 20 nm to 40 nm in width. Ex. 1001 at 20:2-4. Filters may be used in front of one or more detectors in the detection system to select the wavelengths of light to be detected. Ex. 1001 at 17:50-54. The detection system generates a signal in response to the detected light, which may be generated by comparing signals at different wavelengths of light. Ex. 1001 at 5:18-21, 8:29-34. The wearable measurement device improves the signal-to-noise ratio of the signal with various techniques, which improves the accuracy of the measurement of the user's physiological parameters despite interference from spectral artifacts. Ex. 1001 at 16:54-17:6, 3:59-4:32.

59. The '533 Patent includes 18 claims. Claims 1, 5, and 13 are independent claims. The Petition challenges dependent claims 6 and 11-12 (which depend from claim 5) and dependent claims 14 and 18 (which depend from claim 13). Independent claim 5 is reproduced below with claim identifiers added for ease of reference:

[5.pre]	A measurement system comprising:
[5.a]	a light source comprising a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes configured to generate an output optical beam with one or more optical wavelengths, wherein at least a portion of the one or more optical wavelengths is a near-infrared wavelength between 700 nanometers and 2500 nanometers,
[5.b]	the light source configured to increase signal-to-noise ratio by increasing a light intensity from at least one of the plurality of semiconductor sources and by increasing a pulse rate of at least one of the plurality of semiconductor sources;

[5.c]	an apparatus comprising a plurality of lenses configured to receive a portion of the output optical beam and to deliver an analysis output beam to a sample
[5.d]	a receiver configured to receive and process at least a portion of the analysis output beam reflected or transmitted from the sample and to generate an output signal, wherein the receiver is configured to be synchronized to the light source;
[5.e]	a personal device comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, one or more buttons or knobs, a microprocessor and a touch screen, the personal device configured to receive and process at least a portion of the output signal, wherein the personal device is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link; and
[5.f]	a remote device configured to receive over the wireless transmission link an output status comprising the at least a portion of the processed output signal, to process the received output status to generate processed data and to store the processed data.

VI. PROSECUTION HISTORY OF THE '533 PATENT

60. I have reviewed and analyzed the prosecution history of the '533 Patent. I understand that the '533 Patent issued from U.S. Patent Application No. 14/875,709, which was filed on October 6, 2015.

61. I understand that U.S. Patent Application No. 14/875,709 was a continuation of U.S. Patent Application No. 14/108,986, which was filed on December 17, 2013 and issued as U.S. Patent No. 9,164,032.

62. I understand that the '533 Patent claims priority to Provisional Application No. 61/747,487, which was filed on December 31, 2012 and drafted at least as early as October 10, 2012.

63. I understand that a third party previously filed a petition requesting *inter partes* review of claims 5, 7-10, 13, and 15-17 of the '533 Patent and that the Board found those claims unpatentable as obvious. I understand that the Board did not address the patentability of the challenged claims in this Petition during the prior proceeding.

VII. CHALLENGED CLAIMS

64. I understand that the Petition challenges claims 6, 11-12, 14, and 18 ("the challenged claims") of the '533 Patent. Petition at 7.

65. Claim 6 recites: "at least one of the light emitting diodes emits light with a bandwidth between 20 nanometers to 40 nanometers." Ex. 1001 at 30:11-13.

66. Claim 11 recites: "the receiver further comprises one or more filters in front of one of more detectors to select a fraction of the one or more optical wavelengths." Ex. 1001 at 30:38-41.

67. Claim 12 recites: "the output optical beam comprises a plurality of optical wavelengths, and the output signal is generated in part by comparing signals at different optical wavelengths." Ex. 1001 at 30:42-45.

68. Claim 14 recites: "at least one of the light emitting diodes emits light with a bandwidth between approximately 20 nanometers to approximately 40 nanometers." Ex. 1001 at 31:21-24.

69. Claim 18 recites: "the receiver further comprises one or more filters in

front of one of more detectors to select a fraction of the one or more optical wavelengths." Ex. 1001 at 32:19-22.

VIII. CLAIM CONSTRUCTION

70. Petitioners and Dr. Anthony note that certain terms in the '533 Patent have been construed in prior Board or district court proceedings, but otherwise contend that the remaining terms or phrases in the challenged claims of the '533 Patent do not require construction and can be afforded their plain and ordinary meanings. Petition at 16-18; Ex. 1003 at ¶¶ 59-67.

71. I understand that Petitioners have proposed certain claim constructions and the district court has issued a claim construction order for the '533 Patent in the pending Texas Case. Ex. 1119; Ex. 2047.

A. Prior Constructions of the Board

72. I understand that in the prior IPR of the '533 Patent, the Board construed the term "personal device" as "a computer or microprocessor-based device having a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, one or more buttons or knobs, a microprocessor, and a touch screen." Ex. 1008 at 10.

73. I understand that in the prior IPR of the '533 Patent, the Board construed the term "a light source comprising a plurality of semiconductor sources that are light emitting diodes ... configured to increase signal-to-noise ratio by ... increasing a pulse rate of at least one of the plurality of semiconductor sources" as "a light

source containing two or more light emitting diodes (semiconductor sources), wherein at least one of the light emitting diodes is capable of having its pulse rate increased to increase a signal-to-noise ratio." Ex. 1008 at 10, 12.

74. For purposes of this declaration, I have been asked to apply the Board's constructions for these terms in my analysis of the grounds in the Petition.

B. Petitioners' Constructions in the Texas Case

75. I understand that the district court has adopted plain and ordinary meaning for the term "one or more filters" in claim 11 of the '533 Patent in the Texas Case. Ex. 1119 at 9, 18.

76. The same term also appears in claim 18 of the '533 Patent, which is not asserted in the Texas Case.

77. I understand that the parties have agreed the construction for the term "personal device" in claim 5 of the '533 Patent in the Texas Case as "a computer or microprocessor-based device having a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, one or more buttons or knobs, a microprocessor, and a touch screen," which is the same as the construction of the Board in the prior IPR of the '533 Patent. Ex. 2047, 3-5; Ex. 1008 at 10. The same phrase also appears in claim 13 of the '533 Patent. As explained above, for purposes of this declaration,

I have been asked to apply the Board's construction for this term in my analysis of the grounds in the Petition.

78. I understand that the parties have agreed to a construction for the term "beam" in claim 12 of the '533 Patent in the Texas Case which is: "photons or light transmitted to a particular location in space." EX2047, 5. The same phrase also appears in claims 5 and 13 of the '533 Patent. For purposes of this declaration, I have been asked to apply this construction for this term in my analysis of the grounds in the Petition.

79. My opinions regarding Grounds 1-4 as set forth in this declaration would not change regardless of which of the constructions noted above is adopted. I reserve the right to update my opinions should the district court or the Board issue claim constructions for these terms/phrases (or any other term or phrase in the '533 Patent).

IX. OVERVIEW OF ASSERTED GROUNDS AND REFERENCES IN THE PETITION

A. Petitioners' Obviousness Grounds

80. I understand that Petitioners have challenged claims 6, 11-12, 14, and 18 of the '533 Patent as allegedly obviousness under 35 U.S.C. § 103 based on four (4) separate Grounds, as follows (Petition at 7):

Ground	Claims	Asserted Reference(s)		
1	6, 12, 14	Lisogurski		
2	6, 11-12, 14, 18	Lisogurski	Carlson	
3	6, 14	Lisogurski		Tam
4	6, 14	Lisogurski	Carlson	Tam

B. Summary of Asserted References

81. I understand that Grounds 1-4 assert various combinations of the following references: "Lisogurski" (Ex. 1025), "Carlson" (Ex. 1028), and "Tam" (Ex. 1030). Petition at 6-7. I understand that Petitioners' Grounds rely on Lisogurski alone or in various combinations with Carlson and/or Tam. Petition at 7. Herein, I refer to these alleged prior art references individually or in various combinations (depending on context) as the "the asserted reference[s]." Below are brief summaries of the asserted references.

1. Lisogurski (Ex. 1025) (Grounds 1-4)

82. U.S. Patent No. 9,241,676 ("Lisogurski") describes a non-invasive physiological monitoring system using pulse oximetry to measure blood oxygen saturation and related parameters. Ex. 1025 at 3:61-4:5. The system is illustrated in Figures 3 and 1:

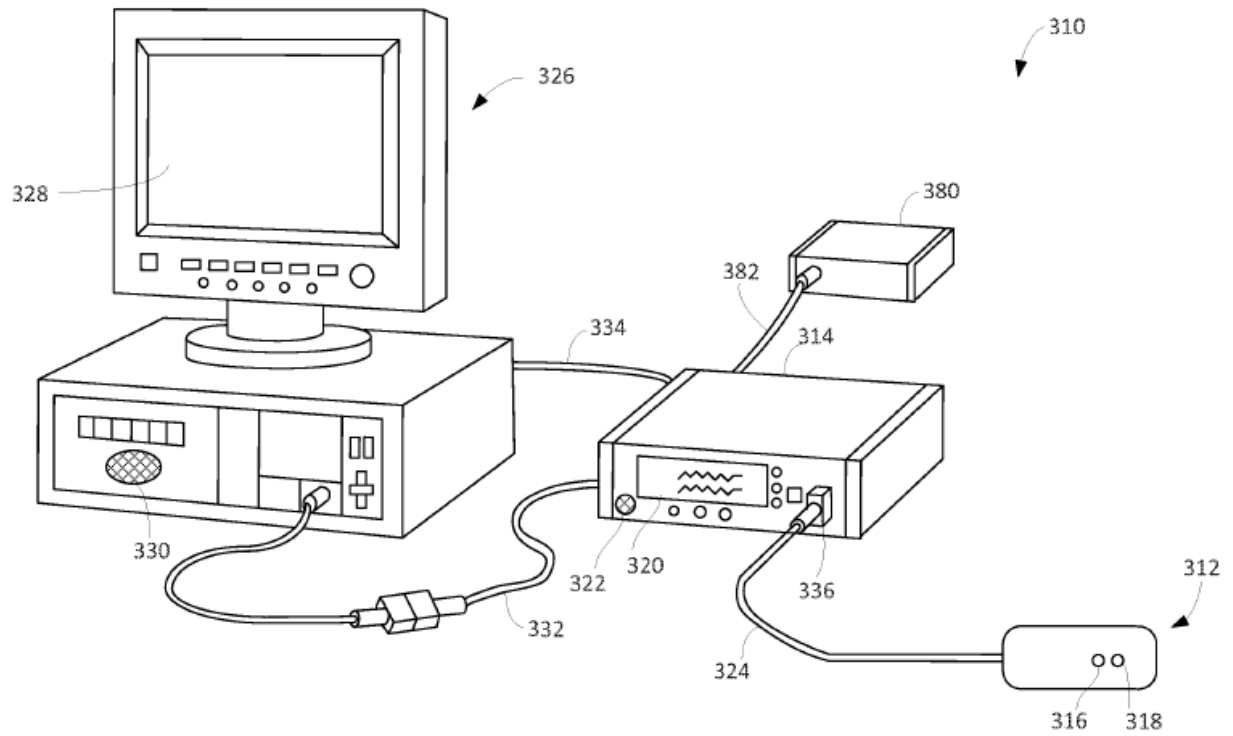


FIG. 3

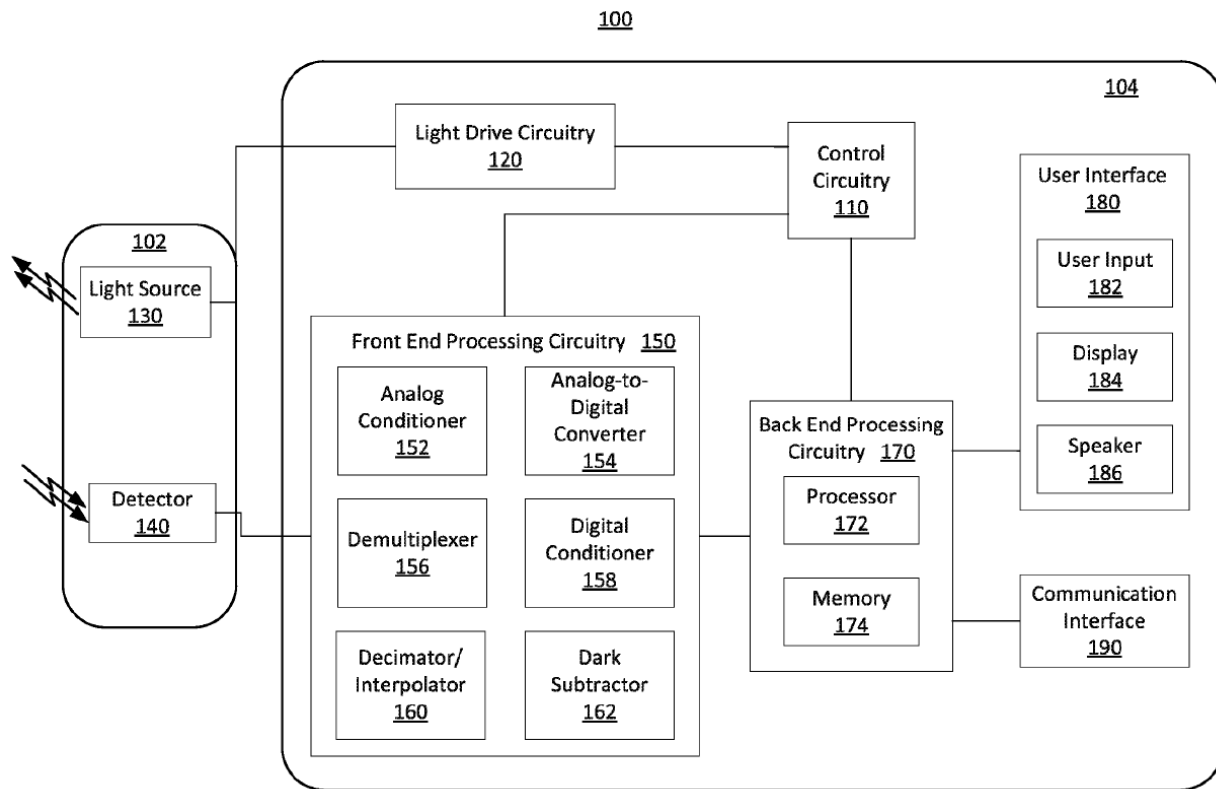


FIG. 1

Ex. 1025 at Figures 3, 1. Sensor unit 312 is wearable by a user, while the other components calibrate the system, process collected data, and display information.

Ex. 1025 at 17:54-18:15, 18:32-67. The system uses semiconductor emitters at different wavelengths to illuminate tissue, and a photodetector receives light and converts it into an electrical signal. Ex. 1025 at 4:42-62; 10:48-64. Front end processing circuitry 150 processes the electronic signal. Ex. 1025 at 12:42-49. Then, "[p]rocessor 172 may receive and process physiological signals received from front end processing circuitry 150. For example, processor 172 may determine one or more physiological parameters based on the received physiological signals." Ex.

1025 at 14:60-64. Based on known differences in the absorption spectra of oxyhemoglobin or deoxyhemoglobin, the system compares the intensities at the different wavelengths to estimate blood oxygen saturation. Ex. 1025 at 24:58-25:5.

2. Carlson (Ex. 1028) (Grounds 2 and 4)

83. U.S. Pat. App. Pub. No. 2005/0049468A1 ("Carlson") describes an optical pulse oximeter for non-invasive measurement of pulsation and blood oxygen saturation. Ex. 1028 at ¶ [0002]. Carlson describes an ear-clip form factor. Ex. 1028 at ¶¶ [0048]-[0049]. That form factor is illustrated in Figures 1 and 2:

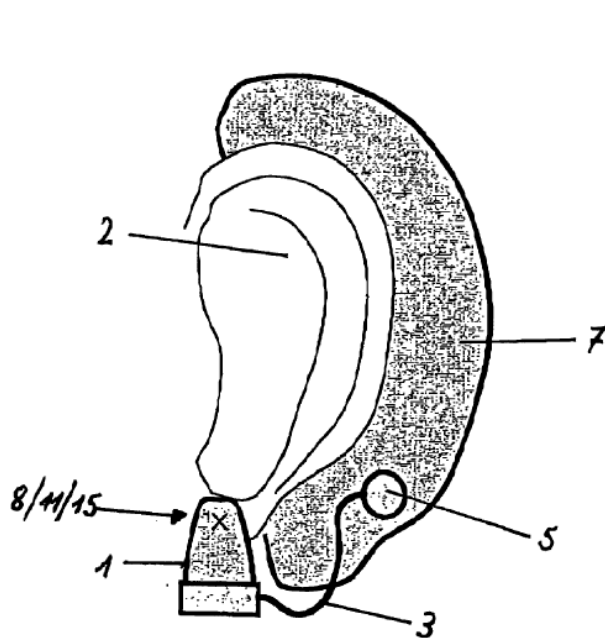


Figure 1

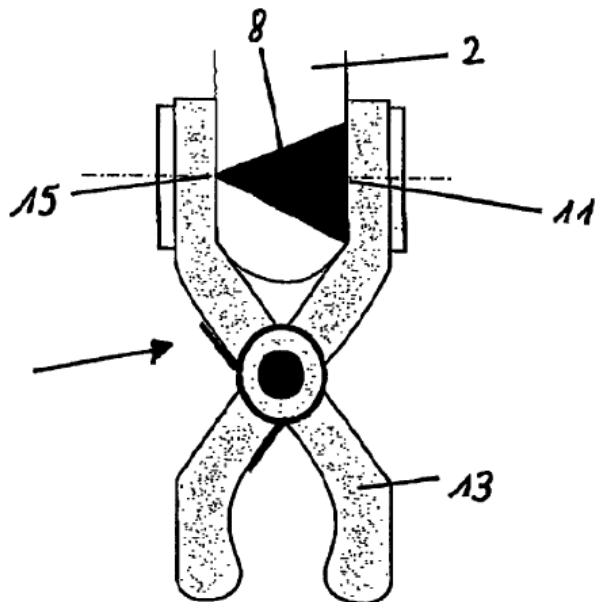


Figure 2

Ex. 1028 at Figures 1-2. Carlson describes optical and/or electronic means to improve signal-to-noise and signal-to-background performance by using beam shaping optical elements, such as diffractive or refractive lenses, to direct light into

tissue and a photo detecting element. Ex. 1028 at ¶¶ [0010], [0013]-[0014], [0062]. Carlson also discloses the use of "optical wavelength filters" for filtering light to a particular range of wavelengths before it reaches a photo detecting element. Ex. 1028 at ¶¶ [0026], [0062]. Finally, Carlson describes module packaging arrangements integrating these optical elements. Ex. 1028 ¶¶ [0041], [0062], Figure 6c.

3. Tam (Ex. 1030) (Grounds 3 and 4)

84. U.S. Patent No. 7,029,628 describes a portable co-oximeter for measuring hemoglobin derivatives in a blood sample using LED light. Ex. 1030 at 1:48-65. Tam describes LEDs having bandwidths between 7 to 100 nm. Ex. 1030 at 13:45-52. Light is transmitted through the blood sample and absorbed by photodetectors. Ex. 1030 at 13:2-5. The detected light is then analyzed by a processor. Ex. 1030 at 11:22-41.

X. OPINIONS ON GROUNDS IN THE PETITION

85. The Petition and Dr. Anthony's declaration include four grounds challenging the validity of the '533 Patent. My opinions on each ground follow.

A. Ground 1: Obviousness Based on Lisogurski (Claims 6, 12, and 14)

86. In Ground 1, Petitioners and Dr. Anthony assert that claims 6, 12, and 14 of the '533 Patent are obvious over Lisogurski. Petition at 21-45; Ex. 1003 at ¶¶ 76-158. For at least the reasons discussed below, I disagree.

1. Independent Claims 5 and 13

87. I am informed and understand that the Board previously found that independent claims 5 and 13 of the '533 Patent were unpatentable as obvious over Lisogurski and Carlson. Ex. 1008 at 51. Petitioners and Dr. Anthony assert that the limitations in claims 5 and 13 of the '533 Patent are met in view of the prior final written decision. Petition at 30-40; Ex. 1003 at ¶¶ 110-135; Ex. 1008 at 51. I have not been asked to render any opinions regarding the patentability independent claims 5 and 13 at this time.

2. Dependent Claims 6 and 14

88. Claim 6 depends on independent claim 5, which recites, among other things, "a light source comprising a plurality of semiconductor sources that are light emitting diodes." Ex. 1001 at 29:44-45, 30:11. Dependent claim 6 further recites: "wherein at least one of the light emitting diodes emits light with a bandwidth between 20 nanometers to 40 nanometers." Ex. 1001 at 30:11-13.

89. Claim 14 depends on independent claim 13, which recites, among other things, "a light source comprising a plurality of semiconductor sources that are light emitting diodes." Ex. 1001 at 30:48-50, 31:21. Claim 14 further recites: "wherein at least one of the light emitting diodes emits light with a bandwidth between approximately 20 nanometers to approximately 40 nanometers." Ex. 1001 at 31:21-24.

90. The "bandwidth" recited in claims 6 and 14 refers to the range of wavelengths of light emitted by a light source. *See, e.g.*, Ex. 1001 at 7:44-46, 19:24-35, 20:2-9, 20:36-47. Thus, when the claims refer to a bandwidth of 40 nm, this means that a light-emitting diode ("LED") could emit light with wavelengths ranging from 400 nm to 440 nm, from 740 nm to 780 nm, or from 2300 nm to 2340 nm, etc. *See, e.g.*, Ex. 1001 at 29:44-50; 30:48-55. When the claims refer to a bandwidth of 20 nm, this means that an LED could emit light with wavelengths ranging from 400 nm to 420 nm, from 740 nm to 760 nm, or from 2300 nm to 2320 nm, etc. The claims do not specify particular wavelengths.

91. Consistent with the claim language, the specification of the '533 Patent teaches that "LED's are solid state components that emit a wavelength band that is of moderate width, typically between about 20 nm to 40 nm." Ex. 1001 at 20:2-4. The specification distinguishes LEDs with a bandwidth between 20 nm to 40 nm from "so-called super-luminescent LEDs that may even emit over a much wider wavelength range." Ex. 1001 at 20:4-9. Tam, for example, discloses LEDs with bandwidths of up to 100 nm. Ex. 1030 at 13:45-48.

92. Dr. Anthony asserts that Lisogurski (Ex. 1025) "discloses, and at minimum renders obvious, that at least one of its 'LEDs' emits light with a bandwidth between 20 nanometers to 40 nanometers." Ex. 1003 at ¶¶ 142 (claim 6), 154-158 (claim 14); Petition at 41-42. I disagree.

93. Lisogurski does not disclose "at least one of the light emitting diodes emits light with a bandwidth between [approximately] 20 nanometers to [approximately] 40 nanometers." *See* Ex. 1025. While Lisogurski describes LEDs, it does not disclose the bandwidths of the LEDs. For example, Lisogurski discloses a red LED and an IR LED and states that "the Red wavelength may be between about 600 nm and about 700 nm and the IR wavelength may be between about 800 nm and about 1000 nm." Ex. 1025 at 10:52-58. Petitioners and Dr. Anthony do not explain how this description in Lisogurski discloses an LED with "a bandwidth between 20 nanometers to 40 nanometers." Petition at 41-42, 45; Ex. 1003 at ¶¶ 142-143, 157-158.

94. A POSITA would understand that Lisogurski is merely referring to the wavelengths of light that the LEDs may emit, rather than a defined narrow bandwidth. Ex. 1025 at 10:52-58. This description does not expressly disclose what the bandwidth of the LEDs would be (let alone a bandwidth between 20 nm and 40 nm as claimed). For example, if an LED emits light having a wavelength between 600 nm at the low end and 700 nm at the high end, the bandwidth for that LED would be 100 nm, which is greater than and outside the claimed bandwidth range of 20 nm to 40 nm. These figures are consistent with what a POSITA would expect for red and IR LEDs as infrared LEDs tend to have broader spectra with a bandwidth extending beyond 100 nm.

95. A POSITA would recognize that Lisogurski's LEDs could be super-luminescent LEDs—which are contemplated by the '533 Patent's disclosure—that emit light of a much wider wavelength range than LEDs with a wavelength band of 20 to 40 nm. Ex. 1025 at 10:56-58; Ex. 1001 at 20:2-9 (distinguishing super-luminescent LEDs from LEDs with a tighter wavelength band of 20 to 40 nm); The Biomedical Engineering Handbook (Ex. 1038) at 63 (disclosing that "commonly available" LEDs "typically" have bandwidths up to 50 nm, which is outside the range recited in claims 6 and 14); *see also* Ex. 1030 at 13:45-48 (disclosing LEDs with bandwidths of up to 100 nm). A super-luminescent LED would not have a bandwidth between 20 nm and 40 nm as required in claims 6 and 14 of the '533 Patent.

96. Dr. Anthony also asserts that a POSITA "would have understood that LED emission bandwidths in the 20 nm to 40 nm range are industry-standard characteristics" and "[s]tandard commercial LEDs designed for medical and physiological monitor applications, such as those described by Lisogurski, inherently exhibit these bandwidth characteristics." Ex. 1003 at ¶ 143. To the extent Dr. Anthony is suggesting that LEDs with a bandwidth between 20 nm and 40 nm are inherently disclosed in Lisogurski, I disagree. As discussed above, the LEDs in Lisogurski are not necessarily LEDs with a bandwidth between 20 nm and 40 nm. Other bandwidths are possible. Ex. 1030 at 13:45-48; Ex. 1038 at 63. For example, it is possible that Lisogurski's LEDs are super-luminescent LEDs, which do not have

a bandwidth between 20 nm and 40 nm as claimed. Ex. 1001 at 20:2-9. Aside from asserting that LEDs with a bandwidth between 20 nm and 40 nm were known and allegedly an industry standard, Dr. Anthony does not explain why he believes this bandwidth range is inherent in Lisogurski. I reserve the right to supplement my opinions should Petitioners and/or Dr. Anthony clarify their argument.

97. With respect to alleged obviousness, Petitioners and Dr. Anthony assert that "[i]t was well known in the art that LEDs typically have bandwidth range of 20 to 40 nm." Petition at 42 (citing Ex. 1030 at 9:57-60; Ex. 1071 at 2:22-24); Ex. 1003 at ¶ 142 (same). But the Petition does not explain why a POSITA would allegedly be motivated to use such LEDs with a bandwidth range of 20 to 40 nm as opposed to LEDs with a greater bandwidth, such as 50 nm. Petition at 41-42, 45; Ex. 1003 at ¶¶ 142-143, 157-158; Ex. 1038 at 63 (disclosing that "commonly available" LEDs "typically" have bandwidths up to 50 nm).

98. Dr. Anthony asserts that a POSITA "would have understood, or at least found it obvious, that Lisogurski's LEDs use conventional LEDs that have bandwidths 'typically between 20 nm to 40 nm' to increase compatibility with standard, off-the-shelf LEDs and simplify design and integration process, and reduce overall system complexity and cost." Ex. 1003 at ¶¶ 142-143, 157-158. I disagree.

99. As noted above, a POSITA would understand that there were standard, off-the-shelf LEDs that did not have a bandwidth between 20 nm and 40 nm. Dr.

Anthony's assertions appear to be premised on the notion that standard LEDs necessarily had a bandwidth within this range, which is not the case. Further, Dr. Anthony does not explain why using an LED with a bandwidth between 20 nm and 40 nm would allegedly "simplify design and integration process, and reduce overall system complexity and cost" relative to an LED with a bandwidth outside of this range. Ex. 1003 at ¶ 142. To the contrary, Tam shows that modifying Lisogurski to include LEDs with a bandwidth between 20 nm and 40 nm would potentially increase cost. Tam teaches that "LEDs are available in tighter bandwidths by selection at a premium price." Ex. 1030 at 9:61-62; Ex. 1025 at 10:56-58; *infra*, § X.C. In other words, Tam teaches that selecting an LED with a tighter bandwidth would be more expensive than using an LED with a broader bandwidth, e.g., selecting an LED with a bandwidth of 20 nm (within the claimed range) would be more costly than an LED with a bandwidth of 50 nm (outside the claimed range).

100. Dr. Anthony also asserts that LEDs with "emission bandwidths in the 20 nm to 40 nm range are industry-standard characteristics." Ex. 1003 at ¶ 143. Dr. Anthony cites no evidence that this bandwidth range is an industry standard for medical and physiological monitoring applications. *Id.* As discussed above, the references in the Petition show that LEDs were used with bandwidths outside of this range. *See, e.g.*, Ex. 1038 at 63 (disclosing that "commonly available" LEDs "typically" have bandwidths up to 50 nm).

101. Dr. Anthony also asserts that "incorporating such standard components into the described monitoring systems would be obvious, practical, and technically advantageous." Ex. 1003 at ¶ 143. Again, it appears that Dr. Anthony's assertions is premised on the notion that standard LEDs had a bandwidth between 20 nm and 40 nm, which he has not shown. Further, Dr. Anthony does not explain why using an LED with a bandwidth between 20 nm and 40 nm would be "technically advantageous" relative to an LED with a bandwidth outside of that range.

102. Dr. Anthony further asserts that "[a] person of ordinary skill in the art would also appreciate that using standard LEDs would reduce development risk, simplify procurement, lower system cost, and improve reliability due to well-established and widely accepted specifications and performance criteria." Ex. 1003 at ¶ 143. Similar to his assertions above, Dr. Anthony does not explain why or how any of these alleged benefits could be achieved by using an LED with a bandwidth between 20 nm and 40 nm as opposed to an LED with a bandwidth outside of that range. Dr. Anthony does not identify what "well-established and widely accepted specifications and performance criteria" he is referring to or what those specifications and criteria are. Additionally, as I noted above, there is evidence in the Petition (e.g., Tam) that teaches that using such LEDs would actually increase costs.

103. Dr. Anthony does not assert that LEDs with a broader bandwidth, such

as 50 nm, are not standard, off-the-shelf LEDs. Ex. 1003 at ¶¶ 142-143, 157-158. As noted above, the evidence in the Petition shows that LEDs with bandwidths outside the claimed range were typical or standard. *See, e.g.*, Ex. 1038 at 63 (disclosing that "commonly available" LEDs "typically" have bandwidths up to 50 nm); Tam (Ex. 1030) at 13:45-48 (disclosing "LEDs having bandwidths from about 7 to 100 nm" for co-oximeters). I note that Dr. Anthony does not explain why he believes that using LEDs with a bandwidth between 20 and 40 nm, relative to LEDs with a greater bandwidth such as 50 nm, would simplify the design and integration process, why he believes that such LEDs would reduce overall system complexity, procurement complexity, development risk, and cost, or why he believes that they would improve reliability. Ex. 1003 at ¶¶ 142-143, 157-158. LEDs with a bandwidth between 20 and 40 nm would involve the same level of design and implementation complexity and reliability as LEDs with a greater bandwidth such as 50 nm.

3. Dependent Claim 12

104. Claim 12 depends on independent claim 5, which recites, among other things, "light emitting diodes configured to generate an output optical beam with one or more optical wavelengths" and "a receiver configured ... to generate an output signal." Ex. 1001 at 29:44-50, 29:59-62, 30:42. Claim 12 further recites: "wherein the output optical beam comprises a plurality of optical wavelengths, and the output signal is generated in part by comparing signals at different optical wavelengths."

Ex. 1001 at 30:42-45.

105. Petitioners and Dr. Anthony assert that Lisogurski (Ex. 1025) renders obvious claim 12. Petition at 42-44; Ex. 1003 at ¶¶ 144-153. They assert that "the output signal" is disclosed by the "processed signals" of Lisogurski. Petition at 43; Ex. 1003 at ¶ 149.

106. I understand that in the prior IPR for the '533 Patent, the Board stated that "[t]he receiver [of Lisogurski] generates an output signal because front end processing circuitry 150 'receive[s] a detection signal from detector 140 and provide[s] one or more processed signals to back end processing circuitry 170.'" Ex. 1008 at 39. The Board identified the "output signal" on a modified version of Lisogurski's Figure 1:

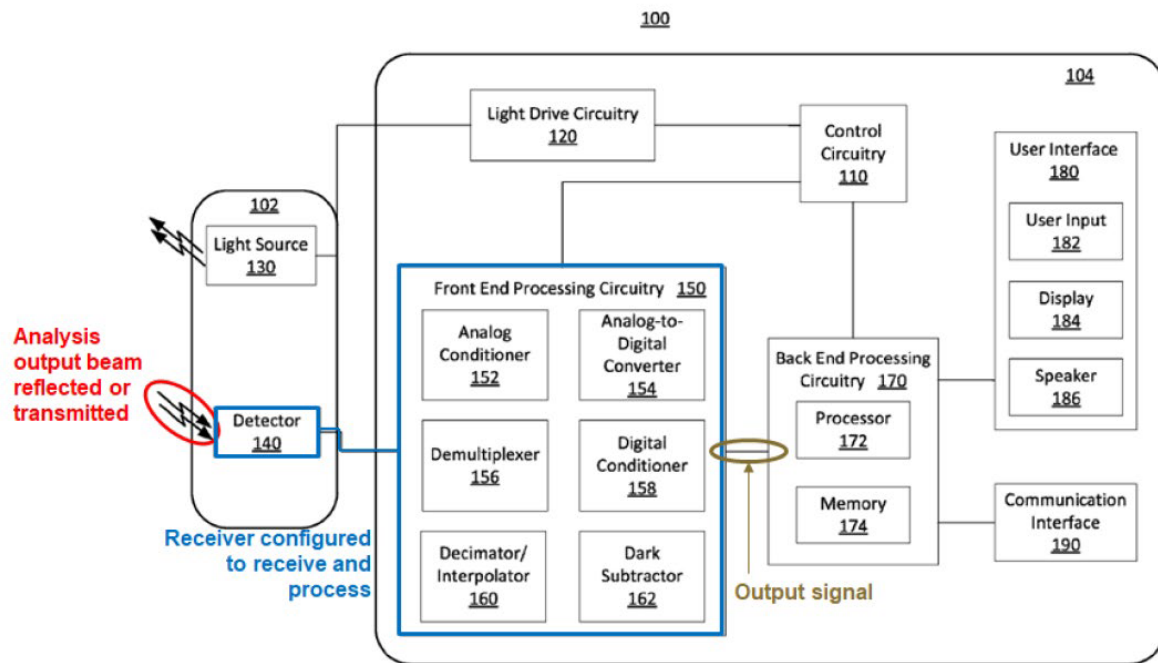


FIG. 1

Ex. 1008 at 38. Thus, I understand the Board determined that the "output signal" limitation of the '533 Patent is disclosed by the "processed signals" of Lisogurski, which are provided by "front end processing circuitry 150" to "back end processing circuitry 170." Ex. 1008 at 38-39. The prior Board Decision does not address whether the "processed signal" of Lisogurski is "generated in part by comparing signals at different optical wavelengths." Ex. 1008 at 38-39.

107. Petitioners and Dr. Anthony assert that the "processed signal" of Lisogurski is generated in part by comparing signals at different optical wavelengths based on Lisogurski's disclosure that "[b]y comparing the intensities of two wavelengths at different points in the pulse cycle, it is possible to estimate the blood oxygen saturation of hemoglobin in arterial blood." Petition at 43-44; Ex. 1003 at ¶

150; Ex. 1025 at 48-51. I disagree.

108. Lisogurski does not disclose that its "processed signal" is "generated in part by comparing signals at different optical wavelengths" as required in claim 12. Lisogurski does not disclose *where* in the system the "comparing the intensities of two wavelengths" is allegedly performed. Ex. 1025 at 4:42-56. Petitioners and Dr. Anthony do not explain where they believe the "comparing the intensities of two wavelengths" takes place, either. Petition at 43-44; Ex. 1003 at ¶ 150. Their assertion that the processed signal is "generated in part by comparing the intensities of two different wavelengths (e.g., Red and IR) to determine physiological parameters" is not supported by the disclosure in Lisogurski that they cite. Petition at 44; Ex. 1003 at ¶ 152; Ex. 1025 at 4:42-56, 14:60-62. For example, Petitioners and Dr. Anthony cite to Lisogurski's disclosure that "[p]rocessor 172 may receive and process physiological signals received from front end processing circuitry." Ex. 1025 at 14:60-62. But, according to Figure 1 from Lisogurski (*see above*), the processor 172 receives the "processed signal" (output signal) after it has already been generated by the detector 140 and front end processing circuitry 150. Ex. 1008 at 38 (Fig. 1). Accordingly, Lisogurski does not disclose that the "output signal is generated in part by comparing signals at different optical wavelengths."

109. While the '533 Patent claims *generating* an output signal by comparing signals, Lisogurski discloses comparing intensities *after* output signals have been

generated. *See, e.g.*, Ex. 1008 at 38 (Fig. 1). The Lisogurski system "compar[es] the intensities of two wavelengths" in the back end processing circuitry 170, which includes the processor 172. Ex. 1025 at 4:48-51. Lisogurski states that "[p]rocessor 172 may receive and process physiological signals received from front end processing circuitry 150. For example, processor 172 may determine one or more physiological parameters based on the received physiological signals." Ex. 1025 at 14:60-64. Lisogurski lists "blood oxygen saturation" as one such physiological parameter. Ex. 1025 at 1:22-25. In other words, the processor 172 *receives* output signals and then *compares* them to determine blood oxygen saturation. Ex. 1025 at Fig. 1, 1:22-25, 14:60-64. Accordingly, the "output signals" of Lisogurski (i.e., the "processed signals") are not "generated in part by comparing signals at different optical wavelengths." Dr. Anthony's deposition testimony further confirms that the comparison in Lisogurski occurs after the alleged "processed signal" is generated. He testified that the functionality of "processing and comparing" the signals "could be done in ... 150 or in 170"—i.e., either the front end or back end processing circuitry. Ex. 2046, 364:8-366:18. When asked whether he had "an opinion on which component in Figure 1...performs the comparison between different intensities," Dr. Anthony did not identify a specific component. Ex. 2046, 364:2-365:15. Dr. Anthony's inability to identify where the comparison occurs underscores Petitioners' failure to establish that the comparison is part of generating the

“processed signal” (i.e., the output signal), as required by claim 12. At best, Dr. Anthony confirmed that the relevant comparison could be performed in the back end processing circuitry 170, meaning that the comparison occurs after the “processed signal” has already been generated and transmitted from front end processing circuitry 150 to back end processing circuitry 170.

110. For at least these reasons, I disagree with Petitioners' and Dr. Anthony's conclusions for Ground 1 and claims 6, 12, and 14 of the '533 Patent.

B. Ground 2: Obviousness Based on Lisogurski in view of Carlson (Claims 6, 11-12, 14, and 18)

111. In Ground 2, Petitioners and Dr. Anthony assert that claims 6, 11-12, 14, and 18 of the '533 Patent are obvious over Lisogurski in view of Carlson. Petition at 45-62; Ex. 1003 at ¶¶ 159-190. For the reasons discussed below, I disagree.

1. Dependent Claims 6 and 14

112. Petitioners and Dr. Anthony assert that claim 6 and claim 14 are additionally rendered obvious by Lisogurski (Ex. 1025) in view of Carlson (Ex. 1028) for the same reasons supporting their assertions that Lisogurski alone renders obvious claim 6 (Petition at 56-57, 41-42; Ex. 1003 at ¶¶ 138-143, 180) and claim 14 (Petition at 56-57, 45; Ex. 1003 at ¶¶ 154-158, 180) in Ground 1. Petitioners and Dr. Anthony do not cite to Carlson to support their assertions with respect to the claim limitations recited solely in dependent claims 6 and 14, as opposed to the claim

limitations recited in independent claims 5 and 13 on which claims 6 and 14 depend, respectively. Petition at 56-57. In other words, Petitioners and Dr. Anthony do not contend that Carlson discloses an LED that "emits light with a bandwidth between 20 nanometers and 40 nanometers" as recited in claims 6 and 14. Accordingly, I disagree with Petitioners' and Dr. Anthony's assertions in connection with Ground 2 for at least the same reasons that I provided above for Ground 1. *Supra*, § X.A.2.

2. Dependent Claim 12

113. Petitioners and Dr. Anthony assert that claim 12 is rendered obvious by Lisogurski (Ex. 1025) in view of Carlson (Ex. 1028) for the same reasons that Lisogurski alone allegedly renders obvious claim 12 as set forth in Ground 1. Petition at 56-57, 42-44; Ex. 1003 at ¶¶ 144-153, 180. Petitioners and Dr. Anthony do not cite Carlson to support their assertions with respect to the claim limitations recited solely in dependent claim 12, as opposed to the claim limitations recited in independent claim 5 on which claim 12 depends. Petition at 56-57. Accordingly, I disagree with Petitioners' and Dr. Anthony's assertions in Ground 2 for the same reasons that I provided above in Ground 1. *Supra*, § X.A.3.

3. Dependent Claims 11 and 18

114. Claim 11 depends on independent claim 5, which recites, among other things, "light emitting diodes configured to generate an output optical beam with one or more optical wavelengths" and "a receiver configured to receive and process at

least a portion of the analysis output beam reflected or transmitted from the sample."

Ex. 1001 at 29:44-47, 29:56-62, 30:38. Claim 11 further recites: "wherein the receiver further comprises one or more filters in front of one of more detectors to select a fraction of the one or more optical wavelengths." Ex. 1001 at 30:38-41.

115. Claim 18 depends on independent claim 13, which recites, among other things, "light emitting diodes configured to generate an output optical beam with one or more optical wavelengths" and "a receiver configured to receive and process at least a portion of the analysis output beam reflected or transmitted from the sample." Ex. 1001 at 30:50-52, 30:64-67, 32:19. Claim 18, similar to claim 11, further recites: "wherein the receiver further comprises one or more filters in front of one of more detectors to select a fraction of the one or more optical wavelengths." Ex. 1001 at 32:19-22.

116. Petitioners and Dr. Anthony assert that claims 11 and 18 are obvious over Lisogurski (Ex. 1025) in view of Carlson (Ex. 1028). Petition at 57-62; Ex. 1003 at ¶¶ 181-190. I disagree.

117. Lisogurski alone does not disclose a physical optical filter positioned "in front of" its detectors.

118. Dr. Anthony states that "Lisogurski discloses the receiver (e.g., detector 140/318 and front end processing circuitry 150 in modified sensor, see Sections IX.A.2-IX.A.3) has one of more detectors." Ex. 1003 at ¶ 183. Dr. Anthony also

argues that "a person of ordinary skill in the art would have been motivated to apply Carlson's filter teachings to Lisogurski's wireless sensor to advantageously filter out unwanted background noise and ambient light before they reach the detector(s) in Lisogurski's sensor." Ex. 1003 at ¶ 188. Dr. Anthony further argues that "*as modified by Carlson's filtering teachings* (see my discussion in Section IX.B.2), a person of ordinary skill in the art would have understood, or at least found obvious, that Lisogurski's sensor would include one or more filters in front of one or more detectors." Ex. 1003 at ¶ 189 (emphases added). Dr. Anthony does not cite any of Lisogurski's descriptions of the filter or the filter's position. Ex. 1003 at ¶ 181-190.

119. Dr. Anthony does not rely on Lisogurski alone as disclosing "one or more filters in front of one or more detectors." Ex. 1003 at ¶ 189. Instead, Dr. Anthony relies additionally on Carlson [Ex. 1028] as supplying this limitation. Ex. 1003 at ¶¶ 188-189. This is because Lisogurski does not disclose any optical filter positioned "in front of" its detector 140. Ex. 1025 at FIG. 1, 10:42-49, 11:8-27.

120. Lisogurski's sensor 102 includes a light source 130, a detector 140. Ex. 1025 at FIG. 1, 10:42-49, 11:8-27. Lisogurski discloses that "In operation, light may enter detector 140 after passing through the subject's tissue." Ex. 1025 at 11:13-14. Lisogurski does not disclose any filter component—positioned in the optical path between incoming light and detector 140. Ex. 1025 at FIG. 1, 11:8-27.

121. Dr. Anthony admitted that he does not rely on Lisogurski by itself to

disclose one or more filters as claimed in Claims 11 and 18 of the '533 Patent:

Q You are not opining that Lisogurski by itself discloses one or more filters as claimed in Claims 11 and 18 of the '533 patent. Correct?

...

THE WITNESS: I am proposing Lisogurski in view of Carlson.

Ex. 2046 at 369:17-24 (internal objections omitted).

122. Regarding why a POSITA would allegedly be motivated to combine Lisogurski with Carlson, the Petition asserts the following: "As discussed above (*see* §IX.C.2), a POSITA would have been motivated to apply Carlson's filter teachings to Lisogurski's wireless sensor to advantageously filter out unwanted background noise and ambient light before they reach the detector(s) in Lisogurski's sensor." Petition at 62 (citing Ex. 1003 at ¶ 188); *see also* Petition at 48, 52-53; Ex. 1003 at ¶ 170. Similarly, Dr. Anthony's declaration refers back to discussion in "Section IX.B.2" of his declaration. Ex. 1003 at ¶ 188. Based on my review, the Petition's single paragraph addressing the alleged motivation to combine Carlson's "filter teachings" with Lisogurski only contains cites to Lisogurski for a single assertion: that "Lisogurski and Carlson both recognize the desirability of removing background noise to improve the quality of physiological measurements." Petition at 52 (citing Ex. 1025 at 6:7-31, 14:46-55, 12:42-49, 11:9-27). Likewise, the only citations to Lisogurski in paragraph 170 of Dr. Anthony's declaration are for this same assertion.

Ex. 1003 at ¶ 170 (citing Ex. 1025 at 6:7-31, 14:46-55, 12:42- 49, 11:9-27).

123. Based on my review, Section IX.C.2 of the Petition includes the following assertion regarding an alleged motivation to combine Carlson's "filtering [teachings]" with Lisogurski's sensor:

Third, with respect to Carlson's filtering teachings, a POSITA would have been motivated to apply Carlson's teachings of filtering out optical wavelengths to Lisogurski's modified sensor 102/312 (as discussed in §IX.C.2) to advantageously filter out unwanted background/ambient light before it reaches Lisogurski's detector(s) (e.g., "detector" 140) and negatively impacts Lisogurski's physiological measurements. ... Thus, a POSITA would have been motivated to apply Carlson's filter teachings to Lisogurski's sensor to filter out unwanted background noise and ambient light before they reach Lisogurski's detector(s) to improve the quality of physiological measurements determined by Lisogurski's physiological monitoring system. Anthony at ¶ 170.

Petition at 52-53. I note that the Petition does not cite directly to Lisogurski or Carlson to support those assertions and instead only cites to paragraph 170 of Dr. Anthony's declaration. Petition at 52-53 (citing Ex. 1003 at ¶ 170).

124. Paragraph 170 of Dr. Anthony's declaration similarly does not provide citations to Lisogurski or Carlson for the following assertions:

With respect to Carlson's filtering teachings, a person of ordinary skill in the art would have been motivated to apply Carlson's teachings of filtering optical wavelengths to Lisogurski's modified sensor 102/312 (as I discussed in Section IX.A.2) to advantageously filter out (i.e., significantly suppress or remove) unwanted background/ambient light before it reaches Lisogurski's detector(s) (e.g., "detector 140) and negatively impacts Lisogurski's physiological measurements. ... A person of ordinary skill in the art would have understood the practical benefits of Carlson's optical filtering techniques including

understanding that implementing such filters significantly reduce interference from ambient and stray light, which ensures that detectors measure primarily relevant and accurately conditioned light that was generated/transmitted by the device (e.g., source LEDs) instead of originating from the environment. Thus, a person of ordinary skill in the art would thus have been motivated to apply Carlson's filter teachings to Lisogurski's sensor to filter out unwanted background noise and ambient light before they reach Lisogurski's detector(s) to increase the signal-to-noise ratio of the signal detected by Lisogurski's detector(s), thus improving the quality of physiological measurements determined by Lisogurski's physiological monitoring system.

Ex. 1003 at ¶ 170. I note that Dr. Anthony does not support these assertions with evidence from the asserted references (Lisogurski and Carlson) or otherwise. Ex. 1003 at ¶ 170. For example, Dr. Anthony cites no evidence for his assertions that Lisogurski suffers from "interference from ambient and stray light" or "detectors measur[ing] ... light ... originating from the environment" or evidence that Carlson's "filter teachings" would "significantly reduce" such "interference" or "ensure[] that detectors measure primarily relevant and accurately conditioned light." Ex. 1003 at ¶ 170.

125. The Petition and Dr. Anthony's declaration assert that "Lisogurski and Carlson both recognize the desirability of removing background noise" and that Carlson's filter allegedly "addresses this problem." *See* Petition at 52-53 (citing Ex. 1025 at 6:7-31, 14:46-55, 12:42-49, 11:9-27; Ex. 1028 at ¶¶ [0059], [0062], [0063], [0026]); Ex. 1003 at ¶ 170 (same). I disagree because (1) the cited portions of

Lisogurski and Carlson relate to *different* problems and (2) Carlson's cited filter teaching does not address the problem in Lisogurski.

126. A POSITA would have understood that the cited disclosures of Carlson address a desire to limit the light received by detecting element 35 to a target wavelength(s) of light, which Carlson addresses with a "[wavelength] filter[]" that limits the received light to the target wavelength(s). Ex. 1028 at ¶¶ [0059], [0062], [0063] (disclosing that "double pass filter 33" (a "wavelength filter[]") only transmits "light in the range of approximately 660 nm and in the range of approximately 890 nm"), [0026] ("wavelength filters"); *see also* ¶ [0038], FIG. 5C (showing a "transmission spectrum of a double band pass filter" where the filter limited the received light to target wavelengths of approximately 660 nm and 890 nm).

127. By contrast, a POSITA would have understood that the cited disclosures of Lisogurski address a different desire to remove background noise (e.g., based on ambient light) from the signal (a.k.a. peak) *at the target wavelength*, with no discussion regarding limiting the received light to that target wavelength to begin with, as in Carlson. Ex. 1025 at 6:7-31 ("The system may measure the ambient light detected by the detector during the 'dark' period and then subtract this ambient contribution from the signals received during the ... 'on' periods"—i.e., as further explained at 13:60-14:10, "determine a subtraction amount from the dark signal portion of the detection signal and subtract it from the peak portion of the detection

signal ... to reduce the effect of the dark signal on the peak" and "generate adjusted Red and IR signals"), 14:46-55 (reducing the effect of ambient light on the detection signal), 12:42-49, 11:9-27.

128. The Petition and Dr. Anthony's declaration conflate and oversimplify these two different problems in Lisogurski and Carlson as the same purported problem of "removing background noise" and inaccurately argue that Carlson's solution of "'optical wavelength filters'" would "address [the] problem" in Lisogurski. Petition at 52-53 (quoting Ex. 1028 at ¶ [0026]); Ex. 1003 at ¶ 170 (same). A POSITA would have understood, as depicted in the annotated figures below, that the cited portions of Carlson and Lisogurski address different problems because Carlson addresses excluding light (blue) outside of a target wavelength (red), whereas Lisogurski addresses adjusting the detected signal at that target wavelength (red) by removing a portion of the detected signal attributable to background/ambient noise (green). *E.g.*, Ex. 1025 at 6:7-31; Ex. 1028 at ¶ [0062].

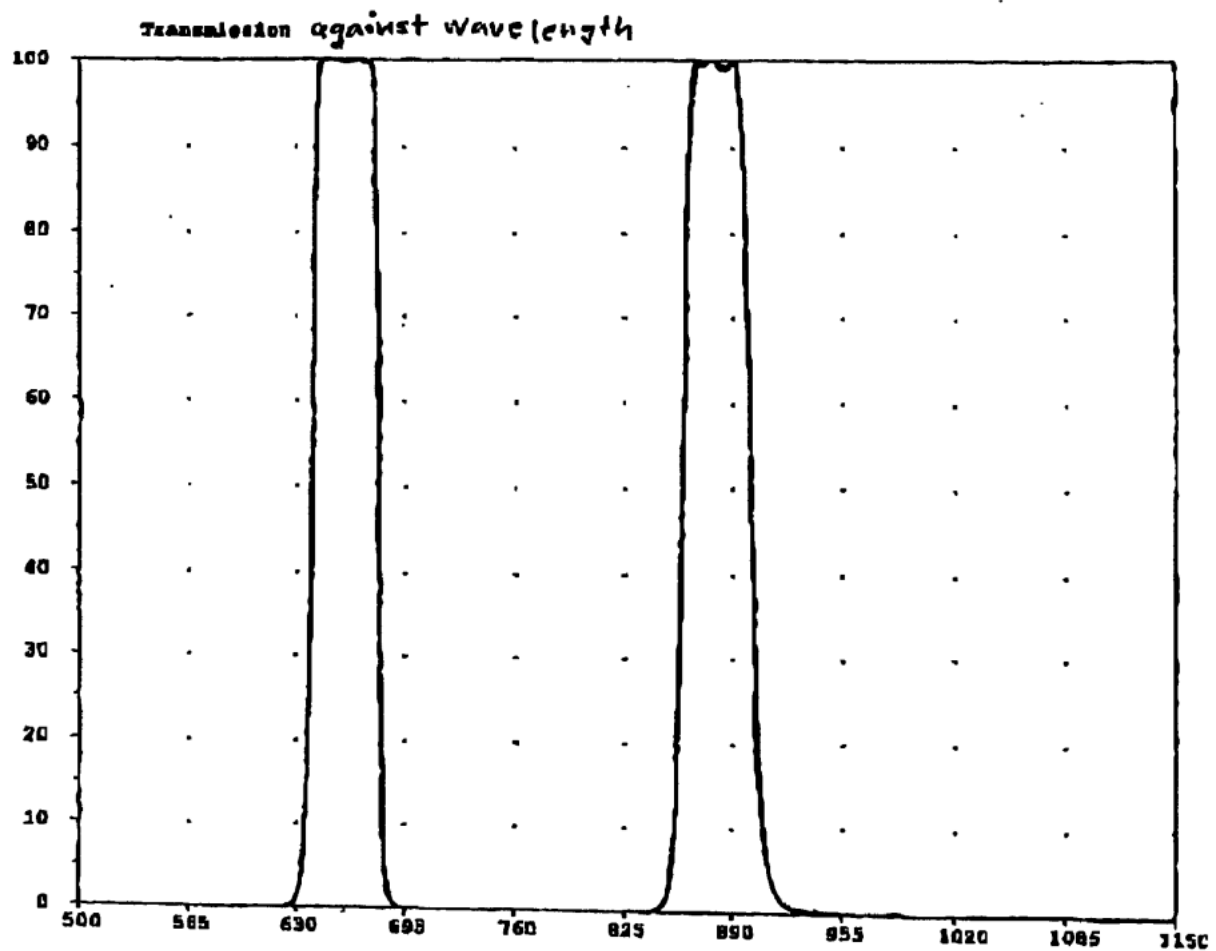


Figure 5c

Ex. 1028 at FIG. 5C (annotated); *see* Ex. 1028 at ¶¶ [0038], [0056].

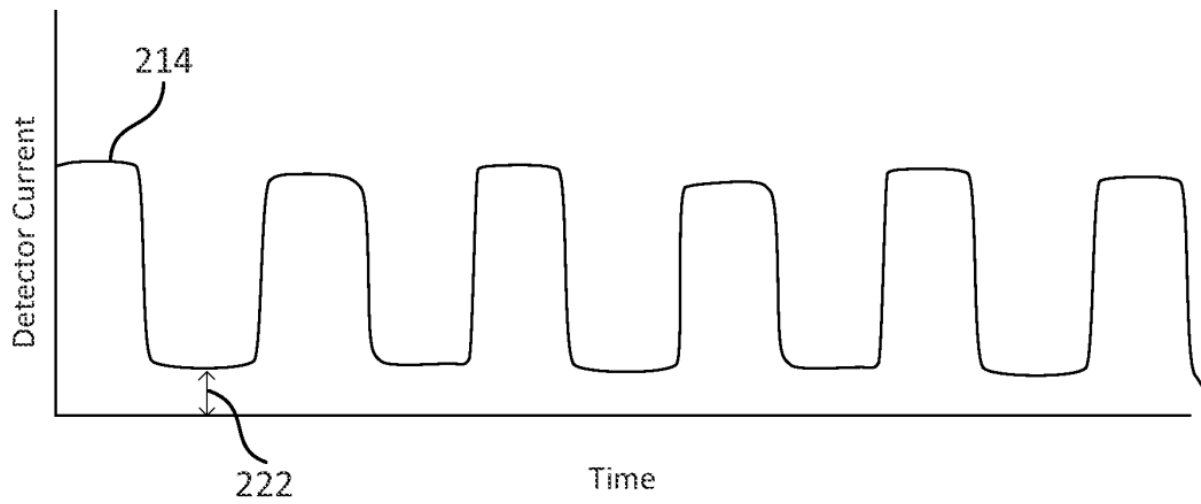
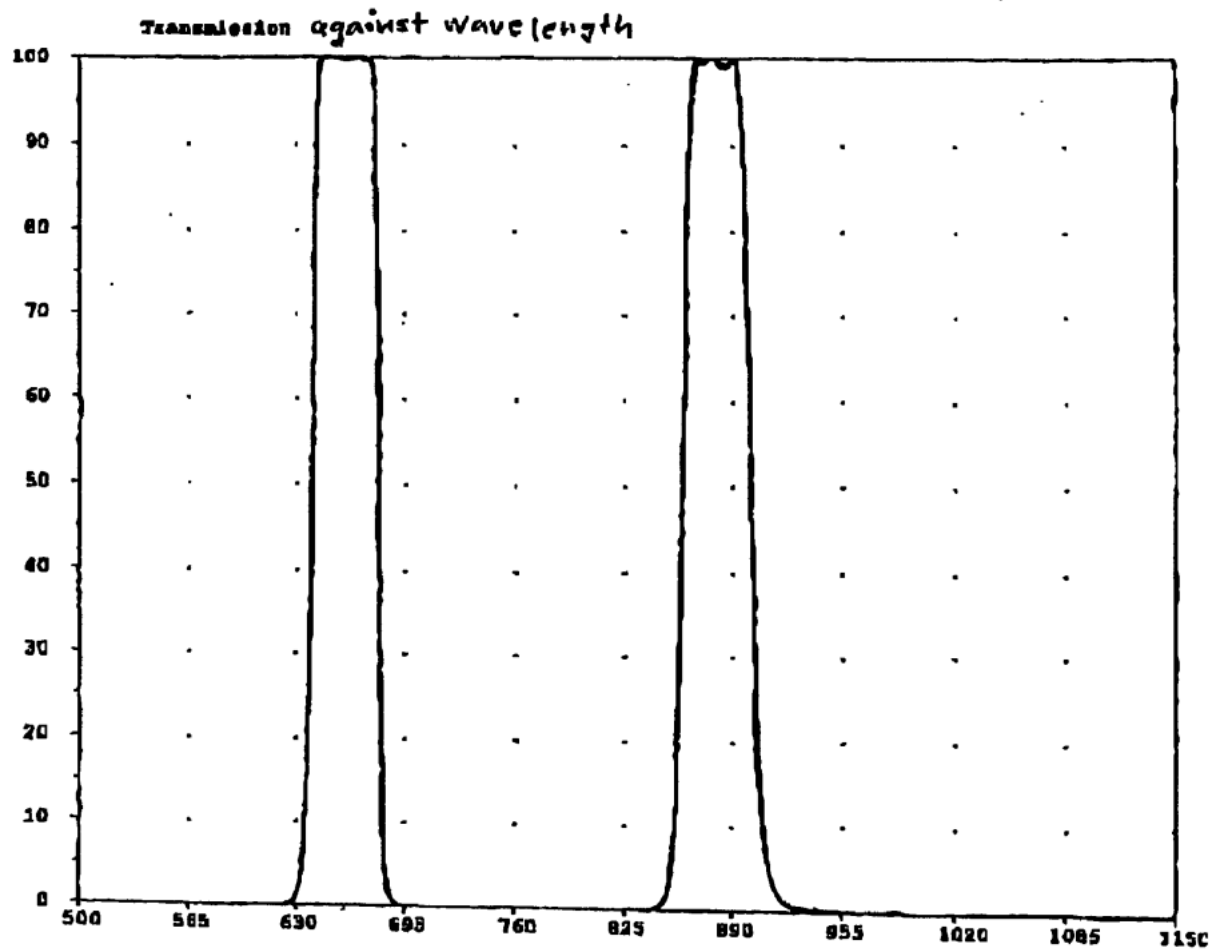


FIG. 2B

Ex. 1025 at FIG. 2B (annotated); *see* Ex. 1025 at 2:17-19, 12:42-13:6, 13:60-14:10.

**Figure 5c**

Ex. 1028 at FIG. 5C (annotated).

129. Further, a POSITA would have understood that Carlson's solution of an optical wavelength filter would not address or solve the problem described in the cited portions of Lisogurski because Carlson's wavelength filter can only limit the detected light to a target wavelength and cannot, as Lisogurski addresses, identify or remove the background noise detected at that target wavelength. Ex. 1028 at ¶¶ [0026], [0062]; Ex. 1025 at 6:7-31. Thus, a POSITA would not have been motivated

to incorporate and use Carlson's optical wavelength filter to address the alleged problem in Lisogurski identified in the Petition and Dr. Anthony's declaration. *See* Petition at 52-53; Ex. 1003 at ¶ 170. A POSITA would have instead used Lisogurski's electronic signal processing techniques described below, not Carlson's optical wavelength filtering, to address the problem of background noise as described in the cited portions of Lisogurski. *See* Ex. 1025 at 6:7-31, 12:42-51, 13:7-12, 13:60-14:10. As discussed below, the Petition and Dr. Anthony's declaration fail to consider these signal processing techniques in Lisogurski for addressing background noise. *See* Petition at 52-53; Ex. 1003 at ¶ 170.

130. Additionally, contrary to Petitioners and Dr. Anthony's assertions, not all of the portions of Lisogurski cited as "recogniz[ing] the desirability of removing background noise" discuss a desire to remove background noise to improve measurements. *See* Petition at 52; Ex. 1025 at 12:42-49, 11:9-27 (no discussion of removing background noise from ambient light).

131. To the extent that the cited portions of Lisogurski suggest that background noise is problematic and that removing background noise is desirable, a POSITA would have understood that Lisogurski already teaches solutions for removing background noise, such that there would be no reason for a POSITA to turn to Carlson. *See* Ex. 1025 at 6:7-31 (disclosing "a technique to remove ambient and background signals," i.e., Lisogurski's dark subtraction process), 14:46-55

(disclosing that "filtering or signal modification techniques may be employed to reduce the effect of ambient light," referring to Lisogurski's teachings of filtering or signal modification, for example, by components 152, 156, 158, 160, and 162 disclosed at 13:13-20, 13:31-14:10), 12:42-49 (disclosing that Lisogurski's "[f]ront end processing circuitry 150 may perform various analog and digital processing of the detector signal").

132. The Petition and Dr. Anthony's argument for incorporating Carlson's optical filter into Lisogurski fail to consider or discuss the existing aspects of Lisogurski, including Lisogurski's teachings directed to addressing background noise and ambient light. *See* Petition at 52-53. For example, a POSITA would have understood that Lisogurski already discloses several techniques for excluding unwanted background noise and ambient light, such as a "drive cycle modulation technique" (Ex. 1025 at 6:7-31) with a dark subtractor (Ex. 1025 at 13:60-14:10), increasing the LED brightness (Ex. 1025 at 9:46-57), changing to a "constant light output" (Ex. 1025 at 9:57-60), and "passive or active filtering or signal modification techniques" (Ex. 1025 at 14:46-55). With the "drive cycle modulation technique," the system of Lisogurski "may measure the ambient light detected by the detector during the 'dark' period and then subtract this ambient contribution from the signals received during the first and second 'on' periods." Ex. 1025 at 11:16-19. The dark subtractor "determine[s] a subtraction amount from the dark signal portion of the

detection signal and subtract[s] it from the peak portion of the detection signal in order to reduce the effect of the dark signal on the peak." Ex. 1025 at 13:63-65; FIG. 2A.

133. Additionally, increasing the brightness of the LEDs in Lisogurski would reduce noise because "the system may require increased signal amplitudes to differentiate between fiducial and other points of interest related to physiological parameters and those related to noise or motion." Ex. 1025 at 9:50-57. Lisogurski's system can "change from a modulated light output to a constant light output in response to noise, patient motion, or ambient light." Ex. 1025 at 9:57-60. Lisogurski further teaches that "passive or active filtering or signal modification techniques may be employed to reduce the effect of ambient light on the detection signal that is applied to analog-to-digital converter 154, and thereby reduce the contribution of the noise component to the converted digital signal." Ex. 1025 at 14:51-55.

134. Further, the Petition and Dr. Anthony's declaration do not allege that there would be any benefit or advantage to applying Carlson's "filter teachings" in addition to, or as a substitute for, any of Lisogurski's disclosed techniques for addressing background noise. Petition at 52-53; Ex. 1003 at ¶ 170. Even assuming that the problem of background noise as discussed in the cited portions of Lisogurski could be addressed by Carlson's "filter teachings" as the Petition and Dr. Anthony assert (it is not, as explained above), a POSITA would have understood Carlson's

"filter teachings" to be redundant and unnecessary given that Lisogurski already discloses how to address that problem. Petition at 52-53; Ex. 1003 at ¶ 170; *see, e.g.*, Ex. 1025 at 6:7-31, 9:46-60, 13:60-14:10, 14:46-55, 16:48-53, 17:5-10.

135. According to the Petition and Dr. Anthony's declaration, Carlson's filter is a "wavelength filter" that excludes light that is outside of a target wavelength(s). Petition at 52-53 (citing Ex. 1028 at ¶¶ [0059], [0062], [0063], [0026]); Ex. 1003 at ¶ 170 (same). For claims 11 and 18, the Petition and Dr. Anthony's declaration rely on Lisogurski's LEDs emitting light of target wavelengths, specifically that "Lisogurski's LEDs ... emit light in the red wavelength range ... and infrared wavelength range." Petition at 58 (citing Ex. 1025 at 10:48-63); Ex. 1003 at ¶ 184 (same). And for alleged motivation to combine, the Petition and Dr. Anthony's declaration rely on Lisogurski's disclosure regarding dark subtraction, which teaches turning a light source "on" for a period to measure the light during that period, turning the light source "off" to measure the ambient light during a "dark" period, and then subtracting to remove the amount of ambient light detected during the "dark" period from the signal received during the "on" period. Petition at 52 (citing Ex. 1025 at 6:7-31); Ex. 1003 at ¶ 170 (same).

136. A POSITA would have understood that together, these relied-upon teachings in Lisogurski include a method of first measuring detected light when the LEDs "on," including light emitted from the LEDs at the target wavelength (such as

red or infrared light) and any light outside of the target wavelength, then measuring detected light when the LEDs are "off," which again includes any light outside of the target wavelength, and finally subtracting the second measurement from the first measurement, which retains the LEDs' emitted light at the target wavelength and effectively excludes any light outside of the target wavelength. *See* Ex. 1025 at 10:48-64, 12:23-27; 6:7-31. Thus, a POSITA would have understood in light of Lisogurski's teachings that adding Carlson's wavelength filter to Lisogurski would be redundant and unnecessary, and a POSITA therefore would not have been motivated to incorporate Carlson's filter into Lisogurski.

137. For at least these reasons, I disagree with Petitioners' and Dr. Anthony's conclusions for Ground 2 and claims 6, 11-12, 14, and 18 of the '533 Patent.

C. Ground 3: Obviousness Based on Lisogurski in view of Tam (Claims 6 and 14)

138. In Ground 3, Petitioners and Dr. Anthony assert that claims 6 and 14 of the '533 Patent are obvious over Lisogurski in view of Tam. Petition at 62-65; Ex. 1003 at ¶¶ 191-199. For the reasons discussed below, I disagree.

139. Petitioners and Dr. Anthony assert that a POSITA would have been motivated to combine Tam's LEDs with Lisogurski's system "in order to minimize manufacturing cost, while maintaining the accuracy of the measurement." Petition at 63-65; Ex. 1003 at ¶¶ 195-199. I disagree.

140. Replacing the LEDs of Lisogurski (which do not have a bandwidth between 20 nm and 40 nm as claimed) with the LEDs of Tam would not minimize manufacturing cost. Lisogurski discloses red and IR light LEDs where "the Red wavelength may be between about 600 nm and about 700 nm and the IR wavelength may be between about 800 nm and about 1000 nm." Ex. 1025 at 10:52-58. Lisogurski does not disclose the bandwidths of its LEDs. *See id.* However, to cover the wavelength ranges disclosed by Lisogurski—600 nm to 700 nm and 800 nm to 1000 nm—a POSITA would use super-luminescent LEDs, which emit light over a wider wavelength range than 20 nm to 40 nm. *See* Ex. 1001 at 20:4-9; *see also* Ex. 1030 at 13:45-48 (disclosing LEDs with bandwidths of up to 100 nm). Tam, however, discloses a "40 nm bandwidth" and "about 20 nm bandwidth." Ex. 1030 at 9:57-60.

141. Petitioners and Dr. Anthony assert that one would use Tam's LEDs in Lisogurski "for ease of use and to avoid unnecessary 'premium cost' required for LEDs with smaller bandwidth such that manufacturing cost can be decreased." Petition at 63; Ex. 1003 at ¶ 196. To support their assertion, they reference Tam, which states that "LEDs are available in tighter bandwidths by selection at a premium price." Ex. 1030 at 9:61-62. In other words, Petitioners and Dr. Anthony assert that POSITA would have been motivated to replace the LEDs of Lisogurski with the tight-bandwidth LEDs of Tam in the interest of decreasing manufacturing

costs. Petition at 63; Ex. 1003 at ¶ 196. However, as discussed above (1) modifying Lisogurski to use Tam's LEDs would result in a system with LEDs with tighter bandwidths, and (2) Tam expressly teaches that using tighter-bandwidth LEDs **increases** manufacturing costs. Ex. 1030 at 9:61-62. Thus, if a POSITA were motivated to decrease manufacturing costs, as Petitioners and Dr. Anthony allege, a POSITA would not modify Lisogurski to use the LEDs from Tam.

142. Petitioners state that “Tam discloses that light sources with high bandwidth (e.g., ~100nm) would not allow accurate measurements or even have the capability of distinction between hemoglobin derivatives, while bandwidth filters such as ‘a 40 nm bandwidth ‘filter’” would improve the accuracy of the measurement device.” Petition, 63-64 (citing Ex. 1030, 13:45-14:10). But, Petitioners misquote Tam, omitting that Tam states that “[i]t is clear that small optical components alone, such as LEDs having bandwidths *from about 7 to 100 nm*, would *not allow accurate measurements* or even have the capability of distinction between hemoglobin derivatives.” Ex. 1030, 13:45-52 (emphasis added). Petitioners and Dr. Anthony fail to explain why a POSITA would have been motivated to combine Tam with Lisogurski in view of this disclosure or what the relevance is of a “40 nm bandwidth filter” for claims 6 and 14. I also note that Tam states that “[i]t is clear that small optical components alone, such as LEDs having bandwidths from about 7 to 100 nm, would not allow accurate measurements or even have the capability of distinction

between hemoglobin derivatives.” Ex. 1030 at 13:45-52. The claimed range of 20 nm to 40 nm falls within the 7 to 100 nm range described as inadequate in Tam for accurate measurements. Dr. Anthony also acknowledged that a “bandwidth filter” is a separate optical component from the LED itself, which “narrows the bandwidth of light emitted by an LED.” Ex. 2046, 349:1-350:13. Thus, Tam’s reference to a “40 nm bandwidth filter” does not disclose an LED that itself emits light with a bandwidth between 20 nm and 40 nm as required by claims 6 and 14. Rather, it describes a separate filter component that restricts the bandwidth of light after emission.

143. For at least these reasons, I disagree with Petitioners' and Dr. Anthony's conclusions for Ground 3 and claims 6 and 14 of the '533 Patent.

D. Ground 4: Obviousness Based on Lisogurski in view of Carlson in Further view of Tam (Claims 6 and 14)

144. In Ground 4, Petitioners and Dr. Anthony assert that claims 6 and 14 of the '533 Patent are obvious over Lisogurski in view of Carlson and further view of Tam. Petition at 62-65; Ex. 1003 at ¶¶ 191-199. Specifically, Petitioners and Dr. Anthony argue that a POSITA would have been motivated to combine Tam's LEDs with Lisogurski's system in view of Carlson "in order to minimize manufacturing cost, while maintaining the accuracy of the measurement." Petition at 63-65; Ex. 1003 at ¶¶ 195-199. Petitioners and Dr. Anthony also assert that the

"motivation and reasonable expectation of success would remain the same for Lisogurski's system alone [as in Ground 3] or in view of Carlson," providing no additional evidence or explanations and providing no citations to Carlson. Petition at 64-65, Ex. 1003 at ¶ 198. Accordingly, I disagree with Petitioners' and Dr. Anthony's assertions for the same reasons that I provide above for Ground 3. *Supra*, § X.C.

E. Secondary Considerations of Non-Obviousness

145. Non-obviousness is shown by evidence of a long-felt need in the industry that went unmet until the patented inventions provided a solution, as well as evidence that members in the industry, such as Samsung, responded to the '533 Patent's innovations by copying the patented technology rather than designing around it. This evidence, viewed together, helps to validate and confirm my opinions that the claimed inventions represented a meaningful advance over the prior art, not merely an obvious combination of known elements.

1. Copying

146. For the reasons set forth below, evidence demonstrates a pattern in which Samsung was directly exposed to the specific patented technologies disclosed and claimed in the '533 Patent through a series of in-person meetings, virtual conferences, and detailed presentations by Dr. Islam. Ex. 2100 at ¶¶ 7-21. Samsung subsequently implemented those teachings in its Accused Products (I

refer herein to Samsung's products shown in Exhibit 2116 as the "Accused Products.")

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U.S. Patent No. 9,651,533
IPR2025-01250

Declaration of Igor Efimov, Ph.D.

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157. The presentations and materials shared by Dr. Islam with Samsung did not describe mere general information. The slide decks and materials shared with Samsung specifically identified multiple Omni MedSci patents and pending applications, and described the precise techniques for improving signal-to-noise ratio that are disclosed and claimed in those patents. *See* Ex. 2103; Ex. 2106; Ex. 2100 at ¶¶ 13, 16, 30; *see also* Ex. 2113; Ex. 2114.

158. For example, the presentation materials shared with Samsung specifically identified the following proprietary techniques:

[REDACTED]

[REDACTED]

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[REDACTED]

See Ex. 2100 at ¶¶ 13, 16, 30; Ex. 2103; Ex. 2106. I have reviewed the claim chart in Exhibit 2116 and agree with the analysis therein.

159. The presentation materials also explicitly identified Omni MedSci's patents by number, including the '533 Patent and related patent applications, and described their coverage of these specific techniques. Ex. 2106 at OMS_SAM0031857; Ex. 2100 at ¶¶ 15-16. Dr. Islam further offered that "we could help Samsung incorporate these techniques with a strong patent protection / barrier to entry for others." Ex. 2100 at ¶ 16; Ex. 2106 at OMS_SAM0031856.

160. Without a license or approval from Omni Med Sci, Samsung took the information it learned from Dr. Islam regarding the technologies disclosed and claimed in the '533 Patent and implemented those teachings into its own Accused Products. Dr. Islam confirmed that Samsung never ended up collaborating with Omni MedSci. Ex. 2100 at ¶ 18.

161. Samsung's Accused Products practice the challenged claims of the '533 Patent by incorporating the same suite of SNR-improvement techniques that Dr. Islam disclosed to Samsung, including: (1) increasing LED light intensity to improve SNR; (2) increasing LED pulse rate to improve SNR; and (3)

synchronization of the detection system with the light source. Ex. 2116; Ex. 2100 at ¶ 30.

162. These are not generic or commonplace features. The inventive contribution of the ‘533 Patent lies in this coordinated suite of hardware and signal-processing techniques to overcome the challenges of improving the signal-to-noise ratio of physiological measurements obtained from wearable devices during real-world conditions. These techniques address the challenge of accurately measuring physiological parameters using optical wearable devices during physical activity, when numerous factors degrade measurement accuracy.

c) Conclusion

163. The evidence establishes a nexus between Samsung’s exposure to Omni MedSci’s patented technology and the implementation of those same technologies in Samsung’s products. From 2017 through 2023, Dr. Islam shared detailed information with Samsung personnel at multiple levels of the organization, from the President of Samsung SDS, to senior vice presidents at Samsung Electronics, to senior managers and engineers at Samsung subsidiaries, specifically identifying the ‘533 Patent and related patents or patent applications and the techniques they disclosed for improving the signal-to-noise ratio of wearable physiological measurement devices. The copying factor of secondary considerations weighs strongly in favor of the non-obviousness of the challenged

claims.

2. Long-Felt but Unsolved Need: Motion Artifacts and Ambient Light Degradation of PPG Signals in Wearable Devices

164. Non-obviousness is further supported by the well documented, long felt need in the wearable health monitoring industry for techniques that would enable accurate photoplethysmographic (PPG) measurement of physiological parameters, such as heart rate, heart rate variability, and blood oxygen saturation, during conditions involving user motion and exposure to ambient light.

165. The prior art and industry evidence demonstrate that, prior to the ‘533 Patent, the degradation of PPG signal quality caused by motion artifacts and ambient light interference was a persistent, widely recognized problem that the field had been unable to solve by conventional means. Instead, the prevailing approaches required patients to remain still, confined measurements to controlled clinical environments, or relied on filtering and software algorithms that were themselves acknowledged as insufficient.

166. The ‘533 Patent addressed this long felt need by disclosing a suite of integrated hardware and signal processing techniques, including synchronization of LED transmitters and receivers, and dynamic adjustment of LED light intensity, that collectively enabled sufficiently accurate physiological measurements during the daytime and during exercise, conditions under which prior devices had

consistently failed.

a) The Recognized Problem: Motion Artifacts Degrade PPG Signal Quality

167. The prior art documents produced by the Petitioners in related district court litigation confirm that motion artifacts were a pervasive and intractable obstacle to accurate PPG-based physiological measurement in wearable devices. Ex. 2100 at ¶¶ 22-23. For example, U.S. Pat. No. 5,632,272 to Diab et al. and assigned to Masimo Corp. explains the fundamental challenge: “When the patient moves, this causes perturbation such as changing optical pathlength due to movement of background fluids.... Therefore, the measured signal becomes erratic. Erratic motion induced noise typically cannot be predetermined and/or subtracted from the measured signal via traditional filtering techniques.” Ex. 2108 at 34:1-7; Ex. 2100 at ¶ 22. This candid admission, that motion-induced noise “typically cannot be predetermined and/or subtracted” through traditional filtering, illustrates that the problem was not merely one of optimization but of fundamental technical inadequacy. The prior art filtering approaches simply could not handle the unpredictable, non-periodic nature of motion artifacts in real-world use.

168. U.S. Patent No. 7,738,935 to Turcott and assigned to Pacesetter, Inc. corroborates the severity and pervasiveness of this challenge: “A problem with current methods and devices for performing pulse oximetry is that they are acutely

sensitive to sensor and/or tissue motion. Even rather subtle motion can (and often do) swamp the detected optical signals and render the oxygen saturation measurements unusable. For example, with pulse oximetry devices that measure blood volume changes in a fingertip or earlobe, such subtle motion may be caused by a patient's slight movement of their finger or head.” Ex. 2109 at 3:24-34; Ex. 2100 at ¶ 23. The use of the word “swamp” is telling, indicating that even minor, involuntary movements were sufficient to overwhelm the PPG signal entirely, rendering the resulting measurements not merely degraded but “unusable.”

b) The Inadequacy of Pre-Existing Solutions

169. Prior to the techniques disclosed in the ‘533 Patent, the industry’s response to the motion artifact problem fell into three general categories, each of which was widely recognized as inadequate for enabling the kind of continuous, real world health monitoring that consumer expect from their modern wearable devices. Ex. 2100 at ¶¶ 24-28.

170. **First**, requiring the patient to remain still. Ex. 2100 at ¶ 25. The most common workaround was simply to restrict measurements to periods when the user was immobile. For example, U.S. Pat. No. 6,126,595 to Amano et al. and assigned to Seiko Epson Corp. is unusually explicit on this point, commenting that “when, for example, the test subject is waving his arm, the blood pulse wave cannot be measured. Accordingly, measurements obviously cannot be made during sports

activity, while activities such as walking inside a room or outside are also not suitable for measurements.” Ex. 2110 at 61:38-43. The patent goes on to explain that the user was instructed to “sit in the chair... and place the arm with the watch on the desk, taking care not to move his hand.” *Id.* at 61:44-47. This was not a temporary limitation; it was the design specification. If the user was not in “a state of repose,” the device would notify the user via its output and would only proceed with measurements “after confirming that the user is in a suitable state of repose.” *Id.* at 68:39-49. The entire measurement paradigm was predicated on the assumption that motion and accurate measurement were fundamentally incompatible.

171. **Second**, conducting testing in controlled environments. Ex. 2100 at ¶ 26. A closely related approach was to confirm measurements to clinical or controlled settings. Prior to the claimed inventions of the ‘533 Patent, devices were largely confined to controlled and static environments, like doctor’s offices and laboratories. The non-invasive consumer wearable devices providing consumers with 24/7 physiological measurements were simply not available. The experimental protocol explained in the Seiko Epson ’595 patent exemplifies this approach, explaining that “13 healthy male subjects, aged 21 ± 9 years, were required to carry out identical activities in the same facility for a 36-hour period spanning 2 days. Ambient temperature was maintained in the range of 24.0° to

24.5° C., with humidity held in the range of 40 to 50%.... The subjects were required to assume a state of repose 15 minutes prior to making any of the measurements. While measurements were being taken, the subjects were required to breath at a regular rate in time with a 0.25 Hz metronome.” Ex. 2110 at 16:1-23. The need for such tightly controlled conditions underscores the fragility of PPG-based measurements in real world environments.

172. **Third**, implementing filtering and software algorithm techniques. Ex. 2100 at ¶ 26. The third approach, the use of adaptive filters, Kalman filters, or other software-based motion compensation, was acknowledged as an improvement over mere stillness but was itself recognized as insufficient. U.S. Pat. Pub. No. 2014/0275854 filed by Fitbit, Inc. in 2014 discloses that “the raw heartbeat waveform signal measured by a PPG sensor may be improved by using one or more algorithms to remove motion artifacts... The goal of such algorithms is to remove components of the PPG signal attributable to movement (movement artifacts) using the movement signal captured from the other sensors as a guide.” Ex. 2111 at ¶ [0136]. However, these algorithms were explicitly designed only for the case where “the user’s motion is periodic,” that is, repetitive activities like walking or running, and even then, required multiple passes of adaptive filtering to produce acceptable results. *Id.* at ¶ [0147]. The ’272 Patent assigned to Masimo Corp. confirms, “erratic motion induced noise typically cannot be predetermined

and/or subtracted from the measured signal via traditional filtering techniques.”

Ex. 2108 at 34:1-7.

173. The GE Dash 2000 Patient Monitor manual provides a clinical perspective on the same limitations: “Motion artifact occurs with excessive motion of the probe, the cable leading to the probe or the cable/probe junction... The main problem motion artifact can cause is erroneous SPO2 readings. Motion artifact can be reduced, if not eliminated, by selecting a ‘quieter’ site on the patient.” Ex. 2112 at DEFS-PA_0007696; Ex. 2100 at ¶ 28. The manual’s proposed solution, choosing a “quieter” body site or taping cables to the patient’s hand is a mechanical workaround, not a technological solution, and it confirms that even in clinical grade devices, the engineering community had not solved the underlying problem.

c) The Ambient Light Problem Compounded the Challenge

174. Ambient light interference posed an additional and compounding obstacle to accurate PPG measurements, particularly during the daytime and outdoor settings where wearable health monitoring is most needed. The ’854 application filed by Fitbit in 2014 acknowledges that “[a]mbient light and skin color may make it difficult to extract a user’s heart rate from a PPG signal” and describes a technique for reducing the effect of ambient light by “subtracting a value of the received detected light signal when the PPG light source is off from

the value of the received detected light signal when the PPG light source is on.”

Ex. 2111 at ¶ [0194]; Ex. 2100 at ¶ 29.

175. The combined challenge of ambient light and motion was precisely what the ‘533 Patent was designed to address. Ex. 2100 at ¶ 30. Earlier wearable devices could reliably capture physiological measurements only under ideal conditions, such as during motionless sleep at night, relying on low-power light sources and modest sampling rates. However, obtaining accurate measurements became significantly more difficult during daytime use and periods of physical activity such as exercise, which are precisely the scenarios in which such data is most valuable to the wearer. Exposure to ambient daylight and bodily movement during activities like exercise degraded the accuracy of physiological readings, often pushing them below acceptable accuracy levels.

d) The Academic Literature Confirms the Unresolved Nature of the Problem

176. Academic sources confirm that the motion artifact problem remained unsolved during the relevant time period. A 2012 paper titled “A review of wearable sensors and systems with application in rehabilitation” by Patel et al. identifies motion artifacts in wearable PPG sensors as an open problem: “Although systems of this type have shown promising results, additional work appears to be necessary to achieve motion artifact reduction. Proper attenuation of motion

artifacts is essential to the deployment of wearable sensors.” Ex. 2115 at OURA_0026873. The authors further observe that “[s]ome of the problems due to motion artifacts could be minimized by integrating sensors into tight fitting garments,” but emphasize that “further advances in signal processing techniques to mitigate motion artifacts are needed.” *Id.* The use of the phrase “additional work appears to be necessary” and “further advances... are needed” is the language of an unsolved problem existing in 2012 when this paper was published, not one for which the prior art had already provided obvious solutions.

e) The Industry’s Continued Failure to Solve the Problem

177. Major companies in the industry continued to struggle with solving the SNR and motion artifact problem by 2016-2017. Ex. 2100 at ¶¶ 31-33. For example, in Dr. Islam’s slides presented to Samsung in 2017, he included studies documenting the problem and the failure of industry participants such as Samsung, Fitbit, and Microsoft to solve it. Ex. 2100 at ¶¶ 31, 33; Ex. 2103 at OMS_SAM0031786; Ex. 2106 at OMS_SAM0031851; Ex. 2113; Ex. 2114. As another example, Apple was investigating solutions to the problem up through at least 2017, including meeting with Dr. Islam. Ex. 2100 at ¶ 32.

f) The Challenged Patent Solves the Problem

178. The claimed inventions of the ’533 Patent solve this long-felt and unresolved need by combining an integrated suite of hardware and SNR-

improvement techniques—as I discuss above in Section X.E.1.b with respect to Samsung’s Accused Products copying the claimed invention—including (1) increasing LED light intensity to improve SNR; (2) increasing LED pulse rate to improve SNR; and (3) synchronization of the detection system with the light source. Ex. 2100 at ¶ 30; *supra*, § X.E.1.b. The claimed inventions thereby enabled accurate physiological measurements despite problems of ambient light and motion artifacts. Ex. 2100 at ¶ 30.

g) Conclusion

179. The evidence from the prior art patents, industry documents, and academic literature demonstrates a clear and well documented long felt need for techniques enabling accurate PPG based physiological measurement during motion and under varying ambient light conditions. The pre-existing approaches, requiring the patient to remain still, confining measurements to controlled environments, and applying filtering algorithms, were universally acknowledged as inadequate for the demands of real world wearable health monitoring. Ex. 2100 at ¶¶ 22-33. The ‘533 Patent disclosed an integrated suite of techniques that collectively addressed this long felt need, enabling, for the first time, the sufficiently accurate measurement of heart rate, SpO₂, and other physiological parameters during the daytime and during exercise. Ex. 2100 at ¶ 30.

180. For example, the following claimed features address the long-felt

needs that others failed to solve:

- “the light source configured to increase signal-to-noise ratio by increasing a light intensity from at least one of the plurality of semiconductor sources”; “the light source configured to increase signal-to-noise ratio by increasing a light intensity from at least one of the plurality of semiconductor sources” (claims 5, 13);
- “the light source configured to increase signal-to-noise ratio ... by increasing a pulse rate of at least one of the plurality of semiconductor sources”; “the light source configured to increase signal-to-noise ratio by increasing a light intensity from at least one of the plurality of semiconductor sources and by increasing a pulse rate of at least one of the plurality of semiconductor sources” (claims 5, 13);
- “wherein the receiver is configured to be synchronized to the light source”; “wherein the wearable measurement device receiver is configured to be synchronized to pulses of the light source” (claims 5, 13).

XI. CONCLUSION

181. In my opinion, the challenged claims of the ‘533 Patent would not have been obvious to a POSITA as of the priority date of the ‘533 Patent in view of the asserted references that Petitioners and Dr. Anthony rely upon in Grounds 1-4.

U.S. Patent No. 9,651,533
IPR2025-01250

Declaration of Igor Efimov, Ph.D.

Accordingly, it is my opinion that all challenged claims of the '533 Patent are patentable over the asserted references.

182. I reserve the right to modify or supplement my opinions, if necessary, based on further review and analysis of the evidence in this case, including review and analysis of information that may be provided to me subsequent to the date of this Declaration.

U.S. Patent No. 9,651,533
IPR2025-01250

Declaration of Igor Efimov, Ph.D.

I declare that all statements made herein of my own knowledge are true and all statements made on information and belief are believed to be true, and further 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.

Date: May 7, 2026



Igor Efimov, Ph.D.