IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SAMSUNG ELECTRONICS CO., LTD. AND
SAMSUNG ELECTRONICS AMERICA, INC.,

Petitioners,

v.

MAXELL, LTD.,

Patent Owner

IPR2025-01315

U.S. Patent No. 8,471,950

DECLARATION OF DR. MATTHEW TURK IN SUPPORT OF PATENT OWNER'S RESPONSE TO PETITION FOR *INTER PARTES REVIEW* OF U.S. PATENT NO. 8,471,950

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PATENT OWNER'S EXHIBIT LIST

Exhibit #	Description
2001	Notice Letter to Samsung (July 7, 2021)
2002	Follow-up Notice Letter to Samsung (December 29, 2021)
2003	Docket Navigator Time to Trial Statistics for the Eastern District of Texas
2004	Docket Control Order, *Maxell, Ltd. v. Samsung Elecs. Co., Ltd.*, No. 5:25-cv-00052-RWS (E.D. Tex.)
2005	Jury Trial Transcript, Vol. 4, *Maxell, Ltd. v. Samsung Elecs. Co., Ltd.*, No. 5:23-cv-00092-RWS (E.D. Tex.)
2006	Complaint, *Maxell, Ltd. v. Samsung Elecs. Co., Ltd.*, No. 5:25-cv-00052-RWS (E.D. Tex.)
2007	Follow-up Notice Letter to Samsung (April 21, 2025)
2008	Law360 Article, "Maxell Settles Patent Suit Against Apple Over Mobile Tech"
2009	Law360 Article, "Maxell Scores $43M EDTX Jury Win In ZTE Patent Trial"
2010	Law360 Article, "Maxell, Huawei Reach Terms To End Smartphone Patent Suit"
2011	Hudson Institute Article, "Google's Loss to Sonos Settles It, Big Tech Has an IP Piracy Problem"
2012	PatentRenewal.com Article, "which-companies-hold-the-most-patents-in-the-world"
2013	Motion for Partial Summary Judgment of Validity Based on Sotera Stipulations, *Maxell, Ltd. v. Samsung Elecs. Co., Ltd.*, No. 5:23-cv-00092-RWS (E.D. Tex.)
2014	Follow-up Notice Letter to Samsung (November 28, 2024)
2015	Declaration of Dr. Matthew Turk in Support of Patent Owner's Response
2016	Transcript of April 30, 2026 Deposition of Dr. Dan Schonfeld
2017	P.R. 4-3 Joint Claim Construction and Prehearing Statement, *Maxell, Ltd. v. Samsung Elecs. Co., Ltd.*, No. 5:25-cv-00052-RWS (E.D. Tex.)

LISTING OF CHALLENGED CLAIMS

Claim	Claim Text
[1pre]	A signal processor comprising:
[1a]	a feature detection unit which detects a position where features of each pixel of an input picture signal have changed;
[1b]	a region creation unit which creates a region by removing pixels with the features from an evaluated value extraction region;
[1c]	an evaluated value extraction unit which extracts an evaluated value in accordance with the evaluated value extraction region;
[1d]	a processing unit which applies predetermined processing to the picture signal; and
[1e]	a control unit which controls the processing unit in accordance with the evaluated value having been extracted by the evaluated value extraction unit;
[1f]	wherein the control unit controls the processing unit by using an evaluated value of a region from which pixels having an extracted predetermined feature are removed.
[2pre]	A signal processor according to claim 1, wherein
[2a]	the feature detection unit includes: a hold unit which holds position information of the detected pixels; and
[2b]	the region creation unit which creates a region by excluding the held positions from an evaluated value extraction region.
[3pre]	A signal processor according to claim 2, wherein:
[3a]	the processing unit includes a focus lens, and a drive unit for driving

	the focus lens;
[3b]	a photoelectric conversion unit for performing photoelectric conversion is disposed between the focus lens and the extraction unit; and
[3c]	the control unit controls the processing unit by using an evaluated value of a region from which pixels having an extracted predetermined feature are removed.
[4pre]	A signal processor according to claim 2, wherein:
[4a]	the processing unit is a signal processing unit for adjusting white balance of an input picture signal; and
[4b]	the control unit controls the processing unit by using an evaluated value of a region from which pixels having an extracted predetermined feature are removed.
[5pre]	A signal processor according to claim 2, wherein:
[5a]	the region creation unit includes a region segmentation unit for segmenting an effective region in advance, and an overlap detection unit which detects overlap of position information output from the hold unit with blocks segmented by the region segmentation unit; and
[5b]	the control unit controls the processing unit by using an evaluated value of a region from which pixels having an extracted predetermined feature are removed.
[6pre]	A signal processor according to claim 2,
[6a]	wherein the region creation unit includes a unit which keeps the total area of the evaluated value extraction region constant by excluding unnecessary portions from the evaluated value extraction region.

[7pre]	A signal according to claim 2, wherein:
[7a]	the processing unit is a light intensity adjustment unit for controlling exposure;
[7b]	a lens and a photoelectric conversion unit for performing photoelectric conversion are disposed between the light intensity adjustment unit and the extraction unit; and
[7c]	the control unit controls the processing unit by using an evaluated value of a region from which pixels having an extracted predetermined feature are removed.
[8pre]	A signal processor according to claim 7, wherein:
[8a]	the region creation unit includes a region segmentation unit for segmenting an effective region in advance, and an overlap detection unit which detects overlap of position information output from the hold unit with blocks segmented by the region segmentation unit; and
[8b]	the control unit controls the processing unit by using an evaluated value of a region from which pixels having an extracted predetermined feature are removed.
[9pre]	A signal processor according to claim 7,
[9a]	wherein the region creation unit includes a unit which keeps the total area of the evaluated value extraction region constant by excluding unnecessary portions from the evaluated value extraction region.
[10pre]	A signal processor according to claim 1, wherein:
[10a]	the processing unit is a light intensity adjustment unit for controlling exposure;
[10b]	a lens and a photoelectric conversion unit for performing

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	photoelectric conversion are disposed between the light intensity adjustment unit and the extraction unit; and
[10c]	the control unit controls the processing unit by using an evaluated value of a region from which pixels having an extracted predetermined feature are removed.
[11pre]	A signal processor according to claim 1,
[11a]	wherein the region creation unit includes a unit which keeps the total area of the evaluated value extraction region constant by excluding unnecessary portions from the evaluated value extraction region.
[12pre]	A signal processor according to claim 1, wherein:
[12a]	the processing unit includes a focus lens, and a drive unit for driving the focus lens;
[12b]	a photoelectric conversion unit for performing photoelectric conversion is disposed between the focus lens and the extraction unit; and
[12c]	the control unit controls the processing unit by using an evaluated value of a region from which pixels having an extracted predetermined feature are removed.
[13pre]	A signal processor according to claim 12,
[13a]	wherein the region creation unit includes a unit which keeps the total area of the evaluated value extraction region constant by excluding unnecessary portions from the evaluated value extraction region.
[14pre]	A signal processor according to claim 1, wherein:
[14a]	the processing unit is a signal processing unit for adjusting white balance of an input picture signal; and

[14b]	the control unit controls the processing unit by using an evaluated value of a region from which pixels having an extracted predetermined feature are removed.
[15pre]	A signal processor according to claim 14,
[15a]	wherein the region creation unit includes a unit which keeps the total area of the evaluated value extraction region constant by excluding unnecessary portions from the evaluated value extraction region.

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I. INTRODUCTION

1. My name is Dr. Matthew Turk. I have been asked by Patent Owner, Maxell, Ltd. ("Maxell"), to provide my opinion as to the patentability of claims 1-15 ("Challenged Claims") of U.S. Patent No. 8,471,950 ("'950 Patent") (EX1001). I have also been asked to provide my understanding of the claim construction and level of ordinary skill in the art related to this patent, as well as to explain the relevant technical background related to this patent.

2. Depending on new information learned during this proceeding, or positions taken throughout this IPR by Petitioner or its expert, I may edit, add to, or otherwise refine the topics and expected testimony described here. I reserve the right to supplement my opinions based on new information.

3. Although I am being compensated at my usual consulting rate of $625 per hour for my time reviewing materials and preparing this declaration, my opinions expressed here are my own. My compensation is in no way dependent on the outcome of this proceeding or upon the Board accepting my opinions. I have no other financial interest in this matter or the parties thereto.

4. If called upon to do so, I am prepared to testify regarding my opinions expressed here.

II. BACKGROUND AND QUALIFICATIONS

5. My qualifications to testify about the '950 Patent and the relevant

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technology are set forth in my curriculum vitae ("CV"), which I have attached here as Appendix A. My CV includes the matters in which I have testified (either at trial, hearing, or by deposition) at least in the past five years. It also includes a list of all my publications within at least the past twenty years.

6. I will briefly summarize my qualifications to render opinions regarding this technology in the following paragraphs.

7. I am an Emeritus Professor in the Department of Computer Science at the University of California, Santa Barbara (UCSB) and the former President of the Toyota Technological Institute at Chicago (TTIC). I have worked and studied in the field of computer vision and image processing since 1984, as well as in related areas of pattern recognition, machine learning, augmented and virtual reality, and human-computer interaction. The field of computer vision is concerned with determining how computers can extract, analyze and understand information from images and video, and my work has been directed to a wide range of application, including improving camera image and video outputs (a.k.a. computational photography), estimating 3D scene structure for autonomous vehicles or augmented reality interaction, recognizing objects such as faces, and modeling human movements and gestures for gaming, surveillance, and other interactive systems.

8. I received my Bachelor of Science degree in Electrical Engineering

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from Virginia Tech (VPI&SU) in Blacksburg, Virginia in 1982, where my senior honors thesis was on image processing, and my Master of Science degree in Electrical and Computer Engineering from Carnegie Mellon University in 1984, where my research focused on robot fine motion planning. I received my doctorate degree in Media Arts and Sciences from the Massachusetts Institute of Technology (MIT) in 1991. My doctoral research was in the area of computer vision, specifically concerning automatic face recognition, introducing a now widely recognized approach to representing and recognizing human faces in images called Eigenfaces. This research helped lead to practical automated face recognition systems that are used in today's consumer applications and security and surveillance systems. My work on Eigenfaces received several awards, including an IEEE Computer Society Outstanding Paper award at the IEEE Conference on Computer Vision and Pattern Recognition (CVPR) in 1991 and a "Most Influential Paper of the Decade" award from the International Association for Pattern Recognition (IAPR) Workshop on Machine Vision Applications (MVA 2000).

9. My industry experience includes working for Martin Marietta Denver Aerospace from 1984 to 1987, where I worked primarily on computer vision for autonomous vehicle navigation. In 1992, I was a visiting researcher at LIFIA/ENSIMAG in Grenoble, France and from 1993 to 1994, I worked for Teleos

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Research in Palo Alto, CA; in both of those positions, I worked on computer vision methods for recognizing human faces, gestures, and activity. From 1994 to 2000, I was a researcher for Microsoft Research, where I founded the Vision Technology Research Group and conducted research in vision-based human computer interaction and related areas.

10. In 2000, I joined the faculty of the University of California, Santa Barbara, as an Associate Professor. In 2005, I was promoted to Full Professor and served as the Chair of the Media Arts and Technology Graduate Program from 2005 to 2010. In 2017, I was appointed as Chair of the Department of Computer Science. At UCSB, I taught graduate and undergraduate courses related to computer vision, mobile imaging, human computer interaction, computer graphics, machine learning, and several other topics. My graduate courses covered the fundamentals of imaging systems related to mobile devices, including the capture, storage, display, retrieval, and processing of images, as well as the nature of light, color, optics, human vision, and multispectral imaging, sensors, cameras, and illumination.

11. In 2003, I co-founded the Four Eyes Lab at UCSB, where the research focus is on the "four I's" of Imaging, Interaction, and Innovative Interfaces. The Four Eyes Lab researches a variety of topics, including computer vision, pattern recognition, virtual and augmented reality, and human-computer interaction

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technologies. I worked on and supervised many research projects in these areas.

12. In 2014, I co-founded a startup company, Caugnate, to commercialize computer vision and augmented reality technology for remote collaboration. Caugnate was acquired by PTC Inc. in 2016, and subsequently formed the core of the Vuforia Chalk augmented reality product.

13. In 2019, I became President of the Toyota Technological Institute at Chicago, an independent graduate academic institution, where the research and education focus of the faculty and Ph.D. students is on computer science theory, machine learning, artificial intelligence, and related areas such as computer vision, speech and language processing, robotics, and computational biology.

14. I have received several other awards at professional conferences and workshops for my work in computer vision, image processing, and augmented reality, including several best paper awards and winning the ACM Multimedia Open Source Competition in 2015. My co-authors and I presented the paper "Location-based augmented reality on mobile phones," at the 2010 IEEE International Workshop on Mobile Vision and received the Best Paper Award. At the 2012 IEEE International Symposium on Mixed and Augmented Reality (ISMAR), my co-authors and I received the Best Paper Award for "Live tracking and mapping from both general and rotation-only camera motion." At the 2015 IEEE International

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Symposium on Mixed and Augmented Reality (ISMAR), my co-authors and I received the Best Short Paper Award for "Efficient Computation of Absolute Pose or Gravity-Aware Augmented Reality." My co-authors and I also received a Best Paper Honorable Mention for our paper, "Interpreting 2D Gesture Annotations in 3D Augmented Reality," at the 2016 IEEE Symposium on 3D User Interfaces (3DUI).

15. As a result of my work and research, I am a named inventor of U.S. Patent Number 6,674,877 entitled "System and Method for Visually Tracking Occluded Objects in Real-time," U.S. Patent Number 5,164,992 entitled "Face Recognition System," and U.S. Patent Number 9,495,761 entitled "Environment mapping with automatic motion model selection."

16. I was a founding member of the Advisory Board for the International Conference on Multimodal Interfaces (ICMI), which provides a venue for disseminating recent advances in multimodal interaction research, systems, and methods, which includes combining visual modalities with audio, haptic, or other modalities. I served as the Chair of the ICMI Advisory Board from 2006 to 2009. I was also a founding member of the Advisory Board for the IEEE International Conference on Automatic Face and Gesture Recognition and served as the General Chair for the conference in 2011. I have been a primary organizer of several top

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research conferences, including serving as General Chair for the 2014 IEEE Conference on Computer Vision and Pattern Recognition, the primary annual conference in the field of computer vision, with over 2000 attendees, Program Chair for the 2017 IEEE Winter Conference on Applications of Computer Vision, and General Chair of the 2019 International Conference on Multimodal Interfaces (ICMI).

17. I am currently an Associate Editor of the ACM Transactions on Intelligent and Interactive Systems and the International Journal of Computer Vision and Signal Processing and was formerly an Associate Editor of Image and Vision Computing. I have also served as a guest editor of several other journals related to computer vision, machine learning, and interactive systems.

18. A listing of my publications is included in my *curriculum vitae* attached to this declaration. I am a named author on over 250 refereed publications dated back to 1985. My research publications have received over 45,000 citations.

19. In 2020, I was elected a Fellow of the Association for Computing Machinery (ACM), the preeminent professional society in the field of computer science, for "contributions to face recognition, computer vision, and multimodal interaction." In 2013, I was elected as a Fellow of the Institute of Electrical and Electronics Engineers (IEEE), an award conferred by the Board of Directors of the

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IEEE upon a person with an extraordinary record of accomplishments in any of the IEEE fields of interest. In 2014, I was elected as a Fellow of the International Association for Pattern Recognition (IAPR). In 2022, I was named as a Fellow of the Asia-Pacific Artificial Intelligence Association. In 2023, I was named as a Fellow of the International Artificial Intelligence Industry Alliance. I am also the recipient of the 2011-2012 Fulbright-Nokia Distinguished Chair in Information and Communications Technologies. I have given many keynote presentations at top conferences and workshops in my fields.

III. UNDERSTANDING OF LEGAL STANDARDS

20. I am not a lawyer and I am not offering any opinions regarding legal matters. However, the legal principles relevant to my opinion herein have been explained to me by Patent Owner's counsel. In this section, I summarize these legal principles as they have been explained to me.

21. I reserve the right to change or formulate new opinions in the event there is a change in the law concerning my opinions provided in this report.

A. Claim Construction

22. I understand that the claim construction exercise begins with the language of the claims themselves, and that the general rule is that claim terms are given their plain and ordinary meaning to a person of ordinary skill in the art, in view of the specification of the patent, at the time of the invention. I also understand that

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the intrinsic evidence (*i.e.*, the claims, the written description including the figures, and prosecution history) are the primary sources used in interpreting claim language.

23. I understand that if disputed claim language is clear on its face, the intrinsic evidence should be consulted to determine whether some deviation from the ordinary meaning of the claim language is warranted.

24. When the disputed claim language is not clear on its face, I understand that the intrinsic evidence should be used to resolve, if possible, any lack of clarity. I also understand that the specification is the best evidence of what the patentee intended the term to mean when there is no clear meaning of a claim term, and that the prosecution history may also shed light on the meaning of ambiguous terms. However, I understand that it is improper to import limitations from the specification into a patent claim through claim construction.

25. I have been informed that sometimes the ordinary meaning of claim language as understood by a person of ordinary skill in the art may be readily apparent even to lay persons. I understand that claim construction in such cases involves little more than the application of the widely accepted meaning of commonly understood words.

B. Presumption of Validity

26. I understand that all patents enjoy a presumption of validity. In other

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words, patents are presumed to have been correctly issued by the United States Patent and Trademark Office after undergoing a rigorous examination process that often lasts for years.

27. For this reason, I understand that Petitioner's burden to show invalidity of the '950 Patents' claims is a high one. Specifically, I am informed that the burden for proving a patent claim is invalid is by the "preponderance of the evidence."

C. Obviousness

28. I understand that a patent claim can be invalid under 35 U.S.C. § 103 if the claimed subject matter would have been "obvious" to a person of ordinary skill in the art as of the priority date of the patent based upon one or more prior art references. I understand that an obviousness analysis should consider each of the following so-called "*Graham* factors": (1) the scope and content of the prior art; (2) the differences between the claims and the prior art; (3) the level of ordinary skill in the pertinent art; and (4) secondary considerations, if any (such as unexpected results, commercial success, long felt but unsolved needs, failure of others, copying by others, licensing, and skepticism of experts).

29. I understand that a conclusion of obviousness may be based upon either a single prior art reference or a combination of prior art references, particularly if the combination of elements does no more than yield predictable results. However,

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I understand that merely demonstrating that each of the claim elements was, independently, known in the prior art does not prove that a patent composed of several claim elements is obvious.

30. Moreover, I understand that it can be important to identify a reason that would have prompted a person of ordinary skill in the relevant field to combine the elements in a way the claimed new invention does.

31. I further understand that, to determine obviousness, courts look to the interrelated teachings of multiple patents or other prior art references, the effects of demands known in field of art or present in the marketplace, and the background knowledge possessed by a person having ordinary skill in the art.

32. I also understand that, in determining whether a combination of prior art references renders a claim obvious, it may be helpful to consider whether there is some teaching, suggestion, or motivation to combine the references and a reasonable expectation of success in doing so. I understand, however, that the teaching, suggestion, or motivation to combine inquiry is not required and may not be relied upon in lieu of the obviousness analysis outlined above.

33. I understand that the following exemplary rationales may lead to a conclusion of obviousness: the combination of prior art elements according to known methods to yield predictable results; the substitution of one known element

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for another to obtain predictable results; and the use of known techniques to improve similar devices in the same way.

34. However, a claim is not obvious if the improvement is more than the predictable use of prior art elements according to their established functions. Similarly, a claim is not obvious if the application of a known technique is beyond the level of ordinary skill in the art.

35. Further, when the prior art teaches away from combining certain known elements, discovery of successful means of combining them is not obvious. I understand that similar subject matter may not be sufficient motivation for a person of skill in the art to combine references if the references have conflicting elements.

36. I understand that, in order to be used in an obviousness combination, a prior art reference must be "analogous." I understand that a prior art reference may be analogous if it is in the same field of endeavor as the other references with which it is combined, or if the reference is reasonably pertinent to the solving the problems the inventors of the patent-at-issue sought to solve.

37. I understand that obviousness of a patent claim cannot properly be established through hindsight, and that elements from different prior art references, or different embodiments of a single prior art reference, cannot be selected to create the claimed invention using the invention itself as a roadmap. I understand that the

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claimed invention as a whole must be compared to the prior art as a whole, and courts must avoid aggregating pieces of prior art through hindsight that would not have been combined absent the inventor's insight. I understand that the obviousness determination is based on at least whether the differences between the patented subject matter and the prior art would have been obvious at the time of invention to a person of ordinary skill in the art.

38. I understand that obviousness is not established by simply combining previously known elements from the prior art. A patent composed of several elements is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art. Rather, a claim is unpatentable as obvious if, at the time of the invention, a person of ordinary skill in the art would have had a reason to combine or modify the prior art to arrive at the claimed invention, with a reasonable expectation of success.

39. I understand that obviousness of a patent cannot properly be established by mere conclusory statements. Instead, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness. When an expert opines that all the elements of a claim disparately exist in the prior art, the expert should provide the rationale to combine the disparate references. A reason for combining disparate prior art references is a critical component of an

obviousness analysis. The obviousness analysis should be made explicit and needs to provide an articulated reasoning with some rational underpinning to identify the reason that would have prompted a person of ordinary skill in the relevant field to combine the elements in the way the claimed new invention does.

40. I also understand that inventions in most, if not all, instances rely upon building blocks long since uncovered, and claimed discoveries almost of necessity will be combinations of what, in some sense, is already known. This is another reason why merely pointing to the elements being known in the art in separate locations is not the end of the obviousness inquiry.

41. I understand that technical experts may testify to matters like the level of skill in the art at the time of the invention and what a skilled artisan might find obvious in light of the prior art without addressing objective evidence of non-obviousness. However, where an expert purports to testify not just to certain factual components underlying the obviousness inquiry, but to the ultimate question of obviousness, the expert must consider all factors relevant to that ultimate question, including all objective evidence of nonobviousness.

D. Level of Ordinary Skill in the Art

42. I understand that claims are to be interpreted from the viewpoint of one of ordinary skill in the relevant art. To determine the level of skill that would be

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"ordinary," I understand that a person of ordinary skill must generally have the capability of understanding the general principles that are applicable to the pertinent art.

43. I am informed that the factors to be considered in determining the level of ordinary skill in the art are: (1) the education level of active workers in the field, (2) the type of problems encountered in the art, (3) prior art solutions to those problems, (4) the speed with which innovations are made, and (5) the sophistication of the technology in the art.

44. I have also been asked to assume that the relevant time period for determining the level of skill in the art for the '950 Patent is its earliest claimed priority date, November 28, 2008.

IV. MATERIALS CONSIDERED

45. I considered the following materials at the time I formed my opinions set forth herein. Among those materials are the '950 Patent (EX1001); the file history of the '950 Patent (EX1002); the Petition and all accompanying exhibits, including, for example, Dr. Schonfeld's declaration (EX1003) and the alleged prior art; the Institution Decision (Paper 13); all other papers and exhibits filed in this IPR; the deposition transcript of Petitioner's expert, Dr. Schonfeld (EX2016); and other materials that I specifically cite to and mention throughout my declaration.

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46. In addition to these materials, I also relied upon my extensive experience and expertise in computer science and electrical engineering, particularly in image and video capturing and processing, as discussed herein. In forming my opinions, I have also taken into account the knowledge and background principles that a person of ordinary skill in the art would be familiar with at the time of Patent Owner's invention (no later than November 28, 2008), as well as my experience and training in the field of art.

V. OVERVIEW OF THE '950 PATENT

A. Technical Background

47. Based on my review, the '950 Patent, entitled "Signal Processor For Adjusting Image Quality Of An Input Picture Signal," was issued from U.S. Application No. 12/621,304, which was filed on November 18, 2009, and which claims priority to Japanese Patent Application No. 2008-303423, filed on November 28, 2008. EX1001.

48. It is my understanding that the '950 Patent is generally directed to signal processor architecture used in imaging devices—such as video cameras and digital still cameras—to enhance image quality by deriving reliable evaluated values that can be used to drive automatic adjustment functions. EX1001, Abstract, 1:8-10, 1:47-49.

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49. From my review of the specification, prior-art signal processors typically handled bright content in one of two ways: by dynamically selecting evaluation regions when high-luminance content is detected, or by defining a fixed set of candidate regions in advance and choosing among them. EX1001, 1:20-31. As I understand the disclosure, both approaches break down when an image contains multiple bright artifacts (such as spotlights or other point sources) and differ based on whether or not the candidate evaluation regions are fixed, because constant region switching becomes necessary and every predefined region may be tainted by bright pixels, leaving no satisfactory region from which to extract evaluated values. EX1001, 1:27-39.

50. In my opinion, those shortcomings translate into observable image-quality defects, including incorrect exposure (with non-highlight areas sinking into shadow), unreliable autofocus (where high-frequency content from bright sources can produce spurious peaks at non-focal positions), and inaccurate white balance. See EX1001, 1:27-39, 5:30-41, 6:24-33, 6:56-7:3. The inventors of the ’950 Patent expressly recognized these inefficiencies and inaccuracies in the conventional approach. EX1001, 1:27-39, 4:36-58.

51. The ’950 Patent addresses these problems by identifying, at the pixel level, locations within an input picture signal where image features have changed

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and then excluding some or all of those pixels from the downstream image-adjustment processing. EX1001, 2:22-36. For example, in the disclosed embodiments, a region creation unit forms an evaluation region by removing pixels (or pixel blocks) that have been flagged as having features distinct from their surroundings, with horizontal and vertical differential thresholds being used to localize sharp transitions. EX1001, 3:60-4:23.

52. An evaluated value extraction unit then operates on this cleaned region, and a control unit uses the resulting evaluated value to drive the relevant processing path—light-intensity adjustment for exposure, lens drive for focus, or color-gain adjustment for white balance—based on the resulting evaluated values. EX1001, 4:24-40. An exemplary configuration of these components is shown in Figure 4 of the ’950 Patent.

VI. SUMMARY OF INSTITUTED GROUNDS

53. It is my understanding that the Board instituted review of all of claims 1-15 of the ’950 Patent on three asserted grounds of unpatentability. *See* Pet. at 1-2; Paper 13. The instituted grounds are obviousness under 35 U.S.C. § 103 over: (1) Tsujino in view of Iwasaki; (2) Tsujino in view of Shui and Iwasaki; and (3) Shui in view of Iwasaki.

54. I have reviewed each of the three references on which the Petition

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relies. I summarize my understanding of those references below.

A. Overview of Tsujino (EX1005)

55. Tsujino is U.S. Patent No. 8,237,850, issued August 7, 2012. Based on my review, Tsujino is directed to an electronic camera that "executes an AF process for adjusting a distance from the focus lens to the imaging surface to a distance corresponding to a focal point, based on the object scene image generated by the image sensor." EX1005, Abstract.

56. Tsujino describes a "high-luminance excluding function" that excludes from the autofocus target "a partial image having a luminance exceeding 'TH1' out of the object scene image generated by the image sensor." EX1005, Abstract, 12:41-51. According to Tsujino, this function "is turned on when capturing the object scene including the light source LS" so as to "avoid a situation in which focusing control fails due to the blurred image of the light source LS." EX1005, 9:33-37.

57. From my review, Tsujino determines whether a scene contains a bright light source by comparing the ratio K2/K1—where K1 and K2 count pixels exceeding two luminance thresholds—against a threshold THR. EX1005, 8:61-67. Where K2/K1 exceeds THR, Tsujino sets the reference value REF to TH1; otherwise, REF is set to THmax, which corresponds to a saturation value. EX1005, 9:2-11; *see also id.* 11:24-40.

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58. When the high-luminance excluding function is engaged, Tsujino describes that "the switch SW1 is turned off during a time period T1," which removes the high-pass-filter output from the AF integrators during that interval. EX1005, 9:20-10:41. The CPU then modifies the AF values "according to Equation 1" through "Equation 5," each of which numerically subtracts from AF(X,Y) based on luminance differences in the target or adjacent blocks. *Id*. The AF controller subsequently performs a "hill-climbing AF process" that moves the focus lens "in a direction in which a total value of the focus evaluation values AF(1,1) to AF(8,8) increases"—*i.e.*, summing across the same fixed 8×8 grid of evaluation areas after gating and numeric reductions. EX1005, 12:1-29.

59. In my opinion, Tsujino's approach is fundamentally different from that of the '950 Patent. Tsujino operates by controlling the use of a comparator and numerically modifying AF values across a fixed 8×8 grid of evaluation areas. Tsujino does not perform the per-pixel, directional-differential detection or positional holding contemplated by the '950 Patent's claims, nor does it "create[] a region by removing the held positions from the evaluated value extraction region," nor does it control downstream processing exclusively based on "an evaluated value of a region from which pixels having an extracted predetermined feature are removed."

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B. Overview of Iwasaki (EX1007)

60. Iwasaki is U.S. Patent Application Publication No. 2007/0189758, published August 16, 2007. As I understand Iwasaki, it is directed to "a camera and a method of imaging capable of appropriately photographing a scene having a large difference in luminance." EX1007, ¶ 7.

61. Iwasaki describes a camera that includes "a photometry section, an exposure calculating section, and a correction calculating section." EX1007, ¶ 9. The correction calculating section "obtains a correction value for correction of the exposure value based on a second highest photometry value excluding a highest value out of the plurality of photometry values obtained by the photometry section." EX1007, ¶ 14.

62. From my review, Iwasaki further discloses that an "analyzing calculating section 34 excludes from objects of calculation for the highest value a group showing an average luminance value larger than a predetermined value," and on that basis "obtains the exposure correction value and the gradation characteristic data." EX1007, ¶¶ 84-86. Iwasaki computes "an exposure correction value for correcting a proper exposure value based on a difference value between the proper exposure value for the photographic screen and an upper limit luminance value (highest value) in a predetermined luminance range," and similarly determines "a

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proper gradation characteristic… based on the difference value." EX1007, ¶¶ 57-58.

63. In my opinion, Iwasaki's grouping-and-luminance-averaging approach is technologically distinct from the pipeline of the '950 Patent, which detects per-pixel feature-change positions and then forms a new extraction region by removing those specific positions in order to drive downstream control.

C. Overview of Shui (EX1006/EX1008)

64. Shui is Japanese Patent Application Publication No. 2007-25559, published February 1, 2007. Based on my review, Shui is directed to "a focal position detection method and apparatus capable of accurately detecting focal position even in cases where a high luminance point light source exists, such as during nighttime photography." EX1006, ¶ 6.

65. Shui addresses what it describes as a deficiency of contrast-detection autofocus in the presence of saturated point sources—namely the appearance of "virtual peaks" in the focus-evaluation curve that can lead to incorrect focus when peak position alone is relied on. EX1006, ¶¶ 2-8, 56-61. To remedy this, Shui jointly uses focus evaluation values and photometric values across the field, detects the peak focus-evaluation position X0, and then assesses the change in photometric values immediately before and after that peak. EX1006, ¶ 7.

66. In another embodiment, Shui describes comparing "the positions XA,

XB, and XC where the focus evaluation value peaks for each area A, B, and C," and where a "greatly disturbed area is detected," excluding that entire area before averaging the focus-evaluation curves of the remaining areas. EX1006, ¶¶ 136-138; *see also id*. ¶¶ 145-148.

67. In my opinion, Shui differs from the '950 Patent in important respects. Unlike the '950 Patent, Shui neither detects and holds per-pixel feature-change positions in the image plane, nor "creates a region by removing the held positions from the evaluated value extraction region," nor does it control any processing unit based on evaluated values extracted exclusively from such a newly created region.

VII. LEVEL OF ORDINARY SKILL IN THE ART

68. It is my understanding that Petitioner proposes that a person of ordinary skill in the art ("POSITA") would have had "a bachelor's degree in computer science, electrical or computer engineering, or a comparable field of study, plus approximately two to three years of professional experience with image processing, video processing, or other relevant industry experience." Pet. at 3; see also EX1003 at ¶ 35. While I do not necessarily agree with every aspect of Petitioner's proposed level of ordinary skill in the art, I do not contest, for purposes of this proceeding, that the relevant fields of art include computer science, electrical engineering, or computer engineering, with experience in image or video processing. Based on my

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background and qualifications set forth above, I qualify as a POSITA.

VIII. CLAIM CONSTRUCTION

A. POM Terms

69. I agree that the plain and ordinary meaning ("POM") terms identified in the Petition (Pet. at § IV(1)) should be given their plain and ordinary meaning as understood by a POSITA in the context of the '950 Patent. To the extent that any of these terms are interpreted under 35 U.S.C. § 112, ¶ 6, however, in my opinion the Petition and Dr. Schonfeld assert overly narrow and unsupported constructions, as explained below. Further, Petitioner's proposed constructions repeatedly contend that the structure of the claimed units is a "software algorithm executing on a processor." To the extent that Petitioner means that the structure of the claimed units is a combination of a processor (or equivalent processing hardware) and software executable by the processor, I do not disagree.

70. **Processing Unit**. In my opinion, the function of the "processing unit" is "applies predetermined processing to the picture signal." The corresponding structure includes, for example, processing unit 1 and/or general picture-signal processing unit 35, which performs image-quality adjustments such as controlling signal intensity. *See* EX1001, 2:14-27, 3:6-59, 4:29-40, 5:1-64, 6:24-44; FIGs. 1, 5, 10, 11, 13.

71. **Control Unit**. In my opinion, the function of the "control unit" is to

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"control[] the processing unit in accordance with the evaluated value" and to "control[] the processing unit by using an evaluated value of a region from which pixels having an extracted predetermined feature are removed." The corresponding structure includes, for example, control unit 3, which receives evaluated values from unit 7 and issues control signals that adjust the processing unit—actuating drive unit 31 to adjust light-intensity unit 28 for exposure, commanding focus lens drive unit 33 for autofocus, and setting color gains in signal processing unit 35 for white balance. *See* EX1001, 2:14-16, 4:29-67, 5:1-64, 6:24-44; FIGs. 1, 6, 7, 10, 11, 13.

72. **Hold Unit**. In my opinion, the function of the "hold unit" is to "hold[] position information of the detected pixels." The corresponding structure includes, for example, hold unit 5, which stores position information, including identified feature-change positions. *See* EX1001, 2:14-36, 3:23-67, 4:53-58; FIGs. 1, 2, 6, 7, 10, 11, 13.

73. **Light Intensity Adjustment Unit**. In my opinion, the function of the "light intensity adjustment unit" is "controlling exposure." The corresponding structure includes, for example, light-intensity adjustment unit 28 used for exposure control. *See* EX1001, 4:60-5:23; FIG. 6.

74. **Drive Unit**. In my opinion, the function of the "drive unit" is "driving the focus lens" and actuating other controlled elements. The corresponding structure

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includes, for example, focus lens drive unit 33, which adjusts the position of focus lens 32 for autofocus, and drive unit 31, which adjusts the light-intensity adjustment unit 28 for exposure. *See* EX1001, 5:1-64, 6:17-23; FIGs. 6, 7.

75. **Photoelectric Conversion Unit**. In my opinion, the function of the "photoelectric conversion unit" is "performing photoelectric conversion." The corresponding structure includes, for example, photoelectric conversion unit 30, which converts the image formed on its photo-acceptance surface into an electrical picture signal. *See* EX1001, 5:1-34; FIGs. 6, 7.

B. MPF Terms

76. It is my understanding that the parties agreed upon the constructions of "feature detection unit," "region creation unit," "evaluated value extraction unit," "region segmentation unit," and "overlap detection unit" in the associated district court proceeding. I have reviewed the agreed-upon constructions and I have no reason to disagree with them. *See* EX2017.

IX. NONE OF THE CHALLENGED CLAIMS ARE RENDERED OBVIOUS BY THE REFERENCES CITED IN THE PETITION

77. In my opinion, Petitioner has failed to show by a preponderance of the evidence that any of Grounds 1–3 renders any of claims 1–15 obvious. Based on my review of the references on which Petitioner relies, the asserted combinations of Tsujino, Iwasaki, and Shui fail to disclose or render obvious several aspects of the

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Challenged Claims.

78. Moreover, in my view the Petition rests on numerous conclusory statements, which (1) are not bolstered by the equally conclusory statements in Dr. Schonfeld's declaration (EX1003), and (2) fail to demonstrate by a preponderance of the evidence that any of the Challenged Claims are rendered obvious by the asserted combinations of references.

A. Ground 1: Tsujino and Iwasaki Fail to Render Obvious Claims 1–15

79. In my opinion, Petitioner has not shown by a preponderance of the evidence that the alleged combination of Tsujino and Iwasaki would have been obvious to a POSITA, for the reasons set forth below. Notably, by adding Shui to the combination in Ground 2, Petitioner appears to acknowledge that the combination of Tsujino and Iwasaki alone does not render obvious at least Elements [1a] and [1b]; otherwise, Ground 2 would be superfluous.

80. In addition, the '950 Patent has a single independent claim (claim 1). It is my understanding that upon confirming the validity of claim 1 over the asserted prior art, the validity of the dependent Challenged Claims should also be confirmed.

1. Petitioner Fails to Establish that a POSITA Would Have Combined Tsujino and Iwasaki

81. In my opinion, Petitioner's assertion that a POSITA would have combined Tsujino and Iwasaki is the product of hindsight and disregards the fact

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that those references address distinct problems with fundamentally different solutions. Pet. at 11-12. Tsujino is directed to driving the adjustment of the distance of the camera lens relative to the imaging surface for proper autofocus operation. EX1005, Abstract, 1:51-67.

82. As Tsujino itself explains, the benefit of its invention is "to correctly arrange the focus lens 12 at the focal point while avoiding the defocusing caused by the blurred image on a periphery of the light source LS." EX1005, 13:20-23. To achieve this control of the lens's focal point, Tsujino discloses a CPU-based high-luminance excluding function intended to prevent saturated or near-saturated pixels from affecting focus evaluation when a bright source is present. EX1005, 9:31-37.

83. Iwasaki, by contrast, is not concerned with autofocus or lens position. Rather, Iwasaki is directed to performing automatic image processing to avoid oversaturation of light and dark values—i.e., to avoid over- or under-exposure. EX1007, ¶ 108. Iwasaki describes that its analyzing calculating section 34 determines the highest "average luminance values of the respective groups as objects of calculation as the highest value," which is then used to adjust the exposure correction value and gradation characteristic data. EX1007, ¶¶ 84-93. Section 34 automatically adjusts those values "based on the difference value between the proper exposure value (obtained in S107) and the highest value (obtained in S108)."

EX1007, ¶ 108.

84. In my opinion, although Tsujino and Iwasaki both perform processes that operate on luminance values, they do so by different mechanisms, for different purposes, and without any need for the teachings of the other. Tsujino does not describe a need for the type of exposure-correction processing that Iwasaki teaches. Conversely, Iwasaki does not describe a need for the type of autofocus correction that Tsujino teaches. The mere fact that both references work with luminance values does not, in my opinion, give a POSITA a reason to combine them to arrive at the claimed features of the ’950 Patent absent some additional evidence of motivation, which Petitioner has not provided.

85. Petitioner contends that a POSITA would have found it obvious to combine Tsujino and Iwasaki because “combining these complementary techniques would result in a comprehensive camera system capable of handling both autofocus and exposure control in scenes with challenging lighting conditions.” Pet. at 12. In my opinion, this rationale is hindsight-driven for at least two reasons.

86. First, Tsujino was filed after Iwasaki was published (Iwasaki published August 16, 2007 and is based on JP2006-036243 filed February 14, 2006). If exposure-control techniques like those of Iwasaki were genuinely complementary to Tsujino’s autofocus approach, those techniques could have been incorporated into

Tsujino. Tsujino, however, addressed "challenging lighting conditions" through autofocus control of the lens alone.

87. Second, there is no evidence of record—including in Dr. Schonfeld's declaration (EX1003)—that a POSITA would have found it obvious to modify Tsujino with Iwasaki. Petitioner's stated rationale of addressing "challenging lighting conditions" is already addressed by Tsujino's autofocus features, and there is insufficient evidence provided by Petitioner of any need to add Iwasaki's exposure-control processing on top of Tsujino's autofocus control absent improper hindsight reasoning.

88. Accordingly, in my opinion, a POSITA would not have found it obvious to combine Tsujino and Iwasaki to achieve the claims of the '950 Patent absent improper hindsight.

2. Tsujino and Iwasaki Fail to Render Obvious Claim Element [1a]

89. Claim Element [1a] recites that a feature detection unit of the signal processor "detects a position where features of each pixel of an input picture signal have changed" (emphasis added). In my opinion, the Petition fails to establish this limitation.

90. Petitioner alleges that Tsujino's light-source determining process (step S9) performs the claimed detection. Pet. at 13-14. As I read Tsujino, however, that

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process is described in connection with FIGs. 4-8(b) and merely determines whether a light source LS is included in an image based on "a ratio of a partial image having a Y data value above 'TH2' to a partial image having a Y data value above 'TH1' … (TH2>TH1)." EX1005, 8:61-64. Tsujino describes that "the number of pixels in which the Y data value exceeds 'TH1' is evaluated as a coefficient K1, and the number of pixels in which the Y data value exceeds 'TH2' is evaluated as a coefficient K2, and then, 'K2/K1' is compared with a threshold value THR." EX1005, 8:64-9:11.

91. Looking at the process shown in FIG. 12 of Tsujino, in step S23 the CPU 46 determines "whether or not a current pixel is a start pixel (a pixel arranged at an upper left in the coordinate) for the focus area FA," and if so, "whether or not the Y data value of the current pixel exceeds 'TH1.'" EX1005, 11:24-31. "[W]hen the Y data value exceeds 'TH1' and equal to or less than 'TH2', only the coefficient K1 is incremented, and when the Y data value exceeds 'TH2', the coefficients K1 and K2 are both incremented." Id. 11:36-40. Once that comparison is performed for the relevant pixels, the CPU 46 determines whether the ratio K2/K1 exceeds threshold THR. Id. 11:47-49. Where K2/K1 exceeds THR, TH1 is set as the reference value REF; otherwise THmax is used. Id. 11:49-53; see also id. 8:55-60.

92. Petitioner asserts that this light-source determining process is a "pixel-

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by-pixel analysis [that] identifies changes in luminance for each pixel of the input picture signal," and therefore renders Element [1a] obvious. *See* Pet. at 14 (citing EX1005, 11:26-36); *see also* EX2016, 37:1-2. In my opinion, this characterization distorts what Tsujino actually describes. Tsujino's process simply evaluates whether each pixel's Y data value exceeds particular thresholds (TH1, TH2, and/or THmax). EX1005, 11:24-49. Each pixel is compared to the same set of thresholds; nothing in Tsujino describes evaluating a change of a feature of any pixel. During his deposition, Dr. Schonfeld acknowledged that Tsujino does not perform a comparison of a pixel to determine the feature change. *See* EX2016, 71:13–18 (Q: "But Tsujino does not actually discuss that comparison of a pixel with its neighbors, does it?" A: "No. As I said, it is implicit…").

93. Accordingly, in my opinion, Tsujino fails to disclose or render obvious "a feature detection unit which detects a position where features of each pixel of an input picture signal have changed," as recited in Element [1a].

94. Iwasaki also fails to disclose or suggest Element [1a]. Petitioner asserts that Iwasaki teaches "feature detection through its analyzing calculating section 34 that performs subject segmentation processing to group pixel areas belonging to the same subject and calculates average luminance values for each grouped area." Pet. at 15 (citing EX1007, ¶¶ 80-82). As I read Iwasaki, however, the analyzing

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calculating section 34 simply determines the highest "average luminance values of the respective groups as objects of calculation as the highest value" (EX1007, ¶¶ 84-93) and uses those values to perform exposure correction and gradation-characteristic correction (id. ¶¶ 55-58, 75-82). Iwasaki does not describe detecting or determining features of each pixel that have changed.

95. Petitioner offers only conclusory statements that identifying "positions where different subjects with different luminance characteristics are located … corresponds to detecting positions where pixel features have changed." Pet. at 15-16. In my opinion, however, that assertion is not grounded in either reference's actual disclosure. There is no explanation of how Tsujino's threshold comparisons, when combined with Iwasaki's grouping and average-luminance calculations, would render obvious "a feature detection unit which detects a position where features of each pixel of an input picture signal have changed."

96. As discussed above, in my opinion the combination of Tsujino and Iwasaki itself would not have been obvious. Even if it were, the combined teachings still do not detect features of each pixel that have changed, for the reasons explained above. For at least these reasons, Petitioner fails to show by a preponderance of the evidence that Element [1a] would have been rendered obvious by Tsujino in view of Iwasaki.

3. Tsujino and Iwasaki Fail to Render Obvious Claim Element [1b]

97. Claim Element [1b] recites a region creation unit that creates a region "by removing pixels with the features from an evaluated value extraction region." In my opinion, the Petition fails to establish this limitation.

98. Tsujino describes "a high-luminance excluding function for excluding from a target to be noticed of the AF process a partial image having a luminance exceeding 'TH1' out of the object scene image generated by the image sensor." EX1005, Abstract. The purpose of that function, as Tsujino itself states, is to prevent saturated or near-saturated pixels from affecting focus evaluation when a bright source is present. EX1005, 9:31-42. The high-luminance excluding function excludes from the focus evaluation circuit 30 a partial image having a luminance exceeding TH1, when that partial image has a luminance exceeding TH2 (where TH2 > TH1). EX1005, 12:41-51.

99. The Petition makes the conclusory assertion that Tsujino's "excluding high-luminance pixels from focus evaluation consideration" and the claimed creation of a region by removing pixels with features are "functionally equivalent." Pet. at 16-17. In my opinion, however, Tsujino is silent as to "creat[ing] a region" as recited by claim 1. There is no recitation of "region" or "region creation" anywhere in Tsujino, much less any disclosure tying region creation to the exclusion of

saturated or high-luminance pixels from focus evaluation circuit 30. Dr. Schonfeld appears to implicitly confirm as much as his deposition when he could not identify any actual creation of a new region and instead pointed only to this exclusion functionality. *See* EX2016, 84:6-19; 90:11-20. The claim, by contrast, requires that the pixels with the changed features be in an evaluated value extraction region and then removed to form the region created by the region creation unit.

100. Neither Petitioner nor Dr. Schonfeld provides evidence supporting the conclusory assertion that not considering certain oversaturated pixels at a focus evaluation circuit corresponds to the claimed region creation unit.

101. Iwasaki similarly fails to disclose or suggest removing pixels from an evaluated value extraction region to form the region created by the region creation unit. Like Tsujino, Iwasaki is silent as to any "region" or "region creation," and it does not describe pixels being within an evaluated value extraction region and then removed to create a new region. The combined teachings of Tsujino and Iwasaki therefore do not render Element [1b] obvious.

4. Tsujino and Iwasaki Fail to Render Obvious Claim Element [1f]

102. Claim Element [1f] recites "wherein the control unit controls the processing unit by using an evaluated value of a region from which pixels having an extracted predetermined feature are removed." In my opinion, the Petition fails to

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establish this limitation.

103. As I explained above, neither Tsujino nor Iwasaki, individually or in combination, renders obvious detecting pixels with features that have changed or removing those pixels from an evaluated value extraction region to create a region by the region creation unit. Without disclosing or rendering obvious those underlying steps, Tsujino's CPU 46 and Iwasaki's CPU 42 cannot be said to control a processing unit using an evaluated value of a region from which pixels having an extracted predetermined feature are removed.

104. The Petition and Dr. Schonfeld's declaration provide nothing more than conclusory statements that rely on the same mischaracterizations and misunderstandings of Tsujino and Iwasaki described above.

105. Even setting aside that the combination of Tsujino and Iwasaki is itself not obvious, the combined teachings still do not detect feature changes of pixels and create a region by removing pixels with such features from an evaluated value extraction region—the very steps that the claimed control unit must use to control the processing unit. For at least these reasons, in my opinion Petitioner has failed to show by a preponderance of the evidence that Element [1f] would have been rendered obvious by Tsujino in view of Iwasaki.

5. Tsujino and Iwasaki Fail to Render Obvious Claim 2

106. Claim 2 recites: "A signal processor according to claim 1, wherein the feature detection unit includes: a hold unit which holds position information of the detected pixels; and the region creation unit which creates a region by excluding the held positions from an evaluated value extraction region." Because claim 2 depends from claim 1, it incorporates each of the limitations that, as discussed above, the alleged combination of Tsujino and Iwasaki fails to teach (Elements [1a], [1b], and [1f]). In my opinion, Petitioner's argument as to claim 2 fails for at least the same reasons.

107. In addition, with respect to Claim Element [2a], in my opinion the combination of Tsujino and Iwasaki fails to disclose or suggest "a hold unit which holds position information of the detected pixels." The Petition relies on the bare fact that Tsujino discloses an SDRAM 34 to argue that Tsujino renders this limitation obvious. As Petitioner's own conclusory statements implicitly acknowledge, however, there is no disclosure that Tsujino's SDRAM 34 holds or stores position information of pixels that have been detected to have features that have changed (per Element [1a]).

108. Petitioner takes an even bigger logical leap with respect to Iwasaki, asserting that Iwasaki implicitly teaches memory resources because its CPU 42

would necessarily use memory components. In my opinion, however, nothing in Iwasaki discloses, or would render obvious to a POSITA, "a hold unit which holds position information of the detected pixels."

109. For at least these reasons, in my opinion Petitioner has failed to show by a preponderance of the evidence that claim 2 would have been rendered obvious by the combination of Tsujino and Iwasaki.

6. Tsujino and Iwasaki Fail to Render Obvious the Remaining Dependent Claims

110. The remaining dependent claims—claims 3–15—each ultimately depend from claim 1, and so each incorporates the limitations that, in my opinion, the combination of Tsujino and Iwasaki fails to teach (Elements [1a], [1b], and [1f]). For that reason, Petitioner's arguments with respect to each of those claims fail for the reasons given above with respect to claim 1.

111. In addition, claims 3, 5–9, and 12 all ultimately depend from claim 2 and therefore also incorporate the deficiencies relating to claim 2 discussed above—including, in particular, the absence of "a hold unit which holds position information of the detected pixels." In my opinion, Petitioner's arguments with respect to those claims fail for at least these additional reasons.

112. For at least these reasons, in my opinion Petitioner has failed to show by a preponderance of the evidence that any of the dependent Challenged Claims

would have been rendered obvious by the combination of Tsujino and Iwasaki.

B. Ground 2: Tsujino, Shui, and Iwasaki Fail to Render Obvious Claims 1–15

113. In my opinion, Petitioner has not shown by a preponderance of the evidence that the alleged combination of Tsujino, Shui, and Iwasaki would have been obvious to a POSITA, or that it discloses or suggests key features of the ’950 Patent’s invention, for the reasons set forth below.

1. Petitioner Fails to Establish that a POSITA Would Combine Tsujino, Shui, and Iwasaki

114. In my opinion, Petitioner’s assertion that a POSITA would have combined Tsujino, Shui, and Iwasaki rests on hindsight and disregards the fact that those references address distinct problems with fundamentally different solutions. Pet. at 36-38.

115. As discussed above, Tsujino is directed to driving lens-position adjustment for autofocus, using a high-luminance excluding function to prevent saturated or near-saturated pixels from affecting the focus evaluation. EX1005, Abstract, 1:51-67, 9:31-37. Iwasaki is directed to automatic image processing to avoid oversaturation of light and dark values and automatically adjusts the exposure correction value and gradation characteristic data. EX1007, ¶ 108. Shui is directed to a focal-position detection method intended to improve autofocus accuracy in the

presence of high-luminance point light sources, such as in nighttime photography. EX1006, Abstract.

116. More specifically, Shui describes that, in contrast-detection autofocus, saturated signals from bright point sources can produce "virtual peaks" in the focus-evaluation curve, leading to incorrect focus when peak position alone is relied on. EX1006, ¶¶ 2-8, 56-61. Shui addresses this by jointly using "focus evaluation values and photometric values … in the entire field from the minimum distance to infinity," detecting the peak focus-evaluation position X0, and then evaluating the change in photometric values immediately before and after that peak. EX1006, ¶ 7.

117. In my opinion, although Tsujino, Shui, and Iwasaki each operate on luminance values, they do so by distinct procedures and without any need for the teachings of the others. Tsujino and Shui both relate to autofocus but address the problem of point light sources from different angles—Tsujino by excluding areas above certain luminance thresholds, and Shui by performing contrast-detection autofocus across the entire field, detecting the peak focus-evaluation position, and evaluating the change in photometric values immediately before and after that peak. Iwasaki, again, is not concerned with autofocus but with avoiding oversaturation.

118. The Petition provides no evidence—nor does Dr. Schonfeld's declaration (EX1003)—that a POSITA would have found it obvious to modify

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Tsujino with Shui and Iwasaki. Petitioner's stated rationale of addressing "challenging lighting conditions" is already addressed by Tsujino's autofocus features, and there is no evidence of any need to add Shui's or Iwasaki's processing on top of Tsujino's autofocus control absent improper hindsight reasoning. Accordingly, in my opinion a POSITA would not have found it obvious to combine Tsujino, Shui, and Iwasaki to achieve the claims of the '950 Patent.

2. Petitioner Fails to Establish That Claim Element [1a] Would Have Been Obvious Based on Tsujino in view of Shui and Iwasaki

119. Claim Element [1a] recites that a feature detection unit of the signal processor "detects a position where features of ***each pixel of an input picture signal have changed***." (Emphasis added). The Petition fails to establish this limitation.

120. With respect to the individual claim elements, the alleged combination of Tsujino and Iwasaki fails to disclose or render obvious Elements [1a], [1b], and [1f] for the reasons discussed above with respect to Ground 1. In my opinion, Shui does not cure those deficiencies. As to Element [1a], Shui describes jointly using "focus evaluation values and photometric values … in the entire field from the minimum distance to infinity," detecting the peak focus-evaluation position X0, and then evaluating the change in photometric values immediately before and after that peak. EX1006, ¶ 7.

121. Petitioner contends that combining Shui with Tsujino's threshold-based detection would allow the resulting system to identify positions where pixel features change in visual characteristics. Pet. at 39-40. As I read Shui, however, it does not detect a position where features of each pixel of an input picture signal have changed; in particular, Shui does not disclose that the locations of the peak X0 and the positions immediately before and after that peak are necessarily different or adjacent pixels. The conclusory statements offered by Petitioner and Dr. Schonfeld are untethered from Shui's actual disclosure. Accordingly, in my opinion, even if the proposed combination were obvious (which it is not, for the reasons explained above), the alleged combination of Tsujino, Shui, and Iwasaki does not disclose or render obvious Element [1a].

3. Tsujino, Shui, and Iwasaki Fail to Render Obvious Claim Element [1b]

122. Claim Element [1b] requires a region creation unit that creates a region "by removing pixels with the features from an evaluated value extraction region." In my opinion, the Petition does not establish this limitation.

123. For the reasons set forth above with respect to Ground 1, the combination of Tsujino and Iwasaki fails to disclose or render obvious Element [1b], and Shui does not remedy that deficiency. Shui describes that a focus area may be divided into multiple areas for the focal-position detection method, and that focus-

evaluation values "for the entire range from the minimum distance to infinity are obtained for each area." EX1006, ¶ 15.

124. In my opinion, the Petition mischaracterizes that disclosure as corresponding to the claimed region creation unit. Pet. at 40-41. Shui's exclusion of certain areas in which the differential between minimum and maximum photometric values exceeds a threshold (EX1006, ¶ 16) is not the same as removing pixels from an evaluated value extraction region to form the region created by the region creation unit. Beyond conclusory assertions, Petitioner offers no explanation of how excluding certain areas for focal calculation would correspond to the claimed operation.

125. For at least these reasons, in my opinion the alleged combination of Tsujino, Shui, and Iwasaki does not render Element [1b] obvious.

4. Tsujino, Shui, and Iwasaki Fail to Render Obvious Claim Element [1f]

126. Claim Element [1f] recites "wherein the control unit controls the processing unit by using an evaluated value of a region from which pixels having an extracted predetermined feature are removed." In my opinion, the Petition does not establish this limitation.

127. As discussed above, Shui (alone or in combination with Tsujino and Iwasaki) does not render obvious detecting pixels with changed features or removing

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those pixels from an evaluated value extraction region to form the region created by the region creation unit. Without those underlying steps, the combination cannot satisfy a control unit that controls a processing unit using an evaluated value of such a region. The Petition and Dr. Schonfeld's declaration offer nothing more than conclusory statements that recycle the same mischaracterizations of the references discussed above.

128. For at least these reasons, in my opinion Petitioner has failed to show by a preponderance of the evidence that Element [1f] would have been rendered obvious based on the combination of Tsujino, Shui, and Iwasaki.

5. Tsujino, Shui, and Iwasaki Fail to Render Obvious Claim 2

129. Because claim 2 depends from claim 1, it incorporates each of the limitations that the alleged combination of Tsujino, Shui, and Iwasaki fails to teach (Elements [1a], [1b], and [1f]). In my opinion, Petitioner's argument as to claim 2 fails for at least the same reasons.

130. In addition, with respect to Element [2a], the alleged combination fails to disclose or suggest "a hold unit which holds position information of the detected pixels." The Petition relies on the bare disclosure that Tsujino includes SDRAM 34 and Shui includes RAM 46 to argue that this limitation is rendered obvious. As Petitioner's own conclusory statements implicitly acknowledge, however, neither

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reference describes those memories holding or storing position information of pixels detected as having changed features. Petitioner's reliance on Iwasaki's CPU 42 implicitly using memory components is no more probative—nothing in Iwasaki discloses, or would render obvious to a POSITA, the claimed hold unit.

6. Tsujino, Shui, and Iwasaki Fail to Render Obvious Claims 3 and 12

131. Claims 3 and 12 each ultimately depend from claim 1 and therefore incorporate the limitations that the alleged combination of Tsujino, Shui, and Iwasaki fails to teach (Elements [1a], [1b], and [1f]). In my opinion, Petitioner's arguments as to claims 3 and 12 fail for at least the same reasons. Petitioner's arguments with respect to claim 3 also fail because of the deficiencies discussed above with respect to claim 2.

7. Tsujino, Shui, and Iwasaki Fail to Render Obvious Claims 4 and 14

132. Claims 4 and 14 each ultimately depend from claim 1 and incorporate the limitations that the alleged combination of Tsujino, Shui, and Iwasaki fails to teach. In my opinion, Petitioner's arguments fail for at least the same reasons. Petitioner's argument as to claim 4 also fails because of the deficiencies discussed above with respect to claim 2.

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8. Tsujino, Shui, and Iwasaki Fail to Render Obvious Claims 5 and 8

133. Claims 5 and 8 each ultimately depend from claim 1 and incorporate the limitations that the alleged combination of Tsujino, Shui, and Iwasaki fails to teach. In my opinion, Petitioner's arguments fail for at least the same reasons. Petitioner's arguments as to claims 5 and 8 also fail because of the deficiencies discussed above with respect to claim 2, on which those claims also depend.

9. Tsujino, Shui, and Iwasaki Fail to Render Obvious Claims 6, 9, 11, 13, and 15

134. Claims 6, 9, 11, 13, and 15 each ultimately depend from claim 1 and incorporate the limitations that the alleged combination of Tsujino, Shui, and Iwasaki fails to teach. In my opinion, Petitioner's arguments fail for at least the same reasons. Petitioner's arguments as to claims 6 and 9 also fail because of the deficiencies discussed above with respect to claim 2, on which those claims also depend.

10. Tsujino, Shui, and Iwasaki Fail to Render Obvious Claims 7 and 10

135. Claims 7 and 10 each ultimately depend from claim 1 and incorporate the limitations that the alleged combination of Tsujino, Shui, and Iwasaki fails to teach. In my opinion, Petitioner's arguments fail for at least the same reasons.

Petitioner's argument as to claim 7 also fails because of the deficiencies discussed above with respect to claim 2, on which claim 7 depends.

136. For at least these reasons, in my opinion Petitioner has failed to show by a preponderance of the evidence that any of claims 1–15 would have been rendered obvious by the combination of Tsujino, Shui, and Iwasaki.

C. Ground 3: Shui and Iwasaki Fail to Render Obvious Claims 1–15

137. In my opinion, Petitioner has not shown by a preponderance of the evidence that the alleged combination of Shui and Iwasaki would have been obvious to a POSITA, or that it discloses or suggests key features of the '950 Patent's invention.

1. Petitioner Fails to Establish that a POSITA Would Combine Shui and Iwasaki

138. First, as discussed above, Shui is directed to a focal-position detection method intended to improve autofocus accuracy in the presence of high-luminance point light sources (EX1006, Abstract; ¶¶ 2-8, 56-61), while Iwasaki is directed to automatic image processing to avoid oversaturation, using analyzing calculating section 34 to adjust exposure correction values and gradation characteristic data (EX1007, ¶ 108). In my opinion, although Shui and Iwasaki each work with luminance values, they do so by distinct procedures and without any need for the teachings of the other. Shui uses contrast-detection autofocus across the entire field,

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detecting the peak focus-evaluation position and evaluating photometric-value changes around it, whereas Iwasaki is not concerned with autofocus but with avoiding oversaturation by adjusting exposure correction values and gradation characteristic data based on the difference between the proper exposure value and the highest value. EX1007, ¶ 108. The mere fact that both references operate on luminance values does not, in my opinion, give a POSITA a reason to combine them to arrive at the claimed features of the ’950 Patent.

139. Petitioner contends that a POSITA would have found it obvious to combine Shui and Iwasaki because “combining these complementary techniques would result in a comprehensive camera system capable of handling both autofocus and exposure control in scenes with challenging lighting conditions.” Pet. at 50. In my opinion, that rationale is hindsight-driven. Petitioner’s rationale of addressing “challenging lighting conditions” is already addressed by Shui’s autofocus improvements, and there is no evidence of any need to layer Iwasaki’s exposure-control processes on top of Shui’s autofocus control absent improper hindsight. Accordingly, in my opinion a POSITA would not have found it obvious to combine Shui and Iwasaki to achieve the claims of the ’950 Patent.

2. Shui and Iwasaki Fail to Render Obvious Claim Element [1a]

140. Second, even if the combination were obvious, Shui and Iwasaki,

individually or in combination, fail to disclose or render obvious Element [1a]. As discussed above, Shui describes jointly using focus-evaluation values and photometric values across the field, detecting the peak focus-evaluation position X0, and then evaluating the change in photometric values immediately before and after that peak. EX1006, ¶ 7. Shui further explains that when the absolute differential ΔY1–2 between photometric values at positions X1 and X2 around X0 is below an allowed value α, X0 is accepted as the focal position; if it meets or exceeds α, the system instead identifies position X3 where the photometric value is minimum and treats that as the focal position. EX1006, ¶¶ 7-8.

141. Petitioner alleges that "Shui's detection of positions in the image where the calculated differential meets or exceeds a threshold, directly corresponds to detecting positions where features of pixels have changed, because these calculations identify locations in the image where visual characteristics transition or differ from surrounding pixels." Pet. at 52 (citing EX1006, ¶¶ 56-57). In my opinion, however, Shui does not detect a position where features of each pixel of an input picture signal have changed; detection of the peak focus-evaluation position X0 and evaluation of the change in photometric values immediately before and after that peak does not satisfy Element [1a], and Shui does not disclose that those locations are necessarily different or adjacent pixels.

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3. Shui and Iwasaki Fail to Render Obvious Claim Element [1b]

142. As to Element [1b], Shui describes that a focus area may be divided into multiple areas for the focal-position detection method and that focus-evaluation values "for the entire range from the minimum distance to infinity are obtained for each area." EX1006, ¶ 15. The Petition mischaracterizes that disclosure as corresponding to a region creation unit that creates a region by removing pixels with features from an evaluated value extraction region. Pet. at 53-54. In my opinion, Shui's exclusion of certain areas in which the differential between minimum and maximum photometric values exceeds a threshold (EX1006, ¶ 16) is not the same as removing pixels from an evaluated value extraction region to form the region created by the region creation unit.

4. Shui and Iwasaki Fail to Render Obvious Claim Element [1f]

143. As to Element [1f], for the reasons explained above in connection with Elements [1a] and [1b], Shui does not render obvious a control unit that controls a processing unit using an evaluated value of a region from which pixels having an extracted predetermined feature are removed. Iwasaki does not cure these deficiencies. The Petition and Dr. Schonfeld's declaration provide nothing more than conclusory statements that recycle the mischaracterizations described above. For at least these reasons, in my opinion Petitioner has failed to show by a preponderance of the evidence that Element [1f] would have been rendered obvious based on the

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combination of Shui and Iwasaki.

5. Shui and Iwasaki Fail to Render Obvious Claim 2

144. Because claim 2 depends from claim 1, it incorporates each of the limitations that, as discussed above, the alleged combination of Shui and Iwasaki fails to teach (Elements [1a], [1b], and [1f]). In my opinion, Petitioner's argument as to claim 2 fails for at least the same reasons.

145. In addition, with respect to Element [2a], the alleged combination fails to disclose or suggest "a hold unit which holds position information of the detected pixels." The Petition relies on the bare disclosure that Shui includes RAM 46 to argue that this limitation is rendered obvious. As Petitioner's own conclusory statements implicitly acknowledge, however, nothing in Shui describes RAM 46 holding or storing position information of pixels detected as having changed features. Petitioner's invocation of Iwasaki's CPU 42 implicitly using memory components is no more probative—nothing in Iwasaki discloses, or would render obvious to a POSITA, the claimed hold unit.

6. Shui and Iwasaki Fail to Render Obvious Claims 3 and 12

146. Claims 3 and 12 each ultimately depend from claim 1 and incorporate the limitations that the alleged combination of Shui and Iwasaki fails to teach (Elements [1a], [1b], and [1f]). In my opinion, Petitioner's arguments as to claims 3

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and 12 fail for at least the same reasons. Petitioner's argument as to claim 3 also fails because of the deficiencies discussed above with respect to claim 2.

7. Shui and Iwasaki Fail to Render Obvious Claims 4 and 14

147. Claims 4 and 14 each ultimately depend from claim 1 and incorporate the limitations that the alleged combination of Shui and Iwasaki fails to teach. In my opinion, Petitioner's arguments fail for at least the same reasons. Petitioner's argument as to claim 4 also fails because of the deficiencies discussed above with respect to claim 2.

8. Shui and Iwasaki Fail to Render Obvious Claims 5 and 8

148. Claims 5 and 8 each ultimately depend from claim 1 and incorporate the limitations that the alleged combination of Shui and Iwasaki fails to teach. In my opinion, Petitioner's arguments fail for at least the same reasons. Petitioner's arguments as to claims 5 and 8 also fail because of the deficiencies discussed above with respect to claim 2, on which those claims also depend.

9. Shui and Iwasaki Fail to Render Obvious Claims 6, 9, 11, 13, and 15

149. Claims 6, 9, 11, 13, and 15 each ultimately depend from claim 1 and incorporate the limitations that the alleged combination of Shui and Iwasaki fails to teach. In my opinion, Petitioner's arguments fail for at least the same reasons.

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Petitioner's arguments as to claims 6 and 9 also fail because of the deficiencies discussed above with respect to claim 2, on which those claims also depend.

10. Shui and Iwasaki Fail to Render Obvious Claims 7 and 10

150. Claims 7 and 10 each ultimately depend from claim 1 and incorporate the limitations that the alleged combination of Shui and Iwasaki fails to teach. In my opinion, Petitioner's arguments fail for at least the same reasons. Petitioner's argument as to claim 7 also fails because of the deficiencies discussed above with respect to claim 2, on which claim 7 depends.

151. For at least the reasons set forth above, in my opinion Petitioner and Dr. Schonfeld have failed to show by a preponderance of the evidence that any of the Challenged Claims is unpatentable.

X. CONCLUSION

152. For at least the foregoing reasons, it is my opinion that the Petitioner and Dr. Schonfeld have failed to show by a preponderance of the evidence that any of the Challenged Claims are unpatentable.

153. In addition to the opinions and evidence expressed herein, I reserve the right to rebut any arguments made or evidence presented in response to this report. I also reserve the right to supplement this report based on further investigation or analysis.

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154. I hereby declare under the penalty of perjury under the laws of the United States of America that the opinions set forth herein are true and accurate to the best of my knowledge, information, and belief.

Dated: May 12, 2026

Matthew Turk, Ph.D.

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CURRICULUM VITAE

Matthew A. Turk, Ph.D.

Fellow, Association for Computing Machinery (ACM)
Life Fellow, Institute of Electrical & Electronics Engineers (IEEE)
Fellow, International Association for Pattern Recognition (IAPR)
Fellow, Asia-Pacific Artificial Intelligence Association (AAIA)
Fellow, Artificial Intelligence Industry Alliance (AIIA)

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PRIMARY RESEARCH INTERESTS AND EXPERTISE:

Computer vision and image processing, artificial intelligence and machine learning, pattern recognition, multimodal human-computer interaction, augmented and virtual reality, computer graphics, mobile imaging, and optics, biometrics, AI ethics and regulation

PROFESSIONAL EXPERIENCE:

2010-pres. **Santa Barbara Technology Consulting** Santa Barbara, CA
Principal Consultant
Helping companies with technical, policy, and legal matters related to computing technology and strategy.

2000-pres. **University of California, Santa Barbara** Santa Barbara, CA
Professor Emeritus (2019-pres.)
Professor (2005-2019), Associate Professor (2000-2005)
Co-director, Four Eyes Laboratory
Appointments: Computer Science (67%), Media Arts & Technology (33%), Electrical & Computer Engineering (0%), Dynamical Neuroscience (0%)
Chair, Department of Computer Science (2017-2019)
Chair, Media Arts and Technology (2005-2010)
Vice Chair, Media Arts and Technology (2005)

2019-2025 **Toyota Technological Institute at Chicago** Chicago, IL
President and Professor
Member, Board of Trustees

2020-2025 **Toyota Technological Institute at Japan** Nagoya, Japan
Board Councilor

2014-2016 **Caugnate** Santa Barbara, CA
Co-founder and CEO

	Startup company commercializing remote telecollaboration augmented reality software. Participated in UCSB Technology Management Program New Venture Competition and in the Citrix Innovator's Program. Acquired by PTC Inc.; the technology became PTC's Vuforia Chalk product.	
2012	**University of Oulu** Visiting Professor, Department of Computer Science & Engineering (Jun-Aug)	Oulu, Finland
2011	**University of Tampere** Visiting Professor, School of Information Science (Aug-Sept)	Tampere, Finland
2003, 2004	**Ecole Polytechnique Fédérale de Lausanne (EPFL)** Visiting faculty (August 2003, July 2004)	Lausanne, Switzerland
1994-2000	**Microsoft Research** Researcher Founded the Vision Technology Research Group; research in computer vision, vision-based human-computer interaction and perceptual user interfaces.	Redmond, WA
1993-94	**Teleos Research** Computer Scientist Research in vision-based interaction with people, object recognition, mobile robots.	Palo Alto, CA
1993	**Stanford University** Lecturer Computer Science Department	Palo Alto, CA
1992	**LIFIA-IMAG** Postdoc / Visiting Researcher Research in face recognition and visual interpretation of human gestures, applications to human-computer interfaces.	Grenoble, France
1991	**Massachusetts Institute of Technology** Postdoctoral Fellow, MIT Media Laboratory Research on human face recognition for applications to security and man-machine communication; image database indexing and retrieval.	Cambridge, MA
1984-87	**Martin Marietta Denver Aerospace** Engineer, Senior Engineer Research in vision algorithm development and implementation for mobile robot navigation (DARPA Autonomous Land Vehicle program).	Denver, CO
1983-84	**University of Pittsburgh** Computer Technician, Dept. of Neurophysiology Electronics, image processing, and computer system support.	Pittsburgh, PA

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EDUCATION:

1987-91 **Massachusetts Institute of Technology** Cambridge, MA
Ph.D. from the Media Laboratory, Vision and Modeling Group
Committee: Alex P. Pentland (advisor), Ted Adelson, Nicholas Negroponte

Dissertation: *Interactive-Time Vision: Face Recognition as a Visual Behavior*

The dissertation introduced "Eigenfaces," an appearance-based approach to face and object recognition. A prototype system was built to track and recognize people as they entered a room; we showed how this approach could be used to represent, detect, and recognize other object properties such as facial expression. Papers on this work received an "Outstanding Paper" award (1991) and a "Most Influential Paper of the Decade" award (2000).

1982-84 **Carnegie Mellon University** Pittsburgh, PA
M.S. in Electrical and Computer Engineering
Advisors: Matt Mason, Marc Raibert

Thesis: *A Fine Motion Planning Algorithm for Robots*
The thesis investigated robot manipulation planning techniques in the face of uncertainty in sensing and world modeling. A 2D planner was developed to automatically construct a plan, by reasoning in configuration space, to successfully manipulate an object along a constrained path.

1978-82 **Virginia Tech (VPI&SU)** Blacksburg, VA
B.S. in Electrical Engineering, *magna cum laude*
Advisor: Robert Haralick

Senior Honors Project in computer vision; segmentation algorithms implemented in the GYPSY image processing system.

RECENT EXPERT TESTIFYING EXPERIENCE (2022-2026):

2026 Cerence AI in the Matter of Certain Smart Televisions
U.S. International Trade Commission
Investigation No. 337-TA-1461
Declaration on Claim Construction

2025-2026 FaceTec, Inc. v. Jumio Corp.
USPTO Patent Trial and Appeal Board
Case IPR2025-00106, -00107, -00108, -00109
Expert Declaration, Deposition

2024-2025 Hayden AI Technologies, Inc. v. Safe Fleet Holdings LLC et al.
Case No. 1:23-CV-03471
Eastern District of New York and Western District of Washington
Declaration on Claim Construction, Deposition

2024 Avelardo Rivera and Yasmine Romero et al. v. AWS
U.S. District Court Western District of Washington at Seattle
Case No. 2:22-cv-00269-JHC
Expert Report

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2024	RoboticVISIONTech, Inc. v. ABB Inc. U.S. District Court for the District of Delaware Case No. 1:22-cv-01257-GBW Declaration on Claim Construction, Deposition
2023-2024	NantWorks, LLC and Nant Holdings IP, LLC v. Niantic, Inc. U.S. District Court Northern District of California, San Francisco Division Case No. 3:20-cv-06262-LB Expert Report, Rebuttal Expert Report, 2 Depositions
2022-2024	The State of Texas v. Meta Platforms, Inc., F/K/A Facebook, Inc. District Court, 71st Judicial District, Harrison County, Texas Cause No. 22-0121 Expert Report, Deposition
2022-2024	Volkswagen Group of America v. Yechezkal Evan Spero USPTO Patent Trial and Appeal Board Cases IPR2022-01586, IPR2022-00197, IPR2023-00315, IPR2023-00328, IPR2023-00318, IPR2023-00335, IPR2023-00336 Mercedes-Benz USA, LLC v. Yechezkal Evan Spero USPTO Patent Trial and Appeal Board Cases IPR2023-01026, IPR2023-01027, IPR2023-01039, IPR2023-01040, IPR2023-01034 23 Declarations, 5 Depositions
2022	Samsung Semiconductor, Inc. v. Gerard "Dirk" Smits JAMS Arbitration Ref. No. 1100111885 2 Expert Reports Deposition, Arbitration Hearing
2021-2022	Indect USA Corp v. Park Assist District Court for the Southern District of California Case No. 3:18-cv-2409-BEN-MDD Expert Report, Deposition, Trial

HONORS AND AWARDS:

2024	Recognized by the IEEE as *IEEE Life Fellow*
2023	Elected as *AIIA Fellow* (Artificial Intelligence Industry Alliance)
2022	Elected as *AAIA Fellow* (Asia-Pacific Artificial Intelligence Association)
2022	Appointed to the *Computing Community Consortium (CCC) Council*, charged with catalyzing and empowering the U.S. computing research community to articulate and advance major research directions for the field (term: 2022-2025)
2020	Elected as *ACM Fellow* (Association for Computing Machinery) for "contributions to face recognition, computer vision, and multimodal interaction"
2016	*Best Paper Honorable Mention* at the 2016 IEEE Symposium on 3D User Interfaces (3DUI) for "Interpreting 2D Gesture Annotations in 3D Augmented Reality," with B. Nuernberger, K. Lien, and T. Höllerer
2015	*Winner, ACM Multimedia Open Source Software Competition* for "Theia: A Fast and Scalable Structure-from-Motion Library," with C. Sweeney and T. Höllerer

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2015 *Best Short Paper Award* at the 2015 International Symposium on Mixed and Augmented Reality (ISMAR), for "Efficient Computation of Absolute Pose for Gravity-Aware Augmented Reality," with C. Sweeney, B. Nuernberger, and T. Höllerer

2015 *Outstanding Reviewer Award* at the 2015 IEEE International Conference on Automatic Face and Gesture Recognition

2014 Elected as *IAPR Fellow* (International Association for Pattern Recognition) for "contributions to computer vision and vision-based interaction"

2014 Received inaugural *ICMI Community Service Award* for organizational and service contributions to the multimodal interaction research community

2012 Elected as *IEEE Fellow* (Institute of Electrical and Electronics Engineers) for "contributions to computer vision and perceptual interfaces"

2012 *Best Paper Award* at the 2012 International Symposium on Mixed and Augmented Reality (ISMAR), for "Live tracking and mapping from both general and rotation-only camera motion," with S. Gauglitz, C. Sweeney, J. Ventura, and T. Höllerer

2012 *Best Paper Honorable Mention* at the 2012 International Conference on Human-Computer Interaction with Mobile Devices and Services (MobileHCI), for "Integrating the physical environment into mobile remote collaboration," with S. Gauglitz, C. Lee, and T. Höllerer

2012 *Best Student Paper Finalist* (PhD student Victor Fragoso) at the 2012 International Conference on Image Processing (ICIP), for "Locating Binary Features for Keypoint Recognition using Noncooperative Games," with V. Fragoso and J. Hespanha

2012 Selected to participate in the National Academy Keck Futures Initiative on The Informed Brain in a Digital World (invitation only)

2011 Awarded the *2011-2012 Fulbright-Nokia Distinguished Chair in Information and Communications Technologies*

2010 *Best Paper Award* at the 2010 IEEE International Workshop on Mobile Vision, for "Location-based augmented reality on mobile phones," with R. Paucher

2006 *One of the Best Image Processing and Computer Vision Papers* in SIBGRAPI 2006, for "Dealing with multi-scale depth changes and motion in depth edge detection," with R. Feris and R. Raskar

2004 *Best Paper Award* at the 2004 IEEE Workshop on Real-Time Vision for Human Computer Interaction, for "Fast 2D hand tracking with flocks of features and multi-cue integration," with M. Kölsch

2004 *Communication and Technology Top Paper Award*, for "Non-zero sum gaze and persuasion," with J. Bailenson, A. Beal, J. Blascovich, and J. Loomis; selected for presentation at the 54th Annual Conference of the International Communication Association (2004)

2000 *Most Influential Paper of the Decade Award* from the International Association for Pattern Recognition (IAPR) Workshop on Machine Vision Applications (MVA-2000)

1999 Selected to attend the National Academy of Engineering Symposium on Frontiers of Engineering (one of 70 chosen nationwide)

1992 Selected to attend *Comparative Approaches to Cognitive Science* international summer school (with scholarship)

1991 C.N.O.U.S. post-doctoral fellowship grant (France)

1991 IEEE Computer Society Outstanding Paper Award, Conference on Computer Vision and Pattern Recognition (CVPR), for "Face recognition using eigenfaces," with A. Pentland

1988-90 SPIE Scholarships in Optical Engineering

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1990	MIT Japan Science, Technology, Management Prize
1988	Author of the Year award, Martin Marietta Information Systems , for "VITS – a vision system for autonomous vehicle navigation," with D. Morgenthaler, K. Gremban, and M. Marra
1978-82	Marshall Hahn Engineering Scholarship (Virginia Tech)

SELECT KEYNOTE AND INVITED TALKS:

Oct 2025	Panelist, CCC Community Chat, *Envisioning Possible Futures for AI Research* (Webinar)
May 2024	Invited Speaker, IEEE Computer Society San Diego Chapter (San Diego, CA)
Feb 2024	Session Organizer and Panel Moderator, *Generative AI and Science*, AAAS Annual Conference (Denver, CO)
Jan 2023	Keynote Speaker, IEEE International Conference on Face and Gesture Recognition (Kona, HI)
Jan 2023	Keynote Speaker, WACV Workshop on Demographic Variations in Performance of Biometric Algorithms (Kona, HI)
Feb 2022	Milestone Systems (Brondby, Denmark)
Jan 2022	Keynote Speaker, WACV Workshop on Real-World Surveillance: Applications and Challenges (Waikoloa, Hawaii)
Dec 2021	Keynote Speaker, International Conference on 4th Industrial Revolution and Beyond (Dhaka, Bangladesh)
Oct 2021	Keynote Speaker, IEEE International Workshop on Machine Learning for Signal Processing
Mar 2021	Brandeis University (Waltham, MA)
Nov 2020	Keynote Speaker, IEEE Conference on Automatic Face and Gesture Recognition
Aug 2020	Invited Speaker, ECCV Workshop on Fair Face Recognition and Analysis
Mar 2020	Invited Speaker and Panelist, California State Assembly Committee on Privacy and Consumer Protection (Sacramento, CA)
Nov 2019	Distinguished Speaker, Ohio State University ECE Department (Columbus, OH)
Oct 2019	Invited speaker, ICCV Workshop on Real-World Recognition from Low-Quality Images and Videos (Seoul, South Korea)
Oct 2019	Toyota Technological Institute Japan (Nagoya, Japan)
Jul 2019	Keynote speaker, 14th International Symposium on Signals, Circuits, and Systems (Iasi, Romania)
Aug 2018	Invited talk, Forum on The Future of ISEA (Port Hueneme, CA)
Mar 2018	University of Primorska (Slovenia)
Mar 2018	Arizona State University
Jul 2017	PTC (San Diego, CA)
Jun 2017	Keynote speaker, Global Virtual Reality Conference (CVRC) (Shanghai, China)
Jun 2017	Invited talk, Shanghai Tech (Shanghai, China)
Feb 2017	Santa Barbara Science & Religion Study Group
Nov 2016	Keynote speaker, The Chinese Conference on Pattern Recognition (Chengdu, China)
Oct 2016	Invited talk, Science and Engineering Council of Santa Barbara (Santa Barbara, CA)
May 2016	UCSB Dean's Cabinet
Apr 2016	Invited talk, Field Service USA 2016 (Palm Springs, CA)
Apr 2016	Invited talk, Computer Science Academy, Santa Barbara High School (Santa Barbara, CA)

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Mar 2016	Invited panelist, Graduate Student Workshop on Computing, UCSB (Santa Barbara, CA)
Feb 2016	University of Massachusetts, Amherst (Amherst, MA)
Oct 2015	University of Notre Dame (South Bend, IN)
Sept 2015	Invited talk, Andreessen Horowitz Academic Roundtable (Menlo Park, CA)
Sept 2015	Invited talk, Citrix Online (Santa Barbara, CA)
June 2015	Keynote speaker, 4th International Conference on Informatics, Electronics, and Vision (Fukuoka, Japan)
May 2015	Keynote speaker, 11th IEEE International Conference on Face and Gesture Recognition (Ljubljana, Slovenia)
May 2015	Invited panelist, 11th IEEE International Conference on Face and Gesture Recognition (Ljubljana, Slovenia)
Mar 2015	Invited speaker, San Marcos High School Distinguished Educator/Innovative Researcher (Santa Barbara, CA)
Dec 2014	Keynote speaker, 17th International Conference on Computer and Information Technology (Dhaka, Bangladesh)
Dec 2014	Daffodil University (Dhaka, Bangladesh)
Nov 2014	Zhejiang University (Hangzhou, CA)
Nov 2014	CTO Forum: Rethink Disruption (San Francisco, CA)
Jan 2014	Keynote speaker, Gsolutionz, Inc. (Carpinteria, CA) annual company meeting
Dec 2013	Panelist, ICCV Workshop on Visual Commerce
Oct 2013	Ohio State University
Jul 2013	Google (Mountain View, CA)
Apr 2013	Amazon (Seattle, WA)
Sept 2012	Proceedings of the IEEE 100th Anniversary Forum on Improving Quality of Life Through Engineering Innovations (scheduled keynote)
Aug 2012	University of Oulu, Finland
May 2012	Invited talk, HK-UST International Workshop on Embedded System Design
Apr 2012	Qualcomm Research (San Diego, CA)
Aug 2011	University of Oulu, Finland
Aug 2011	University of Tampere, Finland
Aug 2011	Nokia Innovation Center, Tampere, Finland
Apr 2011	University of Texas, Austin
Mar 2011	Keynote speaker, Infoplosion Symposium (Tokyo, Japan)
Mar 2011	University of Kyoto
Feb 2011	University of Houston
Jan 2011	University of California, Riverside
Nov 2010	Keynote speaker, 15th Ibero-American Congress on Pattern Recognition (Sao Paulo, Brazil)
Sept 2010	Keynote speaker, IEEE Fourth International Conference On Biometrics: Theory, Applications and Systems (BTAS 2010), Washington, D.C.
Jul 2010	Lecturer, Sino-USA Summer School in Vision, Learning and Pattern Recognition (Xi'an, China)
Feb 2010	University of Denver (Denver, CO)
Apr 2010	Rensselaer Polytechnic Institute (Troy, NY)

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GRANTS, CONTRACTS, AND INDUSTRY GIFTS:

2019-2022	"Robust Inside-Out Simultaneous Localization and Mapping for Environment Monitoring and Equipment Maintenance," U.S. Navy (PI), $447,845
2018-2019	"EAGER: Attention-Aware Mixed Reality Interfaces," NSF (Co-PI), $244,997
2015	Equipment gift (in-kind), Nokia Corp., OZO professional VR camera, $60,000
2015-2017	"One+ Class Support Vector Machine Learning for Interactive Object Detection," U.S. Navy, $47,000
2015-2016	"Improving Live Telecollaboration," Citrix Online, $80,000
2015	Equipment gift (in-kind), FLIR Systems, Inc.: FLIR ONE thermal infrared cameras
2014-2015	"Eye Gaze Correction for Improving Video Interaction," Citrix Online, $70,500
2014-2017	"Crowd-Sourcing the World: Scalable Methods for Dynamic Structure from Motion," NSF (PI), $477,428
2012-2015	"US-Finland Planning Visit: Transformed Social Interaction and Telecollaboration for Collaborative Learning," NSF (PI), $40,791
2012-2016	"Telecollaboration in Physical Spaces," NSF (PI), $499,970
2012-2015	"Interactive Panoramas on Google Glass," Google, Inc. Google Glass Research Awards Program, $18,000 + $4500 equipment gift (in-kind)
2011-2012	Equipment gift (in-kind), NVIDIA Research: Tegra Tablet, $1500
2009-2013	"CRI: Equipping the Allosphere, an Environment for Immersive Data Exploration," NSF (PI), $749,894
2010	Research and equipment gift funding, Nokia Corp., $9,600
2009	Equipment gift (in-kind), Nokia Corp., $11,033
2009	Equipment gift (in-kind), HRL Labs, $16,832
2009	Research gift funding, Nokia Corp., $10,000
2008-2011	Internal funding for Allosphere facility and research, UCSB (PI), $622,052
2008-2011	"MRI: Development of the Allosphere, an Immersive Instrument for Scientific Exploration," NSF (PI), $500,000
2008-2009	"Scalable Visualization and Constrained Interaction for Large Graphs – Supporting the Collaborative Analysis of High-dimensional Data Sets," NSF (Co-PI), $263,000
2006-2007	"Scalable Visualization and Constrained Interaction for Large Graphs – Supporting the Collaborative Analysis of High-dimensional Data Sets," NSF (Co-PI), $230,000
2008-2009	"Multimodal Wireless Sensor Network Infrastructure," DARPA (Key personnel), $655,174
2006-2007	"Scalable Visualization and Constrained Interaction for Large Graphs," DOD/NSF (Co-PI), $234,321
2005-2009	"A Tangible Interaction Window between Korea and the United States," Korean Institute of Science and Technology (Co-PI), $274,605
2006	"Foundations of Multimedia Research," UC Opportunity Award, $14,950
2005-2008	"Detecting and Analyzing Discontinuities in Computer Vision," NSF (PI), $328,303
2003	Microsoft unrestricted gift, $65,000
2003	"STTR Phase I: Sensors and Methods to Handle UAV," U.S. Navy Air Systems Command (PI, subcontract to Develosoft Corp.), $21,000
2003	Lawrence Livermore Laboratory UCRP Award (PI), $40,000
2003	Microsoft Research Learning Science and Technology (co-PI), $40,000
2003	Mitsubishi Equipment Gift, $650

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2003	UCSB Instructional Improvement Grant (PI), $12,150
2003	DiMI Opportunity Award (PI), $14,000
2003	Microsoft Equipment Gifts, $50,000
2003-2008	NSF, "Digital Multimedia IGERT: Graduate Training Program in Interactive Digital Multimedia" (Co-PI), $3,426,376
2002-2005	NSF, "ITR: Using Virtual Environment Technology to Understand and Augment Social Interaction" (Co-PI), $1,100,000
2002	UCSB Research Across Disciplines (Co-PI), $14,400
2002	UCSB Research Across Disciplines (Co-PI), $11,000
2001	DiMI Opportunity Award (Co-PI), $8000

TEACHING EXPERIENCE:

(* - *created new course*)

2000-2019	*Graduate courses*: Human Computer Interaction Technologies*, Computer Imaging*, Mobile Imaging*, Computer Vision, Probabilistic Models and Methods in Computer Science*, Artificial Intelligence, Multimodal Interaction on Mobile Computing Platforms* *Undergraduate courses*: Foundations of Computer Science, Computer Graphics, Artificial Intelligence*, Machine Learning, Introduction to Computer Vision, Introduction to C, C++, and Unix *Seminar courses*: Topics in Computer Vision, Human-Computer Interaction, A History of Computing*, Perceptual User Interfaces*, Visualization, Media Arts and Technology*
2012	Mobile Computer Vision course, Computer Science and Engineering Department, University of Oulu, Finland
2011	Computational Illumination course, School of Information Sciences, University of Tampere, Finland
2010	Guest lecturer, Sino-US Summer School in Vision, Learning, and Pattern Recognition (Perception, Motion, and Events), Xi'an, China
1993	Lecturer, Stanford University – Taught *Concurrent Programming* (CS140) in the Department of Computer Science, televised via the Stanford Instructional Television Network.
1990, 1991	MIT Media Lab – Co-organized and co-taught *Practical Issues in Color Processing* (4.999), lecturing on color imaging and human color vision.*
1989-90	MIT – Guest lecturer at MIT Summer Course on flight simulation.
1989-90	Graduate Tutor at "pika," an MIT undergraduate living group. Responsible for tutoring students in a variety of subjects.
1986	Created and taught *Computer Vision* course (CS-369) for the Martin Marietta Institute *
1985-86	Organized weekly computer vision seminars at Martin Marietta. Lectured on topics in vision and AI.

STUDENTS SUPERVISED:

Postdoctoral researcher supervised:

Changbo Hu (2001-2003)
Ismo Rakkolainen (2004-2006)
Jae Sik Chang (2005-2007)

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Chunghoon Kim (2007-2009)
Stefan Arisona (2007-2008)
Masahiro Toyoura (2008-2009)
Erno Makinen (2009)
Steffen Gauglitz (2014)
Julia Kuosmanen (2015)

Ph.D. Thesis Committees Chaired (in addition to 25+ M.S. committees chaired and 27+ undergraduate projects directed)**:**

UCSB Computer Science students, unless otherwise noted

Rainer Stiefelhagen (University of Karlsruhe, co-chair), 2002
Mathias Kölsch, 2004
Rogerio Feris, 2006
Ya Chang, 2006
Haiying Guan, 2007
Longbin Chen, 2010
Daniel Vaquero, 2012
Steffen Gauglitz (co-chair), 2014
Victor Fragoso, 2014
Chris Sweeney (co-chair), 2016
Kuo-Chin Lien (ECE), 2016
Domagoj Baricevic (co-chair), 2016
Dianna Han, 2017
Ben Nuernberger (co-chair), 2017
Jedrzej Kozerawski, 2021
Pushkar Shukla (TTIC), 2025

SELECT PROFESSIONAL ACTIVITIES AND SERVICE:

Academic advisory boards and external reviews:

Member, International Advisory Board, Idiap Research Institute, Martigny, Switzerland (2021-present)
Member, Advisory Board, CHIL (Computers in the Human Interaction Loop) Program, University of Karlsruhe (2005)
Member, Traumatic Brain Injury Resource Optimization Center Advisory Board (2008-2018)
Member, Project Career Advisory Board, National Institute on Disability and Rehabilitation Research (NIDDR) Field Initiated Program research study on Cognitive Support Technologies for Traumatic Brain Injury, (2014-2018)
External Reviewer, University of Toronto Department of Computer Science (2022)
External Reviewer, John Hopkins University Department of Computer Science and Engineering (2021)
External Reviewer, Virginia Tech Center for Human Computer Interaction (2017)
Member, External Review Committee for Korean Institute of Science and Technology (2009)
Member, DARPA IXO Immersive Operations Planning Panel (2006-2007)
Member, NSF Committee of Visitors for CISE-IIS (2005)

Journal editorships, conference board positions, professional society positions, key service:

Member, CRA Computing Community Consortium (CCC) (2022-2025)
Founding Associate Editor, ACM Transactions on Interactive Intelligent Systems (2009-present)

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Chair, Editor-in-Chief Search Committee, ACM Transactions on Interactive Intelligent Systems (2015)
Associate Editor, Journal of Image and Vision Computing (2006-2019)
Associate Editor, International Journal of Computer Vision and Signal Processing (2011-present)
Guest Editor, Special Issue on Behavior Understanding for Arts and Entertainment, ACM Transactions on Interactive Intelligent Systems (TiiS) (2015)
Guest Editor, Special Issue on Machine Learning for Vision Based Motion Analysis, Journal of Image and Vision Computing (2012)
Guest Editor, Special Issue on Real-World Face Recognition, IEEE Transactions on Pattern Analysis and Machine Intelligence (PAMI) (2011)
Guest Editor, Special Issue on Mobile Computer Vision, International Journal of Computer Vision (2011)
Chair, ICMI Steering Committee (2006-2009)
Member, ACM ICMI Steering Committee (2003-2015)
Member, ACM ICMI Advisory Committee (2024-pres.)
Chair, IEEE PAMI-TC Open Access Committee (2013)
Member, Advisory Board, IEEE International Conference on Imaging, Vision, & Pattern Recognition (2016-present)
Member, STEAM Advisory Council, MOXI: The Wolf Museum of Exploration and Innovation, Santa Barbara, CA (2012-2016)
Member, IEEE Automatic Face and Gesture Recognition Steering Committee (2011-2015)
Member, IEEE International Conference on Social Computing Steering Committee (2010-2015)
Member, ACM Transactions on Interactive Intelligent Systems (TiiS) Best Article Award Committee (2015)
Member, Maria Petrou Prize Committee, International Association for Pattern Recognition (2022-2028)

Key organizing committee positions:
IEEE Conference on Computer Vision and Pattern Recognition (CVPR) (General Chair 2014, Area Chair 2001, 2007, 2009, 2012, 2017, 2019, 2022, 2026)
International Conference on Computer Vision (ICCV) (Area Chair 2019, 2021, 2025)
IEEE Winter Conference on Applications of Computer Vision (WACV) (Program Chair 2017, Area Chair 2005, 2024, Best Paper Award Committee 2023)
International Conference on Informatics, Electronics & Vision (General Chair 2012, 2013, 2014, 2015, 2016, 2019, 2021, 2023)
IEEE Conference on Automatic Face and Gesture Recognition (General Chair 2011, Special Session Chair 2008, 2013, Test of Time Award Committee 2013, Best Paper Award Committee 2023, Area Chair 2025)
ACM Conference on Multimedia (General Chair 2006)
International Conference on Multimodal Interfaces (ICMI) (General Chair 2008, 2019, Paper Awards Committee Chair 2007, 2008, 2014, Program Chair 2004, Area Chair 2005, 2006, Publicity Chair 2010, Awards Committee 2007, 2008, 2014, 2016, 2025)
ACM CHI (Area Chair 2001, Area Chair 2013, Associate Chair for CHI Notes 2006)
IEEE Workshop on Analysis and Modeling of Faces and Gestures (AMFG) (General Chair 2013, 2018, Honorary Chair 2021)
IEEE Workshop on Recognizing Families In the Wild (RFIW) (Honorary Chair 2020)
ACM Conference on Intelligent User Interfaces (IUI) (Senior Program Committee 2018)
IEEE Workshop on CVPR for Human Communicative Behavior Analysis (2008, 2009, 2010, 2011)

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IEEE Workshop on Machine Learning for Vision-Based Motion Analysis (2011)
Workshop on Media Arts, Science, and Technology (2009)
Workshop on Perceptive User Interfaces (2001)
Workshop on Multimodal User Authentication (2003, 2006)
DiMI Workshop on Perceptive Animated Interfaces (2003)
NSF Virtual Human Workshop (2004)
Award Committee, Outstanding Young Researcher in Automatic Human Behaviour Analysis (2011)
Member, ACM SIGIR Best Papers Committee (2004)

UNIVERSITY SERVICE AT UC SANTA BARBARA:

Campus and UC Level Service

2018-2019 Proposing team and advisory board, Mellichamp Academic Initiative for Mind and Machine Intelligence
2017-2019 Faculty Grievance Advisor to the Committee on Privilege and Tenure
2017 Judge, Grad Slam Competition
2016-2019 Faculty Advisor, UCSB Machine Learning Club
2015 Advisor, TMP New Venture Competition Finalist Team
2014-2019 Affiliate, Center for Digital Games Research
2013-2019 Member, Executive Council, SAGE Center for the Study of the Mind
2011-2015 Member, Committee on Privilege and Tenure
2009-2019 Member, Steering Committee, Center for Information Technology and Society (CITS)
2009-2019 Member, Steering Committee, Cognitive Science Program
2008-2019 Member, Executive Committee, Center for Spatial Studies
2007-2009 Member, Council on Planning and Budget
2006-2010 Member, CNSI Administrative Committee
2006-2009 UCSB Representative, IUCRP Digital Media Executive Committee
2006 Member, Academic Personnel Ad Hoc Committee
2005-2008 Member, College of Engineering Administrative Committee
2004-2008 Founding Member, Transliteracies Project
2002-2005 Member, Central Fellowships Committee
2002 Member, Dissertation Awards Committee
2001-2004 Member, Graduate Council

Primary Department Level Service

2017-2019 Chair, Department of Computer Science
2016-2017 Chair, CS Faculty Recruiting Committee
2013 Chair, CS Business Officer Search Committee
2012-2013 Chair, MAT Graduate Admissions Committee
2011-2019 Chair, CS Public Relations Committee
2009-2010 Chair, MAT Academic Program Review Committee
2007-2009 Chair, MAT Faculty Search Committee
2006-2010 Chair, MAT Curriculum Committee
2005-2010 Chair, MAT Web and Public Relations Committee
2005-2010 Chair, Media Arts and Technology Graduate Program
2005-2010 Chair, MAT Graduate Program

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2005 Vice Chair, Media Arts and Technology Graduate Program
2004-2006 Chair, MAT By-Laws Committee
2003-2007 Co-Chair, MAT Colloquium Series Committee
2003-2005 CS Graduate Advisor
2003-2005 Chair, CS Graduate Affairs and Advising Committee
2001-2002 Chair, MAT Graduate Admissions Committee
2000-2001 Chair, CS External Relations Committee

CONSULTING (selected):

2017-pres. Clear Protocol, Inc. (Healthcare IT company)
Advisor
2010-pres. Various patent-related and other litigation-related consulting engagements
2016-2018 PTC, Inc. (San Diego, CA)
Technical consulting on augmented reality for remote collaboration
2013-2018 Kent State University
NIDRR Project Career – Development of technology to support the transition of students with traumatic brain injuries from postsecondary education to employment
2011-2013 3DiVi Inc. (Chelyabinsk, Russia) – 3D gesture recognition
2011-2012 InTouch Health, Inc. – Computer vision
2009 Scholastic, Inc.
2007 I2R, Singapore
2006 Capstone Press for Inventions and Discovery
2005 National ICT Australia (NICTA), Sydney, Australia
2004 Biometrics Engineering Research Center, Yonsei University (Korea)
2004 Korea Institute of Science and Technology (KIST), Seoul, Korea
2004 Samsung Corporation (Korea)
2001 Toyon Corporation (Santa Barbara)

PATENTS:

2016 U.S. Patent #9,495,761 – "Environment Mapping with Automatic Motion Model Selection," with S. Gauglitz, C. Sweeney, J. Ventura, and T. Höllerer
2004 U.S. Patent #6,674,877 – "System and method for visually tracking occluded objects in real time," with N. Jojic
1999 German Patent DE69,130,616, "A Face Recognition System," with A. Pentland
1992 US Patent #5,164,992: "A Face Recognition System," with A. Pentland

OPEN SOURCE SOFTWARE, DATA SETS:

2015 Theia: A Fast and Scalable Structure-from-Motion Library, available at http://www.theia-sfm.org/
Winner, ACM Multimedia Open Source Software Competition (C. Sweeney, T. Höllerer, M. Turk)
2010 Visual tracking dataset with ground truth, available at http://ilab.cs.ucsb.edu/index.php/datasets
2009 Partial shape matching source code, available at

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https://code.google.com/p/shapematching/source/list

2004 "The HandVu Vision-Based Hand Gesture Interface," available at http://www.movesinstitute.org/~kolsch/HandVu

PEER-REVIEWED DEMONSTRATIONS:

2014 "World-Stabilized Annotations and Virtual Scene Navigation for Remote Collaboration," S. Gauglitz, B. Nuernberger, M. Turk, and T. Höllerer, ACM Conference on User Interface Software and Technology (UIST), Honolulu, HI, October 2014.

2012 "A Prototype Setup to Integrate the Physical Environment into Mobile Remote Collaboration," S. Gauglitz, C. Lee, M. Turk, and T. Höllerer, MobileHCI, San Francisco, September 2012.

2005 "Depth Edges in Real Time using Multi-Flash Camera," A. Agrawal, V. Branzoi, R. Chellappa, R. Feris, R. Raskar, K. Tan, and M. Turk, CVPR, New York, 2005.

2004 "HandVu – Vision-Based Hand Gesture Recognition," M. Kölsch, M. Turk, and T. Höllerer), ISMAR '04, Arlington, VA, Oct 31-Nov 5, 2004

CO-AUTHORED REPORTS for the CRA Computing Community Consortium (CCC) Council:

Jensen, D., Danks, D., Elbaum, S., Regli, W., Turk, M., Wierman, A., Yanco, H., Maher, M., Griffin, H., *CCC White Paper: Envisioning Possible Futures for AI Research,* July 2025.

A. Aiken, G. Allen, O. Daescu, D. Danks, S. Elbaum, R. Ghani, C. Gill, W. Gropp, D. Jensen, M. Lin, B. Mosley, M. Parashar, R. Rajaraman, W. Regli, E. Schooler, S. Shekhar, R. Sloan, M. Taufer, M. Turk, H. Wright, H. Yanco, *CRA's Response to the Request for Information on the Development of an Artificial Intelligence (AI) Action Plan*, March 2025.

M Taufer, R. Mihalcea, M. Turk, D. Lopresti, A. Wierman, K. Butler, S. Koenig, D. Danks, W. Gropp, M. Parashar, Y. Gil, W. Regli, R. Rajaraman, D. Jensen, N. Bliss, M.L. Maher, *CCC Quad Paper: Now More Than Ever, Foundational AI Research and Infrastructure Depends on the Federal Government*, 2025.

R. Mihalcea, N. Andalibi, D. Jensen, M. Turk, P. Wisniewski, H. Yanco, *CCC Quad Paper: Which Humans? Inclusivity and Representation in Human-Centered AI*, 2025.

D. Danks, C. Gill, I. Foster, W. Gropp, D. Lopresti, M. Parashar, M. Turk, K. Yelick, *CCC's Response to the Notice of Request for Information (RFI) on Frontiers in AI for Science, Security, and Technology (FASST) Initiative*, November 2024.

D. Danks, C. Gill, M. Lin, D. Lopresti, M. Parashar, W. Regli, M. Turk, *CCC's Response to the Request for Comments on the U.S. Artificial Intelligence Safety Institute's Draft Document: Managing Misuse Risk for Dual-Use Foundation Models*, September 2024.

A. Aiken, N. Bliss, D. Danks, C. Gill, D. Jensen, D. Lopresti, M.L. Maher, C. Moore, W. Regli, M. Turk, *CCC's Response to the Defense Industrial Base Adoption of Artificial Intelligence for Defense Applications*, July 2024.

A. Aiken, N. Bliss, D. Danks, C. Gill, D. Jensen, D. Lopresti, M.L. Maher, C. Moore, W. Regli, M. Turk, *CCC's Response to the Defense Industrial Base Adoption of Artificial Intelligence for Defense Applications; Notice of Availability*, July 2024.

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Bliss, N., Butler, K., Danks, D., Topcu, U., Turk, M., *CCC White Paper: Addressing the Unforeseen Harms of Technology*, June 2024.

N. Bliss, K. Butler, D. Danks, S. Forrest, C. Gill, D. Lopresti, M.L. Maher, H. Mentis, C. Moore, S. Shekhar, A. Stent, M. Turk., *CCC's Response to the National Institute of Justice's Request for Input on Section 7.1(b) of Executive Order 14110, "Safe, Secure, and Trustworthy Development and Use of Artificial Intelligence,"* May 2024.

D. Danks, C. Gill, D. Lopresti, R. Rajaraman, M. Taufer, Ufuk Topcu, M. Turk, H. Yanco, *CCC's Response to the Request for Information (RFI) Related to NIST's Assignments Under Sections 4.1, 4.5 and 11 of the Executive Order Concerning Artificial Intelligence*, February 2024.

D. Danks, H. Griffin, D. Jensen, C. Krintz, D. Lopresti, R. Rajaraman, M. Turk, H. Yanco, *CCC's Response to the Office of Management and Budget's Request for Comments on Advancing Governance, Innovation, and Risk Management for Agency Use of Artificial Intelligence Draft Memorandum*, December 2023.

M. Gini, M. Hunter, S. Koenig, D. Lopresti, R. Rajaraman, U. Topcu, M. Turk, H. Yanco, *CCC's Response to PCAST Working Group on Generative AI Invites Public Input*, July 2023.

J. Biddle, E. Bradley, D. Danks, M. Gini, A. Goel, A. Guha, M. Hunter, D. Jensen, S. Koenig, C. Krintz, D. Lopresti, A. McGovern, D. Molzahn, R. Rajaraman, A. Singh, M. Turk, H. Yanco, *CCC's Response to RFI on National Priorities for Artificial Intelligence*, July 2023.

D. Lopresti, M. Turk, A. Schwartz, and C. Gill, *CCC's Response to RFI on Federal Video and Image Analytics Research and Development Action Plan,* September 2022.

REFEREED PUBLICATIONS and BOOKS:

P. Shukla, A. Chinchure, E. Diana, K. Hosanagar, A. Tolbert, and M. Turk, "Mitigate One, Skew Another? Tackling Intersectional Biases in Text-to-Image Models," Findings of the Association for Computational Linguistics: EMNLP 2025, November 2025.

C. Moore, C. Gill, N. Bliss, K. Butler, S. Forrest, D. Lopresti, M.L. Maher, H. Mentis, S. Shekhar, A. Stent, and M. Turk, "Concerning the Responsible Use of AI in the U.S. Criminal Justice System," Communications of the ACM, September 2025.

A. Chinchure, P. Shukla, G. Bhatt, K. Salij, K. Hosanagar, L. Sigal, and M. Turk, "TIBET: Identifying and Evaluating Biases in Text-to-Image Generative Models," European Conference on Computer Vision (ECCV), October 2024.

Md. A. R. Ahad, U. Mahbub, M. Turk, and R. Hartley (editors), Computer Vision: Challenges, Trends, and Opportunities, Chapman and Hall / CRC Press, 2024.

Y. Gizatdinova, O. Špakov, O. Tuisku, M. Turk, and V. Surakka, "Vision-based interfaces for character-based text entry: comparison of errors and error correction properties of eye typing and head typing," Advances in Human-Computer Interaction, Hindawi, June 2023.

P. Shukla, S. Bharati, and M. Turk, "CAVLI – Using image associations to produce local concept-based explanations," CVPR Workshop on Explainable AI for Computer Vision (XAI4CV), June 2023.

E.R. Davies and M. Turk (editors), Advanced Methods and Deep Learning in Computer Vision, Elsevier 2021.

J. Robinson, C. Qin, M. Shao, M. Turk, R. Chellappa, and Y. Fu, "Recognizing Families In the Wild

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(RFIW): The 5th Edition," IEEE Conference on Automatic Face and Gesture Recognition, December 2021.

J. Kozerawski, V. Fragoso, N. Karianakis, G. Mittal, M. Turk, and M. Chen, "BLT: Balancing Long-Tailed Datasets with Adversarially-Perturbed Images," Asian Conference on Computer Vision (ACCV), Nov-Dec 2020.

J. Robinson, Y. Yin, Z. Khan, M. Shao, S. Xia, M. Stopa, S. Timoner, M. Turk, R. Chellappa, and Y. Fu, "Recognizing Families In the Wild (RFIW): The 4th Edition," IEEE Conference on Automatic Face and Gesture Recognition, November 2020.M. Turk and V. Athitsos, "Gesture recognition," in Computer Vision: A Reference Guide, Springer 2019.

Y. Ding, B. Huynh, A. Xu, T. Bullock, H. Cecotti, M. Turk, B. Giesbrecht, and T. Höllerer, "Multimodal classification of EEG during physical activity," International Conference on Multimodal Interfaces (ICMI), Suzhou, China, October 2019.

P. Shukla, C. Elmadjian, R. Sharan, V. Kulkarni, M. Turk, and W. Y. Wang, "What should I ask? Using conversationally informative rewards for goal-oriented visual dialog," Association for Computational Linguistics (ACL), Florence, Italy, July-August 2019.

B. Nuernberger, T. Höllerer, and M. Turk, "Hybrid orbiting-to-photos in 3D reconstructed visual reality," ACM Symposium on Virtual Reality Software and Technology (VRST), Tokyo, Japan, November 2018.

I. Rakkolainen, R. Raisamo, M. Turk, and T. Höllerer, "Illumination for 360 degree cameras" (poster), ACM Symposium on Virtual Reality Software and Technology (VRST), Tokyo, Japan, November 2018.

Y. Gizatdinova, O. Špakov, O. Tuisku, M. Turk, and V. Surakka, "Gaze and head pointing for hands-free text entry: applicability to ultra-small virtual keyboards," ACM Symposium on Eye Tracking Research & Applications (ETRA), Warsaw, Poland, June 2018.

P. Shukla, H. Sadana, A. Bansal, D. Verma, C. Elmadjian, B. Raman, and M. Turk, "Automatic cricket highlight generation using event-driven and excitement-based features," 4th International Workshop on Computer Vision in Sports (CVsports), Salt Lake City, June 2018.

J. Kozerawski and M. Turk, "CLEAR: Cumulative LEARning for One-Shot One-Class Image Recognition," IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR), Salt Lake City, June 2018.

B. Nuernberger, M. Turk, and T. Höllerer, "Evaluating snapping-to-photos virtual travel interfaces for 3D reconstructed visual reality," ACM Symposium on Virtual Reality Software and Technology (VRST), Gothenburg, Sweden, November 2017.

V. Fragoso, C. Sweeney, P. Sen, and M. Turk. "ANSAC: Adaptive Non-Minimal Sample and Consensus," British Machine Vision Conference (BMVC), London, September 2017.

I. Rakkolainen, R. Raisamo, M. Turk, and T. Höllerer, "Field-of-View Extension for VR Viewers," Mindtrek 2017: 21th International Technology Conference, Tampere, Finland, September 2017.

D. Baričević, T. Höllerer, P. Sen, and M. Turk, "User-perspective AR magic lens from gradient-based IBR and semi-dense stereo," IEEE Transactions on Visualization and Computer Graphics, Vol. 23, Issue 7, pp. 1838-1851, 2017.

I. Rakkolainen, R. Raisamo, M. Turk, and T. Höllerer, "Extreme field-of-view for head-mounted displays," 3DTV Conference (3DTV-CON), Copenhagen, Denmark, June 2017.

D. Baričević, T. Höllerer, and M. Turk, "Densification of semi-dense reconstructions for novel view

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generation of live scenes," IEEE Winter Conference on Applications of Computer Vision (WACV), Santa Rosa, CA, March 2017.

I. Rakkolainen, M. Turk, and T. Höllerer, "A superwide-FOV optical design for head-mounted displays," International Conference on Artificial Reality and Telexistence / European Symposium on Virtual Environments (ICAT-EGVE), Little Rock, AR, December 2016.

D. Baričević, T. Höllerer, P. Sen, and M. Turk, "User-perspective AR magic lens from gradient-based IBR and semi-dense stereo," IEEE Transactions on Visualization and Computer Graphics, Vol. 23, Issue 7, pp. 1838-1851, 2017.

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