

Declaration of Jeremy Cooperstock, Ph.D. in Support of
Petition for *Inter Partes* Review of
U.S. Patent No. 12,019,791 B2

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

META PLATFORMS, INC.
Petitioner

v.

MULLEN INDUSTRIES LLC
Patent Owner

Case IPR2025-00744
U.S. Patent No. 12,019,791 B2
Issue Date: June 25, 2024

Title: AUGMENTED REALITY VIDEO GAME SYSTEMS

DECLARATION OF JEREMY COOPERSTOCK, PH.D.

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I, Jeremy Cooperstock, Ph.D., declare as follows:

I. INTRODUCTION AND QUALIFICATIONS

A. Qualifications and Experience

1. I am an expert in the field of interactive computing systems, including virtual and augmented reality systems, as well as mobile and wearable technologies. I have studied, taught, practiced, and researched the design of such interactive computing technologies for over 30 years, and I have been leading research and development activities pertaining to hardware and software designs for interactive virtual and augmented reality computing systems since at least 2007.

2. I have summarized in this section my educational background, work experience, and other relevant qualifications, as reflected in my curriculum vitae, attached to this declaration as **Appendix A**.

3. I earned a Bachelor of Applied Science (B.A.Sc) degree in Electrical Engineering (Computer Engineering Option) with Honors from the University of British Columbia in 1990, a Master of Science (M.Sc.) degree in Computer Science from the University of Toronto in 1992, and a Doctor of Philosophy (Ph.D.) degree in Electrical and Computer Engineering from the University of Toronto in 1996. My dissertation on “Reactive Environments and Augmented Media Spaces” was nominated by the University of Toronto for the Natural Sciences and Engineering Research Council (NSERC) Doctoral Dissertation Award.

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4. From 1987 to 1988, I worked at IBM Research on very large scale integration (VLSI) circuit simulation, and in 1989, I worked at the IBM T.J. Watson Research Center on very long instruction word (VLIW) simulation. In 1990, I worked at Fibronics Research to develop and test an FDDI-to-token ring bridge for network communication.

5. After obtaining my Doctorate degree, I carried out research and development work at the Sony Computer Science Laboratory in Tokyo, Japan from 1996 to 1997, working in part on “smart” consumer electronics.

6. I have been employed at McGill University since November 1997, where I am currently a Full Professor in the Department of Electrical and Computer Engineering, and recently, the endowed Werner Graupe Distinguished Chair in Automation Engineering.

7. I am a member of the Centre for Intelligent Machines, a founding member of the Centre for Interdisciplinary Research in Music Media and Technology, a member of the International Laboratory on Learning System, a member of the McGill Institute for Aerospace Engineering, and an associate member of Biomedical Engineering at McGill University.

8. In this capacity, I conduct and supervise research activities, directing a group of approximately 50 researchers at the Shared Reality Lab, which focuses on computer mediation to facilitate high-fidelity human communication and the

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synthesis of perceptually engaging, multimodal, immersive environments. Over the span of my academic career, I have supervised more than 100 graduate students and post-doctoral fellows, and approximately 250 undergraduate research students.

9. I have also developed and continue to teach courses on human-computer interaction, artificial intelligence, embedded systems, haptic interaction design, computer architecture, and operating systems.

10. I led the development and demonstrations of the world's first high-fidelity multichannel audio streaming system over the Internet in 1999 and 2000, recognized by a Distinction Award from the Audio Engineering Society, and followed in 2005 by simultaneous low-latency transmission of multiple streams of uncompressed high-definition video as part of the McGill Ultra-Videoconferencing system. This work was recognized by an award for Most Innovative Use of New Technology from the Association for Computing Machinery (ACM) and the Institute of Electrical and Electronics Engineers (IEEE) Supercomputing.

11. Among other projects, I led the development and supported ongoing use of a semi-automated classroom environment (the "Intelligent Classroom"), a high-fidelity orchestra rehearsal simulator ("Open Orchestra,"), a simulation environment that renders graphic, audio, and vibrotactile effects in response to footsteps ("Natural Interactive Walking"), and a mobile game treatment for amblyopia that was licensed to Novartis.

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12. The research and development I supervised on the Autour project earned the Hochhausen Research Award from the Canadian National Institute for the Blind and an Impact Award from the Canadian Internet Registry Association. My Real-Time Emergency Response project won the Gold Prize (brainstorm round) of the Mozilla Ignite Challenge. I have carried out significant research involving design and implementation of haptic feedback systems, virtual and augmented reality, and mobile computing applications. My research experience includes design of systems employing virtual and augmented reality devices for simulation, training, gaming, distributed performance, and medical applications, as well as the use of various sensor technologies including GPS, WiFi and Bluetooth, and inertial measurement units (IMUs) for tracking position and orientation of a user.

13. My research activities are funded by industry contracts, collaboration programs, and government grants. In the past 5 years, I have obtained grants and contracts for my research program of approximately three million dollars.

14. I led the theme of Enabling Technologies for a Networks of Centres of Excellence on Graphics, Animation, and New Media (GRAND), and chaired the Technical Committee on Network Audio Systems. Among other visiting academic appointments, I was a visiting professor at Bang & Olufsen, Denmark, where I conducted research on telepresence technologies as part of the World Opera Project.

15. I have authored and co-authored more than 200 journal articles and

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peer-reviewed conference proceedings papers, mostly concerning human-computer interaction and applications of these technologies. Eight of my publications were finalists or winners of “best paper”, “honorable mention”, and similar awards from scholarly societies. A complete list of my publications is contained in my curriculum vitae.

16. My professional affiliations include services in various professional organizations and serving as a reviewer for a number of technical publications, journals, and conferences, which are listed in my curriculum vitae. I served as an Associate Editor of the Journal of the Audio Engineering Society, and presently serve as Associate Editor in Chief for the IEEE Transactions on Haptics, and Associate Editor for the Frontiers in Virtual Reality.

17. I have also served as an expert in numerous legal proceedings, both on behalf of patent owners and petitioners, including proceedings involving industrial design, hardware architecture, and firmware of wearable technologies. A list of cases in which I have provided written declarations, testified at trial or by deposition is provided in my curriculum vitae.

18. My experience in academic and practical situations as well as my hands-on experience with hardware and software related to virtual and augmented reality systems, provides me with an appreciation of, and expertise in, the technology involved with U.S. Patent No. 12,019,791 B2.

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19. I have been retained by counsel for Petitioner to provide my expert opinion in connection with the above-captioned proceeding as set forth herein. I am being compensated for my work in this case at my standard consulting rate. This compensation is not contingent upon my performance, the outcome of this case, or any issues involved in or related to this case. I have no financial interest in this matter.

B. Materials Considered

20. The analysis that I provide in this Declaration is based on my education, research, and experience, as well as the documents I have considered. In forming my opinions, I have read and considered U.S. Patent No. 12,019,791 B2 (“791 patent”) (**EX1001**) and its prosecution history. I have cited to the following documents in my analysis below:

Exhibit No.	Description of Document
1001	U.S. Patent No. 12,019,791 B2 to Jeffrey David Mullen (filed January 4, 2022, issued June 25, 2024) (“791” or “791 patent”)
1003	U.S. Patent App. Pub. No. 2004/0104934 A1 to Jan G. Fager (filed Feb. 7, 2002; published Jun. 3, 2004) (“Fager”)
1004	U.S. Patent App. Pub. No. 2003/0179218 A1 to Fernando C. M. Martins (filed Mar. 22, 2002; published Sep. 25, 2003) (“Martins”)
1005	U.S. Patent No. 6,411,266 B1 to Francis J. Maguire, Jr. (filed Nov. 17, 1995; issued Jun. 25, 2002) (“Maguire”)

Exhibit No.	Description of Document
1006	Masayuki Kanbara et al., “A stereoscopic video see-through augmented reality system based on real-time vision-based registration,” in Proceedings IEEE Virtual Reality 2000 (2000) (“ Kanbara ”)

II. PERSON OF ORDINARY SKILL IN THE ART

21. I understand that, under the patent laws in effect before the America Invents Act (“AIA”) of 2011, an assessment of claims of a patent filed before the AIA took effect should be undertaken from the perspective of a person of ordinary skill in the art as of the earliest claimed priority date (i.e., the “time the invention was made”). I have preliminarily for purposes of my Declaration only assumed that date to be October 11, 2007, the filing date of the earliest application to which the ’791 patent claims priority (provisional application no. 60/979,379).¹

¹ I express no opinion on whether the ’791 patent is actually entitled to the benefit of the provisional application to which it claims priority (60/979,379). This issue is not relevant here because all of the prior art references relied upon predate that date. In the event entitlement to the provisional filing date may later become relevant, for example based on arguments later presented by Patent Owner, I reserve my right to provide opinions on that issue at that time.

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22. I have also been advised that to determine the appropriate level of a person having ordinary skill in the art, the following factors may be considered: (1) the types of problems encountered by those working in the field and prior art solutions thereto; (2) the sophistication of the technology in question, and the rapidity with which innovations occur in the field; (3) the educational level of active workers in the field; and (4) the educational level of the inventor.

23. The '791 patent states that it “relates to augmented reality.” ('791, 1:19.) The patent states that it provides “[a]ugmented reality video game systems” where “[v]ideo game indicia may be perceived to be located in a user’s physical environment through virtual indicia that are placed on a head-mounted display.” ('791, 1:23-26.)

24. In my opinion, a person of ordinary skill in the art as of October 2007 would have possessed a bachelor’s degree in electrical engineering, computer science, or similar field, with two years combined experience in designing and/or developing interactive location-based computer systems/software, such as video games or other simulations incorporating location information (such as GPS information associated with a user’s physical location), and in designing and/or developing computer systems/software involving graphical virtual and/or augmented reality. A person could also have qualified as a person of ordinary skill in the art with some combination of (1) more formal education (such as a master’s

of science degree) and less technical experience, or (2) less formal education and more technical or professional experience.

25. My opinions regarding the level of ordinary skill in the art are based on, among other things, my experience in the fields of computer science and engineering, my understanding of the basic qualifications that would be relevant to an engineer or scientist tasked with investigating methods and systems in the relevant area, and my familiarity with the backgrounds of colleagues and students, both past and present.

26. Although my qualifications and experience exceed those of the hypothetical person having ordinary skill in the art defined above, my analysis and opinions regarding the '791 patent have been based on the perspective of a person of ordinary skill in the art as of October 2007.

III. STATEMENT OF LEGAL PRINCIPLES

A. Claim Construction

27. I understand that a purpose of claim construction is to determine what a person of ordinary skill in the art would have understood the claim terms to mean. Claim terms are generally given their ordinary and customary meaning, which is the meaning that the term would have to a person of ordinary skill in the art in question as of the effective filing date.

28. I understand that the person of ordinary skill in the art is deemed to read

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the claim term not only in the context of the particular claim in which the disputed term appears, but in the context of the entire patent, including the specification. I understand that the patent specification, under the legal principles, has been described as the single best guide to the meaning of a claim term, and is thus highly relevant to the interpretation of claim terms. And I understand for terms that do not have a customary meaning within the art, the specification usually supplies the best context of understanding the meaning of those terms.

29. I further understand that other claims of the patent in question, both asserted and unasserted, can be valuable sources of information as to the meaning of a claim term. Because the claim terms are normally used consistently throughout the patent, the usage of a term in one claim can often illuminate the meaning of the same term in other claims. Differences among claims can also be a useful guide in understanding the meaning of particular claim terms.

30. I understand that the prosecution history can further inform the meaning of the claim language by demonstrating how the inventors understood the invention and whether the inventors limited the invention in the course of prosecution, making the claim scope narrower than it otherwise would be. Extrinsic evidence, such as dictionaries, may also be consulted in construing the claim terms.

31. I understand that, in *Inter Partes* Review (IPR) proceedings, a claim of a patent shall be construed using the same claim construction standard that would be

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used to construe the claim in a civil action filed in a U.S. district court (which I understand is called the “*Phillips*” claim construction standard), including construing the claim in accordance with the ordinary and customary meaning of such claim as understood by one of ordinary skill in the art and the prosecution history pertaining to the patent.

32. I have been instructed by counsel to apply the “*Phillips*” claim construction standard for purposes of interpreting the claims in this proceeding, to the extent they require an explicit construction. The description of the legal principles set forth above thus provides my understanding of the “*Phillips*” standard as provided to me by counsel.

33. For purposes of my analysis here, I do not believe express claim constructions are necessary because the prior art renders the claims obvious under any reasonable construction.

B. Obviousness (§ 103)

34. I understand that a patent claim is obvious if, as of the effective filing date, it would have been obvious to a person having ordinary skill in the field of the technology (the “art”) to which the claimed subject matter belongs.

35. I understand that the following factors should be considered in analyzing obviousness: (1) the scope and content of the prior art; (2) the differences between the prior art and the claims; and (3) the level of ordinary skill in the pertinent

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art. I also understand that certain other facts known as “secondary considerations” such as commercial success, unexplained results, long felt but unsolved need, industry acclaim, simultaneous invention, copying by others, skepticism by experts in the field, and failure of others may be utilized as indicia of nonobviousness. I understand, however, that secondary considerations should be connected, or have a “nexus,” with the invention claimed in the patent at issue.

36. I understand that a reference qualifies as prior art for obviousness purposes when it is analogous to the claimed invention. The test for determining what art is analogous is: (1) whether the art is from the same field of endeavor, regardless of the problem addressed, and (2) if the reference is not within the field of the inventor’s endeavor, whether the reference still is reasonably pertinent to the particular problem with which the inventor is involved.

37. I understand that a person of ordinary skill in the art is assumed to have knowledge of all prior art. I understand that one skilled in the art can combine various prior art references based on the teachings of those prior art references, the general knowledge present in the art, or common sense. I understand that a motivation to combine references may be implicit in the prior art, and there is no requirement that there be an actual or explicit teaching to combine two references. Thus, one may take into account the inferences and creative steps that a person of ordinary skill in the art would employ to combine the known elements in the prior

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art in the manner claimed by the patent at issue. I understand that one should avoid “hindsight bias” and *ex post* reasoning in performing an obviousness analysis. But this does not mean that a person of ordinary skill in the art for purposes of the obviousness inquiry does not have recourse to common sense.

38. I understand that when determining whether a patent claim is obvious in light of the prior art, neither the particular motivation for the patent nor the stated purpose of the patentee is controlling. The primary inquiry has to do with the objective reach of the claims, and that if those claims extend to something that is obvious, then the entire patent claim is invalid.

39. I understand one way that a patent can be found obvious is if there existed at the time of the invention a known problem for which there was an obvious solution encompassed by the patent’s claims. I understand that a motivation to combine various prior art references to solve a particular problem may come from a variety of sources, including market demand or scientific literature. I understand that a need or problem known in the field at the time of the invention can also provide a reason to combine prior art references and render a patent claim invalid for obviousness. I understand that familiar items may have obvious uses beyond their primary purpose, and that a person of ordinary skill in the art will be able to fit the teachings of multiple prior art references together like the pieces of a puzzle. I understand that a person of ordinary skill is also a person of at least ordinary

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creativity. I understand when there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions, a person of ordinary skill has good reason to pursue the known options within his or her technical grasp. If this finite number of predictable solutions leads to the anticipated success, I understand that the invention is likely the product of ordinary skill and common sense, and not of any sort of innovation. I understand that the fact that a combination was obvious to try might also show that it was obvious, and hence invalid, under the patent laws. I understand that if a patent claims a combination of familiar elements according to known methods, the combination is likely to be obvious when it does no more than yield predictable results. Thus, if a person of ordinary skill in the art can implement a predictable variation, an invention is likely obvious. I understand that combining embodiments disclosed near each other in a prior art reference would not ordinarily require a leap of inventiveness.

40. I understand that obviousness may be shown by demonstrating that it would have been obvious to modify what is taught in a single piece of prior art to create the patented invention. Obviousness may also be shown by demonstrating that it would have been obvious to combine the teachings of more than one item of prior art. I understand that a claimed invention may be obvious if some teaching, suggestion, or motivation exists that would have led a person of ordinary skill in the art to combine the invalidating references. I also understand that this suggestion or

motivation may come from the knowledge of a person having ordinary skill in the art, or from sources such as explicit statements in the prior art. I understand that when there is a design need or market pressure, and there are a finite number of predictable solutions, a person of ordinary skill may be motivated to apply common sense and his skill to combine the known options in order to solve the problem.

41. I understand the following are examples of approaches and rationales that may be considered in determining whether a piece of prior art could have been combined with other prior art or with other information within the knowledge of a person having ordinary skill in the art:

- (1) Some teaching, motivation, or suggestion in the prior art that would have led a person of ordinary skill to modify the prior art reference or to combine prior art reference teachings to arrive at the claimed invention;
- (2) Known work in one field of endeavor may prompt variations of it for use in the same field or a different field based on design incentives or other market forces if the variations would have been predictable to a person of ordinary skill in the art;
- (3) Combining prior art elements according to known methods to yield predictable results;
- (4) Applying a known technique to a known device, method, or product ready for improvement to yield predictable results;

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- (5) Applying a technique or approach that would have been “obvious to try” (choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success);
- (6) Simple substitution of one known element for another to obtain predictable results; or
- (7) Use of a known technique to improve similar products, devices, or methods in the same way.

42. I understand that, when determining whether a claimed combination is obvious, the correct analysis is not whether one of ordinary skill in the art, writing on a blank slate, would have chosen the particular combination of elements described in the claim. Instead, I understand the correct analysis considers whether one of ordinary skill, facing the wide range of needs created by developments in the field of endeavor, would have seen a benefit to selecting the combination claimed.

43. I understand that the test for obviousness is not whether the features of a secondary reference may be bodily incorporated into the structure of the primary reference. The test for obviousness, in other words, is not whether the references could be physically combined but whether the claimed inventions are rendered obvious by the teachings of the prior art as a whole.

IV. THE '791 PATENT

A. Overview of the Specification

44. The '791 patent states that it “relates to augmented reality.” ('791, 1:19.) The patent states that it provides “[a]ugmented reality video game systems” where “[v]ideo game indicia may be perceived to be located in a user’s physical environment through virtual indicia that are placed on a head-mounted display.” ('791, 1:23-26.)

45. Figure 3, reproduced below, “is an illustration of an augmented reality video game system and associated video game played in an environment with a physical obstacle constructed in accordance with the principles of the present invention”:

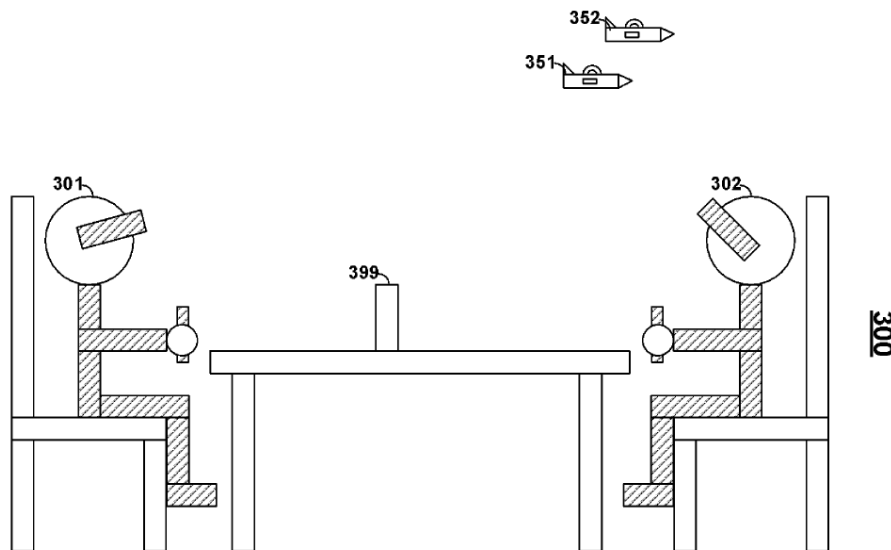


FIG. 3

('791, Fig. 3, 4:48-51.) Referring to Figure 3, the '791 patent states that “the game

may be played in [the user's] actual environment.” (’791, 7:35-37.) “User **301** may control virtual object **351** and user **302** may control virtual object **352**.” (’791, 7:37-39.) Physical surroundings—such as object **399**—can be detected and incorporated into game play:

Physical surroundings (e.g., object **399**) may be detected (either prior to a game during setup and/or during a game) and virtual objects may interact with such physical objects. For example, if a user places object **399** onto a table, plane **351** may be animated to crash into object **399** instead of animated to pass through object **399**.

(’791, 7:39-44.)

46. For example, a user “may be perceived as holding a virtual object such as a virtual basketball” and may “shoot the virtual basketball towards a virtual basketball hoop the user installed in his/her living room.” (’791, 14:45-49.) “[T]he virtual basketball may react with a user’s physical environment,” such as by appearing to bounce off the user’s ceiling:

For example, a user’s head-mounted display may include cameras that are operable to view more of a user’s environment than the user can perceive. The augmented reality system may determine, for example, the location of walls, floors, and other objects. In or near real time, for example, the augmented system may determine that a virtual basketball that was thrown by a user at a trajectory has hit a physical surface (e.g., a ceiling) and the augmented system may utilize this information to

change the course of the virtual ball (e.g., by causing the ball to be
perceived by the user to bounce off the user's ceiling).

('791, 17:49-61.)

47. I discuss additional aspects of the '791 patent in my analysis of the
claims below.

B. The Challenged Claims

48. This Declaration addresses claims 21, 23, 31, 37, 41, and 42 of the '791
patent. Independent claim 21 is representative and recites:

21. A system comprising:

- [a] a head-mounted display comprising a camera for obtaining images in
view of said head-mounted display and utilizing said images to detect
a surface of a physical object included in said images, wherein said
head-mounted display is operable to display a virtual object associated
with an application; and
- [b] a hand-held controller for providing a first three-dimensional control
signal to move said virtual object and a second three-dimensional
control signal to change the movement of said virtual object from the
movement provided from said first three-dimensional control signal,
wherein said first three-dimensional control signal moves said virtual
object three-dimensionally over at least three axes of movement in a
first manner and said second three-dimensional control signal moves
said virtual object three-dimensionally over at least three axes of
movement in a second manner.

49. I address the claims further in my detailed analysis in **Part V** below.

V. APPLICATION OF THE PRIOR ART TO CHALLENGED CLAIMS

50. I have reviewed and analyzed the prior art references and materials listed in **Part I.B** above. In my opinion the claims of the ’791 patent would have been obvious to a person of ordinary skill in the art based on the following combinations of the prior art.

Ground	Claims	Basis for Challenge Under § 103
1	21, 23, 37, 41, 42	Fager in view of Martins
2	31	Ground 1 Prior Art + Maguire

51. I am informed by counsel that each of the references cited in the grounds above qualifies as prior art to the challenged claims because each reference was filed and/or published before the earliest filing date to which the ’791 patent can claim priority (October 11, 2007).

A. Brief Summary and Overview of Prior Art

1. References Common to All Grounds

(a) Fager (EX1003)

52. **Fager**, U.S. Patent App. Pub. No. 2004/0104934 A1, is entitled “Device and A Method for Creating an Environment for a Creature.” I am informed that Fager qualifies as prior art because it was both filed (on February 7, 2002) and

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published (on June 3, 2004) before the earliest priority date of the challenged claims.

53. As shown in my analysis below, Fager discloses and renders obvious the majority of the limitations of the challenged claims—including both “**a head-mounted display comprising a camera**” and “**a hand-held controller.**”

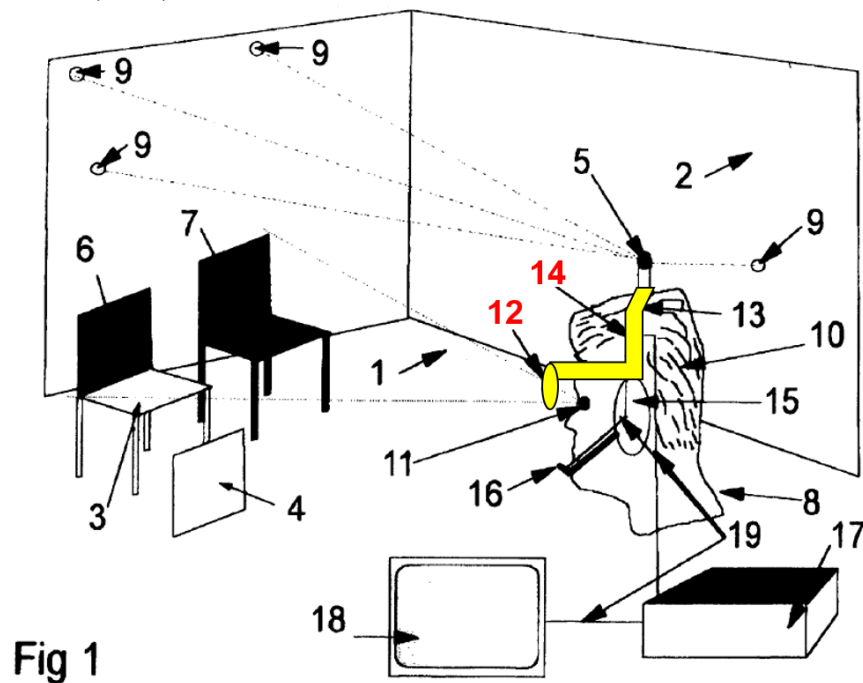
54. Fager discloses an “augmented reality” system in which images of the user’s physical environment captured by a camera of a head-mounted display are combined with virtual images and presented together to the user via the head-mounted display. (Fager, e.g., ¶¶0051-0052, 0069, 0084, 0092, 0094.) Fager refers to “augmented reality” using the term “milieu”:

By the term “milieu” (corresponding to “augmented reality” in the English language), the milieu experienced by a creature is intended, which milieu by providing fictitious creatures, fictitious objects and/or fictitious phenomena to the real environment means that the creature experiences that the milieu has other properties than what is the case for the real environment without these apparent characteristics.

(Fager, ¶0009; *see also id.*, ¶0001.)²

55. Figure 1 of Fager, for example, illustrates a head-mounted device **14** comprising a display **12**:

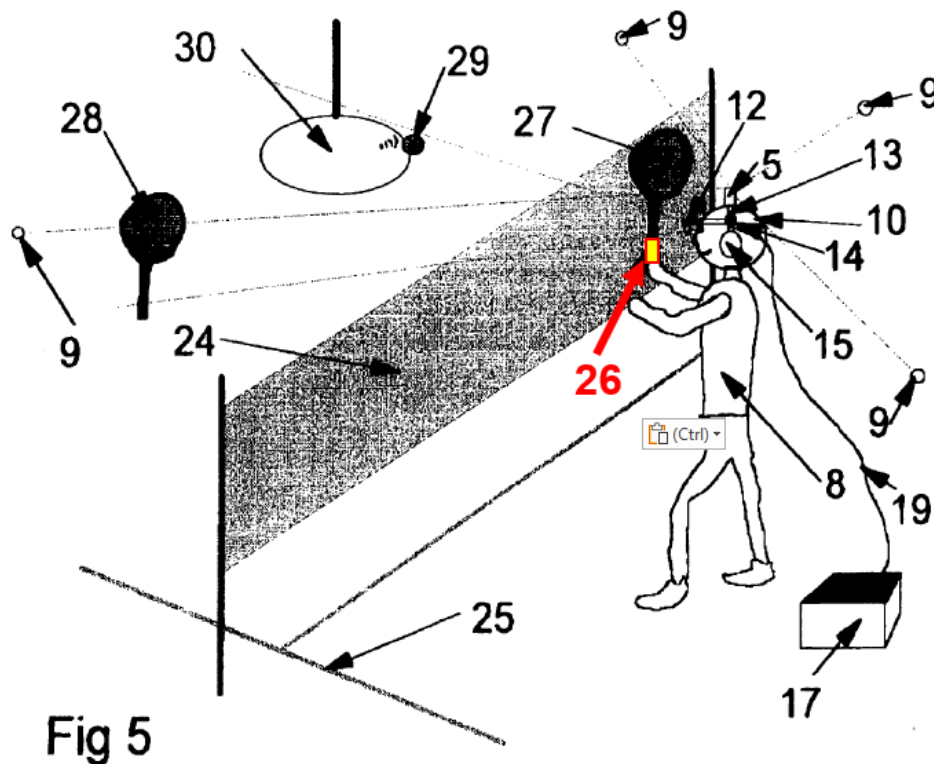
² All underlining added to quoted material unless noted.



(Fager, Fig. 1 (highlighting added).) As I will discuss more in the analysis below, Fager refers to the head-mounted device as “stimulation generating member **14**” and the head-mounted display as “means for transferring visual impressions **12**.” (Fager, e.g., ¶¶0051-0052.) Fager further teaches that the head-mounted display can comprise a camera—which Fager refers to as “obtaining means for obtaining picture information.” (Fager, ¶¶0092, 0094; *see also id.*, ¶0074 (stating “obtaining means” “include[s] IR [infrared] cameras”).)

56. Fager further teaches that, using the head-mounted display with camera and a handheld controller “component 26,” a user can play various virtual games, such as tennis. Figure 5 of Fager illustrates a virtual tennis game, highlighting “component 26,” which is “intended to constitute a tool for performing the actual

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playing act, to hit a ball for instance”:



(Fager, Fig. 5 (highlighting added), ¶0079.) Fager explains that the virtual objects—such as a “fictitious” tennis ball **29** and tennis racket **27**—are displayed to the user via the user’s head-mounted display (i.e., “means **12** for transferring information to the eyesight”):

Information about where and how the pictures of the fictitious net **24**, the fictitious ball **29**, the fictitious lines and the fictitious racket **28** of the simulated opponent are to be generated, is then transmitted from the control- and calculating unit **17** to the transferring unit and its means **12** for transferring information to the eyesight. Also information about the player’s own fictitious racket **27** is generated so that it is added to the real picture of the component **26** which the player sees.

57. Fager also explains that the virtual objects can interact with real-world objects—for example, a “fictitious” ball can bounce off the floor or another detected physical object in the user’s environment. (Fager, ¶¶0082 (“...when a ball hits the floor and bounces.”), 0085 (“[T]he fictitious ball **29** may bounce against the lamp, and thereby a more complicated playing situation is present”).)

58. I will provide more information about Fager in my discussion of the claim limitations below.

(b) Martins (EX1004)

59. **Martins**, U.S. Patent App. Pub. No. 2003/0179218 A1, is entitled “Augmented Reality System.” I am informed that Martins qualifies as prior art because it was both filed (on March 22, 2002) and issued (on September 25, 2003) before the earliest priority date of the challenged claims.

60. My analysis points to Martins in connection with claim 21[a] of the ’791 patent, which recites in part “**utilizing said images to detect a surface of a physical object included in said images.**”

61. Martins describes an “augmented reality system [that] generates a 3D version of a real-world environment and places virtual objects into the 3D version of the real-world environment.” (Martins, ¶0010.) To generate a 3D environment, of a room for example, “[t]he user walks camera **12** around the room, capturing

frames of two-dimensional (2D) video data from different positions in the room.”

(Martins, ¶0013.) To generate a 3D model, features of the room, such as planes corresponding to surfaces of the floor, ceiling and walls, are extracted from the frames and recognized. (Martins, ¶¶0013-0014.) Martins explains:

Process 16 recognizes (34) planes in the real-world environment that are bounded by the corners. Process 16 recognizes planes by identifying clusters of three or more points (e.g., pixels) of the 2D video that behave similarly during motion of camera 12. For example, as camera 12 moves toward a cluster of pixels, the pixels may appear to “grow”, i.e., they may appear larger because they become closer to the camera. Pixels on the same plane may appear to “grow” by about the same amount. Examples of planes that may be identified include a floor, ceiling, and walls of a room.

(Martins, ¶0017.) Martins therefore discloses utilizing images captured by a camera “to detect a surface of a physical object included in said images” as claimed.

62. I will provide more information about Martins in my discussion of the claim limitations below.

2. Additional References

(a) Maguire (EX1005)

63. Maguire, U.S. Patent No. 6,411,266 B1, is entitled “Apparatus and Method for Providing Images of Real and Virtual Objects in a Head Mounted Display.” I am informed that Maguire qualifies as prior art because it was both filed

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(on November 17, 1995) and issued (on June 25, 2002) before the earliest priority
date of the challenged claims.

64. I point to Maguire in connection with claim 31 of the '791 patent, which recites “[t]he system of claim 21, further comprising a second camera and a third camera and the views of said second and third camera overlap.” As I explain below, Fager discloses and renders obvious a head-mounted display that comprises a camera but does not appear to expressly describe a head-mounted display comprising more than one camera.

65. However, Maguire describes head-mounted devices for augmented reality that include a single camera, or, alternatively, a pair of cameras that are used to provide a stereoscopic display to the user. (Maguire, 2:56-3:6 (“the system includes a head mounted display having at least one camera or, alternatively, two cameras for stereoscopic display of images [of] the real objects for a viewer in the object space.”), 4:1-6 (“A pair of head mounted cameras 10, which may be miniature cameras mounted on either side of a viewer’s head 12, provide video signals on a line 14 to a computer and image processor 16. The video signals contain image information relating to the real objects imaged by the cameras in the object space.”).)

66. As I explain below, it would have been obvious to combine Maguire’s teachings regarding *two* cameras having overlapping fields of view in a head-mounted display device with Fager’s augmented reality system.

67. I will provide more information about Maguire in my discussion of the claim limitations below.

B. Ground 1: Claims 21, 23, 37, 41, and 42 are Obvious Over Fager in view of Martins

1. Independent Claim 21: “A system comprising:” (Claim 21[pre])

68. The preamble of claim 21 recites “[a] **system comprising.**” As detailed below, Fager discloses an “augmented reality” system in which images of the user’s physical environment captured by a camera of a head-mounted display are combined with virtual images and presented together to the user via the head-mounted display. (Fager, e.g., ¶¶0051-0052, 0069, 0084, 0092, 0094.) Fager refers to “augmented reality” using the term “milieu”:

By the term “milieu” (corresponding to “augmented reality” in the English language), the milieu experienced by a creature is intended, which milieu by providing fictitious creatures, fictitious objects and/or fictitious phenomena to the real environment means that the creature experiences that the milieu has other properties than what is the case for the real environment without these apparent characteristics.

(Fager, ¶0009; *see also id.*, ¶0001 (“The present invention relates to a device and a method for creating a milieu for a creature in a real environment to the creature, the milieu comprising both at least one part of the real environment and at least one fictitious phenomenon, the properties of said milieu experienced by the creature

depending on the position and/or orientation of the creature, or a part thereof, relative to the real environment....”).) Fager’s system supports multiple users, where each user has their own head-mounted display. (Fager, e.g., ¶0086 (“A real opponent—player—may be equipped with a similar device according to the invention...”).)

69. As explained below, the combination of **Fager** and **Martins** renders the claimed system obvious.

- (a) **“a head-mounted display comprising a camera for obtaining images in view of said head-mounted display and utilizing said images to detect a surface of a physical object included in said images, wherein said head-mounted display is operable to display a virtual object associated with an application; and” (Claim 21[a])**

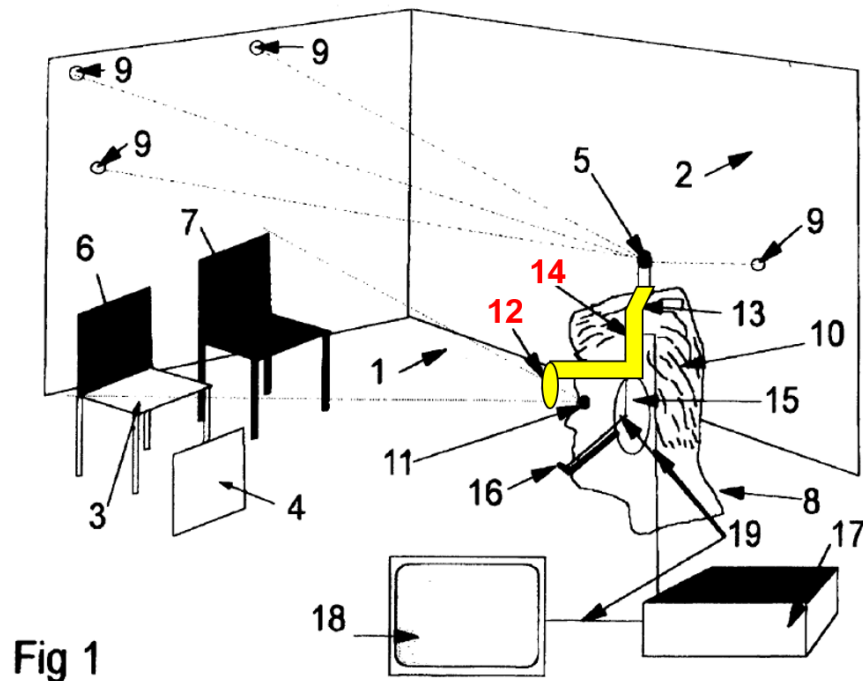
70. I will address this limitation in parts because of its length. As I explain below, this limitation is disclosed by and obvious over **Fager** in view of **Martins**.

- (1) **“a head-mounted display comprising a camera for obtaining images in view of said head-mounted display”**

71. Fager discloses and renders obvious **“a head-mounted display comprising a camera for obtaining images in view of said head-mounted display.”**

72. Starting first with the **“head-mounted display,”** Fager teaches a head-mounted device (referred to as “stimulation generating member 14”) that includes a **“head-mounted display”** comprising one or more of what Fager refers to as “means

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 for transferring visual impressions **12**.” (Fager, e.g., ¶¶0051-0052.) Figure 1 of
 Fager, reproduced with highlighting below, illustrates:



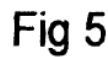
(Fager, Fig. 1 (highlighting added); *see also id.*, ¶¶0051 (“stimulation generating member **14**”; “means included in a transferring unit, for transferring visual information **12** to the creature”), 0052 (“...calculate the information which is to be communicated to the means for transferring visual impressions **12** of the transferring unit, so that generated pictures of the fictitious phenomena may be incorporated with great accuracy in the real picture information of the room **1**, the milieu being realised for the person”), 0077 (“Said device includes...a transferring unit comprising two

means **12** for transferring information to the eyesight, one for each eye....”).³

73. Fager makes clear that the “means for transferring visual impressions” can take the form of a “**head-mounted display**,” such as a device comprising separate LCD displays placed over each eye of the wearer. (Fager, ¶0069 (“[A] unit **12** for transferring stimuli is further included, which comprises two stimulation means, one for each eye,...each a means in the form of a LCD-display, which has the capability to be either transparent or imperious [sic; impervious] to light as regards each pixel in the resolution of the display.”); *see also id.* ¶0084 (“a transparent LCD-display located in the field of vision is used as a part of the transferring means to stimulate the eyesight”).)

74. Turning to a “**a head-mounted display comprising a camera**,” Fager further teaches that the “means for transferring visual impressions **12**” (“**head-mounted display**”) can comprise a “**camera**”—which Fager refers to as “obtaining means for obtaining picture information.” (Fager, e.g., ¶¶0052, 0094.) For example, referring to an augmented reality “tennis example” illustrated in Figure 5 (reproduced below), Fager explains how the “means **12** of the transferring unit for

³ Fager uses the term “creature” to refer to human beings and animals. (Fager, ¶0004.)



In a tennis example where the means 12 of the transferring unit for transferring visual information comprises an obtaining means for obtaining picture information, a means which blocks the light of the environment, and a transferring means for visual information for directly projection of pictures on the retina, and where the tool component 26 is provided with control buttons, a signal is emitted from a control button to the control- and calculating unit 17 so that the milieu which the player experiences is similar to play on a clay court.

35

75. Fager makes clear that the “obtaining means for obtaining picture information” can take the form of a “**camera.**” For example, referring to the “tennis example,” Fager describes using the “obtaining means” to obtain picture information of the user’s physical surroundings so that “[a] fictitious tennis ball in the realised milieu may be seen moving in a potential field in the real environment”:

In a more sophisticated embodiment of the previous example, the transferring means for transferring stimuli to the visual organs have an obtaining means for picture information. Furthermore, the path for the light to incident directly towards the eye is blocked by a blocking means in the form of an impermeable shield. The information obtained from the obtaining means is superimposed with the picture information from electrical potentials simulated in the model of the environment, so that information about the electric properties of the environment is represented by different semitransparent tints seamlessly adapted to the real picture. The transferring unit then generates the whole picture by means of a transferring means for projection of the picture on the retina of the eye. In this case the fictitious tennis ball in the realised milieu may be seen moving in a potential field in the real environment.

(Fager, ¶0092.)

76. A person of ordinary skill in the art would have understood that Fager in the passage above is describing camera functionality and, moreover, that a camera would have been an obvious choice for obtaining “picture information” of the user’s surroundings. In fact, Fager describes an embodiment where an “obtaining means”

“include[s] IR [infrared] cameras for obtaining information about the external environment in the night and/or when fog is present.” (Fager, ¶0074 (“In a further embodiment of the example of the military vehicle, the external obtaining means **39** include IR-cameras for obtaining information about the external environment in the night and/or when fog is present.”).) As noted in Part III.B above, I am informed by counsel that combining embodiments disclosed adjacent to each other in a prior art reference does not require a leap of inventiveness. A person of ordinary skill in the art would have therefore readily appreciated and found it obvious based on Fager’s teachings for the “obtaining means” of Fager’s head-mounted display to comprise a camera.

77. The fact that Fager discloses and renders obvious a head-mounted display comprising a camera is further confirmed by Fager’s discussion in the passage above of a head-mounted display device where “the path for the light to incident directly towards the eye is blocked by a blocking means in the form of an impermeable shield.” (Fager, ¶0092.) A person of ordinary skill in the art would have recognized that Fager is describing what is known as a *video* see-through head-mounted display. There are (and were) two types of head-mounted displays for showing a user images in which the real and virtual environments are merged: (1) *optical* see-through; and (2) *video* see-through. (Kanbara [EX1006], p.0010.) With *optical* see-through, the user can see their real environment through a half-

transparent mirror. (*Id.*) With *video* see-through, the user's direct view of their real

environment is blocked—just as Fager describes—and they instead see image sequences of the real environment captured by a camera of the head-mounted display. (*Id.*) An example of a video see-through head-mounted display is shown at right,



Figure 6. Appearance of stereoscopic video see-through HMD.

where “two small identical CCD cameras (Toshiba IK-UM42) are mounted on a HMD (Olympus Media Mask)[.]” (Kanbara [EX1006], p.0014.)

78. Therefore, a person of ordinary skill in the art would have understood and found it obvious that Fager's head-mounted display “**compris[es] a camera**” as claimed.

79. Fager also teaches that the camera of the head-mounted display would be “**for obtaining images in view of said head-mounted display.**” As explained above, Fager teaches how the “obtaining means” (“**camera**”) is used to obtain picture information of the physical environment in front of the user (“**in view of said head-mounted display**”) so that images combining virtual objects and the user's physical environment can be displayed to the user. (Fager, ¶0092 (“...the fictitious tennis ball in the realised milieu may be seen moving in a potential field in the real

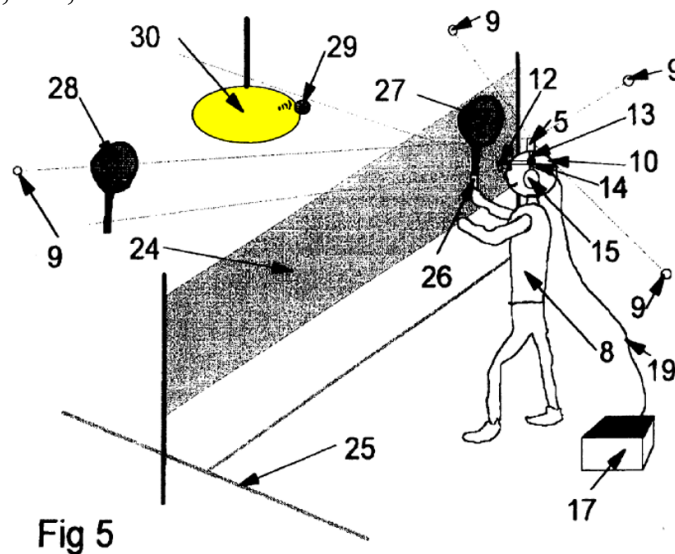
environment.”); *see also id.*, ¶0052 (“...calculate the information which is to be communicated to the means for transferring visual impressions **12** of the transferring unit, so that generated pictures of the fictitious phenomena may be incorporated with great accuracy in the real picture information of the room **1**, the milieu being realised for the person”).)

80. Therefore, Fager discloses and renders obvious “**a head-mounted display comprising a camera for obtaining images in view of said head-mounted display**” as claimed.

(2) “utilizing said images to detect a surface of a physical object included in said images”

81. This portion of claim 21[a] is obvious over Fager in view of **Martins**.

82. Fager generally describes detecting and modeling physical objects in the real world and using that information to determine how the physical objects (such as a lamp or floor surface) affect virtual game play. For example, referring to Figure 5 and the augmented reality tennis example, Fager explains that a real-world suspended lamp **30** can be detected and used to affect the behavior of virtual tennis ball **29**:



In this example, a physical object in the form of a suspended lamp 30 is present in the environment, but the object could be any occurring real object. This object is modelled in the control- and calculating unit 17. Furthermore, in the control- and calculating unit 17 there is stored information about the fictitious ball 29, a fictitious tennis net 24 and fictitious tennis lines 25, calculation models for how a tennis ball physically acts and other rules for how the game tennis is performed in the real world.

(Fager, ¶0080, Fig. 5 (highlighting added to indicate physical object “suspended lamp 30”); *see also id.*, ¶0084 (“When the fictitious match takes place in a real environment, in this case with an additional object in the form of a lamp 30, it may be chosen to consider or not to consider this lamp in the model in the control- and calculating unit 17.”).) For example, “the fictitious ball 29 may bounce against the lamp, and thereby a more complicated playing situation is present”:

In another embodiment of said tennis example, in the calculation of the path of the fictitious ball 29 it is considered that a lamp 30 is present in the environment. Thus, the fictitious ball 29 may bounce against the lamp, and thereby a more complicated playing situation is present. Thus, the player may create more challenging game variants or play the game in milieus which otherwise would be inconceivable.

(Fager, ¶0085.) Fager also describes a virtual ball bouncing when the ball is calculated to hit a floor surface. (Fager, ¶0082 (“Correspondingly, for example the fictitious sound sources that are present are modelled in the control- and calculating unit 17. For example sounds from how it would sound when a ball hits a racket under given conditions or when a ball hits the floor and bounces.”).)

83. Fager does not appear to disclose that the images obtained using the camera of the head-mounted display are utilized “**to detect a surface of a physical object included in said images,**” but this would have been obvious in view of **Martins**. Martins, entitled “Augmented Reality System,” describes an “augmented reality system [that] generates a 3D version of a real-world environment and places virtual objects into the 3D version of the real-world environment.” (Martins, ¶0010.) To generate a 3D environment, of a room for example, “[t]he user walks camera 12 around the room, capturing frames of two-dimensional (2D) video data from different positions in the room.” (Martins, ¶0013.) To generate a 3D model, features of the room, such as planes corresponding to surfaces of the floor, ceiling and walls,

are extracted from the frames and recognized. (Martins, ¶¶0013-0014.) Martins explains:

Process 16 recognizes (34) planes in the real-world environment that are bounded by the corners. Process 16 recognizes planes by identifying clusters of three or more points (e.g., pixels) of the 2D video that behave similarly during motion of camera 12. For example, as camera 12 moves toward a cluster of pixels, the pixels may appear to “grow”, i.e., they may appear larger because they become closer to the camera. Pixels on the same plane may appear to “grow” by about the same amount. Examples of planes that may be identified include a floor, ceiling, and walls of a room.

(Martins, ¶0017.) Martins therefore discloses utilizing images captured by a camera “to detect a surface of a physical object included in said images” as claimed.

84. **Rationale and Motivation to Combine (Fager and Martins).** It would have been obvious to a person of ordinary skill in the art to combine Martins’ teachings regarding using camera images to detect a surface of a physical object with Fager’s augmented reality and head-mounted display system. It would have involved the combination of prior art elements, with no change in their respective functions, according to known methods—i.e., simply using the camera of the user’s head-mounted display for performing surface detection in connection with modeling the user’s physical environment. The combination would have predictably resulted in using the camera of Fager’s head-mounted display to capture images used to

detecting physical surfaces of a play area, such as the floor, ceiling, and walls of a room in which a user wishes to play a game of, for example, virtual tennis. For example, each wall is a physical object, and the combination would utilize the images to detect a surface of each wall. It also would have been obvious for the combination to apply the same functionality to detect the surfaces of other objects in Fager's game, such as the "suspended lamp" described in Fager and other objects, given that Fager's system models the behavior and movement of virtual objects (such as a "fictitious ball") based on the determined surfaces of real-world objects. (See, e.g., Fager, ¶¶0080, 0083, 0085.) The combination accordingly discloses **"utilizing said images to detect a surface of a physical object included in said images"** as claimed.

85. Both Fager and Martins are analogous references to the '791 patent. Like the '791 patent, both Fager and Martins are in the field of augmented reality. ('791, 1:19 ("This invention relates to augmented reality."); Fager, e.g., ¶0009 ("By the term 'milieu' (corresponding to 'augmented reality' in the English language)..."); Martins, ¶¶0010 ("augmented reality system"), 0011.) Moreover, both Fager and Martins would have been reasonably pertinent to problems facing the '791 patent inventor, including techniques for, and ways in which, virtual objects of an augmented reality system can interact with their physical surroundings.

86. Fager provides motivation to combine. Fager explains that its system

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“is intended to be applied primarily ‘indoors’ and ‘semi-indoors’,” in situations that a person of ordinary skill in the art would have understood involve surfaces such as floors, ceilings, and walls. (Fager, ¶0011.) Fager explains that “indoors” involves locations inside buildings and other “enclosings” “in which there are walls, pillars, and/or masts which support some kind of roof.” (Fager, ¶0011.) Similarly, “semi-indoors” places are those that are “located outdoors in the vicinity of constructions or naturally occurring objects and close to the outer limitations of the indoor environments, such as in the vicinity of walls, roofs, masts, pillars, power lines, towers, walls made of bricks or stones, lamp-posts, bridges, trees, rock formations, stones, bushes, long valleys and hills, puddles, shorelines, variations in vegetation, etc., are intended.” (Fager, ¶0011.)

87. Fager further explains that these sorts of physical objects can be incorporated into game play. For example, as discussed, Fager describes detecting and modeling physical objects in the real world and using that information to determine how the physical objects affect virtual game play, such as virtual tennis. (Fager, ¶¶0082 (“when a ball hits the floor and bounces”), 0084-0085 (“[I]n the calculation of the path of the fictitious ball **29** it is considered that a lamp **30** is present in the environment. Thus, the fictitious ball **29** may bounce against the lamp, and thereby a more complicated playing situation is present.”).)

88. Therefore, a person of ordinary skill in the art, looking to implement

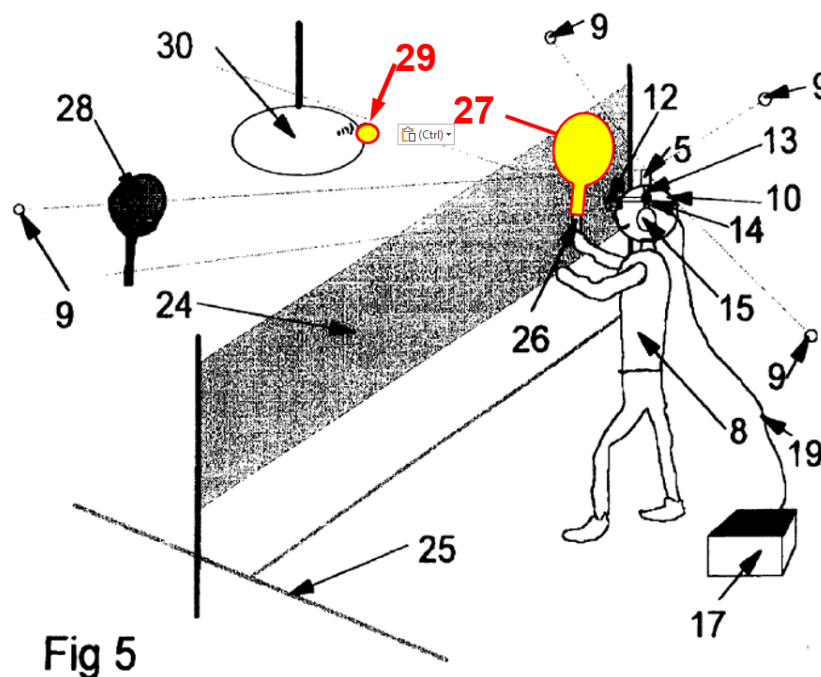
Fager’s system in which physical objects were incorporated into virtual game play, would have been motivated to look to a reference such as Martins for its additional teachings regarding methods to detect and model those physical objects/surfaces, including using a camera. In fact, Fager describes using “obtaining means” to obtain information about the user’s environment to configure game play, such as the size of the playing area and any obstacles. (Fager, ¶0088.) Because Fager already teaches a camera—i.e., the camera included as part of the user’s head-mounted display—a person of ordinary skill in the art would have understood and appreciated that images captured by that camera could be used in accordance with Martins’ teachings to model the user’s physical environment, including floor, ceiling, and wall surfaces.

89. A person of ordinary skill in the art would have had a reasonable expectation that the combination would have been successful. As explained, the combination would have simply involved the straightforward use of the camera of Fager’s head-mounted display to perform camera-based detection of physical surfaces as taught by Martins.

(3) “wherein said head-mounted display is operable to display a virtual object associated with an application”

90. Fager further discloses and renders obvious that the **“head-mounted display is operable to display a virtual object associated with an application”**—

such as a virtual ball or tennis racket (each a “**virtual object**”) associated with a tennis video game “**application.**” (Fager, e.g., ¶¶0031 (“...device offers a very great flexibility and which may be used in several different applications and environments for giving a creature a desired experience...”), 0052 (“programmes which may generate different visual objects”).) Figure 5, annotated below to highlight “fictitious ball 29” and “the player’s own fictitious racket 27,” illustrates a virtual ball and tennis racket:



(Fager, Fig. 5 (highlighting added), ¶0081.) Fager explains that the virtual objects are displayed to the user via the user’s head-mounted display (i.e., “means 12 for transferring information to the eyesight”):

Information about where and how the pictures of the fictitious net 24,

the fictitious ball 29, the fictitious lines and the fictitious racket 28 of the simulated opponent are to be generated, is then transmitted from the control- and calculating unit 17 to the transferring unit and its means 12 for transferring information to the eyesight. Also information about the player's own fictitious racket 27 is generated so that it is added to the real picture of the component 26 which the player sees.

(Fager, ¶0081.)

91. Fager also makes clear that its system's “**virtual objects**” are not limited to fictitious balls and rackets and discloses other examples of “virtual objects” such as virtual swords, firearms, and other game and sports objects. For example, “[t]he fictitious tennis racket 27 of the equipment component may easily be changed, and during a game in progress, for all types of swords, laser swords, lances, firearms etc.” (Fager, ¶0095; *see also id.* (“It should be emphasised that in the use of the device according to the invention or the arrangement according to the invention are not limited to games of fictitious tennis in the variants described or in other variants....[A]ll other forms of games, plays and sports may be performed in an environment with a device according to the invention and be played in a world with fictitious phenomena joined with real pictures of the environment realised in a milieu.”).)

92. Therefore, Fager discloses and renders obvious “**wherein said head-mounted display is operable to display a virtual object associated with an**

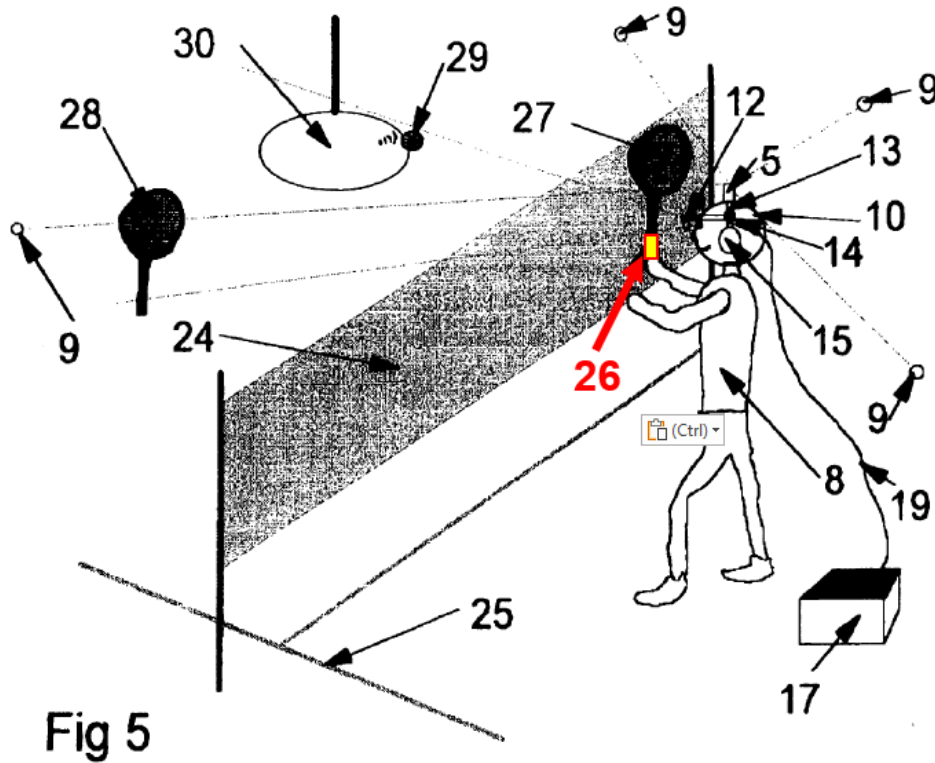
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application” as claimed.

- (b) **“a hand-held controller for providing a first three-dimensional control signal to move said virtual object and a second three-dimensional control signal to change the movement of said virtual object from the movement provided from said first three-dimensional control signal, wherein said first three-dimensional control signal moves said virtual object three-dimensionally over at least three axes of movement in a first manner and said second three-dimensional control signal moves said virtual object three-dimensionally over at least three axes of movement in a second manner.” (Claim 21[b])**

93. I will address this limitation in parts because of its length. As I explain below, this limitation is disclosed by and obvious over **Fager**.

- (1) **“a hand-held controller for providing a first three-dimensional control signal to move said virtual object”**

94. Fager discloses **“a hand-held controller”** in the form of, for example, handheld **“component 26”** that is **“intended to constitute a tool for performing the actual playing act, to hit a ball in tennis, for instance.”** (Fager, ¶0079.) Figure 5 of Fager depicts an example of handheld component **26** (highlighted in yellow):



(Fager, Fig. 5 (highlighting added).) Fager describes component **26**:

[T]he player holds a component 26 in his hand. Said component is intended to constitute a tool for performing the actual playing act, to hit a ball in tennis, for instance. The tool is designed as a handle of an ordinary tennis racket and includes a further transducer which is arranged to determine its position and/or orientation relative to the real environment in six degrees of freedom, and which is mechanically fixed connected to the component otherwise freely movable and to an effecting means for communication of information to the control- and calculating unit 17.

(Fager, ¶0079.)

95. Fager further explains that handheld component 26 (“hand-held

controller") provides a **"first three-dimensional control signal to move said virtual object."** As explained for claim 21[a], Fager discloses **"said virtual object"** in the form of the user's virtual tennis racket (associated with component **26**) or the virtual tennis ball **29**.

96. With respect to a **"three-dimensional control signal,"** Fager explains that the component **26** "includes a further transducer which is arranged to determine its position and/or orientation relative to the real environment in six degrees of freedom"—i.e., three degrees of freedom for position and three for orientation. (Fager, ¶0079; *see also id.*, ¶0013.) With respect to position, Fager explains that "[t]he 'position' of the object is defined by the three quantities which denote translations in relation to the origo [sic; origin] of a current coordinate system," such as the familiar "x, y and z" three-dimensional coordinates. (Fager, ¶0013.) Because the information determined by the transducer contains three dimensions of position, it discloses **"three-dimensional"** information.

97. Fager further teaches that this three-dimensional information detected by component **26** is transmitted to the system's computer and used in calculating both the position and orientation of the user's virtual tennis racket as well as the path of the virtual ball as a result of being hit by the racket, thereby disclosing a **"three-dimensional control signal"**:

[T]he information about the position and orientation of the tool

component 26 is used for calculating if and where in the field of vision of the player the own fictitious racket is present....It should be noted that by means of time sequences of the position- and orientation information of the tool component, the parameters, such as forces and accelerations when the fictitious ball is hit, may be calculated, and thereby the conditions to calculate the movement path of the fictitious ball in every point of time are created.

(Fager, ¶0081; *see also id.*, ¶0086 (describing that the position and orientation information is “transmitted” to the system’s computer unit).) For example, in an augmented reality tennis game involving two real players, Fager explains that position and orientation information of a player’s component 26 is “transmitted to the control- and calculating unit” where it is used as a three-dimensional control signal “for calculating the path of the fictitious ball” and for calculating information about the player’s racket. (Fager, ¶0086 (“In this connection, two sets of position- and orientation information will be transmitted to the control- and calculating unit in common for calculating the path of the fictitious ball, and the respective fictitious racket of both players, and the net and lines, in such a way that the information is created for respective players transferring unit and is transmitted thereto.”).)

98. A person of ordinary skill in the art would have therefore understood and found it obvious that Fager’s handheld component 26 (“a **hand-held controller**”) “**provid[es] a first three-dimensional control signal to move said**

virtual object” in the form of a signal from the component comprising 3-D position and/or 3-D orientation information that is used in controlling the movement of the user’s virtual tennis racket or virtual tennis ball displayed to the user.

(2) “[a hand-held controller for providing]...a second three-dimensional control signal to change the movement of said virtual object from the movement provided from said first three-dimensional control signal”

99. With respect to the claimed “**second three-dimensional control signal,**” a person of ordinary skill would have understood and found it obvious that, during the course of ongoing game play, the user’s handheld component **26** (“**handheld controller**”) would provide a subsequent control signal that would change the movement of the virtual tennis racket or ball. For example, swinging the component **26** again so that the associated virtual racket strikes the virtual tennis ball would provide a second control signal comprising 3-D position and/or orientation information that would be used to change the movement of the racket and ball displayed to the user. (Fager, ¶¶0081, 0086 (describing using position and orientation information).)

100. Fager therefore discloses and renders obvious this portion of claim **21[b]**.

- (3) **“wherein said first three-dimensional control signal moves said virtual object three-dimensionally over at least three axes of movement in a first manner”**

101. As discussed above, Fager teaches using a signal from component **26** comprising 3-D position and/or 3-D orientation information, and that this information is used to calculate the position of both the associated virtual tennis racket and virtual ball. (Fager, ¶0081.) Because, as discussed, Fager explains that position involves an x, y and z coordinate system—i.e., **“three axes of movement”**—Fager teaches that the position/orientation control signal from component **26** would **“move[] said virtual object three-dimensionally over at least three axes of movement in a first manner.”**

- (4) **“said second three-dimensional control signal moves said virtual object three-dimensionally over at least three axes of movement in a second manner”**

102. For the same reasons as the first control signal, a person of ordinary skill in the art would have understood and found it obvious that a subsequent position/orientation control signal from component **26** during ongoing game play in Fager (**“said second three-dimensional control signal”**), would **“move[] said virtual object three-dimensionally over at least three axes of movement in a second manner.”** For example, as discussed, swinging the component **26** again so that the associated virtual racket strikes the virtual tennis ball would provide a second

control signal that would be used to change the three-dimensional movement of the racket and ball displayed to the user—therefore resulting in movement “**in a second manner.**”

2. Claim 23: “The system of claim 21, wherein said application is a video game having a selectable playing area.”

103. Claim 23 is obvious over Fager in view of Martins. With respect to “**said application is a video game,**” as discussed from claim 21[a], Fager details using its augmented reality system with a tennis video game, and explains that the system can be used with all sorts of other video games involving both real and virtual opponents, such as golf or the Harry Potter game Quidditch:

[T]he use of the device according to the invention or the arrangement according to the invention are not limited to games of fictitious tennis in the variants described or in other variants. By an easy exchange of models in the control- and calculating unit, the ground may be altered to games, for example golf or in different degrees of sophistication the game Quidditch. (Quidditch is a game described by J K Rawlings in the books of imaginative literature about Harry Potter and in the special publication “Quidditch Through the Ages and Fantastic Beasts and Where to Find Them” (ISBN: 0439284031)). Furthermore, all other forms of games, plays and sports may be performed in an environment with a device according to the invention and be played in a world with fictitious phenomena joined with real pictures of the environment realised in a milieu.

(Fager, ¶0095; *see also id.*, ¶0086 (“In a further example, it is illustrated that the tennis game in the previous example of embodiment not in any way is restricted to a fictitious opponent. A real opponent—player—may be equipped with a similar device....[T]wo sets of position- and orientation information will be transmitted to the control- and calculating unit in common for calculating the path of the fictitious ball, and the respective fictitious racket of both players, and the net and lines, in such a way that the information is created for respective players transferring unit and is transferred thereto.”).)

104. Fager further teaches a video game—such as “fictitious tennis”—**“having a selectable playing area.”** In particular, Fager discloses how a game can have **“a selectable playing area”** in at least two different ways. First, the user can select the physical area/place in which to play the game. Second, the user can use the system to identify and use a common playing area with other player(s). I will address each way in turn below.

105. First, with respect to a user selecting the physical area/place in which to play the game, Fager discloses that its system enables the user to setup and play a game wherever the user chooses, explaining “[a]dvantageously, the game may be played in premises and at places which require non or minimal preparation to enable that the play is arranged.” (Fager, ¶0083.) In other words, Fager teaches that its video games are not tied or fixed to a particular playing location or area. By allowing

the user to select where to play the game, such as a particular room or building,

Fager's video games have a "**selectable playing area.**"

106. Second, with respect to the user using the system to identify and use a common playing area with other player(s), Fager explains how the system can detect the user's physical environment and select the appropriately sized area for playing against a player in another location, such that the two players have a common playing area:

In one embodiment example, an arrangement according to the invention is used, which arrangement comprises two devices according to the invention in accordance with the previous tennis example and a means for establishing a smallest common court. Furthermore, the arrangement includes two obtaining means for obtaining information about an environment to each creature, which means are constructed so that they use an algorithm implemented in either one of the control- and calculating units included in the devices according to the invention or in a separate control- and calculating unit, to compare how great part of the respective environment that has sufficient properties in common to be used as a court in common, starting from a minimal starting environment. The algorithm increases the area gradually and compares which stationary objects that are found in each step of increasing the area. When an obstacle is found in some of the environments, it is investigated if a corresponding obstacle is present in the other environment. In the latter case, if the obstacles have very similar properties, also the obstacle may be included, otherwise the iteration is

stopped in the directions which the obstacles define. The algorithm is repeated until no way to increase the area remains. The courts obtained in this way then constitute a meeting place between two worlds for playing games, which may give possibilities to experiences of the kind which are increased to a substantial extent compared to the previous mentioned tennis case where only different pieces of scenery for the respective player are created.

(Fager, ¶0088.)

3. **Claim 37: “The system of claim 21, wherein a physical object type of said physical object is operable to be determined from several physical object types, a first type of said several physical object types is a floor and a second type of said several types of physical object types is a wall.”**

107. Claim 37 is obvious over Fager in view of Martins.

108. As discussed for claim 21[a], Martins describes detecting surfaces of several types of physical objects from video images captured by a camera, including a floor, ceiling, and wall. (Martins, ¶0017 (“Examples of planes that may be identified include a floor, ceiling, and walls of a room.”).)

109. With respect to “**determin[ing]**” “**a physical object type...from several physical object types,**” for starters, Martins explains that a floor, ceiling and walls of a room are examples of planes that may be identified. (Martins ¶0017.) Therefore, in order to properly model the room (and use that model), a person of ordinary skill in the art would have understood and found it obvious for the user

and/or system to determine the type of physical object that was detected—for example, that a detected surface was a floor and not the top of a table, or that a detected surface was a wall and not the back of a couch.

110. Moreover, Martins further discloses that information about detected physical objects can also be captured—for example, “the height of a ceiling”—in order to properly place virtual objects within the 3D environment:

Process **16** scales the virtual 3D object by obtaining (50) the size of a target object in the real-world environment and changing (52) the size of the virtual 3D object in accordance with the size of the target. For example, the size of an object (e.g., the height of a ceiling, distance between two objects, etc.) in the 3D environment may be captured beforehand. Using the size of the target as a reference, process 16 may change the size of the virtual 3D object so that its size is smaller or larger to correlate substantially to the size of the target. Process 16 then renders (49) the virtual objects in the virtual environment.

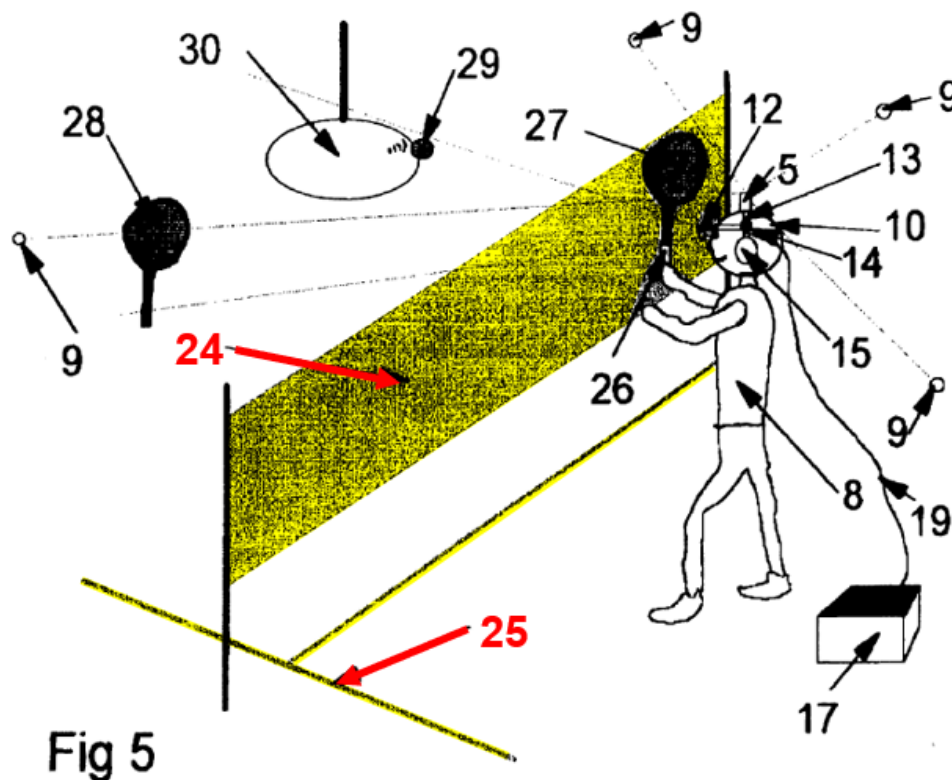
(Martins, ¶0022.) A person of ordinary skill in the art would have understood and found it obvious that associating size information with a physical object to correctly place virtual objects in the 3D environment would involve the user and/or system determining a “**physical object type**” of the physical object—for example, determining that a detected surface corresponded to a ceiling in connection with specifying ceiling height information.

111. Similarly, a person of ordinary skill in the art would have understood

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and found it obvious to determine a “**physical object type**” in connection with placing virtual objects into a scene. For example, it would not make sense to allow a user to place a virtual table on a wall or ceiling surface—instead, it would be desirable to limit the user to placing the table on a floor surface. And if even allowed, users themselves would determine what type of surface the object corresponded to (such as a floor, wall or ceiling) in connection with placing a virtual object.

112. These same practical considerations to determine a physical object type are also present in Fager. For example, Fager explains that its virtual tennis game involves a fictitious net and lines, as highlighted in Figure 5 below:



(Fager, Fig. 5 (highlighting added), ¶¶ 0080 (“a fictitious tennis net **24** and fictitious

tennis lines **25**”), 0088.) Fager also describes how the appearance of a particular physical surface can be virtually modified—for example, “all colours of the floor in the real environment [can be] exchanged for colours in a gravel-like range of colours” to simulate gameplay on a clay tennis court. (Fager, ¶0094.)

113. In both of these examples, a person of ordinary skill in the art would have understood and found it obvious that, to properly place and size virtual objects and other augmentations in the scene displayed to the user, the types of physical objects that were detected—such as a floor type, a ceiling type, and a wall type—would be determined. For example, it would not make sense to allow tennis lines to be placed on a wall or ceiling, or for the color of a wall or ceiling to be changed to a “gravel-like range of colours.” But even if that were possible, users themselves would determine the physical object types to which the various surfaces corresponded in connection with correctly setting up the augmented reality scene.

114. Therefore, the proposed combination of Fager and Martins would have predictably resulted in determining “**a physical object type of said physical object...from several physical object types**” including a “**floor**” type and a “**wall**” type as claimed.

4. **Claim 41:** “The system of claim 21, wherein at least said second three-dimensional control signal moves said virtual object causing said virtual object to interact with said detected surface.”

115. Claim 41 is obvious over Fager in view of Martins. As discussed for claim 21[a], the combination of Fager and Martins discloses a “**virtual object**” in the form of a tennis ball or tennis racket and discloses and renders obvious a “**detected surface**” such as the surface of a floor or wall. As discussed for claim 21[b], Fager teaches a handheld component 26 that supplies control signals to cause an associated virtual tennis racket and tennis ball to move within the augmented reality space displayed to the user.

116. Fager teaches this limitation in two ways. First, with respect to the tennis ball “**virtual object**,” when the component’s control signal corresponds to the virtual tennis racket hitting the ball, a person of ordinary skill in the art would have understood that hitting the ball could cause the ball to interact with the detected surface, such as by bouncing off the surface of the floor or wall. (Fager, ¶0082 (“when a ball hits the floor and bounces”).) Second, with respect to the tennis racket “**virtual object**,” a person of ordinary skill in the art would have also found it obvious that, when the component’s control signal corresponds to the racket colliding with a floor or wall, the tennis racket would interact with the detected surface of the floor or wall, such as by the system being programmed to prevent the

displayed virtual representation of the tennis racket from moving into the space occupied by the floor or wall.

5. Claim 42: “The system of claim 21, wherein said camera for obtaining images in view of said head-mounted display comprises a video camera for obtaining video in a view of said head-mounted display.”

117. Claim 42 is obvious over Fager in view of Martins. In particular, Martins discloses using a **“video camera for obtaining video.”** For example, Martins explains that “camera 12 may be a digital video camera that is capable of capturing frames of video data.” (Martins, ¶0009; *see also id.*, ¶¶0013 (“The user walks camera 12 around the room, capturing frames of two-dimensional (2D) video data”), 0033 (“The process can be used with any type of computer or video camera that together capture and process digital data.”).)

118. I discussed the rationale and motivation to combine Fager and Martins in connection with my analysis of claim 21[a], which applies here as well. Under the proposed combination, the camera in Fager’s head-mounted display would have been a **“video camera”** as taught by Martins. The combination would have predictably resulted in **“said camera for obtaining images in view of said head-mounted display comprises a video camera for obtaining video in a view of said head-mounted display”** as claimed.

**C. Ground 2: Claim 31 is Obvious Over Ground 1 Prior Art in
Further View of Maguire**

- 1. Claim 31: “The system of claim 21, further comprising a second camera and a third camera and the views of said second and third camera overlap.”**

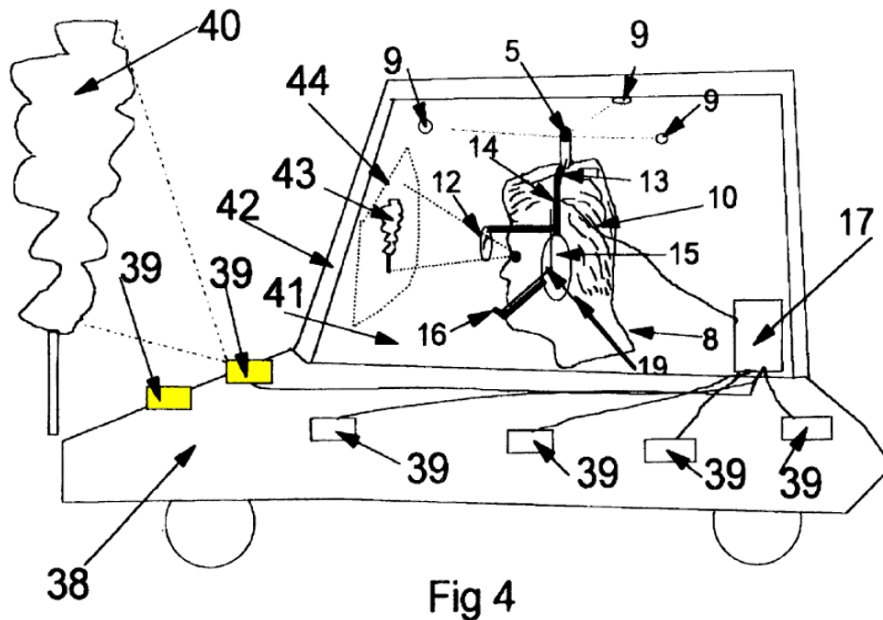
119. As explained below, claim 31 is obvious over Fager and Martins in further view of Maguire.

120. I note that claim 31 does not require the “**second camera**” and “**third camera**” to be part of the head-mounted display recited in claim 21. In other words, to meet the claim, these cameras could be located anywhere within the “system,” provided the second and third cameras have overlapping views. Therefore, for example, the cameras could be part of a second head-mounted display worn by another player within the same interconnected system. As explained below, this sort of scenario would have been obvious in view of Maguire.

121. In particular, Fager describes an augmented reality system for gaming involving multiple players. (Fager, e.g., ¶¶0086 (“A real opponent—player—may be equipped with a similar device according to the invention...”), 0087 (example “embodiment having two tennis players, these two players are located in an environment each in the form of two different rooms...”).) As I discussed for claim 21[a], a person of ordinary skill in the art would have understood and found it obvious that Fager’s head-mounted display would include at least one camera.

Therefore, in a two-player scenario, for example, a person of ordinary skill in the art would have understood and found it obvious that each player's head-mounted display would include at least one camera.

122. With respect to a head-mounted display that includes *two* cameras with overlapping fields of view, Fager does not appear to expressly describe a head-mounted display comprising more than one camera. I note, however, that Fager describes a vehicle-based embodiment that employs *two* cameras having overlapping views, as shown in Figure 4 below:



(Fager, Fig. 4 (highlighting added to indicate cameras); *see also id.*, ¶0074 (“In a further embodiment of the example of the military vehicle, the external obtaining means 39 include IR-cameras for obtaining information about the external

environment in the night and/or when fog is present.”).) Fager therefore clearly contemplates the use of *two* cameras in connection with a single head-mounted display.

123. It would have been obvious for Fager’s head-mounted display to comprise *two* cameras having overlapping views in view of **Maguire**. Maguire, entitled “Apparatus and Method for Providing Images of Real and Virtual Objects in a Head Mounted Display,” describes head-mounted devices for augmented reality that include a single camera, alternatively, a pair of cameras that provide a stereoscopic display to the user. (Maguire, 2:56-3:6 (“the system includes a head mounted display having at least one camera or, alternatively, two cameras for stereoscopic display of images [of] the real objects for a viewer in the object space.”), 4:1-6 (“A pair of head mounted cameras 10, which may be miniature cameras mounted on either side of a viewer’s head 12, provide video signals on a line 14 to a computer and image processor 16. The video signals contain image information relating to the real objects imaged by the cameras in the object space.”).)

124. **Rationale and Motivation to Combine (Ground 1 Prior Art and Maguire)**. It would have been obvious to a person of ordinary skill in the art to incorporate Maguire’s teachings regarding using *two* head-mounted cameras with the head-mounted display taught by the combination of Fager and Martins. The combination would have involved the straightforward addition of a second camera,

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according to its established use as taught by Maguire, to the head-mounted display of Fager. The combination of Fager's multiplayer game, with one or more of the players wearing a head-mounted device comprising a stereoscopic camera pair as taught by Maguire, would have predictably resulted in **“a second camera and a third camera and the views of said second and third camera overlap”** as claimed. Under the proposed mapping, the “first” camera would correspond to a camera in the head-mounted device of a first player, and the claimed **“second camera”** and **“third camera”** would correspond to the camera pair in the head-mounted device of a second player.

125. Maguire is an analogous reference to the '791 patent. Like the '791 patent, Maguire is in the field of augmented reality. (Maguire, e.g., 2:35-42 (“‘[A]ctual’ images of actual objects in an object space, taken from a moving perspective of a viewer in the object space, are combined with retrieved images imitative of stationary or moving ‘virtual’ objects in the object space for providing the combined images to the viewer as if the retrieved images were also actual.”).) Moreover, Maguire would have been reasonably pertinent to problems facing the '791 patent inventor, including techniques for capturing video images of the user's physical surroundings for use in augmented reality.

126. A person of ordinary skill in the art would have been motivated to combine. The use of two cameras, each positioned near a user's eye and having

overlapping fields of view, was known to provide improved realism and depth perception. Maguire, for example, notes how “[v]arious stereoscopic television approaches have also been conceived or developed to increase realism.” (Maguire, 1:34-36.) Similarly, a 2000 paper by Masayuki Kanbara et al. entitled “A stereoscopic video see-through augmented reality system based on real-time vision-based registration” explains that “the stereoscopic video see-through HMD gives a good depth sensation to users and has improved the quality of augmented reality.” (EX1006, p.0014 (p.260, bottom right column).) A person of ordinary skill in the art would have appreciated that improved realism and depth perception would have been particularly advantageous for playing games involving depth perception such as tennis, and therefore particularly relevant and beneficial to Fager. Moreover, because Fager already discloses head-mounted displays comprising separate displays for each eye, a person of ordinary skill in the art would have regarded Maguire’s teachings as a natural fit for providing stereoscopic images to a user—e.g., each display would present the images captured by its respective camera. (Fager, ¶¶0069 (“[A] unit **12** for transferring stimuli is further included, which comprises two stimulation means, one for each eye,...each a means in the form of a LCD-display....”), 0077 (“Said device includes...two means **12** for transferring information to the eyesight, one for each eye....”).) A person of ordinary skill in the art therefore would have been motivated to incorporate two cameras having

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overlapping views into Fager's head-mounted displays.

127. A person of ordinary skill in the art would have had a reasonable expectation of success. As Maguire (and Kanbara) show, head-mounted display devices with stereoscopic cameras were known. The combination with Maguire therefore would have involved the straightforward incorporation of a second camera into a head-mounted display in accordance with known techniques.

V. NO SECONDARY CONSIDERATIONS OF NONOBVIOUSNESS

128. As explained in **Part III.B**, I understand that “secondary considerations” may be used as indicia of nonobviousness, provided that any such consideration has a nexus to the invention claimed. I understand from Petitioner’s counsel that Patent Owner in the related district court litigation has not yet identified any evidence related to secondary considerations with a nexus to the claimed invention. Nor am I aware of information, such as commercial success, unexplained results, long felt but unsolved need, industry acclaim, simultaneous invention, copying by others, skepticism by experts in the field, and failure of others, suggesting that the claims addressed in this Declaration are not obvious. To the extent Patent Owner later provides information it claims relates to secondary considerations, I reserve the right to supplement my analysis and opinions to comment on it.

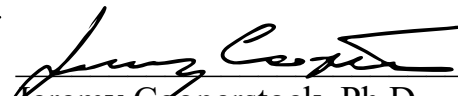
VI. CONCLUSION

129. In signing this Declaration, I recognize that the Declaration will be filed as evidence in a contested case before the Patent Trial and Appeal Board of the United States Patent and Trademark Office. I also recognize that I may be subject to cross-examination in this proceeding. If required, I will appear for cross-examination at the appropriate time. I reserve the right to offer opinions relevant to the invalidity of the challenged claims at issue and/or offer testimony in support of this Declaration.

130. I hereby declare that all statements made herein of my own knowledge are true and that all statements are made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. § 1001.

Dated: March 27, 2025

Respectfully submitted,


Jeremy Cooperstock, Ph.D.
Montreal, Quebec, Canada

APPENDIX A

CURRICULUM VITAE

Jeremy R. Cooperstock
Version as of March 24, 2025

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EDUCATION

Ph.D. Electrical and Computer Engineering, University of Toronto, 1996.
Thesis: “Reactive Environments and Augmented Media Spaces.”
(Nominated for NSERC Doctoral Dissertation Award)
Advisors: Prof. K.C. Smith and Prof. W. Buxton

M.Sc. Computer Science, University of Toronto, 1992.
Thesis: “Neural Network Operated Vision-Guided Mobile Robot Arm
for Docking and Reaching.” Advisor: Prof. E. Milios.

B.A.Sc. Electrical Engineering, Computer Engineering Option, University of
British Columbia, 1990 (Honours)

AWARDS AND DISTINCTIONS

2024	Best Poster Award, “Investigating Haptic Co-Creation with Reinforcement Learning”, Eurohaptics [CP1]
2024-2029	Werner Graupe Distinguished Chair in Automation Engineering, McGill University (\$15,000 plus research stipend of \$30,000 per annum)
2022	Honorable Mention, “The Sound of Hallucinations: Toward a more convincing emulation of internalized voices” (top 5% of papers), Human Factors in Computing Systems (CHI) [C5]
2022	Finalist, Best Applications Paper Award, “Speaking Haptically: from Phonemes to Phrases with a Mobile Haptic Communication System”, Transactions on Haptics [J4]
2019	Honorable Mention, “Detecting Perception of Smartphone Notifications using Skin Conductance Responses” (top 5% of papers), Human Factors in Computing Systems (CHI) [C34]
2019	San Diego Opera, Opera Hack award, Hamsafar! (\$10,000, with 5 co-awardees)
2018	Best poster presentation award, “Enhanced Pressure-Based Multi-modal Immersive Experiences”, Augmented Human [CP12]

2015	Gerald W. Farnell Teaching Scholar, Faculty of Engineering (\$12,500)
2014	US Ignite Best App in Education, Augmented Reality for Improved Training of First Responders
2013	Canadian National Institute for the Blind, Hochhausen Access Technology Research Award (\$10,000)
2013	Best paper award, “Vibrotactile Rendering of Splashing Fluids”, Transactions on Haptics [J17]
2013	Best use of sound award, “The Walking Straight Mobile Application: Helping the Visually Impaired Avoid Veering, International Conference on Auditory Displays [C62]
2012	Mozilla Foundation and NSF Gold Prize in the Mozilla Ignite Challenge (out of 305 submissions in the Brainstorming Round) (\$5,000) for Real-Time Emergency Response
2012	Canadian Internet Registry Association .CA Impact Award (Applications category) for In-Situ Audio Services Project (\$5,000)
2011	Best paper award, “What’s around me? Spatialized audio augmented reality for blind users with a smartphone”, Mobile and Ubiquitous Systems [C73]
2010	Best paper award, “Design of a Vibrotactile Display via a Rigid Surface”, Haptics Symposium [C82]
2009, 2010	Nominee, NSERC Brockhouse Canada Prize
2009	Best paper award, “SoundPark: Exploring Ubiquitous Computing through a Mixed Reality Multi-player Game Experiment”, 9e Conférence Internationale sur Les NOuvelles TEchnologies de la REpartition [C92]
2005	ACM/IEEE Supercomputing, Most Innovative Use of New Technology for Wide Screen Window on the World: Life Size HD Videoconferencing
2001	Audio Engineering Society Citation Award for pioneering the technology enabling collaborative multichannel performance over the broadband internet

WORK EXPERIENCE

CAREER HIGHLIGHTS

Haptic Information Delivery (2018-2021) My lab's haptics research has resulted in prominent visibility in the preeminent journal, IEEE Transactions on Haptics, and the two top-tier international conferences in the field, IEEE Haptics Symposium and IEEE World Haptics Conference, with a dozen publications in these forums between 2020 and 2021. Given my recognition in the field, I was invited to serve on the editorial boards of all of these bodies, in addition to the specialty section on haptics of the Frontiers Journal in Virtual Reality. Specific examples of significant contributions include the performance attained through use of our two-actuator apparatus and phonemic encoding for tactile communication of natural language [C31, J4, C9], which outperformed the previously cited best results on this task, achieved by Facebook Research Labs. A second contribution relates to the high recognition rates we attained for multi-dimensional tacton delivery (3 parameters, each at 3 levels), targeting clinical patient-monitoring scenarios. This work inspired studies of wearable vibrotactile devices for physiological monitoring of patients [C30, C19]. While our results were achieved initially using a set of three actuators [C44, C41, C32, C22], we subsequently demonstrated equivalent recognition performance via only a single vibrotactile actuator, with a novel parameter encoding scheme [C21]. We further demonstrated achievement of the highest information transfer rates reported in the literature for such a single-actuator device [C16].

Physiological Sensing (2017-2020) Our research for detection of smartphone notifications was recognized by an Honourable Mention (top 5% of papers) from the top-tier ACM Conference on Human Factors in Computing ([C34]), and led to a recent patent filing ([P1]). This work has the potential to serve as not only for more intelligent, context-sensitive notification delivery, but also, as a tool that can be exploited to combat the prevalent and adverse effects of Internet addiction, driven largely by “fear of missing out.”

Real-Time Emergency Response (rtER) (2012-2013) provides an envisionment of the future of next-generation 911 (NG-911) technologies, supporting enhanced situational awareness for first responders through the use of citizen-supplied smartphone video streams and other relevant data [J15]. Our work was recognized by the *Gold Prize* from the Mozilla Ignite Fund, featured on the web site of the White House Office of Science and Technology, and prompted the launch of a funding program by the U.S. Department of Justice.

Autour (2009-2018) is an “eyes-free” app for the blind, which provides a rich, spatialized audio representation of one's environment [J22, C73, C64, C61]. The project further motivated a rigorous analysis of smartphone sensor reliability, resulting in what was the first comprehensive examination of practical limits on smartphone sensors, including the problems of gyro drift [C64].

Mobile Treatment Device for Amblyopia (2009-2012, in collaboration with ophthalmologist R. Hess) is a patented prototype Mobile Treatment Device for Amblyopia [P10] (“lazy eye”). Initial trials [J21], based on the popular Tetris game, provided highly promising early results [J29, J24], not only restoring the use of both eyes in a majority of patients but even resulting in binocular (3D) depth perception in some. Most significantly, the treatment has been found to work successfully

on adult populations, whereas the prevailing wisdom had been that treatment was only possible on children. The technology has now been acquired by Novartis, who are commercializing the system.

Natural Interactive Walking (2008-2017) investigated multimodal interaction with virtual ground surfaces, resulting in important findings of tactile discrimination ability [J23] and the role of vibrotactile stimulation in perception of compliance [J30]. Our “Ecotile” prototype (patent [P7]) was showcased at numerous venues including SIGGRAPH, and led to related research involving limb modeling [C75, C59, C53], foot-water interaction [J17], and variable-friction walking interfaces [C69, C60, J8].

Ultra-Videoconferencing (2002-2006) is our low-latency, high-fidelity network transport, used for distance music teaching with Maestro Pinchas Zuckerman, cross-continental jazz jams, and remote sign language interpretation. The *Globe and Mail* described Cooperstock’s 2001 demonstration as “a watershed event for the elite club of the world’s computer network engineers.” Ultra-Videoconferencing garnered my research group a prestigious Citation Award from the Audio Engineering Society and the Award for Most Innovative Use of New Technology from ACM/IEEE Supercomputing (2005). This research directly constituted the basis for subsequent funding of \$2.2M from Valorisation Recherche Quebec and over \$4M from Canarie, and influenced the designs of similar telepresence videoconferencing systems from Cisco, HP, and Polycom. Our follow-up work on **Open Orchestra** (with HQP N. Bouillot, A. Olmos, T. Knight, M. Tomiyoshi), resulted in an immersive simulator for orchestral training, used by professional and semi-professional musicians [J20].

ACADEMIC EXPERIENCE

May 2024–present	McGill University, Montreal, QC Werner Graupe Distinguished Chair in Automation Engineering
Oct 2023–present	McGill University, Montreal, QC Associate Member, Biomedical Engineering
Dec 2022–present	McGill University, Montreal, QC Member, McGill Institute for Aerospace Engineering
May 2022–present	McGill University, Montreal, QC Member, International Laboratory on Learning Systems
Jan 2018–present	McGill University, Montreal, QC Full Professor, Electrical and Computer Engineering. Director, Shared Reality Lab Associate Member, Faculty of Music, Department of Theory Founding Member, Centre for Interdisciplinary Research in Music, Media and Technology Member, Centre for Intelligent Machines
Feb 2022–present	York University, Ontario Affiliate Member, Vision: Science to Applications (VISTA)
Sep 2018–Jun 2019	Technion–Israel Institute of Technology, Haifa, Israel Visiting Professor, Industrial Engineering and Management
Sep 2018–Jun 2019	IDC, Herzliya, Israel Visiting Professor, Department of Computer Science
May 2003–Dec 2017	McGill University, Montreal, QC Associate Professor, Electrical and Computer Engineering
Aug 2011–Jul 2012	University of Auckland, New Zealand Invited Professor, Department of Computer Science
May–June 2009	Bang & Olufsen, Denmark Visiting Professor, World Opera Project
Jan 2009–present	Bielefeld University, Germany Virtual Member, Center of Excellence Cognitive Interaction Technology (CITEC)
Feb 2008	Arizona State University Visiting Scholar, School of Arts, Media and Engineering
Sep 2004–Aug 2005	Université de Paris VI, Paris France Invited Professor, Laboratoire des Instruments et Systemes d'Ile-de-France
Nov 1997–May 2003	McGill University, Montreal, QC Assistant Professor, Electrical and Computer Engineering.

INDUSTRIAL AND CONSULTING EXPERIENCE

Sep 2019–Oct 2021	RedPill Canada VR, Montreal Director and Advisor
Apr–Jun 2019	(Confidential project as consulting expert) Providing expert report on topics concerning Human-Computer Interaction.
Aug–Nov 2014	Menya Solutions and DRDC-Valcartier Providing expert advice related to human-computer interfaces, visualization, and collaboration.
Aug 2012	Tamaggo Inc. Provide guidance and advice on digital imagery
May 2012	York University Review draft application to Canada Excellence Research Chairs program
May 2002 –Nov 2003	Solicitor General of Canada Media streaming configuration and user interface design.
May 2001	National Research Council Instructor of short course in Soft Computing, Institut des Matériaux Industriels.
Jan–Sep 1999	Audio Engineering Society Technical leader of demonstration of multichannel and multimedia audio distribution
Jan–Aug 1999	Ontario Science Center Scientific Director of Timescape Millenium Exhibit
Jul 1998	Nortel Instructor of short course in videoconferencing systems for the Nortel International SL-1 User's Association (ILUA), Long Beach
Sep 1996–Oct 1997	Sony Computer Science Laboratory Visiting Researcher, Sony Computer Science Laboratory, Tokyo, Japan. Developed speech-interface controlled VCR with visual tape database functionality. Wrote two patent applications, one filed.
Jun–Aug 1990	Fibronics Research Visiting Researcher, Fibronics Advanced Research Center, Haifa, Israel. Developed and tested an FDDI-to-token ring bridge.
May–Aug 1989	IBM T.J. Watson Research Center Research Intern, IBM T.J. Watson Research Center, Yorktown Heights, NY. Improved implementation of a VLIW architecture simulator.

LITIGATION AND EXPERT WITNESS EXPERIENCE

Parties I represented are marked by an asterisk.

Jan 2025–ongoing	Earin AB v. Skullcandy, Inc.* Case No. 1:24-cv-00275-RGA and related <i>Inter Partes</i> Review proceedings
Jan 2025–ongoing	Mullen Industries LLC v. Meta Platforms, Inc.* Case No. 1:24-cv-00354 (W.D. Tex.) and related <i>Inter Partes</i> Review proceedings of U.S. Patent Nos. 8,585,476, 9,662,582, 9,744,448, 10,179,277, 10,828,559, 10,974,151, 11,376,493, 11,904,243, 11,947,716, and 12,019,791
Jul–Oct 2024	Haptix Solutions LLC v. Microsoft Corp.* <i>Inter Partes</i> Review proceedings of U.S. Patent No. 8,253,686
Apr 2024–Jan 2025	e-Vision Smart Optics* v. various parties Litigation re U.S. Patent Nos. 8,708,483, 8,801,174, 8,905,541, 10,598,960, and 10,613,355
Jan–Apr 2024	Immersion Corp. v. Valve Corp.* Case No. 2-23-cv-00712 (W.D. Wash.) related to U.S. Patent Nos. 7,336,260, 8,749,507, 9,430,042, 9,116,546, 10,627,907, 10,665,067, and 11,175,738
Nov 2023–ongoing	Sitnet LLC v. Meta Platforms, Inc.* United States District Court, S.D. New York, Case No. 1:23-cv-6389 (AS) and related <i>Inter Partes</i> Review proceedings of U.S. Patent Nos. 8,249,932, 8,332,454, 9,877,345, and 11,470,682. Deposition testimony on expert report
Aug 2023–ongoing	NEC Corporation* v. Peloton Interactive, Inc. et al. United States District Court, District of Delaware, Case No. 1:2022cv00987 and related <i>Inter Partes</i> Review proceedings of U.S. Patent Nos. 9,769,427 and 8,752,101. Deposition testimony on expert reports (3 depositions)
Aug 2023–ongoing	Resonant Systems, Inc. d/b/a RevelHMI v. Samsung Electronics Co., Ltd.* et al. United States District Court, Eastern District of Texas, Case No. 2:22-cv-00423-JRG
May 2023–Dec 2024	LoganTree LP v. Fossil Group, Inc.* United States District Court, District of Delaware Case No. 1:21-cv-00385-JDW and related <i>Inter Partes</i> Review proceedings. Deposition testimony on expert reports (2 depositions)
Feb–May 2023	Immersion Corp. v. Meta Platforms, Inc.* United States District Court, Western District of Texas Case No. 6:22-cv-00541-ADA and related <i>Inter Partes</i> Review proceedings of U.S. Patent Nos. 8,469,806, 8,896,524, 9,727,217, 10,248,298, 10,269,222, and 10,664,143

Feb–May 2023	Playvuu, Inc. v. Snap Inc.* United States District Court, Central District of California Case No. 2:22-cv-06019. Involved in litigation matters related to U.S. Patent No. 10,931,911.
Sep 2022	Apple* v. Taction Technologies, Inc. Retained for <i>Reexamination Requests</i> of U.S. Patent Nos. 10,659,885 and 10,820,117 in the United States Patent and Trademark Office.
Aug 2022–Jun 2024	Westwood One, LLC v. Local Radio Networks, LLC* United States District Court, Northern District of Indiana, Case No. 1:21-cv-00088-HAB-SLC. Involved in litigation matters related to U.S. Patent Nos. 7,412,203 and 7,860,448
Jan–May 2022	Peloton Interactive v. iFIT Inc. f/k/a ICON Health & Fitness* United States District Court, District of Delaware, Civil Action No. 20-cv-1386-RGA. Prepared reports on patent invalidity and non-infringement.
Sep 2021–ongoing	Brazos* v. Google United States District Court, Western District of Texas Waco Division, Case Nos. 6:20-CV-00571-ADA through 6:20-CV-00585-ADA. Deposition testimony on expert reports (2 depositions)
Sep 2021–Aug 2022	Allstate Insurance Co. v. Atos LLC* Involved in <i>Inter Partes</i> Review, IPR2021-01118, of U.S. Patent No. 8,527,140, covering smartphone-based vehicle operation detection. Deposition testimony on expert report.
Jan 2021–Apr 2022	GUI Global Products, Ltd. v. Apple* United States District Court, Southern District of Texas, Case No. 4:20-cv-2652 and <i>Inter Partes</i> Review of U.S. Patent Nos. 10,259,020, 10,259,021, 10,562,077, and 10,589,320 in the United States Patent and Trademark Office. Deposition testimony on expert reports (2 depositions)
Dec 2020–Feb 2021	Expert consultation re possible litigation in IT-related matter Work done on behalf of Sheridan Ross P.C.
Nov 2020–Jun 2022	Koss v. Apple* United States District Court, Western District of Texas Civil Action No. 6:20-cv-00665. Involved in <i>Inter Partes</i> Review of U.S. Patent Nos. 10,206,025, 10,469,934, 10,506,325, 10,491,982, and 10,298,451 before the United States Patent and Trademark Office. Deposition testimony on expert reports (4 depositions).
Oct 2020–Oct 2021	Triller v. ByteDance* and TikTok* <i>Inter Partes</i> Review of U.S. Patent No. 9,691,429 before the United States Patent and Trademark Office. Deposition testimony on expert report.

Sep 2020–Jan 2023	Content Square v. Quantum Metric* and Decibel Insight* United States District Court, Massachusetts District Court, Case No. 1-20-cv-11184 and Delaware District Court, Case No. 20-cv-00832. Involved in invalidity arguments and petitions for <i>Inter Partes</i> Review. Deposition testimony on expert reports (5 depositions).
Sep 2020	Wiesel v. Apple* United States District Court, Eastern District of New York, Case No. 1:19-cv-7261. Engaged for source code review of products related to the Apple Watch (case presently stayed).
Aug–Oct 2020	Finish Time* v. Garmin United States District Court, District of Maine, Case No. 2:20-cv-00184. Involved in review of infringement arguments, discovery, related to fitness applications.
Dec 2019–Nov 2022	Pinn v. Apple* United States District Court, Central District of California, Case No. 8:19-cv1805, <i>Inter Partes</i> Review IPR2020-00999, Post Grant Review PGR2020-00066 and PGR2020-00073. Involved in preparation of expert witness declarations, code analysis involving multiple products related to earbuds and charging circuitry. Deposition testimony on expert reports, in-court trial testimony.
Oct 2019	Qualcomm v. Apple* <i>Inter Partes</i> Review, IPR2018-01279. Deposition testimony on expert witness declaration related to multimedia messaging.
Mar 2019–Feb 2022	Cruz Hernandez* v. Air Canada and Lufthansa Canadian Transportation Agency Case no. 20-01712, Petitioner before the Agency regarding passengers' rights to compensation under EC 261/2014
May 2018–May 2019	Immersion Incorporated v. Samsung Inc.* Civil Action No. 2:18-cv-00055 in the Eastern District of Texas and <i>Inter Partes</i> Review, IPR2018-01499. Consulted on technical details and involved in preparation of two expert witness declarations related to haptic feedback effects and force feedback in a multimodal system. (Patent Nos. 6,429,846, 7,969,288, 7,982,720, 8,031,181, 9,323,332 and 8,619,051)
May 2016–Nov 2017	Cooperstock* v. Air Canada Petitioner before the Canadian Transportation Agency. Brought successful complaint against Air Canada for the airline's making false or misleading statements to the public, Decision No. 105-C-A-2017 (otc-cta.gc.ca/eng/ruling/105-c-a-2017)
Jan–May 2014	St. Lewis v. Rancourt* Provided expert report on web server location, Ontario Superior Court File No. 11-51657

Mar–Sep 2013	Cooperstock* v. United Airlines Brought and argued successful appeal regarding anti-SLAPP legislation before the Quebec Court of Appeal, Decision 2013 QCCA 1670 (goo.gl/pgz301). Argued appeal in person (September 26, 2013)
Nov 2012–Aug 2017	United Airlines v. Cooperstock* Pro se litigant, Federal Court File No. T-2084-12. Deposition as litigant (August 2013) and testified at trial (December 2016).
Nov 2012–Jan 2017	United Airlines v. Cooperstock* Pro se litigant, Quebec Superior Court File No. 500-17-074743-124. Deposition as litigant (October 2014) and testified at trial (April 2016).
Sep 2012	Lukács* v. Air Canada Provided expert report on database query and execution times, Canadian Transportation Agency File No. M4120-3/11-06673, Decision No. 204-C-A-2013
May 2007–Jan 2008	Market Maker c. Brim Solutions* Provided expert witness report and in-court testimony (October 2007) on software-related intellectual property case. Quebec Superior Court File No. 500-17-036750-076.
Feb–Oct 2004	Crawford Adjusters Canada Provided analysis of artifacts in high definition video
Jul 2002–May 2016	Court of Quebec, Small Claims Division Brought 14 consumer rights complaints before the Court, 11 of which were successful

RESEARCH DISSEMINATION

Notes on publication strategy: In my research field, papers in the ACM CHI (H5-index=87), UIST (H5-index=46), DIS (H5-index=33), and Mobile HCI (H5-index=28) conferences are considered to be top-tier, archival publications, competitive with the top HCI journals in terms of impact and visibility. Overall acceptance rates for these conferences are typically in the 20-25% range. As a measure of research impact, my publications have garnered ~5800 citations to date ([Google Scholar](#)) with more one third since 2019, an h-index of 39, and i10-index of 115. HQP under my supervision (names in bold) are typically given first authorship on co-authored work.

ARTICLES IN REFEREED PUBLICATIONS

- [J1] **A. Talhan, Y. Yoo**, and J. R. Cooperstock. “Soft Pneumatic Haptic Wearable to Create the Illusion of Human Touch.” In: *IEEE Transactions on Haptics* 17.2 (June 2024), pp. 177–190. DOI: [10.1109/TOH.2023.3305495](https://doi.org/10.1109/TOH.2023.3305495). URL: <https://ieeexplore.ieee.org/document/10219022>.
- [J2] **J. Regimbal, J. R. Blum, C. Kuo**, and J. R. Cooperstock. “IMAGE: An Open-Source, Extensible Framework for Deploying Accessible Audio and Haptic Renderings of Web Graphics.” In: *ACM Transactions on Accessible Computing* (2024). DOI: [10.1145/3665223](https://doi.org/10.1145/3665223). URL: <https://dl.acm.org/doi/10.1145/3665223>.
- [J3] **N. Duarte**, R. K. Arora, G. Bennett, M. Wang, M. P. Snyder, J. R. Cooperstock, and C. E. Wagner. “Deploying wearable sensors for pandemic mitigation: a counterfactual modelling study of Canada’s second COVID-19 wave.” In: *PLOS Digital Health* PDIG-D-22-00126R1 (Sept. 2022). DOI: [10.1371/journal.pdig.0000100](https://doi.org/10.1371/journal.pdig.0000100). URL: <https://journals.plos.org/digitalhealth/article?id=10.1371/journal.pdig.0000100>.
- [J4] **M. F. de Vargas, D. Marino, A. Weill–Duflos**, and J. R. Cooperstock. “Speaking Haptically: from Phonemes to Phrases with a Mobile Haptic Communication System.” In: *Transactions on Haptics* 14.3 (July 2021), pp. 479–490. DOI: [10.1109/TOH.2021.3054812](https://doi.org/10.1109/TOH.2021.3054812). URL: <https://ieeexplore.ieee.org/document/9337220>. 🏆 Finalist, Best Applications Paper Award.
- [J5] **P. Vyas, F. Al-Taha, J. R. Blum, A. Weill–Duflos**, and J. R. Cooperstock. “Ten Little Fingers, Ten Little Toes: Can Toes Match Fingers for Haptic Discrimination?” In: *Transactions on Haptics* 13.1 (2020). DOI: [10.1109/TOH.2020.2966969](https://doi.org/10.1109/TOH.2020.2966969). URL: <https://ieeexplore.ieee.org/document/8960637>. Also presented at Haptics Symposium 2020.
- [J6] **E. Sulmont**, E. Patitsas, and J. R. Cooperstock. “What Is Hard About Teaching Machine Learning to Non-Majors? Insights From Classifying Instructors’ Learning Goals.” In: *Transactions on Computing Education, Special Issue on Machine Learning Education* 19.4 (Aug. 2019). DOI: [10.1145/3336124](https://doi.org/10.1145/3336124). URL: <http://dl.acm.org/authorize?N682238>.

- [J7] **J. Blum, P. Fortin, F. Al-Taha, P. Alirezaee, M. Demers, A. Weill–Duflos,** and J. R. Cooperstock. “Getting Your Hands Dirty Outside the Lab: A Practical Primer for Conducting Wearable Vibrotactile Haptics Research.” In: *IEEE Transactions on Haptics, Special Issue on Wearable and Hand-held Haptics* 12.3 (July 2019), pp. 232–246. DOI: [10.1109/TOH.2019.2930608](https://doi.org/10.1109/TOH.2019.2930608). URL: <https://ieeexplore.ieee.org/document/8770138>.
- [J8] **G. Millet, M. Otis, D. Horodniczy,** and J. R. Cooperstock. “Design of Variable-Friction Devices for Shoe-Floor Contact.” In: *Mechatronics* 46 (2017), pp. 115–125. DOI: [10.1016/j.mechatronics.2017.07.005](https://doi.org/10.1016/j.mechatronics.2017.07.005). URL: <https://www.sciencedirect.com/science/article/abs/pii/S0957415817301034>.
- [J9] **P. Fortin** and J. R. Cooperstock. “Laughter and Tickles: Toward Novel Approaches for Emotion and Behavior Elicitation.” In: *IEEE Transactions on Affective Computing* 8.4 (2017). TAFFCSI-2016-07-0124.R1, pp. 508–521. DOI: [10.1109/TAFFC.2017.2757491](https://doi.org/10.1109/TAFFC.2017.2757491). URL: <http://ieeexplore.ieee.org/document/8052511/>.
- [J10] E. Aguilera, J. J. Lopez, and J. R. Cooperstock. “Spatial Audio for Audioconferencing in Mobile Devices: Investigating the Importance of Virtual Mobility and Private Communication and Optimizations.” In: *Journal of the Audio Engineering Society* 64.5 (May 2016), pp. 332–341. DOI: [10.17743/jaes.2016.0009](https://doi.org/10.17743/jaes.2016.0009). URL: <http://www.aes.org/e-lib/browse.cfm?elib=18138>.
- [J11] **D. El-Shimy** and J. R. Cooperstock. “User-Driven Techniques for the Design and Evaluation of New Musical Interfaces.” In: *Computer Music Journal* 40.2 (2016), pp. 35–46. DOI: [10.1162/COMJ_a_00357](https://doi.org/10.1162/COMJ_a_00357). URL: http://www.mitpressjournals.org/doi/pdf/10.1162/COMJ_a_00357.
- [J12] **F. Tordini,** A. Bregman, and J. R. Cooperstock. “Prioritizing foreground selection of natural chirp sounds by tempo and spectral centroid.” In: *Multimodal User Interfaces, Special Issue on Auditory Display* 10.3 (Sept. 2016). Ed. by B. Katz and G. Marentakis, pp. 221–234. DOI: [10.1007/s12193-016-0223-x](https://doi.org/10.1007/s12193-016-0223-x). URL: <http://link.springer.com/article/10.1007%2Fs12193-016-0223-x>.
- [J13] R. F. Hess, **L. To,** J. Zhou, **G. Wang,** and J. Cooperstock. “3D Vision: the haves and havenots.” In: *i-Perception* 6.3 (July 2015). DOI: [10.1177/2041669515593028](https://doi.org/10.1177/2041669515593028). URL: <http://ipe.sagepub.com/content/6/3/2041669515593028.full.pdf+html>.
- [J14] **N. Hieda** and J. R. Cooperstock. “Digital Facial Augmentation for Interactive Entertainment.” In: *EAI Endorsed Transactions on e-Learning* 15.8 (Aug. 2015). DOI: [10.4108/icst.intetain.2015.259444](https://doi.org/10.4108/icst.intetain.2015.259444). URL: <https://eudl.eu/doi/10.4108/icst.intetain.2015.259444>.
- [J15] **J. Blum, A. Eichhorn, S. Smith, M. Sterle-Contala,** and J. R. Cooperstock. “Real-Time Emergency Response: Improved Management of Real-Time Information During Crisis Situations.” In: *Multimodal User Interfaces* 8.2 (July 2014). JMUI-D-13-00047R3, pp. 161–173. DOI: [10.1007/s12193-013-0139-7](https://doi.org/10.1007/s12193-013-0139-7). URL: <https://link.springer.com/article/10.1007/s12193-013-0139-7>.
- [J16] **D. Dansereau,** N. Brock, and J. R. Cooperstock. “A Particle Filter for Predicting an Orchestral Conductor’s Baton Movements.” In: *Computer Music J.* 37.2 (Apr. 2013), pp. 28–45. URL: http://www.mitpressjournals.org/doi/pdf/10.1162/COMJ_a_00173.

- [J17] **G. Cirio**, M. Marchal, A. Lécuyer, and J. R. Cooperstock. “Vibrotactile Rendering of Splashing Fluids.” In: *Transactions on Haptics* 6.1 (May 2013), pp. 117–122. URL: http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=6226398. 🏆 Best paper award.
- [J18] F. Grond, **A. Olmos**, and J. Cooperstock. “Making Sculptures Audible through Participatory Sound Design (Artists’ statement).” In: *Leonardo Music J.* 23 (Dec. 2013), pp. 12–13. DOI: [doi:10.1162/LMJ_a_00140](https://doi.org/10.1162/LMJ_a_00140). URL: <https://srl.mcgill.ca/publications/2013-LEONARDO.pdf>.
- [J19] **S. Pelletier** and J. R. Cooperstock. “Real-time free viewpoint video from a range sensor and color cameras.” In: *Machine Vision and Applications* 24.4 (May 2013), pp. 739–751. URL: <http://link.springer.com/article/10.1007%2Fs00138-012-0428-2>.
- [J20] **A. Olmos**, **N. Bouillot**, **T. Knight**, **N. Mabire**, **J. Redel**, and J. R. Cooperstock. “A High-Fidelity Orchestra Simulator for Individual Musicians’ Practice.” In: *Computer Music Journal* 36.2 (2012), pp. 55–73. URL: http://www.mitpressjournals.org/doi/pdf/10.1162/COMJ_a_00119.
- [J21] J. M. Black, R. F. Hess, J. R. Cooperstock, **L. To**, and B. Thompson. “The measurement and treatment of suppression in amblyopia.” In: *Visualized Experiments* 14.70 (Dec. 2012). DOI: [10.3791/3927](https://doi.org/10.3791/3927). URL: <http://www.jove.com/video/3927/the-measurement-and-treatment-of-suppression-in-amblyopia>.
- [J22] **D. El-Shimy**, F. Grond, **A. Olmos**, and J. R. Cooperstock. “Eyes-Free Environmental Awareness for Navigation.” In: *Multimodal User Interfaces, Special Issue on Interactive Sonification* 5.3-4 (2012), pp. 131–141. DOI: [10.1007/s12193-011-0065-5](https://doi.org/10.1007/s12193-011-0065-5). URL: <http://www.springerlink.com/content/857h542884084ql2/>.
- [J23] B. L. Giordano, **Y. Visell**, H. Yao, V. Hayward, J. R. Cooperstock, and S. McAdams. “Identification of walked-upon materials in auditory, kinesthetic, haptic and audio-haptic conditions.” In: *Acoustical Society of America* 131.5 (May 2012). URL: <https://srl.mcgill.ca/publications/2012-JASA.pdf>.
- [J24] R. F. Hess, B. Thompson, J. M. Black, G. Maehara, P. Zhang, W. R. Bobier, **L. To**, and J. R. Cooperstock. “An iPod treatment for amblyopia: An updated binocular approach.” In: *Optometry* 83.2 (Feb. 2012), pp. 87–94. URL: <http://www.ncbi.nlm.nih.gov/pubmed/23231369>.
- [J25] **J. Blum**, **M. Bouchard**, and J. R. Cooperstock. “Spatialized audio environmental awareness for blind users with a smartphone.” In: *Mobile Networks and Applications* 18.3 (Dec. 2012), pp. 295–309. DOI: [10.1007/s11036-012-0425-8](https://doi.org/10.1007/s11036-012-0425-8). URL: <https://srl.mcgill.ca/publications/2012-MONET.pdf>.
- [J26] **S. Pelletier** and J. R. Cooperstock. “Preconditioning for Edge-Preserving Image Super-Resolution.” In: *IEEE Transactions on Image Processing* 21.1 (June 2012), pp. 67–79. URL: <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=5898412>.
- [J27] **Z. Qi** and J. R. Cooperstock. “Toward Dynamic Image Mosaic Generation With Robustness to Parallax.” In: *IEEE Transactions on Image Processing* 21.1 (Jan. 2012), pp. 366–378. URL: <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=5959979>.

- [J28] J. R. Cooperstock. “Multimodal Telepresence Systems: Supporting Demanding Collaborative Human Activities.” In: *IEEE Signal Processing* 28.1 (Jan. 2011). special issue on Immersive Communications, pp. 77–86. DOI: [10.1109/MSP.2010.939040](https://doi.org/10.1109/MSP.2010.939040).
- [J29] **L. To**, B. Thompson, **J.R. Blum**, G. Maehara, R. Hess, and J. R. Cooperstock. “A game platform for treatment of amblyopia.” In: *IEEE Transactions on Neural Systems and Rehabilitation Engineering* 19.3 (Feb. 2011), pp. 280–289. URL: <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=5713843>.
- [J30] **Y. Visell**, B. Giordano, **G. Millet**, and J. R. Cooperstock. “Vibration Influences Haptic Perception of Surface Compliance During Walking.” In: *PLoS ONE* 6.3:e17697 (Mar. 2011). DOI: [doi:10.1371/journal.pone.0017697](https://doi.org/10.1371/journal.pone.0017697). URL: <http://dx.plos.org/10.1371/journal.pone.0017697>.
- [J31] **R. Pellerin**, **N. Bouillot**, **T. Pietkiewicz**, M. Wozniowski, Z. Settel, E. Gressier-Soudan, and J. R. Cooperstock. “SoundPark: Exploring Ubiquitous Computing through a Mixed Reality Multi-player Game Experiment.” In: *Studia Informatica Universalis* 8.3 (2010). Special Issue: Best Papers from NOTERE 2009, 21 pages. URL: <https://srl.mcgill.ca/publications/2009-NOTERE.pdf>.
- [J32] R. H. Ellaway, D. Topps, K. Lachapelle, and J. R. Cooperstock. “Integrating Simulation Devices and Systems.” In: *Studies in Health Technology and Informatics* 142 (Jan. 2009). Ed. by J. D. Westwood, S. W. Westwood, R. S. Haluck, H. M. Hoffman, G. T. Mogel, R. Phillips, R. A. Robb, and K. G. Vosburgh, pp. 88–90. URL: <https://srl.mcgill.ca/publications/2009-MMVR-Ellaway.pdf>.
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- [N15] J. Cooperstock. “Classroom of the Future: Enhancing Education through Augmented Reality.” In: *HCI International, Conference on Human-Computer Interaction (invited)*. New Orleans, 2001.
- [N16] **Sud, D., Cayouette, F., Gu, J.,** and J. Cooperstock. “McGill Reddogs Final Report.” In: *Robocup*. 2001.
- [N17] A. Saroyan, R. Harris, and J. R. Cooperstock. *Applying pedagogical principles to teaching and learning with technology*. Multi-cultural perspectives on the use of technology in education. Montreal, QC, Canada, 2000. URL: <http://www.education.mcgill.ca/NAFTA>.

PATENTS

- [P1] **P. Fortin**, S. Kim, and J. R. Cooperstock. “Closed-loop XR Stimulus Presentation and Perception Feedback using Multi-Channel Physiological Signals.” US12032740B2 (United States). July 2024.
- [P2] **D. Marino, M. Henry, P. Fortin,** and J. R. Cooperstock. “System and method for displaying reaction animations.” US application 18/463,799 (United States). 2023.
- [P3] **H. Lee, C. Ducher, R. Wang, M. Henry,** and J. R. Cooperstock. “Voice Parameter Determination Method, System and Device.” US application 18/310,213; Canada application 3,198,267 (United States). 2023.
- [P4] **P. Fortin, J. Blum, Antoine Weill-Duflos,** and J. R. Cooperstock. “System and Method for Wearable Device Contact Force Estimation and Adjustment Feedback.” application US 20230129166 A1 (United States). 2022.
- [P5] J. R. Cooperstock, **A. Weill-Duflos, J. Regimbal, N. Radi, J. Blum, P. Alirezadee,** and **Y. Zhang**. “Methods and systems for controlling a haptic display.” US 63/006,141, PCT/CA2021/050461, US 17/917,761 (United States). 2021.
- [P6] J. R. Cooperstock and **J. Blum**. “Improving Haptic Feedback on Wearable Devices through Accelerometer Measurements.” provisional application US 62/237,772; US 62/416,910 (United States). 2015.

- [P7] J. R. Cooperstock, **Y. Visell**, **A. Law**, and K. Franinovic. “Floor-based Haptic Communication System.” US 9,041,521 (United States). May 2015.
- [P8] J. R. Cooperstock, **J. Blum**, **M. Bouchard**, **A. Olmos**, **S. Panëels**, and **D. El-Shimy**. “Spatialized audio augmented reality for blind users with a smartphone.” provisional application US 61/727,828 (expired) (United States). 2012.
- [P9] J. R. Cooperstock, **G. Millet**, and **M. Otis**. “Floor-Based Variable Friction Display.” provisional application US 61/577,148 (expired) (United States). 2011.
- [P10] J. R. Cooperstock, **L. To**, and R. Hess. “Binocular vision assessment and/or therapy.” US 8,066,372 (United States). Nov. 2011.
- [P11] **S. Spackman**, **S. Pelletier**, and J. R. Cooperstock. “High-resolution Video Synthesis.” application 2,435,791 filed July 24, 2003 (expired) (Canada). 2003.
- [P12] J. R. Cooperstock, **Y. Zhang**, and **S. Spackman**. “Adaptive Compression for the Storage, Transmission, and Arbitrary Quality Reconstruction of Spatial Data.” US 60/339,816, provisional application filed Dec. 17, 2001 (expired) (United States). 2001.
- [P13] J. R. Cooperstock and **S. Arseneau**. “A robust person tracking method and system.” US 60/234,197 provisional application, filed Sept. 20, 2000 (expired) (United States). 2000.
- [P14] J. R. Cooperstock. “Pixel Count-Sensitive PDA Tool Mechanism with Cut/Paste and/or Copy/Paste Function.” P09-022797, filed in Japan by Sony Corp. (Japan). Feb. 1997.

TECHNOLOGY TRANSFER

License agreement signed in 2014 with amblyotech.com to commercialize amblyopia treatment (protected under US patent 8,066,372 “Binocular vision assessment and/or therapy”). The technology was subsequently [acquired by Novartis](#) in April 2020.

RESEARCH DEMONSTRATIONS

- [D1] 3D Printed Haptic Illusions and Demonstrations. IEEE World Haptics, Tokyo, Japan (conducted by Antoine Weill-Duflos and Pascal Fortin), July 2019.
- [D2] Distributed Musical Practice and Performance, I Medici di McGill, Oscar Peterson Hall, Montreal, April 28, 2008.
- [D3] Wide Screen Window on the World: Life Size HD Videoconferencing. Supercomputing 2005, Bandwidth Challenge, Seattle, November 16, 2005.
- [D4] Streaming DSD Audio comes to the AES. Audio Engineering Society 117th Convention, San Francisco, October 31, 2004.
- [D5] Cross-continental low-latency ultra-videoconferencing. McGill-Stanford jazz jam, June 13, 2002.
- [D6] Remote master’s class using SDI video and multichannel audio. McGill-National Research Council session with Pinchas Zukerman, March 25, 2002.

[D7] SDI video and multichannel audio. CANARIE's 7th Advanced Networks Workshop, Toronto, November 28, 2001.

[D8] Low-latency distributed violin duet in full-frame video. RISQ 2001 Conference, Montreal, November 5, 2001.

The Globe and Mail noted that *"Cooperstock's demonstration was a watershed event for the elite club of the world's computer network engineers. No one had ever before been able to demonstrate that, under the right conditions, it is possible for natural, normal human interaction to occur over the Internet."*

[D9] The Recording Studio that Spans a Continent. Audio Engineering Society 109th Convention, Los Angeles, September 23, 2000.

The Audio Engineering Society noted that this *"Landmark demonstration shows cost effective and high performance transmission systems for high quality 24-bit, 96kHz uncompressed multichannel audio are on horizon"*

[D10] Dolby Digital 5.1 audio with MPEG-2 video around the world. Internet Global Summit INET 2000 Conference, Yokohama, July 20, 2000.

CBC Radio noted that *"McGill University in Montreal has made Internet history by setting up the first intercontinental netcast of a live concert in surround sound and full-screen video."*

[D11] Dolby Digital 5.1 audio with MPEG-2 video. CANARIE's 5th Advanced Networks Workshop, Toronto, November 29, 1999.

[D12] First real-time Multichannel Audio Internet demo. Audio Engineering Society 107th Convention, New York, September 26, 1999.

The Learning Technologies Networked noted that *"The performance marked the first real time multichannel audio Internet transmission, a feat made possible by software developed at McGill University by a team under the leadership of Professor Jeremy Cooperstock."*

INVITED TALKS

Invited Talks to Industry, Students, and the Public

[T1] "HCI Research in the Shared Reality Lab", Professor Speaker Series, Electrical, Computer & Software Engineering Students' Society of McGill University, Montreal, November 8, 2024.

[T2] "AI Digital Nurse Avatar", Place Kensington Retirement Home, Montreal, September 12, 2024.

[T3] "HCI Research in the Shared Reality Lab", Marianopolis Engineering Society, Marianopolis College, Montreal, November 21, 2023.

[T4] "HCI Research in the Shared Reality Lab", Professor Speaker Series, Electrical, Computer & Software Engineering Students' Society of McGill University, Montreal, November 15, 2023.

[T5] "Engineering of Technologies to Improve the Lives of People Living with Vision Loss", Bio-engineering and Biomedical Engineering, McGill University, September 15, 2023.

- [T6] “Using smartphones to answer ‘What’s around me?’, ‘Am I crossing the street safely?’ and ‘Where’s the entrance?’”, Accessible Coding Demonstrations for Youth with Visual Impairment, Science Odyssey 2021, May 1, 2021.
- [T7] “From flight simulators to the passenger experience: what can we learn from pilot-training tools to improve airline customer service”, AIST–NRC Collaboration Meeting on Improving Client-Agent Interaction, January 17, 2020.
- [T8] “I Feel the Earth Move (Under My Feet): Haptic Interaction for Telepresence and Information Delivery”, Department of Information Engineering and Computer Science, University of Trento, July 4, 2019.
- [T9] “I Feel the Earth Move (Under My Feet): Haptic Interaction for Telepresence and Information Delivery”, Department of Industrial Engineering and Management, Ben Gurion University, March 11, 2019.
- [T10] “I Feel the Earth Move (Under My Feet): Haptic Interaction for Telepresence and Information Delivery”, Information Systems, University of Haifa, November 7, 2018.
- [T11] “What’s around me? Audio augmented reality for blind users with a smartphone, Pint of Science, Montreal, May 15, 2018.
- [T12] Presenter at Canadian National Institute for the Blind’s TechnoVision+ Conference, Montreal, May 5, 2017.
- [T13] “Innovations for Gaming, AR, Simulation & Training”, Innovations for gaming, augmented reality, simulation and training, and other applications, Centre d’entreprises et d’innovation de Montreal (CEIM), April 8, 2016.
- [T14] “Enhanced Human: Wearable computing that transforms how we perceive and interact with our world”, Department of Computer Science, Technion–Israel Institute of Technology, February 11, 2016.
- [T15] “Is Humanity Smart Enough for AI?”, McGill Science Outreach Program, Freaky Friday public outreach lecture, October 23, 2015.
- [T16] “Delivering a Compelling User Experience in a Computer-Mediated Environment”, HCIN 5300, Interactive Entertainment Technologies, Carleton University, March 7, 2014.
- [T17] “Multimedia as a Building Block: How audio, video and haptics integrate in a Shared Reality”, Multimedia Systems, GLIS 633, School of Information Studies, McGill University, February 13, 2014.
- [T18] “Are we there yet? Cognitive Science Challenges in Telepresence and Virtual Reality”, Student Association of Cognitive Science, Cognitive Science Research Day, McGill University, November 13, 2013.
- [T19] “Telepresence doesn’t quite cut it: Multimodal Challenges in Virtual and Shared Reality”, Institute of Telecommunications and Multimedia Applications, Universidad Politècnica de València, July 10, 2013.

- [T20] “Telepresence doesn’t quite cut it: Multimodal Challenges in Virtual and Shared Reality”, Dawson College, First Choice Science speakers series, April 17, 2013.
- [T21] “Dangerous AI or dangerous us?”, Academia Week Artificial Intelligence event, Science Undergraduate Society, McGill University, January 24, 2013.
- [T22] “They don’t use Skype on the Holodeck”, Department of Computer Science, University of British Columbia, July 4, 2012.
- [T23] “But can the Holodeck do a good Shiraz?”, School of Computer Science and IT, Royal Melbourne Institute of Technology, February 17, 2012.
- [T24] “But can the Holodeck do a good Shiraz?”, School of Information Technologies, University of Sydney, February 15, 2012.
- [T25] “Distributed Music Performance and Latency Issues”, School of Drama, Fine Art and Music, University of Newcastle (Australia), February 13, 2012.
- [T26] “But can the Holodeck do a good Pinot noir?”, Department of Computer Science, University of Otago, January 23, 2012.
- [T27] “Shared Reality: Toward perceptually convincing computer-mediated environments”, Department of Computer Science, University of Auckland, August 25, 2011.
- [T28] “This is your brain on Shared Reality: Toward perceptually convincing computed-mediated environments”, Vanier College, Science Week Presentation, March 24, 2011.
- [T29] “This is your brain on Shared Reality: Toward perceptually convincing computed-mediated environments”, Simula Lab, Oslo, May 15, 2009.
- [T30] “This is your brain on Shared Reality: Toward perceptually convincing computed-mediated environments”, Ambient Intelligence Group, CITEC, Bielefeld University, May 6, 2009.
- [T31] “Distributed and Multimodal Interaction in Virtual and Augmented Reality Environments”, McGill University, School of Physical and Occupational Therapy, November 25, 2008.
- [T32] “Shared Reality: Effective Interaction for (Demanding) Distributed Tasks”, University of Victoria, September 16, 2008.
- [T33] “Bidirectional video communication for real-time applications”, Institut für Telematik, University of Lübeck, Germany, May 15, 2008.
- [T34] “Shared Reality: Effective Interaction for (Demanding) Distributed Tasks”, Aalborg University, Esbjerg, Denmark, May 14, 2008.
- [T35] “Distributed Multimodal Interaction”, Bang & Olufsen, Struer, Denmark, May 13, 2008.
- [T36] “Distributed Musical Practice and Performance”, Biology and Music Lecture, I Medici di McGill, April 28, 2008.

- [T37] “Shared Reality: Effective Interaction for (Demanding) Distributed Tasks”, Arts, Media and Engineering, Arizona State University, February 29, 2008
- [T38] “From Videoconferencing to Shared Reality” Department of Electrical and Computer Engineering, University of British Columbia, October 4, 2007.
- [T39] “Engaging Technolog(ies) for Effective Interaction” Department of Computer Science, Hebrew University of Jerusalem, April 19, 2005.
- [T40] “Engaging Technolog(ies) for Effective Interaction” Intelligence, Agents, Multimedia Group, University of Southampton, UK, March 7, 2005.
- [T41] “From Videoconferencing to Shared Reality” l’Institut de Recherche et Coordination Acoustique/Musique (IRCAM), Paris, November 25, 2004.
- [T42] “From Videoconferencing to Shared Reality” Taiyuan University, Taiyuan, China, April 18, 2004.
- [T43] “From Videoconferencing to Shared Reality” Tsinghua University, Beijing, China, April 14, 2004.
- [T44] “From Videoconferencing to Shared Reality” Beijing University, Beijing, China, April 14, 2004.
- [T45] “From Videoconferencing to Shared Reality” Beihang University, Beijing, China, April 12, 2004.
- [T46] “From Videoconferencing to Shared Reality” Advanced Telecommunications Research (ATR), Nara, Japan, April 9, 2004.
- [T47] “From Videoconferencing to Shared Reality” Dept. of Industrial Engineering, Musashi Institute of Technology, April 5, 2004.
- [T48] “High-fidelity telepresence” Graphics and Geometric Computing Seminar Series, Technion – Israel Institute of Technology, January 1, 2003.
- [T49] “The Virtual Studio” Royal Conservatory of Music, Toronto, February 25, 2002.
- [T50] “Building a Shared Reality” Department of Computer Science, University of Toronto, February 25, 2002.
- [T51] “Distributed Concerts and Shared Reality: Just how much streamed data and computation do we need to support effective interaction?” Department of Computer Science, Clarkson University, November 1, 2001.
- [T52] “Robotics and Design” Round Table Panel, Centre Design UQAM, February 9, 2000.
- [T53] “The Shared Reality Environment” Department of Electrical and Computer Engineering, Ecole Polytechnique, Montreal, May 28, 1999.

Invited Talks in Scholarly Conferences and Workshops

- [T54] “Intelligent Systems to Enhance Human Experience”, International Laboratory of Learning Systems–DATAIA Workshop, Paris, May 25, 2023.
- [T55] Speaker in “Ethics Research I am Excited About”, Laidley Centre for Business Ethics, Montreal, April 28, 2023.
- [T56] Speaker in “Next Gen Health Powered By The Open Grid And Edge AI”, IEEE Future Networks Forum, Montreal, October 14, 2022.
- [T57] “Touch and feel when it isn’t real: Integrating haptics into the XR experience”, InterDigital Scientific Seminar series, December 4, 2020.
- [T58] “Taking Haptics Out of the Lab and Into the Wild”, Introduction to Haptics for Next Generation XR. International Conference on Intelligent Robots and Systems Tutorial Session, October 29, 2020.
- [T59] “Assistive Technology Research in the Shared Reality Lab”, Conférence scientifique du CRIR-Institut Nazareth et Louis-Braille, September 25, 2019.
- [T60] “Learning from sparse feedback: Adapting an environmental awareness app to visually impaired user preferences”, ACM-SIGCHI sponsored summer school on Intelligent User Interfaces in the Era of IoT and Smart Environments, Haifa, Israel, October 3, 2018.
- [T61] Speaker in “AR/VR panel”, IEEE Multimedia Signal Processing Workshop, Montreal, September 23, 2016.
- [T62] “Immersive multimedia and mobile interaction: Applications to new media, gaming, medicine, and beyond” Keynote speaker, Entertainment Technology Summit, Concordia University, Montreal, September 17, 2016.
- [T63] “Leveraging video in public safety scenarios”, Ninth Canadian Public Safety Interoperability Workshop (CITIG 9), Toronto, December 1, 2015.
- [T64] “Future Cities (2040) – Mind: Human and Machine”, Institute for the Public Life of Arts and Ideas, Symposium on Future Cities, March 13, 2015.
- [T65] “UltraVideo and the Quest for Minimal Latency”, International Workshop on High Quality Dynamic cross-continental Networked Artistic interaction, World Opera Association, Struer, Denmark, August 29, 2013.
- [T66] “Assisting the blind and treating amblyopia: Two more things you can do with your smart-phone”, 15e Symposium scientifique sur l’incapacité visuelle et la réadaptation (presented with J. Blum). University of Montreal, February 12, 2013.
- [T67] “Revolutions in human-device interaction: How new paradigms impact user experience”, International Conference on Consumer Electronics, Consumer Electronics Society, Las Vegas, January 12, 2013.

- [T68] “Around the World in 80 ms.” Panel presentation in Workshop of the Audio Engineering Society Convention, San Francisco, November 5, 2010.
- [T69] “UltraVideo and Virtual Presence: A Video Perspective.” Presentation on Teaching in Distributed Performance, Tromsø, Norway, October 15, 2010.
- [T70] “Future Interfaces for Audio.” Panel presentation in Workshop of the Audio Engineering Society Convention, New York, October 10, 2009.
- [T71] “World Opera Technologies and Tests”, Danish Sound Technology Network, Aalborg University, June 8, 2009.
- [T72] “The Montreal World Opera Experiments”. Presentation at the World Opera Symposium, Struer, Denmark, May 12, 2009.
- [T73] “Audio-Visual-Haptic-Tactile: Putting them all together for an engaging immersive experience”. Panel presentation in Workshop of the Audio Engineering Society Convention, Munich, Germany, May 10, 2009.
- [T74] “New Technologies for Audio over IP”. Panel presentation in Workshop of the Audio Engineering Society Convention, Munich, Germany, May 10, 2009.
- [T75] “A Platform to Create and Support Ocean Science Virtual Organizations (Oceans 2.0)” and “HSVO Health Services Virtual Organization”, RISQ 2008 Colloquium, Montreal, November 14, 2008.
- [T76] “The Future of VC: Music Teaching and High Fidelity Video”, Elevate 2008: Reaching New Heights in Educational Video-conferencing, Banff, August 27–28, 2008.
- [T77] “Creating an immersive video space”, International Symposium on The World Opera: When the Opera stage becomes worldwide, Tromsø, Norway, May 9, 2008.
- [T78] “Multimodal Streaming and Distributed Audio Interaction”, High Quality Audio over Networks (ANET II) Summit, Banff Centre, April 12, 2008.
- [T79] “Music and Games: How Fun Applications Stimulate Core Technologies”, Canadian University Software Engineering Conference, January 19, 2008.
- [T80] “From Teleoperation to Teleimmersion: Design Challenges for Distributed Interaction”, Canadian University Software Engineering Conference, January 19, 2007.
- [T81] “CANARIE sur UCLP et ROADM, deux technologies qui changent le monde des télécoms”, Round Table panel, RISQ Annual Conference, Quebec City, October 16, 2006.
- [T82] “La recherche sur en ultra-videoconference”, Panel on “Vitrine technopédagogique sur la vidéoconférence”, RISQ Annual Conference, Quebec City, October 16, 2006.
- [T83] “Broadband transmission of multimodal content at the Centre for Interdisciplinary Research in Music Media and Technology (CIRMMT)”, RISQ-CA*net4 Advanced Networking Day, Montreal, October 24, 2005.

- [T84] “Low-Latency Ultra-Videoconferencing and Shared Reality” Interfaces Montreal, Rencontre du Génie numérique et des Affaires. Montreal, October 11, 2005.
- [T85] “Shared Spaces” Asia-Pacific Advanced Networks (APAN) Conference, Taipei Aug. 22–27, 2005.
- [T86] “Engaging Technolog(ies) for Effective Interaction” Keynote speaker, World Conference on Educational Multimedia, Hypermedia and Telecommunications, Montreal, June 29, 2005.
- [T87] “Broadband Distance Education in 2007: Views from the Demand Side” Invited Panelist. World Conference on Educational Multimedia, Hypermedia and Telecommunications, Montreal, June 29, 2005.
- [T88] “Ultra-Videoconferencing and Intelligent Classrooms” Keynote speaker, Canadian Higher Education and Information Technology Conference, Montreal, June 28, 2005.
- [T89] “From Videoconferencing to Shared Reality” Bell University Laboratories’ Annual Conference, Toronto, November 3, 2004.
- [T90] “History of Internet Audio Experiments at McGill” High Quality Audio over Networks (ANET) Summit, Banff Centre, August 20–22, 2004.
- [T91] “Advanced Video Applications: Developments in Extreme Video” Southeastern Universities Research Association Video Development Initiative (SURA/ViDe) 6th Annual Digital Video Workshop. Indianapolis, March 24, 2004.
- [T92] “The Democratic Revolutions – Peer to Peer Meets Open Source: Design, Philosophy, Engineering” Intimate Technologies/Dangerous Zones. Banff New Media Institute, Banff Centre, April 27, 2002.
- [T93] “The Development of Ultra VC Applications and Technology” Southeastern Universities Research Association Video Development Initiative (SURA/ViDe) 4th Annual Digital Video Workshop. University of Alabama at Birmingham, April 25, 2002.
- [T94] “High quality wide-screen SDI video and multichannel audio over CA*net3” CANARIE’s 7th Advanced Networks Workshop, Toronto, November 28, 2001.
- [T95] “Low-latency comes to videoconferencing: The Frères Jacques duet at a distance” RISQ 2001 Conference, Montreal, November 5, 2001.
- [T96] Advanced Networking and the Arts: Innovations in Outreach, Collaboration, and Performance. Panel Discussion at Internet Global Summit INET 2001 Conference, Stockholm, June 6, 2001.
- [T97] “The McGill–Calgary Advanced Learnware Network” CANARIE’s 6th Advanced Networks Workshop, Montreal, November 29, 2000.
- [T98] “Networks and Music Instruction” Panel Discussion with Pinchas Zukerman and Wieslaw Woszczyk, CANARIE’s 6th Advanced Networks Workshop, Montreal, November 29, 2000.

- [T99] “Tools for Distributed VR” Canadian Working Group on Virtualized Reality Systems, Montreal, November 28, 2000.
- [T100] “Evolution of the Intelligent Classroom” Multicultural Perspectives on the use of Technology in Education. Montreal, October 2, 2000.
- [T101] The Brave New World of Ubiquitous Bandwidth” Internet Global Summit INET 2000 Conference, Yokohama, July 20, 2000.
- [T102] “Multichannel Audio over the Internet: The Next Phase” RISQ 2000 Conference, May 31, 2000.
- [T103] “Multichannel Audio over the Internet” CANARIE’s 5th Advanced Networks Workshop, Toronto, November 29, 1999.
- [T104] “When Telemedicine feels like Regular Medicine” Communications and Information Technology Ontario (CITO) Healthcare for the Future: Telemedicine, February 18, 1999.

MEDIA EXPOSURE

- [M1] Ami-Télé, Ça me regarde, February 8, 2018
- [M2] Forbes, March 9, 2017
- [M3] Discovery Channel, Daily Planet, Mar. 7, 2017
- [M4] Télé-Québec, Electrons Libre, Jan. 17, 2017
- [M5] ACB Radio, Mainstream, Nov. 18, 2016
- [M6] CBC Radio, Tech Column, Aug. 8, 2016
- [M7] CJAD Radio, Tech Talk, Aug. 6, 2016
- [M8] Mobile Syrup, Aug. 4, 2016
- [M9] CBC News, Aug. 4, 2016
- [M10] Betakit, Aug. 3, 2016
- [M11] Accessible Media Inc., Live from Studio 5, Aug. 2, 2016
- [M12] La Presse, Jul. 31, 2016
- [M13] CTV News, Jul. 29, 2016
- [M14] Stevivor, Mar. 2015
- [M15] Venture Beat, Mar. 3, 2015
- [M16] Club Social (TV5), Feb. 4, 2011
- [M17] Global TV (National), Jan. 29, 2009
- [M18] Global TV (Montreal), Jan. 27, 2009
- [M19] CBC Radio, As it Happens, Jan. 27, 2009
- [M20] National Post, Jan. 27, 2009

- [M21] Montreal Gazette, Jan. 27, 2009
- [M22] Montreal Gazette, Feb. 20, 2009
- [M23] Inside Higher Education, Sept. 3, 2008
- [M24] CBC Radio (Daybreak), Sept. 3, 2008
- [M25] CJAD radio, Sept. 2, 2008
- [M26] Cabling Networking Systems, Jan. 2006
- [M27] McGill Reporter, Nov. 24, 2005
- [M28] CTV Quebec, Global News, Dec. 23, 2002
- [M29] New York Times, Technology Section, Dec. 19, 2002
- [M30] Discovery Channel, Daily Planet, Oct. 30, 2002
- [M31] CFCF (CTV Quebec) Global News, June 19, 2002
- [M32] National Post, June 15, 2002
- [M33] CBC Television, The National, May 3, 2002
- [M34] McGill Reporter, Learning the Strings, April 11, 2002
- [M35] Ottawa Citizen, March 29, 2002
- [M36] Montreal Gazette, March 27, 2002
- [M37] Globe & Mail, Dec. 1, 2001
- [M38] Canal Z, La Revanche des Nerds, Nov. 13, 2001
- [M39] Montreal Gazette, Nov. 10, 2001
- [M40] CJAD Radio, The World Today, July 31, 2001
- [M41] McGill Reporter, April 5, 2001
- [M42] Globe & Mail Report on Business, Oct. 28, 2000
- [M43] TQS Double Clic!, Oct. 7, 2000
- [M44] McGill Reporter, Sept. 21, 2000
- [M45] UPath.com, Vol 40, 2000
- [M46] CBC (Montreal) Home Run, Aug. 22, 2000
- [M47] Montreal Gazette, Aug. 22, 2000
- [M48] CFCF (CTV Quebec) Pulse News, Aug. 21, 2000
- [M49] CBC Radio The Arts Report, July 20, 2000
- [M50] Elle Quebec, June 2000
- [M51] Journal Le Monde des Affaires, May 2000
- [M52] Canal Z, Technofolie, May 3, 2000
- [M53] TQS Double Click, April 29, 2000
- [M54] McGill Reporter, April 6, 2000

- [M55] Briefing Digital, April 2000
- [M56] Interface: La Revue de la Recherche, Vol. 21, No. 2, March-April 2000
- [M57] American Society of Mechanical Engineers, Mechanical Advantage, Vol 9, No 3, March 2000
- [M58] Canal Z, La Revanche des Nerds, Feb. 2000
- [M59] CFCF (CTV Quebec) Pulse News, Feb. 29, 2000
- [M60] Canal Vox: CityMag, Jan. 15, 2000
- [M61] Montreal Mirror, Jan. 6, 2000
- [M62] Plan Mega: La revue du genie québécois, Ordre des ingenieurs du Québec. Vol 1, Jan. 2000
- [M63] Radio Corporation of Singapore: Science and Technology Watch, Dec. 1999
- [M64] Radio Canada (CBC French) Les Annees lumiere, Nov. 28, 1999
- [M65] Financial Times Life/Technology, Nov. 25, 1999
- [M66] CBC Radio: As it Happens, Nov. 22, 1999
- [M67] Journal de Montreal, Nov. 19, 1999
- [M68] Le Devoir, Nov. 18, 1999
- [M69] TVA CyberClub, Nov. 13, 1999
- [M70] La Presse, Sept. 26, 1999
- [M71] CJAD Radio, April 11, 1999
- [M72] Montreal Mirror, April 8, 1999
- [M73] McGill Reporter, Jan. 14, 1999
- [M74] High-Tech Shower International, Nov. 26, 1997
- [M75] CBC Newsworld "Futureworld", Oct. 5, 1996
- [M76] Discovery Channel, Sept. 18, 1996
- [M77] Toronto Star, Sept. 15, 1996
- [M78] University of Toronto Varsity, Sept. 3, 1996
- [M79] TV Ontario "Studio Two", June 26, 1995

RESEARCH SUPERVISION

RESEARCH PROFESSIONALS

Name	Period	Project title	Present Position
Gvozdev, Mikhail	Feb 2025–	AI solutions architect, IMAGE project	
Yousef, Shahd	Sep 2024–	server-side developer, IMAGE project	
Singh, Jaydeep	Sep 2021–	web developer, IMAGE project	
Novack, Kaylee	Sep 2021–Apr 2022	medical doctor researcher on Avatar Therapy project	Medical Resident, Université de Montréal
Kuo, Cyan	Aug 2021 – Dec 2023	Usability Research Lead, IMAGE project	
Patil, Gandharv	Jun 2021 – Mar 2022	ML Research Lead, IMAGE project	PhD student, McGill
Grond, Florian	Apr 2021 – Mar 2023	Audio Research Lead, IMAGE project	Assistant Professor, Concordia University
Eichhorn, Alexander	Feb 2013 – Aug 2013	research associate under GRAND	CTO of Kidtsunami
Bouchard, Mathieu	Jan 2011 – Nov 2018	research assistant under MSG project	
Chen, Guangyi	Jan 2010 – Jul 2010	research associate under Canarie NEP	
Vincent, Coralie	Oct 2010 – Mar 2011	research assistant	Research Engineer, IRCAM, France
Dansereau, Don	Jun 2009 – Jan 2010	research associate under FRQNT grant	Senior Lecturer, University of Sydney

Continued on next page

Name	Period	Project title	Present Position
To, Long	Jan 2009 – Sep 2011	research associate under NSERC I2I	Software engineer, Abcam
Blum, Jeff	Oct 2008 – Aug 2013	research assistant under MSG project	
Olmos, Adriana	Sep 2008 – July 2012	user interface engineer under Canarie NEP	Interaction designer, Google/YouTube
Sun, Haijian	Sep 2008 – Oct 2010	computer engineer under Canarie NEP	ECM Consultant, JCDS Solutions Inc.
Soukhodolski, I.	Oct 2005 – Dec 2007	web services programmer under Ca- narie IIP	Owner, W4 Tech- nology
Kiewe, Howard	Oct 2005 – Dec 2007	user interface developer under Canarie IIP	consultant
Spackman, S.	2000–2006	research associate on Canarie and VRQ projects	Google, Mountain View
Sarikaya, Deniz	2003–2004	research assistant on VRQ projects	deceased
Soucy, Gilbert	1999	research associate on CFI project	Imaging Specialist, 36pix Inc., Mon- treal

POST-DOCTORAL FELLOWS

Name	Period	Project title	Present Position
Byeon, Yeong-Hyeon	Jan 2024 – Nov 2024	Bionic Ear Project	
Bouzekri, Élodie	Sep 2023 – Aug 2024	ADAIR Project	Assistant Professor, Université de Bretagne Occidentale
Fontana De Vargas, Mauricio	Jan 2023 – Nov 2023	Ai-Digital Nurse Avatar (ADiNA)	AI+VR Research Scientist, Meta, Toronto
Sullivan, John	Sep 2021 – Apr 2022	Multimodal Rendering for the IMAGE Project	post-doctoral fellow, Université Paris-Saclay
Jyoti, Vishav	Mar 2021 – Feb 2022	Mixed-Reality Platform for Simulation and Synthesis of Multi-Modal Hallucinations	Software Engineer, Youtube, India
Talhan, Aishwari	Jan 2021 – Dec 2022	Wearable Haptics	Research Scientist, SUNY Research Foundation, Albany, New York
Yoo, Yongjae	Mar 2020 – Jul 2022	Wearable Haptics and Haptics Lead, IMAGE project	Assistant Professor, Hanyang University ERICA, South Korea
Weill-Duflos, A.	Jan 2018 – Jan 2021	Wearable Haptics	Director of Research and Product Integration, Haply Robotics
Arnold, Andre	Oct 2017 – Dec 2017	Wearable Haptics	Product Manager – AI Nuvoola

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Name	Period	Project title	Present Position
Panëels, S.	Jan 2011 – Jan 2012	Natural Interactive Walking and In-Situ Audio Services	Researcher, Commissariat à l'énergie atomique et aux énergies alternatives (CEA)
Pelletier, S.	Nov 2009 – Jun 2011	Real-time Image-based Rendering (Canarie NEP, 2009-2010)	
		Parallax Barrier Display rendering software optimization (NSERC ENGAGE, 2011)	Game Programmer, Behaviour Interactive
Otis, Martin	Jan 2010 – Dec 2010	Natural Interactive Walking (FRQNT Scholarship)	Assoc. Professor, U. Québec à Chicoutimi
Millet, G.	Nov 2009 – Mar 2012	Natural Interactive Walking	Patent Examiner, EPO, The Hague
Bouilllot, Nicolas	Sep 2007 – Dec 2011	Mobile Audio Interaction (NSERC New Media Initiative, 2007-2009)	
		Open Orchestra (Canarie NEP-2 Project)	Co-Founder - Lab148
Darolti, Cristina	Jan – Dec 2009	Real-time Image-based Rendering (Canarie NEP)	Patent Examiner, EPO, The Hague
Wang, Guangyu	Sep 2007 – Mar 2011	Neurosurgical Visualization and Virtual Presence (NSERC Strategic and NCE)	Facebook, Mountain View
Wang, Yan	2002–2003	Channel and spatial view allocation for videoconferencing (VRQ)	V.P. Marketing, AMH Canada

PH.D. STUDENTS

Name	Period	Thesis title	Present Position
Riazifar, Myles	Jan 2025– present	Advanced Airspace Usability	
Pinheiro de Oliveira, Hen- rique Jongh	Mar 2024– present	Orchestrating LLMs for blind and low- vision users, Cotutelle student with Universidade Federal do Rio Grande do Sul	
Kuo, Cyan	Jan 2024– present	Multimodal Perception in Sensory Substitution Frameworks	
Knappe, Sabrina*	Jan 2023– present	Advanced Airspace Usability	
Samuel, Segun*	Jan 2023– present	Spatial content representation strate- gies for blind and low-vision users	
Conan, Corentin*	Sep 2022– present	Advanced Airspace Usability	
Astles, Samantha*	Sep 2022– Jan 2024	Advanced Airspace Usability	
Shen, Lichao*	Oct 2021– Aug 2023	Social telepresence	
Regimbal, J.* ^{§†C}	Sep 2021– present	Audio-haptic authoring for informa- tion rich content delivery	
Fortin, P.* [§]	Sep 2016– Sep 2021	Methods and Interfaces for Closed- Loop Smartphone Communications	Asst. Professor, U. Québec à Chicoutimi
Blum, Jeff* ^{†g}	Sep 2013– present	Implicit Communication for Enriched Human Interaction	
Erfani- Joorabchi, M.*	Jan 2013– Jan 2015		iOS Software Engi- neer, Google

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Name	Period	Thesis title	Present Position
Anlauff, Jan*	Jan 2011– present	Sensor-Actor Wearables	
Tordini, F.	Jan 2011– Feb 2018	Auditory salience modeling for continuous processes sonification	Technology Transfer Manager, Innovation and Partnerships, McGill University
Ghourchian, N.*†	Jan 2010– Apr 2011	Affective Evaluation	transferred to another group
El-Shimy, D.†	Jan 2009– Nov 2014	Reactive Environment for Network Music Performance	Director of UX Research, WISE, London UK
Benovoy, M.†	Oct 2007– Aug 2010	Biosignals analysis	transferred to another group
Visell, Yon	Sep 2005– Mar 2011	Walking on virtual ground: physics, perception, and interface design	Assistant Professor (ECE), UC Santa Barbara
Qi, Zhi	Jan 2004– Dec 2008	Towards dynamic mosaic generation with robustness to parallax effects	Associate Professor (School of Electronic Science & Engineering), Southeast University, China
Pelletier, S. ^p	Jan 2003– Oct 2009	Acceleration methods for image super-resolution	Game Programmer, Behaviour Interactive
Yin, Jianfeng	Sep 2000– Aug 2008	Toward an Alternative Approach to Multi-Camera Scene Reconstruction	Software engineer, Geomagical Labs
Sun, Wei	2002–2006	Multi-camera Object Segmentation in Dynamically Textured Scenes Using Disparity Contours	Apple Inc., Cupertino

Continued on next page

Name	Period	Thesis title	Present Position
Cayouette, F. [†]	2003–2006	human tracking (withdrew from program)	Generalist Programmer, Reflector Entertainment
Arseneau, S.	2000–2006	Representing Junctions through Asymmetric Tensor Diffusion	Chief Technology Officer, MVP, Austin

* McGill Engineering Doctoral Award recipient

[†] NSERC PGS D Scholarship recipient

^{†C} NSERC CGS D Scholarship recipient

[§] FRQNT Scholarship recipient

^g Graphics Animation and New Media (GRAND) Scholarship recipient

^p Precarn Scholarship

ADDITIONAL PH.D. SUPERVISORY SERVICE

I co-supervised a portion of the thesis work of the following students:

- Kilic, Seyma Nur (Jan 2025-), visiting student from Istanbul University-Cerrahpasa
- Du, Xiaoxi (Sep 2023-Aug 2024), visiting student from Southeast University, Nanjing, China
- Mousavi, Mastoureh (Sep 2023-), visiting student from Azad University, Tehran, Iran
- Liu, Xian (Nov 2013-Dec 2015), visiting student from University of Electronic Science and Technology, China
- Xie, Meng (Sep 2012-Mar 2014), visiting student from Beijing University of Aeronautics and Astronautics, China
- Grond, Florian. (Jul-Dec 2010), visiting student from Bielefeld University, Germany
- Zambon, S. (Jul-Oct 2010), visiting student from Verona University, Italy
- Cirio, Gabriel (Jun-Aug 2010), visiting student from INRIA-IRISA, France
- Rizutti, Costantino (Sep-Oct 2008), visiting student from Università della Calabria, Italy
- Bossi, Eugenia (Oct 2008), visiting student from Università della Calabria, Italy
- Pellerin, Romain. (Jun-Sep 2008), visiting student from Conservatoire Nationale des Arts et Métiers, France
- Cupellini, Enrico (Jul-Aug 2007), visiting student from Università della Calabria, Italy
- Usher, John (2003-2004), Ph.D. student, Faculty of Music, McGill University
- Mohammadi, M. (Feb-Aug 2004). visiting student from Sharif University, Iran

I served as external reviewer or examiner of the following theses:

- Mauricio Fontana de Vargas, School of Information Studies, McGill University (2022)
- Richard Olayniyan, Department of Computer Science, McGill University (2021)
- Xavier de Tingu, Université Rennes, France (2020)
- Damien Brun, Le Mans Université, France (2020)
- Cheryl Savery, Queen's University (2014)
- Alexandre Plouznikoff, École Polytechnique de Montréal (2009)
- Xiaoyong Sun, School of Information Technology and Engineering, University of Ottawa (2007)
- Nicolas Bouillot, Conservatoire Nationale des Arts et Métiers, France (2006)
- Harold Okai-Tettey, Computer Science, Rhodes University, South Africa (2006)

I served on the supervisory and/or examination committees of the following students:

- Department of Electrical and Computer Engineering: Edouard Antoniou, Oliver Astley, Carmen Au, Marc Boulé, Wei Chu, Olivier St-Martin Cormier, Vincent Levesque, Muhua Li, Rui Ma, Dante De Nigris Moreno, Jun Ouyang, Jerome Pasquero, Andrew Phan, Ala Qumsieh, Harkirat Sahambi, Wei Sun, Yick Kei Wong, Dingrong Yi, Olivier St-Martin Cormier, Karl Fayad, Shalaleh Rismani, Lixiao Zhu, Amir Abbas (2023), Haji Abolhassani (2024)
- Department of Mechanical Engineering: Zahir Albadawi, Omar Wyman, Ehsan Yousefi
- Department of Biological and Biomedical Engineering: Alireza Heidari
- School of Physical and Occupational Therapy: Jackie Girgis
- School of Information Studies: Xiaofeng (Allan) Yong
- Faculty of Music: Jason Corey, Cory McKay, Caroline Medeiros, Sean Olive, Dale Stammen, Vanessa Yarmechuk, Mark Zadel
- Grad. School of Library and Information Studies: Charles-Antoine Julien
- Department of Educational Psychology and Counselling: Adam Finkelstein
- School of Computer Science: Paul Haroun, Wisam Al Abed

MASTERS STUDENTS

Name	Period	Thesis title	Present Position
Wang, Melody	Jan 2025–	TBD	
Jabbari, Kasra	Jan 2025–	TBD	
Pan, Edina	Sep 2024–	TBD	
Li, Yuancao	Sep 2024–	TBD	
Dhanania, Mansi ^o	Sep 2024–	TBD	
Buller, Abigail ^{oo†C}	Sep 2023–	Haptic displays for multi-patient vital sign monitoring	
Karve, Anay	Sep 2023–	ADvanced AIRspace Usability	
Naik, Khushi	Sep 2023–	Graphical displays for multi-patient vital sign monitoring	
Zou, Yichen	Sep 2023–	Bionic Ear	
Li, Heyang ^s	Jan 2023–	Emotion recognition and expression for ADiNA	
Fu, Jano	Jan 2023–	Dynamic multimodal chart representations for individuals who are blind	
Bazin, Romain	Sep 2022–Dec 2024	Leveraging Large Language Models for Automated Chart Summarization	
Quadros, Venissa Carol	Sep 2022–	Authoring of Audio-Tactile Content for Refreshable Tactile Displays	
Aubet, Antoine	Sep 2022–	Computationally efficient dynamic spatial audio rendering for distributed musical performance	
Liu, Yujing	Sep 2021–2024	Design and Implementation of Conversational Humanoid Avatars for Healthcare Applications	

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Name	Period	Thesis title	Present Position
Wilson, É.	Sep 2021–Sep 2024	Representations for the Blind of Depth Information in Photographs	Technical Product Coordinator, Haply Robotics
Duarte, Nathan [∞]	Sep 2021–Aug 2023	Deploying wearable sensors for pandemic mitigation	Senior Associate, Boston Consulting Group
Henry, Max	Sep 2021–	Spatial-aware audio rendering for immersive telepresence	
Lewis-Lane, Jonathan	Sep 2021–Aug 2023	Haptic Interfaces for Musical Notation and Expression	Haptics Engineer, Apple Computer
Akut, Rohan	Jan 2021–Jul 2023	Enriching AI-based Image Descriptions for People who are Vision-Impaired	Machine Learning Engineer, iCAD Dental
Gannavarapu, S.	Sep 2020–Dec 2023	Haptic Perception and Multimodal Maps for the Visually Impaired	
Isran, Rayan	Sep 2020–Aug 2023	Investigating Audio-Haptic Rendering Methods To Deliver Chart Information to Blind and Low-Vision Individuals	Mechatronics Software Engineer, Bombardier Recreational Products
Kirby, Linnea	Sep 2020–	The Implications of Technology-Augmented Circus in Training, Performance, and Interdisciplinary Research	
Knappe, Sabrina	Sep 2020 – Dec 2022–	Towards a User Interface for Audio-Haptic Exploration of Internet Graphics by People who are Blind and Partially Sighted	Ph.D. student (see above)
Regimbal, J.	Sep 2020 – Aug 2021	Haptic effects authoring in artistic and utilitarian contexts	(fast-tracked to Ph.D. program)

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Name	Period	Thesis title	Present Position
Ducher, Clara	Sep 2019 – Sep 2021	GAN-based interaction paradigms for photorealistic avatar creation (McGill nominee for Northeastern Association of Graduate Schools Distinguished Thesis Award)	Research Software Engineer, European Centre for Medium-Range Weather Forecasts
Marino, David	Sep 2019 – Nov 2021	Implicitly Conveying Emotion While Teleconferencing	R&D Scientist, Hitachi Energy, Montreal
Lee, Hyejin	Sep 2019 – Apr 2022	Generating Convincing Simulation of Internalized Voices for Human-avatar Interaction	Full-stack developer, Société Générale, Montreal
Li, Yaxuan	Sep 2019 – May 2022	Towards Context-aware Automatic Multimodal Haptic Effect Generation for Home Theatre Environments	Ph.D. student, U. Michigan
Bouanane, Y.	Jan 2019 – Dec 2020	EchoDepth: Using a depth camera and sonification for blind navigation	Entrepreneur, sktch.io
Demers, Marc	Sep 2018 – Mar 2021	A Data-Driven Strategy for Evaluating Tacton Perceptual Similarity	Data Scientist, Maxen Technologies
Vyas, Preeti	Sep 2017 – Apr 2020	Foot-based Haptic Interfaces for Numeric Information Delivery and Dance Learning	Ph.D. student, UBC
Sulmont, E.	Sep 2017 – Dec 2018	Improved Learning of Machine Learning by Non-Majors	Curriculum Manager, DataCamp
Patil, Gandharv	Jan 2017 – Dec 2019	Min-Max Inverse Reinforcement Learning for learning bi-modal dialogue policies	Ph.D. student, McGill
Girgis, Roger	Sep 2016 – Apr 2019	Assessing the Use of Deep Learning in Assisting Visually Impaired People with Outdoor Exploration	Ph.D. student, MILA

Continued on next page

Name	Period	Thesis title	Present Position
Kim, Taeyong	Sep 2016 – Aug 2019	Exploration of foot based interaction for menu control and virtual reality applications	HRI Researcher, Hyundai Robotics
Alirezaee, P.	Sep 2016 – Dec 2019	Multimodal approaches to improved hospital alarms	Product Designer, Unity Technologies
Diaz, Manfred	Sep 2016 – Aug 2017	Interactive and Uncertainty-Aware Imitation Learning	Ph.D. student, MILA
Ahmer, Z.	Jan 2016 – Jan 2019	Automated musical accompaniment to children's stories	
Yin, G.	Sep 2015 – Oct 2018-	Augmented Reality Tools for Workplace Safety	Software Engineer, Kooltra
Fortin, P.	Sep 2015 – Aug 2016	Physiological Perception of Tickling Sensation	(fast-tracked to Ph.D. program)
Horodniczy, D. [†]	Sep 2014 – Dec 2016	Characterization and Application of a Variable-Friction Foot Device	Software Developer, Philips Innovative Imaging Technologies
Vuibert, Vanessa	Sep 2013 – Aug 2015	Efficient and Accurate Performance with Unconstrained Mid-air Interaction	Software Developer, Guavus
Hieda, Naoto	Sep 2012 – Aug 2015	Digital Video Projection for Interactive Entertainment	PhD student, Tallinn University, Estonia
Viswanathan, R.	Jan 2010 – Dec 2012	Testing the Two-Stream Hypothesis in an Immersive Virtual Environment	Senior Software Developer, Faurecia Irystec Inc
Knight, Trevor	Jan 2010 – Sep 2011	Music Visualization for Open Orchestra (CIRMMT Student Award)	Software Developer, Noteloop Systems
Li, Weizhong	Sep 2008 – May 2009	(recommended alternative supervision)	

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Name	Period	Thesis title	Present Position
Ip, Jessica	Sep 2008 – Mar 2011	Augmented Reality for Interactive Play in a Virtual and Physical Environment	iOS developer, Shopify, Toronto
Namit, Gaurav	May 2008 – Oct 2009	(withdrew in 2009 to pursue social entrepreneurship venture)	
El-Shimy, D.	Sep 2007 – Dec 2008	Gestural interaction for complex tasks	(fast-tracked to Ph.D. program)
Law, A.	Sep 2007 – Sep 2010	A Vibrotactile Floor for Enabling Interaction through Virtual Walking Spaces	Data Systems Engineer, AECOM, Vancouver
Benovoy, M.	Sep 2006 – Oct 2007	Biosignals analysis and its application in a performance setting	(fast-tracked to Ph.D. program)
Audet, Samuel [†]	2005-2007	Shadow Removal from Multi-Projector Displays via Three-Dimensional Modeling and Object Tracking	Deeplearning4j (Skymind), Tokyo, Japan
Wozniowski, M.	2003-2006	A framework for interactive three-dimensional sound and spatial audio processing in a virtual environment	research engineer, Société des arts technologiques, Montreal
Rudzicz, Frank [§]	2004-2006	CLAVIUS: Understanding Language Understanding in Multimodal Interaction	Associate Professor, University of Toronto (status) and Dalhousie University
Rioux, Francois [†]	2003-2005	Software Framework for Parsing and Interpreting Gestures in a Multimodal Virtual Reality Context	Ph.D., Laval; Software Architect, Thales Canada
Chan, Siu-Chi	2002-2005	Hand and Fingertip Tracking for Gesture Recognition	Technical Staff, AMD Toronto
Hilario, Nadia [§]	2002-2005	Occlusion Detection in Front Projection Environments	Software Developer, Spiria

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Name	Period	Thesis title	Present Position
Perez, Michael	2002-2005	Multimodal Human-Computer Interaction for a Public Kiosk System	User Interface Designer, Nuance
Sud, Daniel	2002-2005	Design of a Multi-Projector Display System	Senior Producer, Lucky Hammers
Boussemart, Y.	2002-2005	Design and Implementation of Framework for Immersive Environments in a Shared Context	Chief Technology Officer, Xerxes Global
Pelletier, S.	2001-2003	High-Resolution Video Synthesis from Mixed-Resolution Video Based on the Estimate-and-Correct Method	(see above)
Gu, Jinhua	2000-2002	A distributed software architecture for the Shared Reality Environment.	VP, Radian Asset Assurance Inc., NY
Yao, Jie	2000-2002	Human Arm Gesture Detection and Recognition in a Classroom Environment.	Ph.D. student, Concordia University
Zhang, Yuan	2000-2002	An efficient coding method for spatial data: the rotating, hierarchical, overlapping representation.	Ph.D. student, University of Delaware
Doutriaux, S.	1998-1999	(withdrew in 1999 to launch start-up company)	
Arseneau, S.	1998-2000	Robust Image Segmentation Towards an Action Recognition Algorithm.	(see above)
Xu, Aoxiang	1998-2000	A High-Performance Audiovisual Communication System.	QNX Software Systems, Ottawa

[†] NSERC PGS M Scholar recipient

^{†C} NSERC CGS M Scholar recipient

[§] FRQNT Graduate Scholarship recipient

[◇] McCall MacBain Scholar finalist

^{◇◇} McCall MacBain Scholarship recipient

ADDITIONAL MASTERS SUPERVISORY SERVICE

I co-supervised a portion of the thesis work of the following students:

- Marcé, Clément (Jul-Aug 2024), visiting student from INSA (Toulouse)

- Albert, Nicolas (Jan-Jun 2024), visiting student from École Polytechnique Fédérale de Lausanne, Switzerland
- Peña Cortés, Dafne Vania (Nov 2023-present), School of Engineering and Sciences, Tecnológico de Monterrey, Mexico
- Dever, Ani (Sep 2017-Feb 2018), visiting student from Polytechnic University of Turin, Italy
- Gallo, Nicola (Sep 2015-Feb 2016), visiting student from Polytechnic University of Turin, Italy
- Roy, Louise (Jul-Dec 2015), visiting student from Ensimag, Grenoble, France
- Glessner, David (Feb-Jun 2012). visiting student from Ensimag, Grenoble, France
- Penin, O. (Jul-Aug 2011). visiting student from Paris-Sud 11, France
- Mabire, N. (Apr-Sep 2010). visiting student from Supélec, Metz, France
- Brulé, M. (Feb-Aug 2009). visiting student from Université de Louis Pasteur, Strasbourg, France
- Anlauff, J. (Dec 2008-Mar 2009). visiting student from Bielefeld University, Germany
- Delattre, G. (Apr-Aug 2007). visiting student from Université Paris VI, France

I served on the supervisory and/or examination committees of the following students:

- Zhonghao Zhao (M. Eng. project), Electrical and Computer Engineering, McGill University
- Anne-Marie Burns, Faculty of Music, McGill University
- Frank Riggi, Electrical and Computer Engineering, McGill University
- Eric Benzacar, Electrical and Computer Engineering, McGill University
- Oles Protsiym, Faculty of Music, McGill University

FUNDING

INDIVIDUAL RESEARCH GRANTS AND CONTRACTS

Date	Source	Amount	Title/Description
2024-2029	NSERC	\$275,000	<i>Multimodal information communication to overcome environmental, sensory, and computer mediation limitations</i> Discovery grant
2024	HBHL/ HumanWare	\$270,867	<i>Advancing IMAGE Support for the HumanWare/APH Monarch</i> Healthy Brains, Healthy Lives (CFREF) + McGill I+P with partner organization HumanWare
2024-2025	MEDTEQ/ NSERC	\$268,115	<i>Improving Intelligibility of Speech in Noisy Environments</i> MEDTEQ Partenar-IA and NSERC Alliance funding
2023	Humanware	\$33,600	<i>Prototype experience for IMAGE content on the Monarch</i> Research contract
2023-2024	MEDTEQ/ HBHL	\$282,188	<i>Haptic devices for conveying non-textual visual information on the internet for individuals with vision loss.</i> MEDTEQ Partenar-IA (Ministère de l'Économie, de l'Innovation et de l'Énergie) and Healthy Brains, Healthy Lives (CFREF)
2022	HBHL	\$50,000	<i>Extending Internet Multimodal Access to Graphical Exploration.</i> Healthy Brains, Healthy Lives (CFREF) Neuro Commercialization Ignite Grant
2022	Meta	\$30,000	Unrestricted gift
2021	Mitacs	\$13,333	<i>Analyse et recherche d'optimisation d'un processus d'adaptation de contenu issu de la numérisation 3D à un contenu photo-réaliste et interactif.</i> Mitacs Accelerate – Intern: Chen, Hongjun
2021-2022	ISED	\$608,594	<i>Enabling Access to Graphical Image Content Published via the Internet for People Who Are Blind, Deaf-Blind or Visually Impaired.</i> Innovation, Science and Economic Development Canada (ISED), Accessible Technology Program (Total project budget of \$765,787)
2019-2021	NSERC/ MEDTEQ	\$374,366	<i>Mixed-Reality Platform for Simulation and Synthesis of Multi-Modal Hallucinations with Applications to Schizophrenia Treatment.</i> Collaborative Research and Development Grant with Industrial Partners, iMD Research and IA Précision Santé Mentale
2019	NSERC	\$25,000	<i>360 degree imaging for navigation assistance for the visually impaired.</i> Engage Grants Program with Industrial Partner, ImmerVision.

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Date	Source	Amount	Title/Description
2019	Mitacs	\$15,000	<i>Advanced sensor control implementations for energy optimization in commercial buildings using machine learning and data visualisation applied to building automation systems.</i> Mitacs Accelerate – Intern: Demers, Marc
2019	Mitacs	\$6,000	<i>Facilitating Human Interaction with a Robotic Exercise Coach using Smart Objects.</i> Mitacs Globalink – Intern: Vyas, Preeti
2018	Mitacs	\$6,000	<i>Mobile Remote Implicit Communication.</i> Mitacs Globalink: Intern: Blum, Jeff
2018	NSERC	\$25,000	<i>Educational wine recommendations from initially sparse data.</i> Engage Grants Program with Industrial Partner, Wineout Inc.
2017-2018	McGill	\$7500	<i>Physiological confirmation of stimulus reception.</i> Faculty of Engineering TechAccelR Grant
2017-2020	NSERC	\$631,650	<i>Wearable Haptics.</i> Collaborative Research and Development Grant with InterDigital Corporation
2017-2018	CIRA	\$44,500	<i>Intelligent Agent for the Visually Impaired: Vision-based scene description and contextual awareness for Autour.</i> Canadian Internet Registry Authority .CA Community Investment Program
2017-2022	NSERC	\$ 222,000	<i>Multimodal Influences on Perception and Action in Computer-Mediated Environments.</i> Discovery grant.
2017-2018	MSP	\$177,673	<i>Social Media Monitoring Architecture.</i> Research Contract with Ministère de la Sécurité publique
2015	CIRA	\$53,878	<i>What's Around Me? Conveying Environmental Awareness to the Visually Impaired Community.</i> Canadian Internet Registry Authority .CA Community Investment Program
2014-2015	Mitacs	\$15,000	<i>Effect of Mobile Technologies in Emergency Response.</i> Mitacs Accelerate – Intern: Erfani-Joorabchi, Minoo
2014	NSERC	\$25,000	<i>Haptic user experience delivered through the shoes.</i> Engage Grants Program with Industrial Partner, InterDigital Canada
2013-2014	NSERC	\$137,474	<i>3D immersive projection infrastructure with full-body motion capture and analysis.</i> Research Tools and Instruments Grants
2012-2013	Mozilla	\$50,000	<i>Real-Time Emergency Response.</i> Mozilla Ignite Development Challenge (in partnership with the National Science Foundation)
2012-2017	NSERC	\$210,000	<i>Improved Shared Reality for Multi-Party, Multimodal Simulation and Interaction.</i> Discovery grant.

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Date	Source	Amount	Title/Description
2012	Toyota	\$30,000	<i>Haptic interaction with an augmented steering wheel.</i> Toyota Infotechnology Centre
2011	HP	\$60,950	<i>Capturing attention via spatialized audio cues.</i> HP Labs Innovation Research Program (IRP)
2011	NSERC	\$25,000	<i>Improved Parallax Barrier Autostereoscopic Display Software.</i> Engage Grants Program with Industrial Partner, Holoptick Technologies Inc.
2010-2011	Google	\$50,000	<i>A Spatialized Audio Map System for Mobile Blind Users.</i> Google Faculty Research Awards.
2010-2011	Honda	\$30,000	<i>Facial Expression Recognition for Machines.</i> Honda Research Institute.
2010	UVic	\$8,000	<i>NEPTUNE Pleora streamer.</i> University of Victoria software license
2008-2012	MDEIE	\$367,195	<i>Natural Interactive Walking.</i> Support for International Research and Innovation Initiatives, Ministère du Développement économique, de l'Innovation et de l'Exportation; for Canadian participation in EU FP-7 program with partners in France, Italy, and Denmark.
2007-2010	MDEIE	\$15,000	<i>Un environnement virtual pour la création de musique et de son à partir de systèmes chaotiques.</i> Support for International Research and Innovation Initiatives, Ministère du Développement économique, de l'Innovation et de l'Exportation.
2006-2009	NSERC	\$317,785	<i>A pervasive multi-user augmented space for mobile immersive interaction with sound and music.</i> (additional funding for artist collaborator received from Canada Council for the Arts) New Media Initiative STPGP 337999-06.
2006-2011	NSERC	\$100,000	<i>Enhanced video for shared reality environments.</i> Discovery grant.
2004-2006	NSERC	\$136,600	<i>Soundscape performance works via interactive environment for immersive audiovisual scene generation.</i> (additional funding for artist collaborator received from Canada Council for the Arts) New Media Initiative NMIPJ 307934-04.
2002-2006	NSERC	\$100,000	<i>Shared Reality Interaction over High Bandwidth Connectivity.</i> Discovery grant.
2000	LUB	\$100,000	<i>Distributed Visualization Environment.</i> Laboratoire universitaire Bell Equipment Grant.

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Date	Source	Amount	Title/Description
1999-2000	Petro-Canada	\$20,500	<i>Interactive Web Tools for Critique of Presentation Skills and Evaluation of Student Learning.</i> Young Innovator Award.
1999-2002	FCAR	\$45,000	<i>Augmenting an Electronic Classroom for Improved Instructor-Student Interaction.</i> New Researchers Award.
1999	FCAR	\$15,700	<i>Augmenting an Electronic Classroom for Improved Instructor-Student Interaction.</i> Equipment Grant.
1999	AES	\$25,000	<i>Multichannel audio over Internet.</i> Audio Engineering Society.
1999	OSC	\$15,000	<i>Timespace Exhibit.</i> Ontario Science Center contract.
1999	MFM	\$10,000	<i>Intelligent Classroom tools.</i> McGill Faculty of Management.
1998-2002	NSERC	\$76,000	<i>Reactive Hospital Environment.</i> Discovery research grant.
1998	FGSR	\$20,000	McGill Graduate Studies and Research Development Fund

TEAM RESEARCH GRANTS AND CONTRACTS

(Percentages refer to my portion.)

Date	Source	Amount	Title/Description
2024	Société inclusive	\$35,000 (?%)	<i>Perceptions des utilisateurs ayant une déficience visuelle concernant l'utilisation des électroménagers et la nécessité d'améliorer la connaissance ou l'expérience utilisateur pour des innovations futures</i> Société inclusive, Programme de recherche participative intersectorielle (with F. Poncet)
2023	Mitacs	\$150,000 (70%)	<i>*Avatar Care Provider for Seniors Residences</i> Mitacs Accelerate (with K. Moffatt)
2022-2025	CRIAQ	\$1,318,171 (35%)	<i>†NSERC Alliance with Consortium for Aerospace Research and Innovation of Québec (CRIAQ) ADvanced Airspace Usability (ADAIR)</i> (with P. Doyon-Poulin (Poltechnique), Joon Chung (Ryerson), and 6 aerospace industrial partners)
2020-2021	CIRMMT	\$1,500	<i>*Agile Seed Funding for Conveying paralinguistic cues and context while teleconferencing</i> (with students David Marino, Max Henry and Pascal Fortin)
2017-2018	SSHRC	\$199,680 (10%)	<i>†Real time impact signalling and collective goods</i> Partnership Development Grant (with R. Janda and 6 co-investigators)
2016-2017	NAKFI	\$100,000 (20%)	<i>Empathy Mirror</i> National Academies Keck Futures Initiative Art and Science, Engineering and Medicine Grant (with B. Korgel and 3 co-applicants)
2015-2018	FRQNT	\$182,880 (25%)	<i>†Étude des modèles d'interactivité humain-robot en réalité mixte afin de réduire l'apparition des troubles musculo-squelettiques en utilisant une cellule de travail hybride</i> Recherche en équipes (with M. Otis and 6 co-applicants)
2014	Mozilla	\$20,000 (90%)	<i>*Augmented Reality Tools for Improved Training of First Responders</i> Mozilla Gigabit Community Fund (with R. Dearden)
2011	CIRMMT	\$10,000 (90%)	<i>*Acoustic Sculptures</i> CIRMMT Strategic Innovation Fund Award (with A. Olmos and 3 others)
2010-2011	NSERC	\$49,815 (90%)	<i>*Novel Portable Treatment Device for Lazy Eye</i> Idea to Innovation (I2I) Booster (Phase Ib) (with R. Hess)

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Date	Source	Amount	Title/Description
2009-2011	MSG	\$200,000 (80%)	<i>*Location-Based Spatialized Audio Interaction for the Blind and Visually Impaired</i> Programme Appui au passage à la société de l'information (Support for the transition to an information society program), Ministère des Services gouvernementaux (MSG) (with M. Wozniowski and Z. Settel)
2010-2014	CHRP	\$327,000 (?%)	<i>Computational and statistical tools for image guided neurosurgery of brain tumors</i> NSERC Collaborative Health Research Projects (with L. Collins and 7 others)
2009-2010	CCSIP	\$48,000 (4%)	<i>*Digitally Merged Environments</i> California-Canada Strategic Initiatives Program (with S. Brown, UCSD and 20 co-applicants)
2009-2011	Canarie	\$927,648 (40%)	<i>†Open Orchestra</i> Network-Enabled Platforms 2 (with J. Roston and W. Woszczyk)
2010-2014	NCE	\$23,000,000 (2%)	<i>†GRAND: Graphics, Animation and New Media</i> Networks of Centres of Excellence (With K. Booth and 49 others)
2009	DND	\$47,500	<i>†Video-Based Facial Recognition-Algorithm and Demonstration</i> Department of National Defence Contract (with M. Levine)
2008-2009	NSERC	\$120,250 (90%)	<i>*Novel Portable Treatment Device for Lazy Eye</i> Idea to Innovation (I2I) (with R. Hess)
2008-2010	Canarie	\$1,397,758 (7%)	<i>NEPTUNE: A Platform to Create and Support Ocean Science Virtual Organizations</i> Network-Enabled Platforms (with B. Pirenne and J. Roston)
2008-2010	Canarie	\$2,000,000 (18%)	<i>Health Services Virtual Organization</i> Network-Enabled Platforms (with R. Ellaway and 8 others)
2008-2010	NSERC	\$196,000 (50%)	<i>*3-D Visualization and gestural interaction with multimodal neurological data</i> Strategic Projects (with 5 others)
2006-2009	FRQNT	\$146,550 (50%)	<i>*Unités agenceables: Réseau d'Environnements Immersifs pour Collaboration à Distance</i> Recherche en équipes (with X.-W. Sha)
2005-2006	Canarie	\$825,000 (50%)	<i>Undersea Window-High Definition Video Online</i> Intelligent Infrastructure Program. (with J. Roston)
2005-2006	SAT	\$1,276,000 (1%)	<i>TOT2: Nouveau Territoires de la Création-Diffusion en Réseau</i> Heritage Canada New Media Research. (M. Savoie, PI)
2004-2006	Canarie	\$568,971 (33%)	<i>Shared Spaces – High Definition Ultra-Videoconferencing</i> Advanced Applications Program. (with J. Roston)
2003-2004	SAT	\$792,082 (1%)	<i>TOT1: Nouveau Territoires de la Création-Diffusion en Réseau</i> Heritage Canada New Media Research. (M. Savoie, PI)

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Date	Source	Amount	Title/Description
2002-2005	IRIS	\$573,000 (25%)	<i>*Parallel Distributed Camera Arrays for Intelligent Environments</i> (with J. Clark, S. Fels, R. Vertegaal)
2002-2005	VRQ	\$2,180,000 (20%)	<i>Real-time Communication Of High-res. Multi-sensory Content via Broadband Networks.</i> Valorisation-Recherche Quebec (with W. Woszczyk and others)
2001-2002	Canarie	\$391,000 (30%)	<i>Remote Video Sign-Language Interpreting.</i> Advanced Networking Apps. Services & Technologies. (with J. Roston and others)
2000-2002	Canarie	\$808,000 (35%)	<i>McGill Advanced Learnware Project.</i> Advanced Networking Applications Services and Technologies. (with B. Pennycook)
2000-2003	LUB	\$150,000 (50%)	<i>*Distributed Shared Visualization Environment.</i> Laboratoire universitaire Bell. (with B. Ozell)
2000-2001	Royal Bank	\$2,000 (80%)	<i>*Improving Teaching through an Interactive Critiquing System.</i> Teaching Improvement Fund Award. (with R. Harris and J. Blatter)
1999-2002	CFI	\$400,000 (50%)	<i>†The Shared Reality Environment.</i> New Opportunities Award. (with J. Clark)
1999-2000	Royal Bank	\$10,000 (80%)	<i>*Interactive Web Tools for Critique of Presentation Skills and Evaluation of Student Learning.</i> TIF (with R. Harris)

*Indicates grants on which I am project leader. †Grant on which I am co-investigator.

CENTRE RESEARCH GRANTS

Date	Source	Amount	Title/Description
2022-2026	ILLS	\$400,000	FRQNT International Laboratory on Learning Systems, funded jointly by CNRS (France) and FRQNT (Quebec), Pablo Piantanida, PI, \$100,000 per annum
2021-2028	FRQSC/ FRQNT	\$2,712,295	Regroupement Stratégique: <i>Centre Interdisciplinaire de Recherche en Musique, Médias et Technologie</i> . (with I. Cossette and 52 others) \$276,000 per annum for 2 years and \$432,059 per annum for the remainder
2019-2025	FRQNT	\$2,160,000	Regroupement Stratégique pour <i>Systèmes cyberphysiques et intelligence machine matérialisée (REPARTI)</i> . (with C. Gosselin and 49 others) \$480,000 per annum.
2015	CFI	\$4,366,723	Innovation Fund: <i>Live Expression "in situ": Musical and Audiovisual Performance and Reception</i> (with M. Wanderley and 9 others)
2014-2021	FRQSC/ FRQNT	\$1,800,000	Regroupement Stratégique: <i>Centre Interdisciplinaire de Recherche en Musique, Médias et Technologie</i> . (with M. Wanderley and 23 others)
2013-2019	FRQNT	\$2,160,000	Regroupement Stratégique pour <i>l'Étude des Environnements PARTagés Intelligents répartis (REPARTI)</i> . (with D. Laurendeau and 34 others) \$359,943 per annum.
2008-2014	FRQSC/ FRQNT	\$1,800,000	Regroupement Stratégique: <i>Centre Interdisciplinaire de Recherche en Musique, Médias et Technologie</i> . (with S. McAdams and 23 others)
2007-2009	NSERC	\$57,630	Major Resources Support: <i>Centre for Interdisciplinary Research in Music Media and Technology (CIRMMT)</i> . (with S. McAdams and 8 others)
2006-2013	FRQNT	\$1,530,000	Regroupement Stratégique pour <i>l'Étude des Environnements PARTagés Intelligents répartis (REPARTI)</i> . (with D. Laurendeau and 23 others) \$100,000 per annum allocated to CIM.
2002-2005	FCAR	\$720,000	Regroupement Stratégique: <i>Réseau Québécois de Recherche en Réalité Artificielle Distribuée (QUERRAnet)</i> . (with F. Ferrie, R. Bergevin, P. Cohen, and others)
2001	CFI	\$6,500,000	Major Facilities Award: <i>Centre for Integrated Research in Music Media and Technology</i> . (with W. Woszczyk and 11 others)
2000-2002	FCAR	\$113,500	Centre de Recherches. (with F. Ferrie and 17 others)

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Date	Source	Amount	Title/Description
2000	NSERC	\$275,000	<i>Information Systems in Support of Intelligent Machine Research.</i> (with F. Ferrie and 17 others)

TEACHING

COURSES TAUGHT

Course title and number	Description	Semester
ECSE-618 <i>Haptics</i>	Graduate course on haptic information design, co-taught with other instructors across Canada, under the informal designation of HAPTICS 501	Winter 2021–present
ECSE-421 <i>Embedded Systems</i>	Undergraduate course dealing with both the theory and practice of design for embedded systems	2018–present
ECSE-526 <i>Artificial Intelligence</i>	Graduate level course in artificial intelligence with emphasis on machine learning and autonomous agents	1998–present
*ECSE-683 <i>Topics in Vision and Robotics</i>	Graduate level laboratory course for RoboCup projects	Fall 2000 Fall 2002
*ECSE-424/542 <i>Human-Computer Interaction</i> [†]	Undergraduate (424) and graduate (542) course in human-computer interaction with emphasis on new interface paradigms	2000–present
ECSE-487 <i>Computer Architecture Laboratory</i>	Undergraduate laboratory course	1999–2018
ECSE-427 <i>Operating Systems</i>	Undergraduate course (core for Computer Engineering students)	1998
CSC-270 <i>Introduction to Modelling and Optimization</i>	Computer Science undergraduate course, University of Toronto	1993–1994
CEE 1714Y <i>Digital Systems and Computers</i>	Continuing Engineering Education course for the Association of Professional Engineers of Ontario	1993–1994
CSC-228 <i>File Structures and Data Management</i>	Computer Science undergraduate course, University of Toronto	1992–1995

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Course title and number	Description	Semester
COSC-3411	Computer Science undergraduate course,	1992
<i>File Structures and Data Management</i>	York University	

*Indicates new course that I created.

†In 2011, a project from this class placed third in the [Usability Professionals Association International Student Design Competition](#). Note that graduate students have also enrolled in this course under the designation of ECSE-681, *Colloquium in Electrical Engineering* or ECSE-689, *Recent Advances in Electrical Engineering*.

UNDERGRADUATE SUPERVISION

ECE Honors Undergraduate Projects (2 semesters)

Name	Year	Research topic
Bu, Bruce	2020	360° Imaging for Navigation Assistance for the Visually Impaired
Akgul, Ahmet	2017-2018	Haptic Wearables
Bashar, Sharhad	2016-2017	Image-based environment description
Wu, Pei Yuan (Richard)	2016	Mixed-Reality Human-Machine Interaction
Gordon, Adam	2011-12	Virtual Presence
Warraich, Shahjahan	2010-11	Natural Interactive Walking
Lin, Nan	2008	Location sensing for mobile apps
Wang, Letao	2007	Interactive Agent
Charlebois, Pierre-Olivier	2004–2005	Sound Objects in a Soundscape
Myer, Sam	2003	Automated Music Transcription
El-Refaei, Sameh	1998–1999	Shared Reality simulator

ECE Undergraduate Design Projects (2 semesters)

Name	Year	Research topic
Archambault, Roxanne	2024-2025	Holoportation: CSA VR Astronaut Training
Dejanov, Aleksej	2024-2025	Holoportation: CSA VR Astronaut Training
Nguyen, Anh Tu	2024-2025	Holoportation: CSA VR Astronaut Training
Turianskyj, Alex	2024-2025	Holoportation: CSA VR Astronaut Training
Lu, Yu-An	2024-2025	AI Digital Nurse Avatar (ADiNA)
Chowdhury, Nazia	2024-2025	AI Digital Nurse Avatar (ADiNA)
Hall, Allison	2024-2025	AI Digital Nurse Avatar (ADiNA)
Gouchee, Annie	2024-2025	AI Digital Nurse Avatar (ADiNA)
Ajji, Maya	2024	AI Digital Nurse Avatar (ADiNA)
Rahman, Nafis	2024	AI Digital Nurse Avatar (ADiNA)
Wang, Jingyi	2024	AI Digital Nurse Avatar (ADiNA)
Zhang, Rong Wei	2024	AI Digital Nurse Avatar (ADiNA)
Srivastava, Atreyi	2024	AI Digital Nurse Avatar (ADiNA)
Ktaily, Nour	2024	AI Digital Nurse Avatar (ADiNA)
Bansal, Pratham	2024	AI Digital Nurse Avatar (ADiNA)
Cattani, Alex	2024	AI Digital Nurse Avatar (ADiNA)
Wang, Bohan	2024	Cybersight
Feng, Shuzhao	2024	Cybersight
Tian, Steven	2024	Cybersight
Wang, Yiqiao	2024	Cybersight
Bebee, Lukas	2023-2024	Force-feedback experiences for IMAGE

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Name	Year	Research topic
Alexander Tsahageas	2023-2024	Force-feedback experiences for IMAGE
Emma Kawczynski	2023-2024	Force-feedback experiences for IMAGE
Massimo Rosati	2023-2024	Force-feedback experiences for IMAGE
Gurhan, Eren	2023-2024	Vision-guided Navigation Assistance
Yan, Ke	2023-2024	Vision-guided Navigation Assistance
Calitoiu, Mihail	2023-2024	Vision-guided Navigation Assistance
Park, John	2023-2024	Vision-guided Navigation Assistance
Hu, David	2023	Vision-guided Navigation Assistance
Gasmi Ilyes	2023	Vision-guided Navigation Assistance
Habelrih Edward	2023	Vision-guided Navigation Assistance
Arabian Ari	2023	Vision-guided Navigation Assistance
Fathi, Saab	2023	Avatar therapy for psychosis
Ham, Sia	2023	Avatar therapy for psychosis
Choi, Myunghoon	2023	Avatar therapy for psychosis
Kruchinski Almeida, Martin	2023	Avatar therapy for psychosis
Kabir, Anika	2023	Chatting with historical figures
Huynh, Vy-Kha	2023	Chatting with historical figures
Solaberrieta, Emilia	2023	Chatting with historical figures
Cui, Bowen	2022-2023	Immersive multimodal CAVE experience
El Haddad, Georges	2022-2023	Immersive multimodal CAVE experience
Fazal, Gohar Saqib	2022-2023	Immersive multimodal CAVE experience
Mahajan, Madhav	2022-2023	Immersive multimodal CAVE experience
Pan, Edwin	2022-2023	Touching faces in VR
Gosman, Mircea	2022-2023	Touching faces in VR
Justin, Legrand	2022	Vision-guided Navigation Assistance
Sen, Wang	2022	Vision-guided Navigation Assistance
Chamberland, Noah	2022	Vision-guided Navigation Assistance
Natchev Keanu	2022	Novel digital representation of sign language
Arabian Matthias	2022	Novel digital representation of sign language
Destiné, Maxens	2022	Novel digital representation of sign language
Jarvis, Thomas	2022	Natural Dialog Generation for Mental Health
Kong, Norman	2022	Natural Dialog Generation for Mental Health
MacNaughton, Ben	2021-2022	plots data parsing for IMAGE project
Williams, Aidan	2021-2022	plots data parsing for IMAGE project
Nunez, Matteo	2021-2022	Foot-fluid interaction simulation in mobile VR
Comeau, Francis	2021-2022	Foot-fluid interaction simulation in mobile VR
Gure, Kaan	2021-2022	Foot-fluid interaction simulation in mobile VR
Calin, Haluk	2021-2022	ML-based Navigation Assistance
Cano, Victor	2021-2022	ML-based Navigation Assistance
Das Sharma, Kaustav	2021-2022	ML-based Navigation Assistance
Dufault, Louca	2021-2022	ML-based Navigation Assistance
Simard, Felix	2021	detecting benevolent sexism in text
Watson, Tyler	2021	detecting benevolent sexism in text

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Name	Year	Research topic
Porporino, Anthony	2021	detecting benevolent sexism in tex
Bourbeau, Charles	2021	detecting benevolent sexism in text
Ko, Neroli	2020-2021	haptic dance shoes
Zwack, Noah	2020-2021	haptic dance shoes
Zhang, Weijing	2020-2021	haptic dance shoes
Szwimer, Benjamin	2020-2021	visually impaired access to web graphics
Zoltak, Matthew	2020-2021	visually impaired access to web graphics
Itovitch, Ethan	2020-2021	visually impaired access to web graphics
Weiss, Ben	2020-2021	mixed-reality for schizophrenia treatment
Bieber, Nicolas	2020-2021	mixed-reality for schizophrenia treatment
Khan, Marwan	2020-2021	360° imaging for navigation assistance
Johansen, Anthony	2020-2021	360° imaging for navigation assistance
Gurkan, Mert	2020-2021	360° imaging for navigation assistance
Warsi, Osman	2020-2021	360° imaging for navigation assistance
Lague, Ethan	2019-2020	AR firefighter situational awareness tools
Masciotra, Alex	2019-2020	AR firefighter situational awareness tools
Philippon, Thomas	2019-2020	AR firefighter situational awareness tools
Bouchard, Tristan	2019-2020	AR firefighter situational awareness tools
Smith, Babette	2019-2020	AR and 360: camera-mediated future
Smith, Lilith	2019-2020	AR and 360: camera-mediated future
Chen, Jennie	2019-2020	Foot-fluid interaction simulation in mobile VR
Servera, Ryan	2019-2020	Foot-fluid interaction simulation in mobile VR
Wong, Tyrone	2019-2020	Foot-fluid interaction simulation in mobile VR
Bluethner, Lucas	2019-2020	Foot-fluid interaction simulation in mobile VR
Volodina, Yuliya	2019	360° camera scene understanding
Ritch, David	2019	360° camera scene understanding
Lam, Guillaume	2019	360° camera scene understanding
Nasseem, Veronica	2019	360° camera scene understanding
Amjad, Adeeb Ibne	2019	360° camera supported intersection-crossing
Amarouche, Hakim	2019	360° camera supported intersection-crossing
Tang, James	2019	360° camera supported intersection-crossing
Commodari, Stefano	2019	360° camera supported intersection-crossing
Regimbal, Juliette	2019	Haptic Wearables
Radi, Nusaiba	2019	Haptic Wearables
Berman, Isaac	2018	Vision-based crossing assistance
Mashaal, Stuart	2018	Vision-based crossing assistance
Liu, Shi Yu	2018	Vision-based crossing assistance
Legrand, Augustin	2018	Force Feedback for VR and AR
Fournier, Clément	2018	Force Feedback for VR and AR
Nith, Romain	2018	Force Feedback for VR and AR
Malik, Numan	2017-2018	Variable-Friction Surface Mechanism
Eshaq, Yousef	2017-2018	Variable-Friction Surface Mechanism
Alalawi, Beshr	2017-2018	Variable-Friction Surface Mechanism

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Name	Year	Research topic
Ahmed, Ridwan	2017-2018	Variable-Friction Surface Mechanism
Nichyporuk, Brennan	2017-2018	AI/vision-based Q&A Dialogue
Benseler, Nick	2017-2018	AI/vision-based Q&A Dialogue
Karatzas, Thomas	2017-2018	Wine recommendation engine
Zhilin, Oleg	2017-2018	Wine recommendation engine
Simard-Morissette, Olivier	2017-2018	Wine recommendation engine
Mirfallah Liarestani, N.	2017	Autour
Kim, Yong Beom	2017	Autour
Gibeault-Girard, Gabriel	2017	AR firefighter display
Velastegui, Nicolas	2017	AR firefighter display
V Cama, Carmen Aimee	2017	AR firefighter display
Dermont, Daniel	2016-2017	Haptic shoes
Makriogiorgos, A.	2016-2017	Haptic shoes
Rohlicek, Greg	2015-2016	Mobile telepresence
Carter, Stephen	2015-2016	Mobile telepresence
Zhang, Zhaowei	2015-2016	Haptic shoes
Huynh, Alex	2015-2016	Haptic shoes
Guzman, Juan	2015-2016	Video analytics
Ali, Hassan	2015-2016	Video analytics
Macario, Daniel	2015-2016	Automated event detection
Arané, Yarden	2015-2016	Automated event detection
Leighton, Brett	2015-2016	Automated event detection
Aird, Nicholas	2015-2016	AR firefighter display
Chen, Yuechuan	2015-2016	AR firefighter display
Lei, Simon	2015-2016	AR firefighter display
Mendonca, Justin	2015-2016	Firefighter IPS
Asfour, Justin	2015-2016	Firefighter IPS
Ward, Thomas	2015-2016	Firefighter IPS
Laramée, Alexandre	2015-2016	Firefighter IPS
Sahib, Shivan	2015-2016	Biosignal wearables
Nath, Saptaparna	2015-2016	Biosignal wearables
Bramson, Shawn	2013-2014	Mobile Telepresence
Larose, Andrew	2013-2014	Mobile Telepresence
Dirik, Alize	2013-2014	Mobile Telepresence
Mansour, Rita	2013-2014	Walking Straight
Elkerdi, Ghali	2013-2014	Walking Straight
Redel, Josh	2012	Augmented Meeting Collaboration
Savchenko, Eugene	2010	3D interaction

ECE Undergraduate Design Projects (1 semester)

Name	Year	Name	Year	Name	Year
Himmelman, Tristan	2009	Glass, Emily	2001	Li, (Shao-Gi) Chris	1999
Ephraim, Theo	2009	Asselin, Ramy	2001	El-Sharif, Osama	1999
Peck, Benjamin†	2008	Sud, Daniel	2001	Nasereddin, Hazem	1999
Mankarios, Daniel	2007	Gapakov, Timofei	2001	Virdi, Gurpratap	1999
Konstantinidis, Alex	2007	Rosenblatt, Avi	2001	Shah, Ali	1999
Pufahl, David	2005	Pekofsky, Gregory	2001	Djihanian, Sylvie	1999
Zhu, Ming-Zhang	2005	Kitisa, Anousack	2000	Moussaoui, Khaled	1999
Chan, Keng Chi	2005	Vial, Thibaut	2000	Dib Youssef	1999
Phan, Andrew	2004	Bernier, Martin	2000	Tam, H.	1999
Saiffee, Ali-Akber	2004	Agha, Khurram Z.	2000	Gagnon, Gabriel	1999
Shield, Robert	2004	Bhattacharya S.	2000	Tjhin, P.	1999
Aubé, Francois	2004	Lavery, William	2000	Luong, Mai	1999
Rudzicz, Frank	2003	Yeung, Jason	2000	Lau, Sau	1999
Sarikaya, Deniz	2002	Liao, Yuan Mei	1999	Tsai, Wanti	1999
Vallianatos, K.	2002	Yee, Amy	1999	Lerner, Sorin*	1999
Hassaine, Sofiane	2002	Pereira, David	1999	Hochstein, Lorin*	1999
Wyse, Marisa	2001	Ciambella, Gary	1999	Pollack, Jonathan	1998
Bancroft, David	2001	Kassouf, Nadim	1999	Nguyen, Bau	1998
		Lee, Garvin	1999		

*Co-supervised with James Clark

†Co-supervised with Paul Kry

Computer Science Undergraduate Projects (1 semesters)

Lakhwani, Sanjeev	Sep–Dec 2024	Musical Telepresence
Kandlikar-Bloch, Mira	Jun–Aug 2024	AI Digital Nurse Avatar
Gostovic, Lilith	Jan– Apr 2024	Visualizing Chronic Pain with Artificial Intelligence
Newman, James	Jan– Apr 2024	Visualizing Chronic Pain with Artificial Intelligence
Song, Juyeon Olivia	Jan– Apr 2024	Visualizing Chronic Pain with Artificial Intelligence
Chowdhury, Shadman	Jan– Apr 2024	Visualizing Chronic Pain with Artificial Intelligence
Liang, Tina	Jan– Apr 2024	Integrating Attention Detection with Human-Avatar Interaction
Nejad, Namdar	2022	Improving Accessible Representations of Web Graphics
Li, Dailun	2022	Training and Testing an Open-Source French TTS Model

Bioengineering Undergraduate Research Projects (1 semesters)

Wang, Angela	Sep–Dec 2024	Characterizing comfort of wearable band tightness
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Mechanical Engineering Undergraduate Design Projects (2 semesters)

Sadaqa, Abdel-Rahman	2020-2021	Haptic illusions
Waite, Emilie	2020-2021	Haptic illusions
Shi, Rock	2020-2021	Haptic illusions
Fitz-Gerald, Thomas	2020-2021	Haptic illusions
Pollet, Nathan	2020-2021	Multimodal haptic armrest
Uzan, Emanuel	2020-2021	Multimodal haptic armrest
Ruivo Patricia	2020-2021	Multimodal haptic armrest
Abravanel Tal	2020-2021	Multimodal haptic armrest
Fowo, Clovis	2017-2018	Haptic interface for the feet
Robert, Gabrielle	2015-2016	Variable friction shoe
King, Michael	2013-2014	Variable Friction Foot-Ground Contact

Undergraduate Internships

Name	Year	Research project
Raza, Abbas	2024	(NYU Abu Dhabi research grant intern) Comparing speech and text interactions with automation in the cockpit
Castrillon Acosta, Isabel	2024	(Mitacs Globalink) Transforming speech into vibrations
Adnaan, Mohammad	2024	(Mitacs Globalink) Autonomous Navigation Assistance for the Visually Impaired
Mandampully, Samyuktha	2024	(Mitacs Globalink) Internet Multimodal Access to Graphical Exploration (IMAGE)
Lu, Calla	Jan–Apr 2024	Visualizing Chronic Pain with Artificial Intelligence
Sarellano, Andrés	Sep– Dec 2023	(Tec de Monterrey Undergraduate Research Trainee) Social Telepresence
Moreno Piedra, Balthazar	Sep– Dec 2023	(Tec de Monterrey Undergraduate Research Trainee) Social Telepresence
Tomiuk, Emma	2023	(ARIA Intern) Musical Telepresence
Gunatilaka, Movinya	2023	(Mitacs Globalink) Musical Telepresence
Lavoie, Gabrielle	2023	(research trainee) Internet Multimodal Access to Graphical Exploration (IMAGE)
Bessonov, Vladimir	2023	(research trainee)
Phan Antoine	2023	(SURE student) Internet Multimodal Access to Graphical Exploration (IMAGE)
MacInnes, Gabrielle	2023	(SURE student) Internet Multimodal Access to Graphical Exploration (IMAGE)
Abderrahim, Ons	2023	(Mitacs Globalink) Autour
Glavas, Theodore	2023	(NSERC USRA) ChatGPT-based health assistants
Li, Hanzi	2022	(CS Intern) Internet Multimodal Access to Graphical Exploration (IMAGE)
Gutiérrez, Diego Macias	2023	(Mitacs Globalink) Haptic dance shoes
Cortes, Dafne Peña	2023	(Tec de Monterrey Undergraduate Research Trainee) Internet Multimodal Access to Graphical Exploration (IMAGE)
Shen, Xing	2022	(ECE Intern) Vision-Guided Navigation Assistance
Dutta, Riana	2022	(NSERC USRA) Internet Multimodal Access to Graphical Exploration (IMAGE)
Pan, Edwin	2022	(SURE Student) Touching Face in VR
Chen, Hongye	2022	(ECE Intern) Internet Multimodal Access to Graphical Exploration (IMAGE)

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Name	Year	Research project
Behal, Rahul	2021-2022	ML-based Navigation Assistance for the Visually Impaired
Rao Appala, Siddharth	2021	(Mitacs Globalink) Making internet graphics accessible through rich audio and touch
Contreras, Luis F. H.	2021	(Mitacs Globalink) Haptic device for sensory re-education application
Bhayana, Rachit	2021	(NSERC USRA) Conveying Paralinguistic and Non-Verbal Cues in Teleconferencing
Reszetnik, Grace	2021	(NSERC USRA) Avatar therapy for psychosis
Jiang, Cecilia	2021	(NSERC USRA) Avatar therapy for psychosis
Radi, Rakshitha	2021	(ECE Intern) Assistive Technology Project
Marshall, Kenji	2020-21	(ECE Intern) Avatar therapy for psychosis
Pollet, Nathan	2020	(SURE Student) 360° camera imaging
Bu, Bruce	2019	(SURE Student) Haptic Wearables
Chen, Jennie	2019	(SURE Student) Haptic Wearables
Zhang, Yukai	2019	(SURE Student) Haptic Wearables
Ratnakirti, Navneet	2019	(SURE Student) Sweatsponse
Al Taha, Feras	2018-2019	(NSERC USRA) Haptic Wearables
Nunez, Matteo	2018	(SURE Student) Haptic Wearables
Huang, Yixiang	2018	(SURE Student) Non-Intrusive Mobile Experience Sampling
Li, Zihang	2018	(Mitacs Globalink) Enhanced Remote Viewing Capabilities from a Camera Array
Kaoubi, Hadir	2018	(Mitacs Globalink) Autour: “What’s around me?”
Ma, Jiantong	2018	Haptic Zoom
Tran, Jessica	2017	Social Media Monitoring
Xing, Emily	2017	Attention Switching Protocols in Family Conversations
Hao, Ju	2017	(Mitacs Globalink research intern) Haptic shoes
Lisus, Daniil	2017	(NSERC USRA) Natural Interactive Walking
Tran, Andrew	2016-2017	Multimodal CAVE integration
Sun, Nan Jin (Kelly)	2016-2017	Multimodal CAVE integration
Liu, Yufei (Kevin)	2016	Flexible graphical display of foot-ground interactions
Kashyap, Sumeha	2016	(Summer Intern from Indian Institute of Technology Guwahati) Walking Straight Project

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Name	Year	Research project
Hamed-Baghi, Bobak	2016	(SURE Student) Game Interaction for Haptic Shoes
Dubé, Felix	2016	(SURE Student) Haptic Shoes
Yang, Yanzhe	2015	(Mitacs Globalink) Enhanced Remote Viewing Capabilities from a Camera Array
Morency-Trudel, Juan	2015	(NSERC USRA) Spatialized audio for environmental awareness for the visually impaired
Liu, Bei Chen	2015	(SURE Student) Haptic in-sole design and implementation
Liu, Shuxuan (Dennis)	2015	Multimodal CAVE integration
Chaudhary, Yetesh	2014	Communication in Emergency and Crisis Response
Pavlassek, Jana	2014	(NSERC USRA) Natural Interactive Walking
Jiang, Mike	2014	(IAESTE student trainee) Graphics Rendering for Multimodal CAVE
Yin, Guofan	2014	(Mitacs Globalink) Enhanced Remote Viewing Capabilities from a Camera Array
Murgai, Prateek	2014	Acoustic Signal Processing
Sharma, Alok	2013-14	(BITS India Student) rt Emergency Response
Gupta, Sakshi	2013	(SURE Student from Indian Institute of Information Technology, Jabalpur) In-Situ Audio Services
Brais, Robert	2013	(NSERC USRA) Natural Interactive Walking
Gourdy, Oriane	2013	(Grenoble INP Student) 3DUI Interaction
Jain, Nehil	2011-12	(BITS India Student) In-Situ Audio Services
Sutcliffe, Andrew	2011	Haptically Augmented Steering Wheel
Greencorn, Dan	2011	Food Analysis Simulation
Redel, Josh	2011	Open Orchestra
Varenne, Dylan	2011	(Polytech Nice-Sophia), In-Situ Audio Services
Tomiyoshi, Marcio	2011	(ELAP Scholarship Student) Open Orchestra
Beniak, Stephane	2010	(NSERC USRA) Natural Interactive Walking
Salenikovich, Stepan	2010	Natural Interactive Walking
Chaw, Gary	2010	Natural Interactive Walking
Redel, Josh	2010	Health Services Virtual Organization
Smith, Severin	2009-11	Natural Interactive Walking

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Name	Year	Research project
Rajalingham, Rishi	2009	(NSERC USRA) Natural Interactive Walking
Rener, Farid	2009	(SURE Student) Natural Interactive Walking
Bae, Sung	2009	Optical Tracking for Audio Graffiti
Jathal, Kunal	2007	Haptic and auditory perception in human walking
Lin, Nan*	2006	(NSERC USRA) Interactive navigational control of robotic wheelchair
Reiter, Philippe	2005	(VP USRA Student) Distributed Video Rendering
Ariane Chan-You	2003	Region-of-Interest Control in Videoconferencing
Ariane Chan-You	2002	Videoconferencing Data Reduction
Gupta, Greeshma	2000	(NSERC Student) Automated slide converter
Cote, Christian	2000	(NSERC Student) Video transformations
Ayatizadeh, Negah	2000	Network communication daemons
Swartz, Tanya	2000	Speech-based TV-tuner interface
Cohen, Ouri	2000	Classroom 2000 access control
Yeong, Jason Aw	1999	(Work Study) Previously Asked Questions system
Agha, Khurram Zubair	1999	(Work Study) URL access tracking
Lim, Weoi Peng	1999	(Work Study) Graffiti board
Agha, Haroon Ali	1999	(Work Study) Classroom 2000 minipres. system
Klinger, Zamir	2000	(NSERC Student) Automated Door Attendant
Hooshangi, Sara	2000	(NSERC Student) Intelligent Classroom
Liao, Yuan Mei	1999	Electronic Classroom control interfaces
Luo, Jiexin	1999	PowerPoint C2000 interface and image libraries
Zhao, Changpeng	1998-99	Seamless PowerPoint upload for Classroom 2000
Lakdawalla, Azeem	1998-99	Real-time conjugate-gradient based head-tracking

*Co-supervised with Joelle Pineau

SERVICE

UNIVERSITY SERVICE

Department Committees

2024-2025	Department Search Committee
2024-2025	Professional Advancement and Recognitions Committee
2020-2022	ECE Unit Lab Access Committee
2017-2018	Undergraduate Recruitment Committee, Chair
2017-2020	Search Committee (Software Engineering, Artificial Intelligence)
2017-2018	Tenure Committee
2015-2025	Safety Committee (Chair in 2015-2017)
2014-2016	Grant Application Support Committee
2012-2024	Graduate Committee
2008-2012	Undergraduate Recruitment Committee
2005-2011	Scholarships/Graduate Student Financing Committee
2002	Ad hoc Committee on Computing Infrastructure for ECE/SOCS
2000-2008	College Liaison Committee
2001-2004	Information Technologies & Undergraduate Lab
2000-2002	Curriculum Committee
2000	Software Engineering subcommittee
2000-2007	Undergraduate Student Advisor

Other University Service

2024	Chair's representative, Biomedical Engineering PhD Committee meeting
2024	Faculty Mentor, McGill Biomechanics Club
2022-2024	Research Axis Co-lead and Member of CIRMMT Executive Committee
2014-2016	Elected Member of Council, McGill Association of University Teachers
2009-2013	Research Axis Co-lead and Member of CIRMMT Executive Committee
2007-2013	Co-chair, Multimodal Immersive Systems research axis, CIRMMT
2006-2008	Member, CIRMMT Board of Directors
2006	Advisory Committee for Dean of Music
2004	Tomlinson University Science Teaching Project adjudication
2003-2004	Royal Bank Teaching and Learning Innovation Fund adjudication
2003	Groupe de travail sur les normes et standards de la formation en ligne. Conférence des recteurs et des principaux des universités du Québec (CREPUQ), McGill University Representative
2002-2003	SC-IST Workgroup on Research Computing
2000-2003	SC-IST Workgroup on Classroom Design
1999-2004	Engineering Committee on Teaching and Learning
1999	SC-IST McGill Machine Project
1998	Workgroup on Educational Technology

Fundraising Activities

2002	RoboCup demonstration at McCord museum for Dean's Circle
2002	Corporate fundraising for McGill RoboCup team
2001-2002	Intelligent Classroom promotion with the Engineering Class of '50; helped raise \$274,000
2001	Trottier Building research promotion

Other Activities

2007-2010	Promotion of Academic Integrity
2001-2002	Design of new Intelligent Classroom systems for ENGMC 304
1999-2002	Maintenance of the Intelligent Classrooms, training other faculty in use of the technology
1999	Curriculum development of three new courses in software engineering

PROFESSIONAL ACTIVITIES

Service to the Community

2023-2024	Local Events Organizer, 2024 IEEE Cognitive and Computational Aspects of Situation Management (CogSIMA)
2023	Sponsorship and Exhibits Co-Chair, 2024 IEEE Haptics Symposium
2019	Government of Canada, Network of Canadian Experts on Virtual Reality
2018	Consulted by Ordre des ingénieurs du Québec regarding the OIQ's position on AI
2018	Invited Member, Fonds de recherche, Chantier sur l'intersectorialité et la créativité
2018	Co-chair, ACM SIGCHI Demonstrations
2017	External member of academic selection committee, École de technologie supérieure
2016	Organizing Committee, IEEE International Workshop on Multimedia Signal Processing, Special Session on Multimodal Interaction with Digital Information in Smart Cities
2016,2019	Selection Committee, Bill Buxton HCI Thesis Award
2016	Digital Media Program Review, York University
2016	Critique of TCPS CORE Tutorial on Research Ethics (Secretariat agreed to remove problematic question associated with the Zimbardo study)
2010-2015	Theme Leader, Enabling Technologies, Graphics Animation and New Media (GRAND) Networks of Centres of Excellence
2010-ongoing	Voting Member, IEEE Communication Society Multimedia Communications Technical Committee (IEEE MMTC)
2009	Organizer and Chair, AES Workshop on Network Technologies for Audio over IP
2008	Tenure Portfolio evaluation, York University
2005-2006	Organizer, AES Tutorial and Workshop on Human Factors in Audio
2004	Founder, AES Technical Committee for Human Factors in Audio Systems
2003	Organizer, Workshop on LAN Delivery of Audio for AES
2002-2003	Comité Scientifique de Robofolies, Centre Science de Montreal
2001	Local Events Organizer, Autonomous Agents Conference, Montreal
2001-2009	Chair, AES Technical Committee for Network Audio Systems
2000-2004	Scientific Organizer, RoboCup Junior, Montreal
2000-2001	Organizing Committee, Robofesta International Robot Games Festival, Japan
1999-2000	Member and Webmaster, Canadian Virtualized Reality Working Group
1998	Co-organizer, AAAI Symposium on Intelligent Environments

Editorial Service

2025-ongoing	Associate Editor-in-Chief, IEEE Transactions on Haptics
2021-2024	Associate Editor, IEEE Transactions on Haptics
2021	Senior Program Committee, International Conference on Multimodal Interaction
2021	Guest Editor, IEEE Transactions on Haptics (WHC track)
2020-ongoing	Associate Editor, Frontiers in Virtual Reality
2019, 2025	Associate Editor, World Haptics Conference
2019	Guest Editor, Multimodal Technologies and Interaction, Special Issue on Multimodal Medical Alarms
2018-2022	Associate Editor, Program Committee member, Haptics Symposium
2013	Guest Editor, Journal of the Audio Engineering Society, Special Issue on Audio Networking
2008-2022	Associate Editor, Journal of the Audio Engineering Society

Journal Referee

2025	Springer Nature Discover Computing
2022	IEEE Multimedia
2021	ACM Transactions on Human-Computer Interaction
2020-21	ACM Transactions on Applied Perception
2020	ACM Interactive, Mobile, Wearable and Ubiquitous Technologies
2019	Frontiers in Neurobotics
2018	Peer J—Journal of Life & Environmental Sciences
2017	Sensor Review
2015	Ambient Intelligence and Smart Environments
2010-20	IEEE Transactions on Haptics
2012	International Journal on Acoustics
2011	BMC Medical Informatics and Decision Making
2011	IEEE Software
2010	IEEE Transactions on Affective Computing
2010	IEEE Transactions on Robotics
2010	IEEE Signal Processing Magazine
2009	IEEE Transactions on Robotics
2008	EURASIP Advances in Signal Processing
2008	EURASIP Image and Video Processing
2008-ongoing	Audio Engineering Society
2007	IEEE Transactions on Systems, Man, and Cybernetics
2006	International Journal of Human-Computer Interaction
2006	Springer Virtual Reality
2005	Elsevier: Computers and Education
2005	Elsevier: Image and Vision Computing
2004, 2019	IEEE Pervasive Computing
2000, 2003	Wiley Journal of Robotic Systems
1999	ACM Transactions on Computer-Human Interaction
1999	IEEE Transactions on Robotics and Automation
1998	IEEE Personal Communications

Conference Review

2024	IEEE Conference on Cognitive and Computational Aspects of Situation Management (CogSIMA)
2023	ACM/IEEE Human-Robot Interaction
2020	IEEE Virtual Reality
2018, 2020, 2024	ACM SIGCHI User Interface Systems and Techniques
2018	Workshop on Assistive Computer Vision and Robotics
2018	Eurohaptics
2017	International Conference on Auditory Display
2017	Mobile HCI
2017-19	IEEE World Haptics
2016	IEEE International Workshop on Multimedia Signal Processing
2015	ACM Multimedia
2015	INTERACT
2014	ACM SIGGRAPH
2012, 2013	Workshop on Context Based Affect Recognition
2012, 2013	International Society for Presence Research
2012	IEEE Canadian Conference on Electrical and Computer Engineering
2011	AES Conference on Audio Networking
2011	Intelligent Robots and Systems
2011	VRIC Wkshop on Haptics for Telepresence, Teleoperation & Collab. Environments
2009	IEEE Haptics Symposium
2009	International Computer Music Conference
2009	Stereoscopic Displays and Applications
2008-19	ACM SIGCHI Human Factors in Computing
2008	Immersive Medical Telepresence
2006	International Conference on Digital Audio Effects
2006, 2007	IEEE Workshop on Projector-Camera Systems (part of CVPR)
2005-2009	Canadian Conference on Computer and Robot Vision
2004, 2009-14, 2016	Graphics Interface
2003, 2006	Audio Engineering Society
2003	New Interfaces for Musical Expression
2002	RoboCup International Symposium
2002, 2015	IEEE International Conference on Robotics and Automation
2001	ACM UbiComp
2001	IEEE International Conference on Computer Vision

Grant Review

2017	NSERC Strategic Project Grants
2017	Member of Expert Committee, CFI Innovation Fund
2016	L'Agence Nationale de la Recherche (France)
2011	NSERC Collaborative Research and Training Experience Program (CREATE)
2009, 2011	Mathematics of Information Technology and Complex Systems (MITACS)
2009	NSERC Strategic Networks (Site Visit Chair)
2008, 2015, 2017	Peer review, NSERC Collaborative Research and Development Grants
2007-2008	NSERC Industrial Research Chair (Site Visit)
2007-2020	Research Grants Council, Hong Kong
2005	NSERC Steacie Memorial Fellowship
2002, 2005-2008	Panel member, NSERC/Canada Council, New Media Initiative
2001-2017	Peer review, NSERC Discovery Grants
2001, 2008	Peer review, CFI (Canada Foundation for Innovation)

Participation in Academic Fora

2019	San Diego Opera – Opera Hack, July 27-28
2019	Dagstuhl Seminar on Ubiquitous Computing Education, June 2-7
2010	Participant, NSF/CCC Workshop on Ultra-Large Scale Interaction

SERVICE TO SOCIETY**Organizations for People with Disabilities**

2024	foster parent for Mira Foundation service dog in training
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Consumer Rights' Advocacy

2013	brought successful appeal (2013 QCCA 1670) before Quebec Court of Appeal regarding anti-SLAPP legislation
2013	initiated petition to improve rights of Canadian airline passengers
2010	advocating for reliable public transportation in Montreal
1997-2019	created and maintained passenger rights website