UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

META PLATFORMS, INC.,
Petitioner

v.

IMMERSION CORPORATION,
Patent Owner

Case IPR2023-00942
U.S. Patent No. 8,469,806 B2
Issue Date: June 25, 2013

Title: SYSTEM AND METHOD FOR PROVIDING COMPLEX HAPTIC STIMULATION DURING INPUT OF CONTROL GESTURES, AND RELATING TO CONTROL OF VIRTUAL EQUIPMENT

DECLARATION OF JEREMY COOPERSTOCK, PH.D.

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(d) "wherein the haptic stimulation includes a first stimulation determined responsive to performance of the initial portion of the control gesture, and a second stimulation that is different from the first stimulation and is determined responsive to performance of the first intermediate portion of the control gesture; and" (11[d]) 81

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I, Jeremy Cooperstock, declare as follows:

I. INTRODUCTION AND QUALIFICATIONS

A. Qualifications and Experience

1. I am a professor in the Department of Electrical and Computer Engineering at McGill University. My Curriculum Vitae is attached as **Exhibit A**.

2. I received my B.Sc. in Electrical Engineering (with Honors) from the University of British Columbia in 1990, my M.Sc. in Computer Science from the University of Toronto in 1992, and my Ph.D. in Electrical and Computer Engineering from the University of Toronto in 1996.

3. I am a member of the Centre for Intelligent Machines, and a founding member of the Centre for Interdisciplinary Research in Music Media and Technology at McGill University. I presently direct a group of approximately 50 researchers at the Shared Reality Lab at McGill, which focuses on computer mediation to facilitate high-fidelity human communication and the synthesis of perceptually engaging, multimodal, immersive environments. I led the development of the Intelligent Classroom, the world's first Internet streaming demonstrations of Dolby Digital 5.1, multiple simultaneous streams of uncompressed high-definition video, a high-fidelity orchestra rehearsal simulator, a simulation environment that renders graphic, audio, and vibrotactile effects in response to footsteps, and a mobile

game treatment for amblyopia.

4. My work on the Ultra-Videoconferencing system was recognized by an award for Most Innovative Use of New Technology from ACM/IEEE Supercomputing and a Distinction Award from the Audio Engineering Society. The research 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, and my Real-Time Emergency Response project won the Gold Prize (brainstorm round) of the Mozilla Ignite Challenge. I am also a recipient of several "best paper" awards from scholarly societies for my research.

5. I have worked with IBM at the Haifa Research Center, Israel, and the Watson Research Center in Yorktown Heights, New York, the Sony Computer Science Laboratory in Tokyo, Japan, and was a visiting professor at Bang & Olufsen, Denmark, where I conducted research on telepresence technologies as part of the World Opera Project. I led the theme of Enabling Technologies for a Networks of Centres of Excellence on Graphics, Animation, and New Media (GRAND) and I am an associate editor of the Journal of the AES, the Frontiers Journal in Virtual Reality, and the Institute of Electrical and Electronics Engineers (IEEE) Transactions on Haptics.

6. I have carried out significant research involving design and implementation of haptic feedback systems, virtual and augmented reality, and mobile computing applications. My work in these areas has been recognized with several best paper awards. In recognition of my expertise in the domain of haptics, I was invited to serve as an Associate Editor for the IEEE Transactions on Haptics, Associate Editor for the Frontiers in Virtual Reality, and Associate Editor for the World Haptics Conference.

7. My experience in academic and practical situations as well as my hands-on experience with multimedia production systems provides me with an appreciation of the technology involved with U.S. Patent No. 8,469,806 B2.

8. I have been retained by counsel for Petitioner to provide my expert opinion in connection with the above-captioned proceeding as set forth herein.

B. Materials Considered

9. 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. 8,469,806 B2 ("'806 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. 8,469,806 B2 to Danny A. Grant, Robert W. Heubel, David M. Birnbaum, and Erin B. Ramsay (filed July 21, 2010 and issued June 25, 2013) ("'806" or "'806 patent")
1003	U.S. Patent Application Publication No. 2008/0024459 A1 to Ivan Poupyrev et al. (filed July 31, 2007 and published January 31, 2008) ("Poupyrev")
1004	U.S. Patent Application Publication No. 2008/0064499 A1 to Danny A. Grant et al. (filed September 13, 2007 and published March 13, 2008) ("Grant '499")
1005	Excerpts from *Microsoft Computer Dictionary* (5th ed. 2002)
1006	Joint Claim Construction Statement, filed in *Immersion Corp. v. Meta Platforms, Inc.*, No. 6:22-cv-00541-ADA (W.D. Tex.) (dated Jan. 21, 2023)
1007	Prosecution history of '806 patent

II. PERSON OF ORDINARY SKILL IN THE ART

10. I am informed by counsel 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"). For purposes of the '806 patent, I have assumed that date to be July 22, 2009, the filing date of the earliest patent application to which the '806

patent claims priority, Provisional Application Ser. No. 61/227,645. I am also informed that in the related district court litigation, Patent Owner has asserted that the '806 patent is entitled to a March 26, 2009 priority date. I express no opinion on whether the '806 patent is actually entitled to a priority date of the provisional application. This issue is not relevant here because all of the prior art references relied upon pre-date that date, and my analysis and conclusions (including POSITA definition) would not change if a priority date earlier in 2009 were applied. In the event the priority date of the '806 patent may 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.

11. I have also been advised by counsel 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.

12. The '806 patent states that it relates to "a system and method of providing haptic stimulation to a user during performance of a complex control gesture, and/or during the control of virtual equipment." ('806, 1:18-21.) The

Background section of the '806 patent states that "[p]rovision of haptic stimulation to users is known. Haptic stimulation provide[s] a physical sensation to users. Haptic stimulation is used in the context of games, and virtual worlds, and in real world control systems." ('806, 1:25-28.)

13. In my opinion, a person of ordinary skill in the art would have possessed a bachelor's degree in electrical engineering or computer science (or an equivalent degree), and two years of practical or industry experience in the field of human computer interaction, including implementation of computer-based systems and software for providing haptic feedback effects to a user. 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 or higher) and less practical or industry experience, or (2) less formal education and more practical or industry experience. Under either formulation, a person of ordinary skill in the art would have understood how to interface with haptic feedback devices using software and/or hardware, and would have understood computer-user interface design including, for example, receiving input from a user through a computer input device (such as touch screen, mouse, or other input device) and displaying information to the user via a graphical user interface.

14. My opinions regarding the level of ordinary skill in the art are based

on, among other things, my decades of experience in the field, 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, research associates, and students, both past and present.

15. 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 '806 patent have been based on the perspective of a person of ordinary skill in the art.

III. STATEMENT OF LEGAL PRINCIPLES

A. Claim Construction

16. 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.

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

18. 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.

19. 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.

20. 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 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.

21. 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.

22. I understand that in the related district court litigation, the parties dispute the meaning of one term appearing in the challenged claims: "**control gesture**." Petitioner asserts that "**control gesture**" as used in the '806 patent has the following meaning:

> a gesture made by a user that is a single and discrete control input having separate portions. The separate portions must be performed in specific order and/or with a specific timing to effectively achieve the control input associated with the "control gesture." Performance of the separate portions, on their own, will not result in the control input associated with the "control gesture" as a whole (e.g., a "control gesture" is not merely a combination of other gestures, each associated with its own control input).

(EX1006 at 001-002.) This proposal matches the description of "**control gesture**" stated in the '806 patent specification: "As used herein, a 'control gesture' refers to a gesture made by a user that is a single and discrete control input having separate portions. The separate portions must be performed in specific order and/or with a specific timing to effectively achieve the control input associated with the 'control gesture.' Performance of the separate portions, on their own, will not result in the control input associated with the 'control gesture' as a whole (e.g., a 'control gesture' is not merely a combination of other gestures, each associated with its own control input)." ('806, 5:7-19.)

23. Patent Owner asserts that the term "**control gesture**" should be given its "plain and ordinary meaning," or alternatively, "a user manipulation having separate portions that must be performed in a specific order and/or with a specific timing." (EX1006 at 001.)

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

B. Obviousness

25. 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.

26. 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 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.

27. 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.

28. 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 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.

29. 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.

30. 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 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 not 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.

31. 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.

32. 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;

(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.

33. 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.

34. 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 '806 PATENT

A. Overview of the Specification

35. The '806 patent, entitled "System and Method for Providing Complex Haptic Stimulation During Input of Control Gestures, and Relating to Control of Virtual Equipment," states that it "relates to a system and method of providing haptic stimulation to a user during performance of a complex control gesture, and/or during the control of virtual equipment." ('806, 1:25-31.)

36. The term "gesture" in the field of human-computer interaction (HCI) generally refers to a physical action taken by a user with respect to a computer that provides an input to the computer, which can range from simple interactions such as tapping and pressing on a touch-sensitive display to more complex interactions such as dragging an item from one location to another. One example of a "gesture" that

would likely have been widely-known to laypersons by July 2009 would have included a "swipe" gesture in which a mobile phone user could touch and slide their finger across a touch-sensitive display to perform a particular action.

37. In the "Background of the Invention" section, the '806 patent acknowledges the existence of systems that provide "haptic stimulation" to users, including in the context of games, virtual worlds, and real world control systems. ('806, 1:25-28.) The patent states that "haptic stimulation may be generated to provide feedback to users that a control input has been received, that another user has input a command, that virtual or real objects have collided, exploded, or imploded, that an ambient force is present (e.g., simulated or real wind, rain, magnetism, and/or other virtual forces), and/or that other phenomena have occurred." ('806, 1:28-34.) The patent also acknowledges that "[c]onventional game and/or virtual world systems that enable a user to control virtual equipment are known." ('806, 1:38-39.)

38. However, the patent asserts that the "control and feedback schemes for interacting with virtual equipment in these conventional systems tend to be limited, and to not correlate strongly with real world control and/or feedback of corresponding real world equipment." ('806, 1:38-43.) The patent also asserts that "[a]lthough basic haptic effects (e.g., vibrate) have been used in mobile and other

computing devices, numerous challenges remain for developers to engage users and provide feedback to enhance the user experience." ('806, 1:44-47.)

39. The patent purports to describe "a system configured to provide haptic stimulation to a user of a game." ('806, 1:51-52.) The system may include "a user interface, an actuator, and one or more processors configured to execute computer program modules." ('806, 1:53-55.) The system may also include a "gesture module" that is configured to "monitor performance of a control gesture by the user based on the output signals of the user interface," where the "control gesture is a gesture associated with a command input to the game, and includes an initial portion, a first intermediate portion, and an ending portion." ('806, 1:58-65.) The patent also purports to describe a "method" of providing haptic stimulation to a user that includes "monitoring performance of a control gesture by a user." ('806, 2:10-24.)

40. I discuss additional aspects of the '806 patent as needed in my analysis below.

B. The Challenged Claims

41. This Declaration addresses claims 11, 12, and 15 of the '806 patent. Claim 11 is an independent claim and recites:

> 11. A computer-implemented method of providing haptic stimulation to a user of a system, the method being implemented in the system which

includes a haptic device and one or more physical processors configured to execute computer program modules, the method comprising:

[a] monitoring, on the one or more processors, performance of a control gesture by a user,

[b] wherein the control gesture is a gesture associated with a command input to the system, and includes an initial portion, a first intermediate portion, and an ending portion,

[c] determining, on the one or more processors, haptic stimulation associated with performance of the control gesture to be generated for the user,

[d] wherein the haptic stimulation includes a first stimulation determined responsive to performance of the initial portion of the control gesture, and a second stimulation that is different from the first stimulation and is determined responsive to performance of the first intermediate portion of the control gesture; and

[e] generating, with the haptic device, the determined stimulation during performance of the control gesture.

('806, claim 11 (bracketed notations, e.g., "**[a]**" added).) I address the claims further in my detailed analysis in **Part V** below.

V. APPLICATION OF THE PRIOR ART TO CHALLENGED CLAIMS

42. I have reviewed and analyzed the prior art references and materials listed in **Part I.B** above. In my opinion the claims of the '806 patent would have been obvious to a person of ordinary skill in the art based on the following prior art.

Ground	Claims	Basis for Challenge (Obviousness)
1	11, 12, 15	Poupyrev
2	11, 12, 15	Grant '499

43. I am informed by counsel that each reference qualifies as prior art to the challenged claims.

A. Brief Summary and Overview of the Prior Art

44. The challenged claims of the '806 patent attempt to lay claim to techniques for user interface control gestures that have multiple portions, each portion generating a specific haptic stimulation. But these techniques were known before the '806 patent, as evidenced by the prior art discussed below.

1. Poupyrev [EX1003]

45. **Poupyrev**, U.S. Patent Application Pub. No. 2008/0024459 A1, is entitled "Apparatus and Method for Touch Screen Interaction Based on Tactile Feedback and Pressure Measurement." I am informed that Poupyrev qualifies as prior art because it was filed on July 31, 2007 and published on January 31, 2008,

both dates being before the filing date of the challenged claims. Poupyrev is an analogous reference in the same field as the '806 patent, which identifies its "Field of the Invention" as relating to "a system and method of providing haptic stimulation to a user during performance of a complex control gesture, and/or during the control of virtual equipment." ('806, 1:18-21.) Poupyrev would also have been reasonably pertinent to a number of problems facing the '806 patent inventors in carrying out the invention, including how to determine when a user is performing a control gesture, and how to provide haptic stimulations corresponding to specific portions of the control gesture, as described below. An ordinarily skilled artisan would have had at least a reasonable expectation of success in carrying out Poupyrev's teachings, as they would have required nothing more than known techniques for processing user input and providing haptic stimulation that could have been implemented using conventional techniques.

46. As its title indicates, Poupyrev discloses techniques for providing haptic feedback to a user in response to a user making contact with a touch screen display. (Poupyrev, Abstract, ¶0002.) The techniques in Poupyrev involve detecting the position and measuring the pressure applied by the user to the touch screen. (Poupyrev, ¶¶0008, 0010, 0051.) Figure 1 shows an exemplary apparatus for implementing an embodiment in Poupyrev:

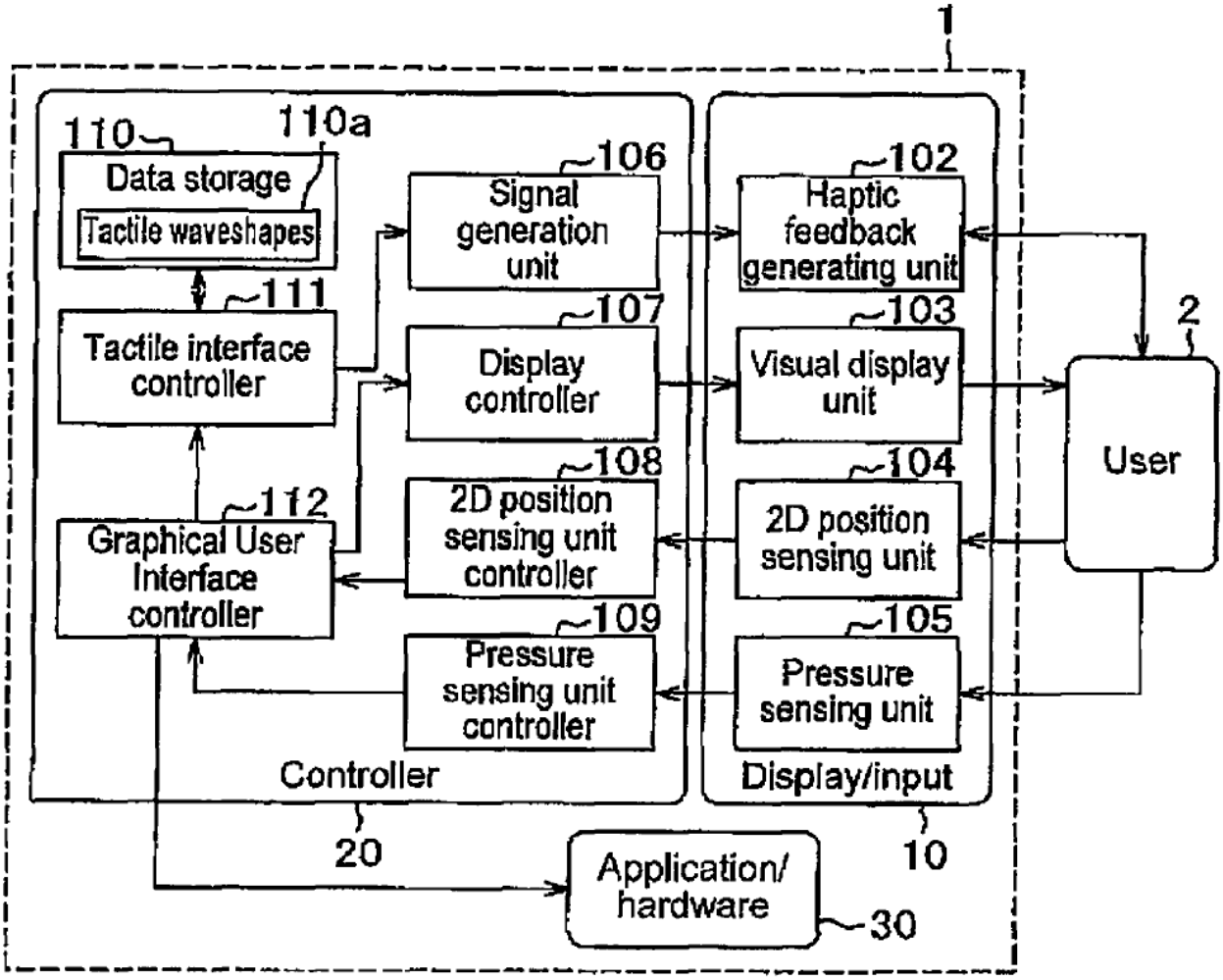

Figure 1

(Poupyrev, Fig. 1, ¶0048.) Figure 1 shows apparatus **1** that includes display/input section **10**, which "displays on a touch screen thereof images of buttons, keys, switches or any other Graphic User Interface (GUI) objects to prompt a user **2** to interact with the apparatus **1**." (Poupyrev, ¶0049.) "The display/input section **10** further detects a touch position of a user's finger or a pointing device on the screen

and pressure applied when the finger or pointing device touches the screen. The display/input section **10** further provides different types of tactile feedback in response to the user's input operation." (Poupyrev, ¶0049; *see also id.*, ¶0076 ("It is desirable to provide different levels of the tactile feedback with a GUI object depending on the pressure applied on the GUI object.").)

47. Figure 1 also shows control section **20**, which receives and responds to the touch position and pressure information provided by display/input section **10**. More specifically, control section **20** "dynamically correlates: (i) the touch position on the screen or a GUI object selected by the user's input operation; (ii) the pressure applied on the screen by the user's input operation; and (iii) a current logical state of the selected GUI object; with the type of tactile feedback to be presented to the user **2**." (Poupyrev, ¶0051.) The third section shown at the bottom in Figure 1 is application section **30**, which "performs various operations or functions in response to the user's input operation detected by the display/input section **10**. The application section **30** may include various applications and software units or hardware." (Poupyrev, ¶0052.)

48. Display/input section **10** detects a user touching the screen using either a finger or pointing device. (Poupyrev, ¶¶0010, 0065, 0073 (touch down event T**1**).) Pressure sensing unit **105**, part of display/input section **10** in Figure 1 above,

"measure[s] pressure applied to the touch screen by the user's input operation." (Poupyrev, ¶0056.) 2D position sensing unit **104**, also part of display/input section **10**, "detects where the user is touching on the touch screen." (Poupyrev, ¶0058.)[1]

49. As shown in Figure 1, pressure and position information is conveyed, respectively, to pressure sensing unit controller **109** and position sensing unit controller **108**, both parts of the controller section **20**. (Poupyrev, Fig. 1.) Pressure sensing unit controller **109** "determines the value of pressure applied when the user

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[1] I note that the written description of Poupyrev sometimes mixes up the numerals (**104**, **105**) used to refer to the pressure sensing unit and the position sensing unit of Figure 1. (Poupyrev, ¶¶0053 ("[A] two-dimensional (2D) position sensing unit **104** and a pressure sensing unit **105**."), 0056 ("… pressure sensing unit **104**"), 0058 ("… position sensing unit **105**….").) For consistency, I will refer to "pressure sensing unit" as **105** and the "position sensing unit" as **104**, consistent with the depiction in Figure 1. An ordinarily skilled artisan would have regarded these inconsistencies as immaterial typographical errors, and none of them would have impeded the ability of an ordinarily skilled artisan to fully understand and apply the teachings of Poupyrev on which I rely in this Declaration.

is touching on the screen." (Poupyrev, ¶0066.) Position sensing unit controller **108** "determines the position where the user **2** is touching on the screen." (Poupyrev, ¶0066.) This information is then conveyed to graphical user interface (GUI) controller **112**, part of control section **20**. (Poupyrev, ¶0066, Fig. 1.)

50. GUI controller **112** then "determines which GUI object the user **2** is intending to interact with." (Poupyrev, ¶0068.) Examples of GUI objects include "images of buttons, sliders, drawing, scroll bars, hyper links and etc." (Poupyrev, ¶0054; *see also id.*, ¶0125.) GUI controller **112** responds by changing the current state of the GUI object. For example, in the case of a graphical button, GUI controller **112** can cause the visual appearance of the GUI object to change to reflect that it is being pressed. (Poupyrev, ¶¶0068, 0074.)

51. GUI controller **112** also sends commands to tactile interface controller **111**, another component of control section **20** in Figure 1, which "generates appropriate commands for driving the tactile signal generation unit **102**." (Poupyrev, ¶0070.) Tactile signal generation unit **102**, which is part of display/input section **10** in Figure 1, may be formed using "piezoelectric bimorph actuators," and "various types of mechanical or electrical or electromagnetic actuators/motors… to generate the tactile feedback depending on a size/mass of the display and/or available power." (Poupyrev, ¶0055.)

52. I will provide further details about Poupyrev in my discussion of **Ground 1** below.

2. Grant '499 [EX.1004]

53. **Grant '499**, U.S. Patent Application Pub. No. 2008/0064499 A1, is entitled "Systems and Methods for Casino Gaming Haptics." I am informed that Grant '499 qualifies as prior art because it was filed on September 13, 2007 and published on March 13, 2008, both dates being before the filing date of the challenged claims. Like Poupyrev discussed above, Grant '499 is an analogous reference in the same field as the '806 patent, which identifies its "Field of the Invention" as relating to "a system and method of providing haptic stimulation to a user during performance of a complex control gesture, and/or during the control of virtual equipment." ('806, 1:18-21.) Grant '499 would also have been reasonably pertinent to a number of problems facing the '806 patent inventors in carrying out the invention, including how to determine when a user is performing a control gesture, and how to provide haptic stimulations corresponding to specific portions of the control gesture, as described below. An ordinarily skilled artisan would have had at least a reasonable expectation of success in carrying out the teachings of Grant '499, as they would have required nothing more than known techniques for processing user input and providing haptic stimulation that could have been

implemented using conventional techniques.

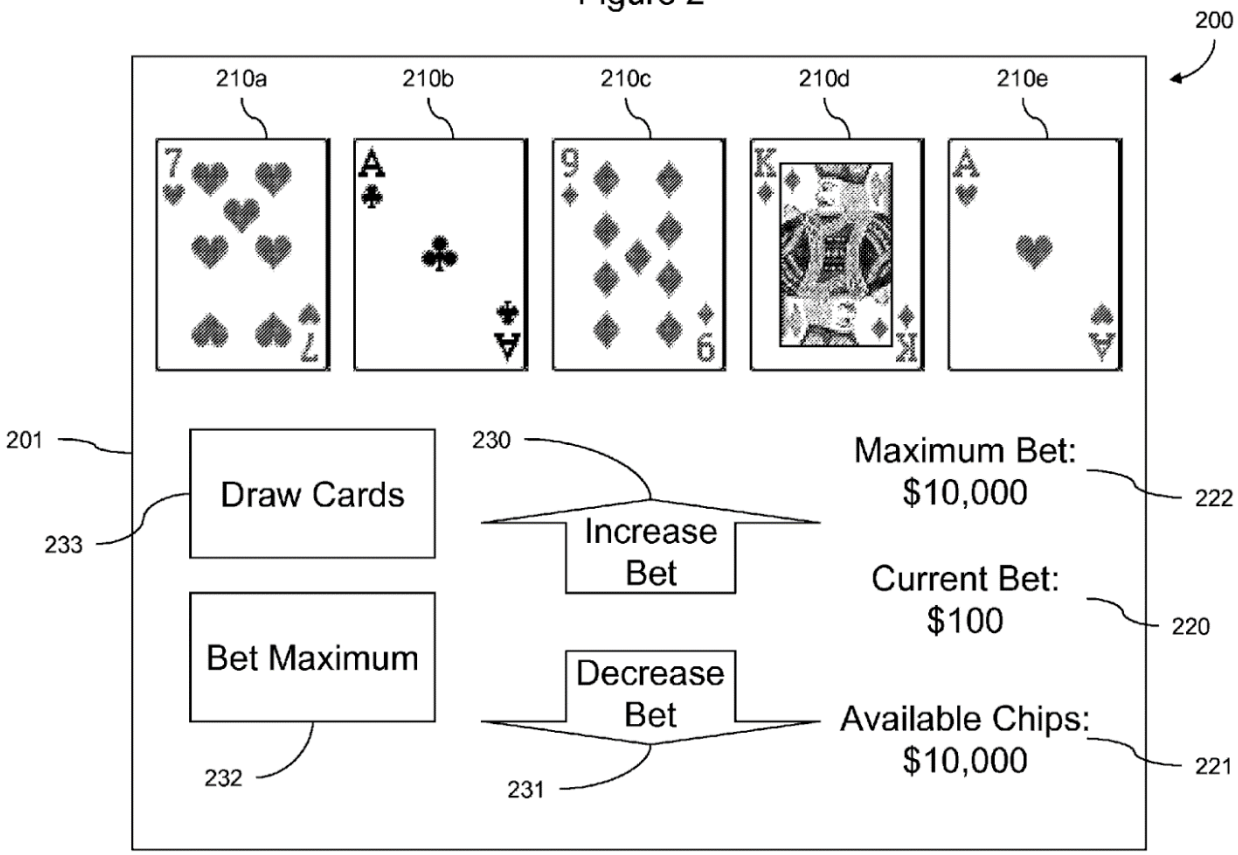
54. Grant '499 names the same lead inventor as the '806 patent (Danny Grant), and both Grant '499 and the '806 patent appear to have originated from Patent Owner. For consistency and clarity, therefore, I will refer to the published Grant patent application upon which I rely as prior art as "Grant '499." Grant '499 does not appear to be related to the patent family for the '806 patent, and I found nothing in the prosecution history to suggest that Grant '499 was cited to or considered by the Examiner during prosecution of the '806 patent. Grant '499 is also not cited or referenced in the written description of the '806 patent.

55. As its title indicates, Grant '499 relates to haptic gaming devices, specifically for casino gaming. (Grant '499, Abstract, ¶0002.) Grant '499 explains that "[w]hile conventional casino gaming machines may provide feedback to a user in the form of visual displays on a screen, or with sounds, conventional casino gaming machines do not provide haptic feedback to a user." (Grant '499, ¶0004.) Grant '499 purports to overcome this limitation by disclosing a system for "casino gaming haptics" that comprises (among other things) a touch-sensitive input device configured to sense a contact from a user, and an actuator configured to output a haptic effect to the touch-sensitive input device. (Grant '499, ¶¶0005, 0023-0024, 0026, Fig. 3 (showing touch-sensitive input device **320** and actuator **330**).) "For

example, in one embodiment of the present invention, a user may contact the touch screen **320** at a location corresponding to a playing card. The computer **310** determines there is an interaction between the contact and the image of the playing card. The computer **310** then generates a haptic effect, such as a vibration, and encodes the haptic effect within an actuator signal. The computer **310** then transmits the actuator signal." (Grant '499, ¶0026; *see also id.*, ¶0028 ("Any suitable actuator may be used in embodiments of the present invention.").)

56. Grant '499 discloses a number of exemplary games that can be configured to include casino gaming haptics, including card games, dice games, roulette, checkers, among others. (Grant '499, ¶0058.) For purposes of my Declaration, I will focus primarily on embodiments in Grant '499 depicted in Figure 2 describing casino haptics for virtual playing cards in games such as poker and blackjack. (Grant '499, ¶¶0019, 0062-0064, Fig. 2.)

Figure 2



(Grant '499, Fig. 2.) Figure 2 shows a touch-screen displaying a five-card poker game **201**. (Grant '499, ¶0019.) "The game **201** shows the five cards **210***a-e* dealt to the player, the current bet **220**, the number of chips **221** the player has, buttons **230**, **231** to allow the user to increase or decrease the wager, a button **232** to place the maximum wager **222**, and a button **233** to draw cards to replace any the player wishes to discard." (Grant '499, ¶0019.)

57. My Declaration will primarily focus on features in Grant '499 relating to discarding virtual playing cards using the touch-screen display. "For example,

the player may choose to discard the seven of hearts **210***a* and nine of diamonds **210***c* by touching the cards on the touch screen **102** [of Fig. 1]." (Grant '499, ¶0019.) Haptic feedback can then be provided to the user. (Grant '499, ¶0020.) Grant '499 goes in to describe, in more detail, the required steps for the user to discard a playing card and the haptic feedback provided to the user during performance of those steps:

> For example, in the embodiment shown in FIGS. 1 and 2, a user may touch the nine of diamonds **210***c*, and feel a light pop (e.g. a low magnitude, high frequency, short duration effect) to indicate that the card has been contacted. The user may then drag the card **210***c* to the edge of the screen **201** to discard the card. While the user is dragging the card, the system **100** may output a low magnitude, low frequency vibration to provide the tactile sensation of a card sliding across a felt surface. When the card reaches the edge of the screen, the system **100** may generate a strong pop (e.g. a high magnitude, high frequency, short duration) effect to indicate the card has been discarded.

(Grant '499, ¶0064.) As I will explain below, the card discarding feature in Grant '499 provides an example of the claimed "**control gesture**."

58. I will provide more details about Grant '499 in my discussion of **Ground 2** below.

B. Ground 1: Claims 11, 12, and 15 Are Obvious Over Poupyrev

1. Independent Claim 11

59. For reference, claim 11 recites:

11 A computer-implemented method of providing haptic stimulation to a user of a system, the method being implemented in the system which includes a haptic device and one or more physical processors configured to execute computer program modules, the method comprising:

[a] monitoring, on the one or more processors, performance of a control gesture by a user,

[b] wherein the control gesture is a gesture associated with a command input to the system, and includes an initial portion, a first intermediate portion, and an ending portion,

[c] determining, on the one or more processors, haptic stimulation associated with performance of the control gesture to be generated for the user,

[d] wherein the haptic stimulation includes a first stimulation determined responsive to performance of the initial portion of the control gesture, and a second stimulation that is different from the first stimulation and is determined responsive to performance of the first intermediate portion of the control gesture; and

[e] generating, with the haptic device, the determined stimulation during performance of the control gesture.

('806, claim 11.)

60. The preamble of claim 11 recites "[**a**] **computer-implemented method of providing haptic stimulation to a user of a system, the method being implemented in the system which includes a haptic device and one or more physical processors configured to execute computer program modules, the method comprising**…." Assuming the preamble of claim 11 imposes a limitation, it is disclosed by and rendered obvious over the prior art.

61. Poupyrev discloses a method of providing haptic stimulation to a user of the system. The "**haptic stimulation**" takes the form of tactile feedback provided to the user through a touch screen display. Figure 1 shows an exemplary apparatus for implementing an embodiment in Poupyrev:

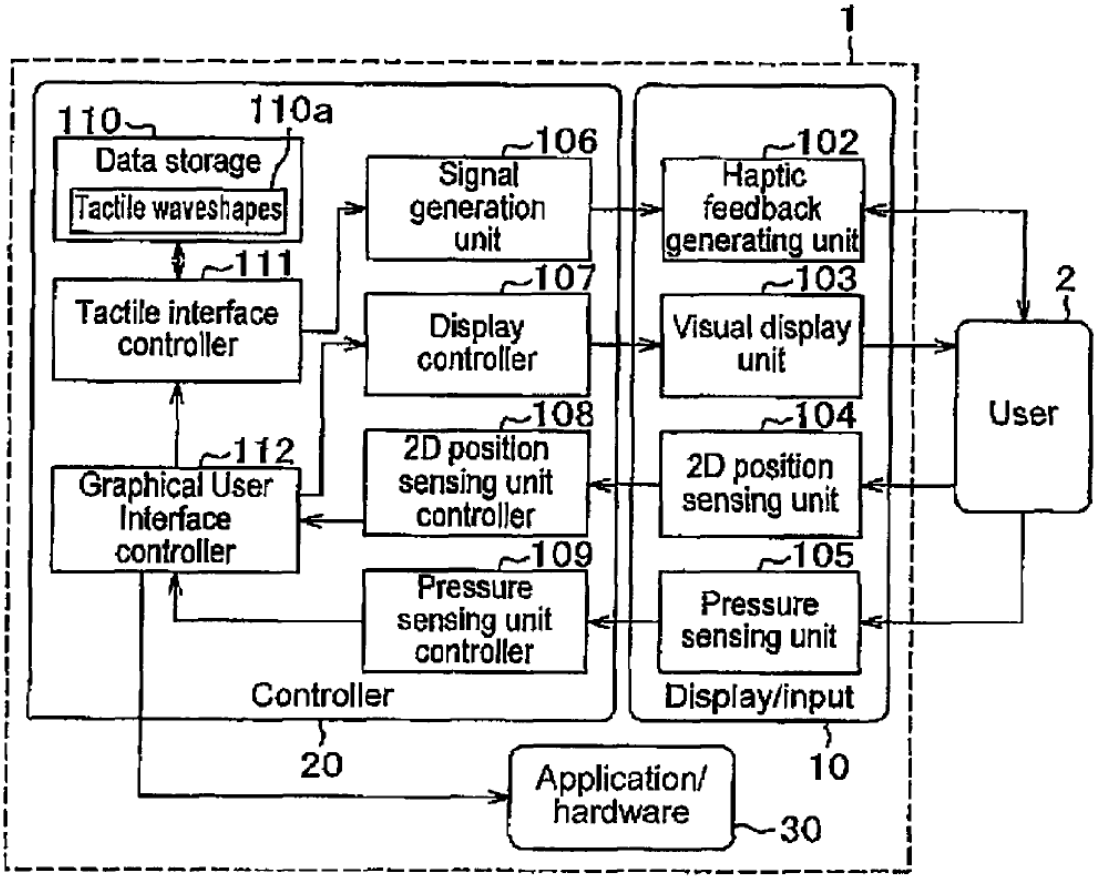


Figure 1

(Poupyrev, Fig. 1, ¶0048.) Figure 1 shows apparatus **1** that includes display/input section **10**, which "displays on a touch screen thereof images of buttons, keys, switches or any other Graphic User Interface (GUI) objects to prompt a user **2** to interact with the apparatus **1**." (Poupyrev, ¶0049.) "The display/input section **10** further detects a touch position of a user's finger or a pointing device on the screen and pressure applied when the finger or pointing device touches the screen. The display/input section **10** further provides different types of tactile feedback in

response to the user's input operation." (Poupyrev, ¶¶0049, 0076 ("It is desirable to provide different levels of the tactile feedback with a GUI object depending on the pressure applied on the GUI object.").)[2] The "**haptic stimulation**" in Poupyrev thus takes the form of tactile feedback provided to the user in response to interacting with a GUI object. (Poupyrev, ¶0050 ("It should be noted, in this specification, that the word 'tactile' and 'haptic' indicate the same sensory effect and are used interchangeably.").) I will provide more detail about the haptic stimulation provided to the user in my discussion of the limitations of claim 11 below.

62. Poupyrev also discloses and renders obvious that the method of providing haptic stimulation to a user is "**computer-implemented**" using a system "**which includes a haptic device and one or more physical processors configured to execute computer program modules**." First, addressing the recitation that the system is "**computer-implemented**" and includes "**one or more physical processors configured to execute computer program modules**," Poupyrev explains that control section **20** discussed above "may be embodied with a

[2] Except as otherwise noted, all underlining added to quotations from prior art references was added by me for emphasis.

computer… which may include a CPU [*i.e.*, central processing unit], a memory, an external data storage, and an input/output interface." (Poupyrev, ¶0060; *see also id.* ¶0070 (discussing that data storage **110**, within control section **20**, may be "[a]ny widely available data storage devices," including "flash memory, ROM, hard drive as well as network storage.").) It would have been obvious that the method in Poupyrev is "**computer-implemented**" because it is implemented by a system including a computer having a CPU ("**one or more physical processors**"). Poupyrev further discloses that "[v]arious functions performed by sub-sections of the control section **20** and the application section **30** may be realized by executing corresponding software installed in the computer…" (Poupyrev, ¶0060.)

63. It would have been obvious to an ordinarily skilled artisan that the software in Poupyrev would have taken the form of "**program modules**," which would have been executed by the CPU of the system ("**one or more physical processors**"). The '806 patent does not define "**program modules**," but explains that these modules may be configured to execute "by software; hardware; firmware; some combination of software, hardware, and/or firmware; and/or other mechanisms for configuring processing capabilities on processor **20**." ('806, 6:65-7:2.) The term "**module**" in the context of computer programming is often understood as referring to a portion of a computer program (such as a collection of routines or procedures)

that performs a particular task. (*See Microsoft Computer Dictionary* (5th ed. 2002) [EX1005], p.346 ("**module** *n.* 1. In programming, a collection of routines and data structures that performs a particular task or implements a particular abstract data type.").) It would have been obvious that processes in Poupyrev are carried out by the CPU executing "**program modules**," which would have included software routines used to carry out the "[v]arious functions performed by sub-sections of the control section **20** and the application section **30**…." (Poupyrev, ¶0060.) For example, it would have been obvious that the claimed "**program modules**" would have included at least software routines associated with control section **20** and application section **30**. I will discuss the functions carried out by the program modules in Poupyrev in further detail below.

64. Finally, the system in Poupyrev "**includes a haptic device**." I note that claim 11 uses the term "**haptic device**" to refer to a device used in generating haptic stimulation. (*See* Claim 11**[e]** ("generating, with the haptic device, the determined stimulation during performance of the control gesture").) The specification of the '806 patent also explains that "actuators **16** are configured to generate haptic stimulus for user **12**" and "may include any device configured to generate [tactile] feedback for application to the users." ('806, 5:54-55, 6:3-10.)

65. The haptic device in Poupyrev thus corresponds to at least haptic

feedback generating unit **102** (also referred to as tactile feedback generating unit **102**) which comprises an actuator that generates the haptic stimulation. (Poupyrev, ¶¶0054-0055, 0063, 0118.) Poupyrev explains that GUI controller **112** sends appropriate commands to tactile interface controller **111**, which in turn sends appropriate commands to signal generation unit **106**, as shown in Figure 1. (Poupyrev, ¶0070.) "The signal generating unit **106** generates and provides a signal to the tactile feedback generating unit **102** for driving tactile feedback generating elements or the piezoelectric actuators." (Poupyrev, ¶0063.) "The haptic feedback generating unit **102** may be formed with piezoelectric bimorph actuators with single or multiple layer structure." (Poupyrev, ¶0055.)

(a) "monitoring, on the one or more processors, performance of a control gesture by a user" (11[a])

(b) "wherein the control gesture is a gesture associated with a command input to the system, and includes an initial portion, a first intermediate portion, and an ending portion" (11[b])

66. Because claims 11**[a]** and 11**[b]** are closely related, I will discuss them together. Poupyrev discloses a "**control gesture**" in the form of a gesture in which a user interacts with and controls a GUI object, such as a button appearing on a touch-sensitive display. I will describe the "**control gesture**" in more detail below.

67. By way of background, a user in Poupyrev can activate a GUI object

(such as a button) on a touch screen by making contact with the object and increasing the pressure applied to it. Figure 5 shows one example:

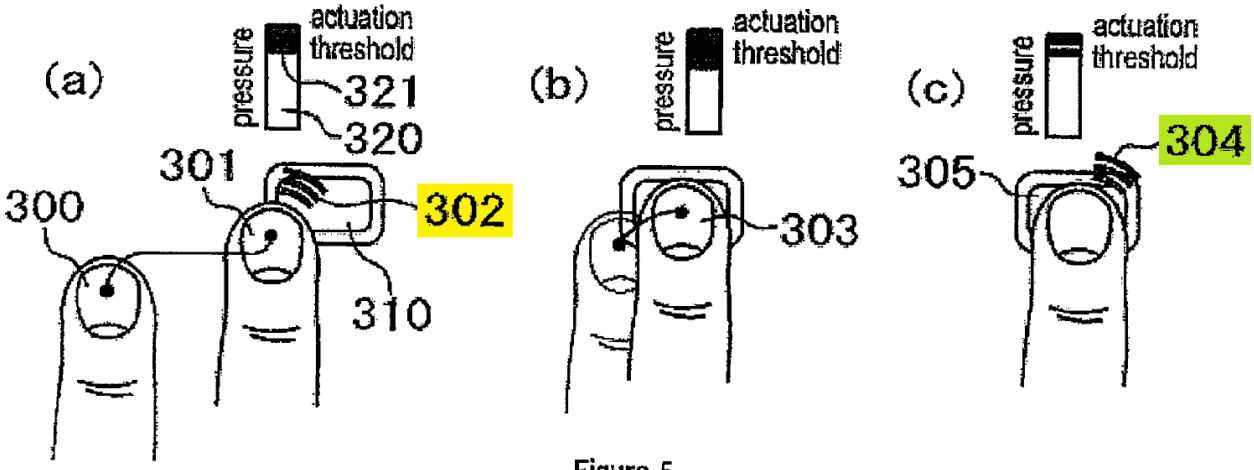
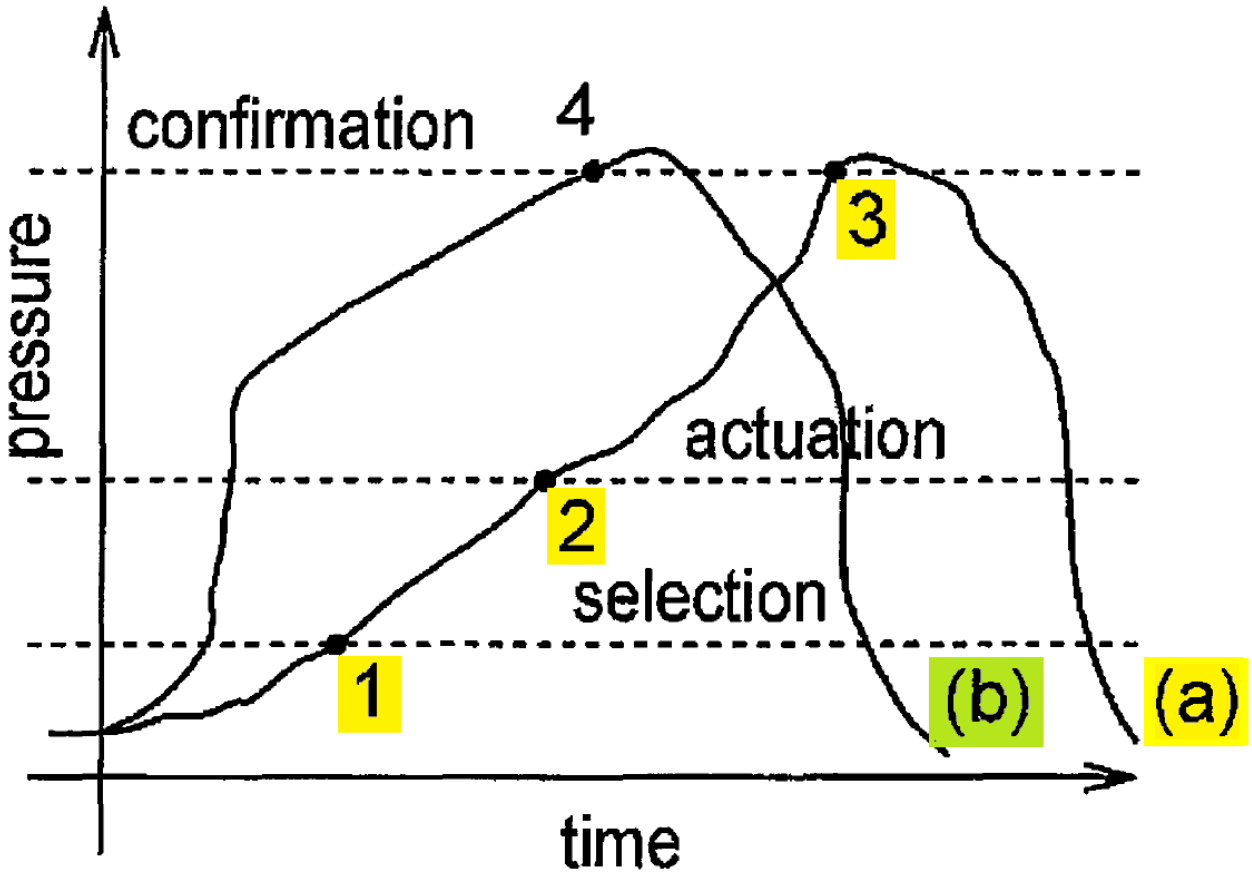


Figure 5

(Poupyrev, Fig. 5 (highlighting added).) Figure 5 shows the apparatus providing haptic feedback **302** and **304**. Starting with Figure 5(a), the user has slid its finger from initial position **300** to position **301** at the boundary of GUI object **310**. (Poupyrev, ¶0085.) The apparatus "provides a tactile feedback **302** to allow the user **2** to 'feel' the GUI object **310**." (Poupyrev, ¶0085.) The user has at this stage selected but not yet activated (actuated) the GUI object. (Poupyrev, ¶0081 ("Accordingly, the user **2** can feel the GUI objects on the screen without activating them").) Figure 5(b) shows that the user has subsequently moved its finger further inside GUI object **310** and increased the pressure (*i.e.*, how strong it is pressing down on the screen) to a level above actuation threshold **321**. (Poupyrev, ¶0086.) This indicates that "the GUI object **310** is actuated," and in response, "tactile feedback

304 is provided as well as visual feedback **305** to inform the user **2** that the GUI object **310** was selected and actuated." (Poupyrev, ¶¶0086, 0082 ("Accordingly, it is possible to let the user **2** knows [sic] that the selected GUI object **203** is activated with the haptic feedback").) Poupyrev makes clear that different haptic feedback effects can be provided for the "selected" and "activated" states of a GUI object. (Poupyrev, ¶0083 ("In the present embodiment, the different haptic feedbacks are provided to distinct the logical states of GUI object, namely 'selected state' and 'activated state'.").) In this example, therefore, two types of haptic stimulation are provided corresponding to the "selected" and "activated" (or "actuated") states of the GUI object.

68. Poupyrev discloses a more sophisticated example of activation of a GUI object to which I have mapped the claimed "**control gesture**." In this further embodiment, "an additional step for confirming the completion of actuating operation, such as adding another pressure threshold or detecting releasing of the finger, may be added to avoid accidental actuation." (Poupyrev, ¶0087.) This example is depicted in Figure 11:

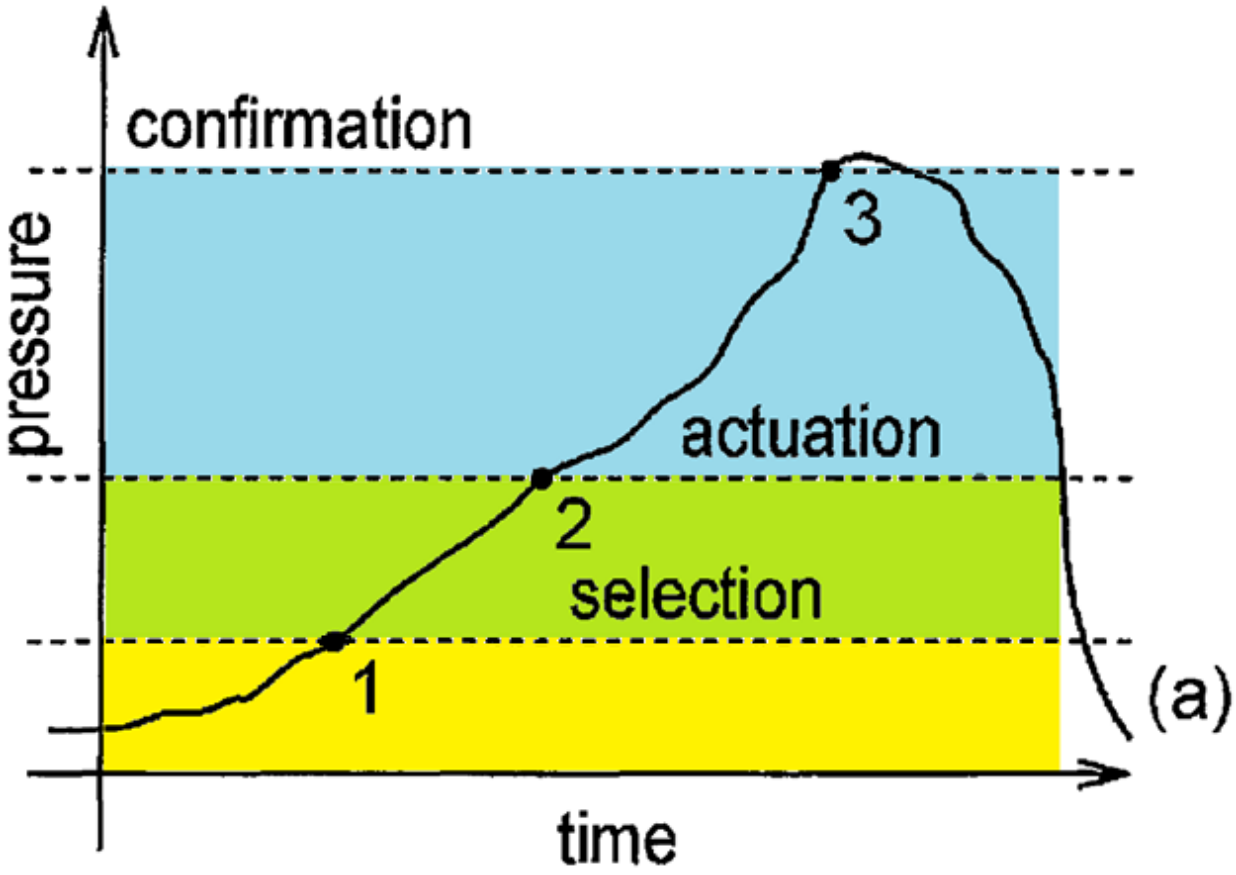


(Poupyrev, Fig. 11 (highlighting added).) Figure 11 shows two exemplary pressure curves **(a)** and **(b)** showing tactile feedback provided to the user based on the pressure applied to a GUI object (vertical axis) over time (horizontal axis). In both examples, the user has touched a GUI object (such as a button) and then increased the amount of pressure applied to the object. For purposes of claim 11, I will focus primarily on Curve **(a)**, which includes Points **1**, **2**, and **3**, as shown.

69. At Point **1**, the user has initiated contact with the GUI object and increased pressure passing the "selection" pressure threshold, causing tactile

feedback to be provided – but at this point the GUI object is not yet activated. (Poupyrev, ¶0119 ("As the user touches and pushes the GUI object to pass a selection threshold, a tactile feedback is provided (Point **1** of Curve (a)) without actuating the GUI object.").) After that, "[t]he user presses further to pass the actuation threshold where a different tactile feedback is provided (Point **2**). In this example, however, the GUI object is not actuated yet. To actuate the GUI object, the user should press further to the confirmation threshold that also provides still another tactile feedback (Point **3**)." (Poupyrev, ¶0119.) The GUI object is therefore activated only after the user passes confirmation threshold at Point **3**. Poupyrev explains that "the reason for providing this additional threshold or confirmation threshold is to avoid accidental activation of the GUI objects." (Poupyrev, ¶0120.)

70. The "**control gesture**" in Poupyrev for purposes of claim 11 corresponds to the gesture shown in Curve **(a)** in which the user controls the GUI object by making contact with the object on the touch-sensitive display and then increasing the pressure until passing the confirmation threshold, at which point the GUI object is activated. This control gesture also "**includes an initial portion, a first intermediate portion, and an ending portion**." I have illustrated these three portions in the following annotated and highlighted version of Figure 11 below:



(Poupyrev, Fig. 11 (highlighting added; Curve **(b)** removed for simplicity).) I have also removed Curve **(b)** for simplicity and to focus on Curve (a). The highlighted Figure 11 above shows that the "**control gesture**" in Poupyrev includes "**an initial portion**," *i.e.*, the portion in which the user initiates contact with the GUI object and/or presses the GUI object with pressure sufficient to pass the selection threshold at Point **1**, as I will discuss in more detail below. Figure 11 also shows "**a first intermediate portion**," *i.e.*, the portion in which the user maintains contact with the GUI object and further increases the pressure until it passes the actuation threshold

at Point **2**, and shows "**an ending portion**" *i.e.*, the portion in which the user further increases the pressure until passing the confirmation threshold at Point **3.**

71. My mapping of this functionality in Poupyrev to the claimed "**control gesture**" is entirely consistent with embodiments in the '806 patent. With respect to the claimed "**initial portion**," Poupyrev discloses this portion in two separate and independent ways. Under a first theory, the "**initial portion**" in Poupyrev corresponds to the user initially making contact with the GUI object using the touch-sensitive display, and then increasing the pressure applied to the GUI object to pass selection threshold at Point **1**, as shown in Figure 11 above. This mirrors an exemplary initial portion in the '806 patent that "may include initiating contact with the touch-sensitive surface at one or more locations," which can specify "a pressure with which contact is initiated," among other factors. ('806, 7:49-57.)

72. As a second and independent theory, the "**initial portion**" in Poupyrev corresponds to the user, who is already making contact with the GUI object, increasing the pressure applied to the GUI object to pass selection threshold at Point **1**. Under this alternative embodiment, therefore, the claimed initial portion does not include the user making initial contact with the GUI object. This is also consistent with the '806 patent, which explains that an "**initial portion**" can exist even "[i]f user **12** is already in contact with the touch-sensitive surface" ('806, 7:57-58), and

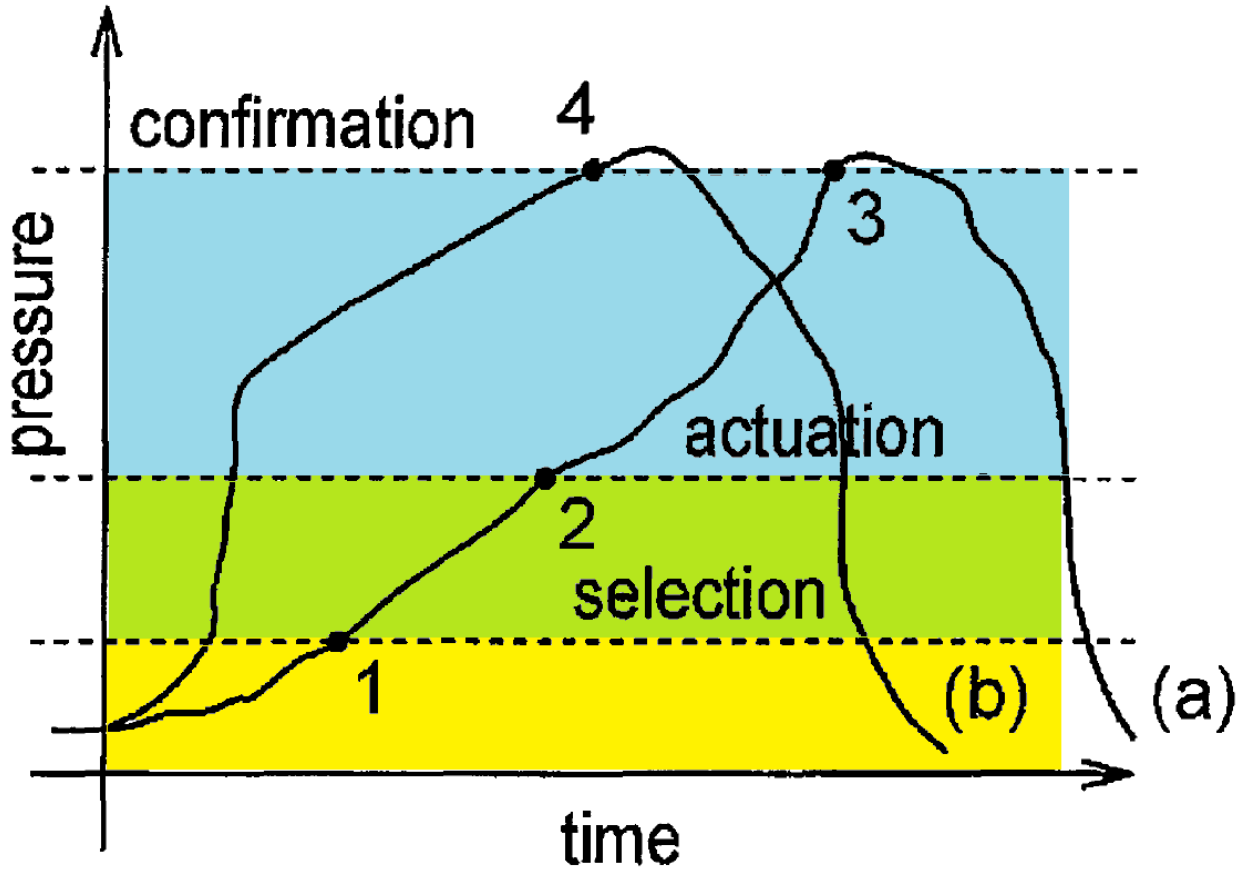
can include a number of actions including "maintaining contact (at specific location(s), or generally) with the touch-sensitive surface" ('806, 7:60-62), among others. Under both of these theories, Poupyrev discloses the claimed initial portion.

73. Moving next to the claimed "**first intermediate portion**," the '806 patent further explains that it "may include "one or more of maintaining contact at one or more points without moving," and may further include "pressing harder or softer on the touch-sensitive surface," among other actions. ('806, 7:65-8:5.) And the claimed "**ending portion**" can also similarly include "pressing harder or softer on the touch sensitive surface," among other actions. ('806, 8:5-11.) These disclosures also mirror Poupyrev, in which the user maintains contact with the GUI object and then increases the pressure applied to the GUI object to pass actuation threshold at Point **2** ("**first intermediate portion**") and then further increases the pressure to pass confirmation threshold at Point **3** ("**ending portion**"), at which point the GUI object is activated. (Poupyrev, ¶0119.)

74. My analysis above focused on Curve **(a)** because it discloses discrete Points **1**, **2**, and **3** at which applicable pressure thresholds are passed and corresponding haptic feedback is provided. (Poupyrev, ¶0119.) My analysis does not rely on Curve **(b)** because that curve does not disclose providing haptic stimulation in response to the "**initial portion**" and "**intermediate portion**," as

required by later limitations (11**[c]-[d]**) of the claim discussed below. But I am informed by counsel that under the patent laws, a prior art reference that "sometimes but not always" embodies a claimed method nonetheless discloses that aspect of the invention. The existence of alternative Curve **(b)** thus does not provide any obstacle to my opinions because, as explained above and further below, Curve **(a)** fully discloses and renders obvious all limitations of claim 11.

75. But with respect to claim 11**[a]-[b]** discussed here, and although not required by the claim or patent laws, Curve **(b)** from Figure 11 does in fact show a "**control gesture**" with the same three claimed portions as Curve **(a)**:



(Poupyrev, Fig. 11 (highlighting added).) As shown, in Curve **(b)** the user presses the GUI object very quickly, passing the confirmation threshold and receiving tactile feedback at Point **4**, but bypassing the separate tactile feedback provided for the selection and actuation thresholds provided to the user in Curve **(a)** at Point **1** and Point **2**. (Poupyrev, ¶¶00121-0122.) But just like Curve **(a)** fully discussed above, Curve **(b)** also shows a control gesture that includes "**an initial portion**, **a first intermediate portion**, **and an ending portion**," because the user touched the GUI object and applied increasing pressure sufficient to pass all three of the pressure

thresholds, including the final confirmation threshold at Point **4**.

76. I also note that a person of ordinary skill in the art would also have found it obvious to choose not to implement Curve **(b)**, such that activation of a GUI object with a confirmation threshold requires that the user follow Curve **(a)**. (Poupyrev, ¶0134 ("Various modifications of the illustrative embodiments… which are apparent to persons skilled in the art to which the invention pertains are deemed to lie within the scope of the invention.").) A person of ordinarily skill in the art would have understood that accidental or unintended activation of the GUI object is less likely to occur under Curve **(a)** than Curve **(b)** because of the longer amount of time the user is pressing on the GUI object to pass the confirmation threshold under Curve **(a)**, and the provision of distinct tactile feedback when the user passes the selection, actuation and confirmation thresholds. Poupyrev itself explains that "[t]he reason for providing this additional threshold or confirmation threshold is to avoid accidental activation of the GUI objects." (Poupyrev, ¶0120.) Pressing the GUI object and increasing pressure very quickly past the confirmation threshold under Curve **(b)**, in other words, is more likely to result in unintended activation of the GUI object when compared to Curve **(a)**. I note that Poupyrev describes an embodiment addressing an analogous problem in which, "when the user **2** slides into the GUI object **310** with pressure already above the actuation threshold," the device

can treat "the GUI object **310** [as] not actuated…." (Poupyrev, ¶¶0090, 0092.) In this example, the user must first decrease the pressure applied on the GUI object **310** below the actuation threshold, and then press stronger again over the actuation threshold, to activate the GUI object. (Poupyrev, ¶¶0094, 0097.) As applied to the embodiment described in Figure 11, it would have been obvious to implement Poupyrev such that the confirmation threshold as shown in Figure 11 can only be accomplished using Curve **(a)**, with the provision of distinct tactile feedback at the selection (Point **1**), actuation (Point **2**), and confirmation (Point **3**) thresholds as discussed above, which would have been particularly beneficial to avoid accidental activation for a GUI object associated with a mission-critical feature or an operation that cannot be undone.

77. Turning back to the claim limitations, the "**control gesture**" in Poupyrev is also "**associated with a command input to the system**," *i.e.*, activation of the GUI object. Poupyrev explains that the touch screen can display "images of buttons, keys, switches or any other Graphic User Interface (GUI) objects to prompt a user **2** to interact with the apparatus **1**." (Poupyrev, ¶0049.) In the example above, the "**command input**" corresponds to the actual activation of the GUI object upon passing the confirmation threshold, which serves as an input for the system to activate the command or function associated with that GUI object. (Poupyrev, *e.g.*,

¶¶0074 ("…when the user **2** indicates that the GUI object should execute an associated command, corresponding to pressing of a physical button."), 0052 ("The application section **30** performs various operations or functions in response to the user's input operation detected by the display/input section **10**.").) Poupyrev explains that "[t]he reason for providing this additional threshold or confirmation threshold is to avoid accidental activation of the GUI objects." (Poupyrev, ¶0120.)

78. It would have been obvious that the functionality or command performed in response to activation of the GUI object would have depended on the function of the underlying software application assigned to the GUI object. (Poupyrev, ¶¶0007 ("Furthermore, it is desirable to provide tactile notification to the user when the functionality of the user interface element is executed."), 0052 ("The application section **30** performs various operations or functions in response to the user's input operation detected by the display/input section **10**. The application section **30** may include various applications and software units or hardware.").) For example, if the GUI object is a button, activating the button would have resulted in the software application carrying out the function or command that corresponds to activation of that button.

79. Poupyrev also discloses and renders obvious "**monitoring, on the one or more processors**," the performance of this control gesture. The claimed

monitoring is performed by GUI controller **112** in Poupyrev (part of control section **20**), which receives information about both the position and pressure being applied to the screen by the user. (Poupyrev, ¶0066 ("The pressure sensing unit controller **109** determines the value of pressure applied when the user is touching on the screen. The position sensing unit controller **108** determines the position where the user **2** is touching on the screen. The determined data is communicated to the GUI controller **112**.").) As Poupyrev explains:

> The GUI controller **112** determines which GUI object the user **2** is intending to interact with. Further, depending on a) the current state of the GUI object and b) pressure value applied to the GUI object, the GUI controller **112** determines an appropriate change in the state of the GUI object. For example, if the GUI object is a graphical button, the GUI controller **112** can calculate is [sic; if] there was enough pressure applied on the graphical button on the screen to change the state of the button from "free" to "pressed" or "non-actuated" to "actuated."

(Poupyrev, ¶0068.) "The GUI controller **112** further sends the commands to the tactile interface controller **111** that generates appropriate commands for driving the tactile signal generation unit 102." (Poupyrev, ¶0070.) It would therefore have been obvious that GUI controller **112** in Poupyrev is responsible for "**monitoring**" the performance of the claimed "**control gesture**," because it determines that the user

pressed the GUI object and measures whether the user has passed the pressure thresholds at Point **1**, Point **2**, and Point **3**, respectively, corresponding to the claimed "**an initial portion**," "**a first intermediate portion**," and "**an ending portion**." It would also have been obvious that the monitoring by GUI controller **112** takes place "**on the one or more processors**," because the functions of GUI controller **112** (a subsection of control section **20**) can be carried out by software executed by the CPU, as explained in the discussion of the preamble above. (Poupyrev, ¶¶0060 ("The control section **20**… may be embodied with a computer (not shown in the figure), which may include a CPU… Various functions performed by sub-sections of the control section **20**… may be realized by executing corresponding software installed in the computer…."), 0062 ("The controller section **20** includes… a graphical user interface (GUI) controller **112**.").)

80. Finally, the "**control gesture**" in Poupyrev described above satisfies each of the definitions proposed in the district court litigation and is consistent with the written description of the '806 patent. As noted in **Part III.A**, Petitioner has proposed that "**control gesture**" be construed as "*a gesture made by a user that is a single and discrete control input having separate portions. The separate portions must be performed in specific order and/or with a specific timing to effectively achieve the control input associated with the 'control gesture.' Performance of the*

separate portions, on their own, will not result in the control input associated with the 'control gesture' as a whole (e.g., a 'control gesture' is not merely a combination of other gestures, each associated with its own control input)." This definition mirrors the description in the written description. ('806, 5:7-16.)

81. Poupyrev satisfies this definition because, first, the gesture described above is a "*single and discrete control input having discrete portions*." With respect to "*control input*," the '806 patent states that a touch sensitive surface – such as Poupyrev's display/input section **10** – is an example of a "control input device." ('806, 5:29- 38.) The '806 patent further explains that a control input device enables the system to receive a control input from the user. ('806, 7:41-43 ("The gesture module **24** is configured to receive one or more output signals generated by user interface **14** indicating control inputs received from user **12**.") (underlining added).) Thus, as applied to Poupyrev, display/input section **10** is a device that enables a user to enter a control input in the form of a gesture in order to control the system. (Poupyrev, *e.g.*, ¶0052 ("The application section **30** performs various operations or functions in response to the user's input operation detected by the display/input section **10**.").) And the gesture-based activation of the GUI object in Poupyrev is a separate and discrete control input that can only occur after the user passes confirmation threshold, with the gesture having three discrete portions, *i.e.*, "**an**

initial portion," "**a first intermediate portion**," and "**an ending portion**" as described. Next, each of these portions "*must be performed in specific order and/or with a specific timing to effectively achieve the control input associated with the 'control gesture*,'" because they must be performed at least in a specific order beginning with the selection threshold, continuing through the actuation threshold and ending at the confirmation threshold, in order for the GUI object to be actually activated. (Poupyrev, ¶0119 ("As the user touches and pushes the GUI object to pass a selection threshold, a tactile feedback is provided (Point **1** of Curve (a)) without actuating the GUI object. The user presses further to pass the actuation threshold where a different tactile feedback is provided (Point **2**). In this example, however, the GUI object is not actuated yet. To actuate the GUI object, the user should press further to the confirmation threshold that also provides still another tactile feedback (Point **3**).").) Finally and for the same reasons, "[*p*]*erformance* of *the separate portions, on their own, will not result in the control input associated with the 'control gesture' as a whole (e.g., a 'control gesture' is not merely a combination of other gestures, each associated with its own control input)*," because activation of the GUI object only occurs in response to the user passing the confirmation threshold. For example, if the user were to press on the GUI object without passing the confirmation threshold pressure (*e.g.* by disengaging contact

with the GUI object or reducing pressure before passing the confirmation threshold), activation of the GUI object would not have occurred. (Poupyrev, ¶¶0119 (explaining that the GUI object is not activated in Curve (a) until the user presses to the confirmation threshold at Point **3**), 120 ("The reason for providing this additional threshold or confirmation threshold is to avoid accidental activation of the GUI objects.").)

82. As also noted in **Part III.A** above, I am informed that Patent Owner contends that "**control gesture**" should be given its plain and ordinary meaning, or alternatively, construed as "*a user manipulation having separate portions that must be performed in a specific order and/or with a specific timing*." This construction is nothing more than a subset of Petitioner's construction and is thus satisfied by Poupyrev for the reasons provided above; the control gesture as noted is a user manipulation having three separate portions that must be performed in at least a specific order.

(c) "determining, on the one or more processors, haptic stimulation associated with performance of the control gesture to be generated for the user" (11[c])

(d) "wherein the haptic stimulation includes a first stimulation determined responsive to performance of the initial portion of the control gesture, and a second stimulation that is different from the first stimulation and is determined responsive to performance of the first intermediate portion of the control gesture; and" (11[d])

83. The "**haptic stimulation associated with performance of the control gesture to be generated for the user**" corresponds to the tactile feedback provided to the user, as explained for claim 11**[a]-[b]** above, at Points **1** and **2** in Curve **(a)** in response to the pressure applied by the user passing the selection and actuation thresholds, respectively:

> As the user touches and pushes the GUI object to pass a selection threshold, a tactile feedback is provided (Point **1** of Curve (a)) without actuating the GUI object. The user presses further to pass the actuation threshold where a different tactile feedback is provided (Point **2**). In this example, however, the GUI object is not actuated yet. To actuate the GUI object, the user should press further to the confirmation threshold that also provides still another tactile feedback (Point **3**).

(Poupyrev, ¶0119.) The "tactile feedback [being] provided" at Point **1** of Curve **(a)** discloses "**a first stimulation determined responsive to performance of the initial**

portion of the control gesture," because it was provided in response to the user making contact with the GUI object and passing the selection threshold. The "different tactile feedback [that] is provided" (*id*.) at Point **2** of Curve **(a)** discloses "**a second stimulation that is different from the first stimulation and is determined responsive to performance of the first intermediate portion of the control gesture**," because it was provided in response to the user maintaining contact with the GUI object and increasing the pressure to pass the actuation threshold, and as noted, is "**different from**" the tactile feedback provided at Point **1**. (Poupyrev, ¶0119.) As shown above and although not required by the claim, Poupyrev discloses a third and different haptic stimulation at Point **3** in response to the user further increasing pressure to pass the confirmation threshold. This is separately discussed for claim 12 below.

84. As fully explained for claim 11**[a]-[b]** above, the alternative Curve **(b)** in Figure 11 of Poupyrev does not provide haptic stimulation for the "**initial portion**" or the "**first intermediate portion**," but this is immaterial for the reasons provided above. As noted, I am informed by counsel that under the patent laws, a prior art reference that "sometimes but not always" embodies a claimed method nonetheless discloses that aspect of the invention. Because the claimed first and second haptic stimulations are in fact provided when the GUI object is operated in

accordance with Curve **(a)**, Poupyrev discloses these limitations. And as noted above, it also would have been obvious to an ordinarily skilled artisan to implement Poupyrev without the alternative Curve **(b)**.

85. And for the same reasons explained for claim 11**[a]-[b]**, each of haptic stimulations recited in claim 11**[a]-[b]** are determined "**on the one or more processors**," as claimed, because the tactile feedback is determined by GUI controller **112**. (Poupyrev, ¶¶0068 ("The GUI controller **112** determines which GUI object the user **2** is intending to interact with. Further, depending on a) the current state of the GUI object and b) pressure value applied to the GUI object, the GUI controller **112** determines an appropriate change in the state of the GUI object. For example, if the GUI object is a graphical button, the GUI controller **112** can calculate is [sic; if] there was enough pressure applied on the graphical button on the screen to change the state of the button from 'free' to 'pressed' or 'non-actuated' to 'actuated.'"), 0070 ("The GUI controller **112** further sends the commands to the tactile interface controller **111** that generates appropriate commands for driving the tactile signal generation unit **102**."), claim 1 ("the controller section determines a form of the haptic feedback to be generated depending on (i) the detected touch position, (ii) the detected pressure value and (iii) the determined current logical state of the graphical user interface object").) As explained for claim 11**[a]-[b]**, it would

have been obvious that the functionality of GUI controller **112** for performing the claimed determining step would have been executed by the one or more processors.

(e) "generating, with the haptic device, the determined stimulation during performance of the control gesture." (11[e])

86. For purposes of claim 11**[e]**, the claimed "**determined stimulation**" corresponds to the tactile feedback provided to the user when pressing the GUI object at Point **1** and Point **2** as discussed above ("**during performance of the control gesture**"). The components used in the generation of the haptic stimulation and the flow of information between them are shown in Figure 1:

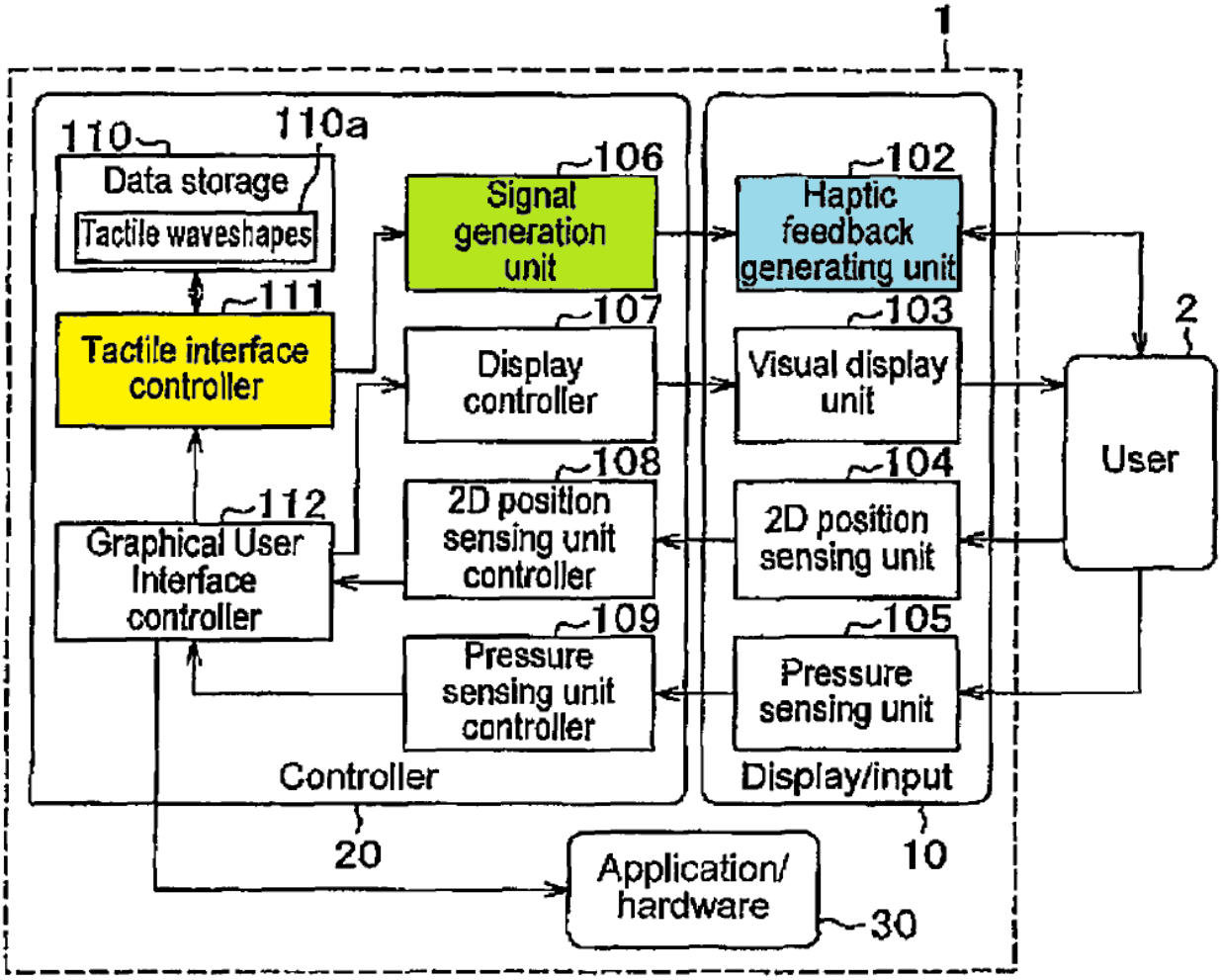


Figure 1

(Poupyrev, Fig. 1 (highlighting added).) Poupyrev explains that GUI controller **112** sends commands to the tactile interface controller **111** to generate appropriate commands for driving the tactile signal generation unit, shown by the information flow arrows in Figure 1 above. (Poupyrev, ¶0070.) "The signal generating unit **106** generates and provides a signal to the tactile feedback generating unit **102** for driving tactile feedback generating elements or the piezoelectric actuators." (Poupyrev,

¶0063.) "The haptic feedback generating unit **102** may be formed with piezoelectric bimorph actuators with single or multiple layer structure." (Poupyrev, ¶0055.) Accordingly, the "**determined stimulation**" is thus generated "**with the haptic device**," *i.e.*, haptic feedback generating unit **102**.

2. Claim 12: "The method of claim 11, wherein the haptic stimulation associated with the control gesture includes a third stimulation different from the first stimulation and the second stimulation that is determined responsive to performance of the ending portion of the control gesture."

87. As fully explained for claim 11**[c]-[d]**, a third stimulation is provided to the user in response to the user increasing pressure to pass the confirmation threshold at Point **3** ("**responsive to performance of the ending portion of the control gesture**"):

> As the user touches and pushes the GUI object to pass a selection threshold, a tactile feedback is provided (Point **1** of Curve (a)) without actuating the GUI object. The user presses further to pass the actuation threshold where a different tactile feedback is provided (Point **2**). In this example, however, the GUI object is not actuated yet. To actuate the GUI object, the user should press further to the confirmation threshold that also provides **still another tactile feedback** (Point **3**).

(Poupyrev, ¶0119.) Poupyrev describes this third haptic stimulation as "still another tactile feedback" (*id.*), confirming that it is "**different from the first stimulation**

and the second stimulation," as claimed, because it is different from the tactile feedback provided at Point **1** and Point **2**.

3. Claim 15: "The method of claim 11, wherein the command input associated with the control gesture is a single, discrete command."

88. As explained fully for claim 11**[b]-[c]**, the command input associated with the control gesture is a "**single, discrete command**," *i.e.*, a single and discrete activation of the GUI object in response to the user passing the confirmation threshold. (Poupyrev, *e.g.*, ¶0074 ("…when the user **2** indicates that the GUI object should execute an associated command, corresponding to pressing of a physical button.").) As explained for claim 11**[b]-[c]**, activation of the GUI object is a discrete event that occurs for Curve **(a)** only after the user passes the confirmation threshold at Point **3** of Figure 11. (Poupyrev, Fig. 11, ¶0119.)

C. Ground 2: Claims 11, 12, and 15 Are Obvious Over Grant '499

1. Independent Claim 11

89. As noted for **Ground 1**, the preamble recites: "[**a**] **computer-implemented method of providing haptic stimulation to a user of a system, the method being implemented in the system which includes a haptic device and one or more physical processors configured to execute computer program modules, the method comprising**…." Assuming the preamble imposes a claim

limitation, it is disclosed by and rendered obvious over the prior art.

90. As explained in more detail in my analysis of the limitations of claim 11 below, Grant '499 discloses a system providing **a computer-implemented method** of casino-type gaming using a touch-sensitive input device (for example, a touch screen) coupled to an actuator for outputting gameplay-related **haptic stimulation** to a user. (Grant '499, *e.g.*, ¶¶0017 ("Embodiments of the present invention provide systems and methods for casino gaming haptics."), 0020 ("[T]he system **100** provides haptic feedback to the player…. [A]ctuator **103** may generate a haptic effect").)

91. Grant '499's system, as shown below in Figure 1, includes "**a computer**" (computer **101**), "**a haptic device**" (actuator **103**), and "**one or more physical processors**" (processor **110**) that execute "**computer program modules**" (e.g., application **120**):

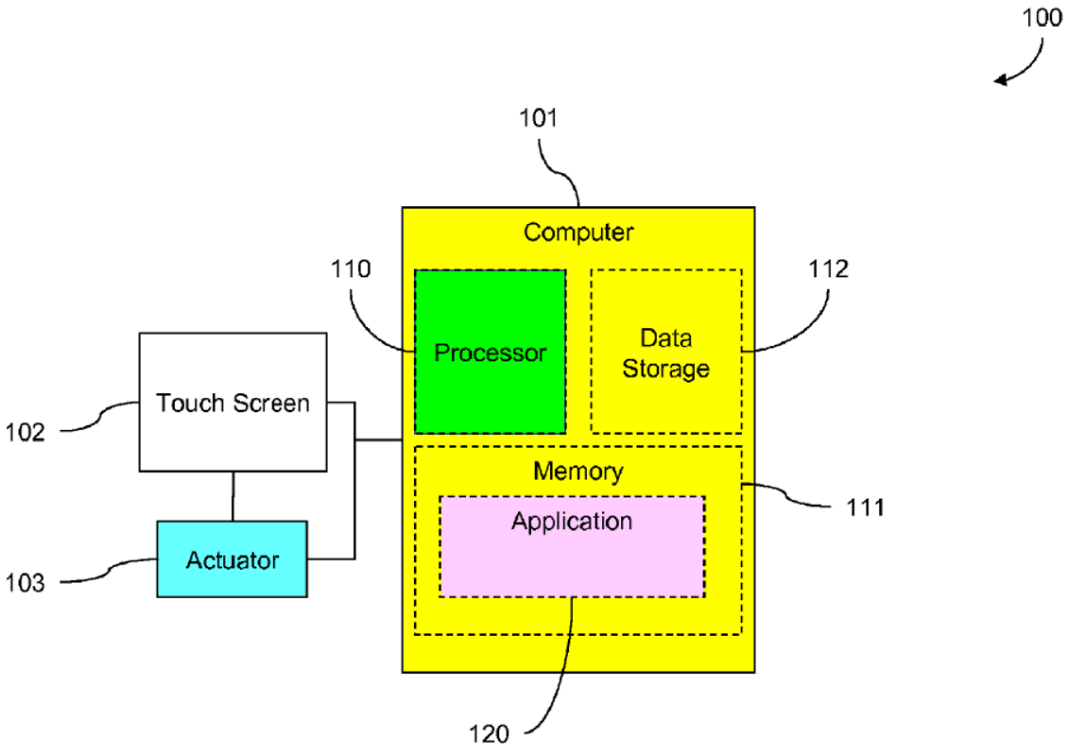


Figure 1

(Grant '499, Fig. 1 (highlighting added); *see also id.*, ¶¶0008 ("FIG. **1** is a block diagram illustrating a system for casino gaming haptics according to one embodiment of the present invention."), 0018.)

92. As I explained for the preamble of claim 11 for **Ground 1**, the recited "**haptic device**" includes a device such as an actuator that is used to generate haptic stimulation. The "**haptic device**" in Grant '499 corresponds to an actuator. Grant '499 explains that "actuator **103**…may be commanded by the computer **101** to

output haptic effects" (Grant '499, ¶0020) and identifies various types of actuators for generating haptic effects, including "pneumatic/hydraulic active actuators" and "piezoelectric actuators." (Grant '499, ¶¶0029, 0029-0030 (identifying various types of actuators).) This is consistent with the '806 patent, which explains that "actuators **16** are configured to generate haptic stimulus for user **12**" and "may include any device configured to generate [tactile] feedback for application to the users." ('806, 5:54-55, 6:3-10; *see also id.*, 6:8-17 (identifying various types of actuators, including piezoelectric and pneumatic actuators).)

93. With respect to the recited "**one or more physical processors configured to execute computer program modules**," a person of ordinary skill in the art would have understood and found it obvious that this was part of Grant '499's system. Grant '499 explains, for example, that "[c]omputer **101** comprises a processor **110**" (Grant '499, ¶0018), and that the processor is a "**physical processor**" that may comprise, for example, "a microprocessor, a digital signal processor (DSP), application-specific integrated circuit," among other components. (Grant '499, ¶0056.) Grant '499 further explains that the processor is configured to load and execute computer program instructions, such as applications. (Grant '499, ¶¶0018 ("[P]rocessor **110** configured to load an application **120** from storage **112** into memory **111**. In this illustrative embodiment, application **120** is a casino gaming

application configured to allow a user to play five-card draw poker." (underlining added)), 0024 ("execute application **312**"), 0049 ("the client **510** may receive a plurality of casino game applications") (underlining added), 0056-0057 (processor "executes computer-executable program instructions" that "can cause the processor to perform" the described casino-gaming methods); *see also id.*, claims 48 & 65 (reciting "program code" for performing various operations).) Claim 11 does not recite any requirements as to the form or functionality provided by the computer program modules that the processor(s) are configured to execute. For purposes of my analysis, the "**computer program modules**," in Grant '499 could thus correspond to applications executed by the processor **110**, or to portions of a single application, for example, as well as any other portions of software executed by the processor **110** for computer **101** to operate.

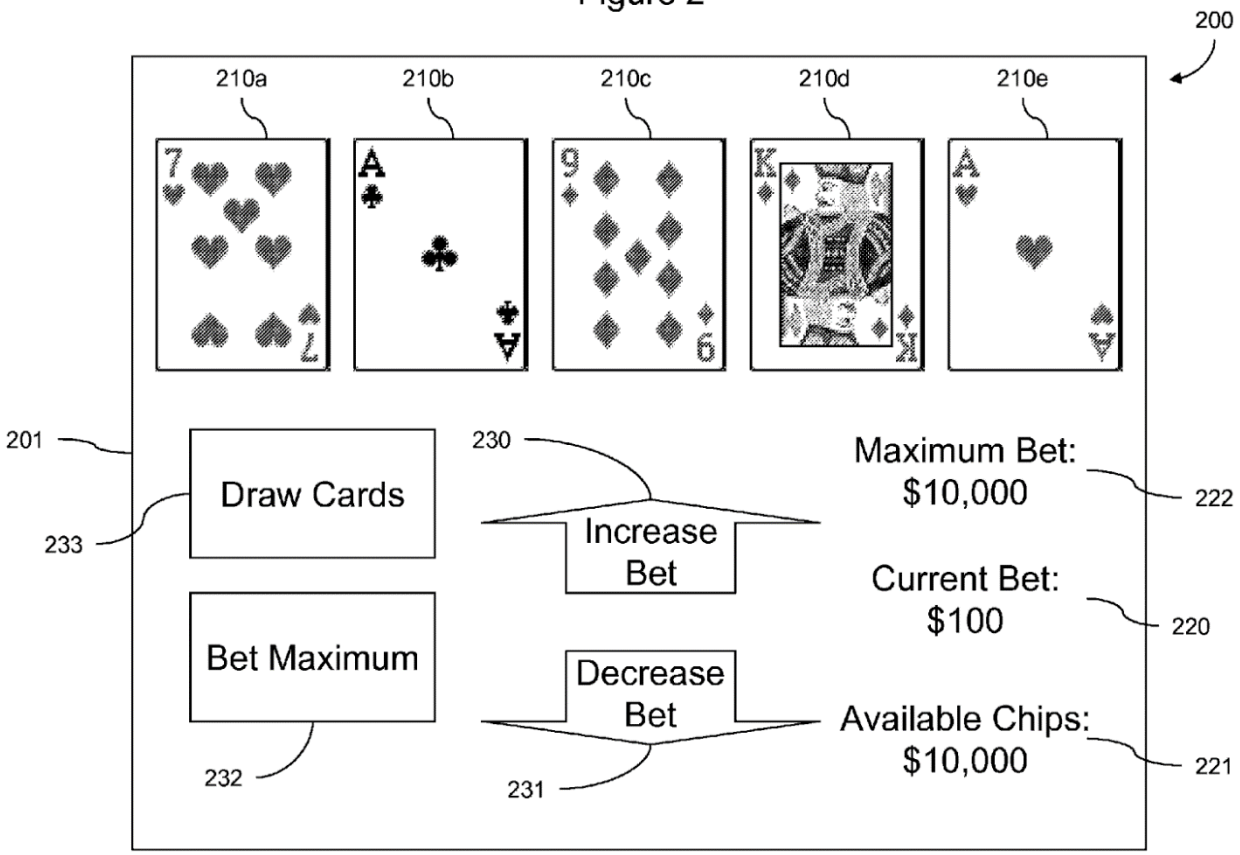
(a) "monitoring, on the one or more processors, performance of a control gesture by a user" (11[a])

(b) "wherein the control gesture is a gesture associated with a command input to the system, and includes an initial portion, a first intermediate portion, and an ending portion" (11[b])

94. Because these two claim limitations are closely related, as with **Ground 1**, I will discuss them together. As explained in **Part V.A.2** and for the preamble above, Grant discloses haptic gaming devices for casino gaming. (Grant '499,

Abstract, ¶0002.) Grant '499 discloses a system for "casino gaming haptics" that comprises (among other things) a touch-sensitive input device configured to sense a contact from a user, and an actuator configured to output a haptic effect to the touch-sensitive input device. (Grant '499, ¶¶0005, 0023-0024, 0026, Fig. 3 (showing touch-sensitive input device **320** and actuator **330**).) Grant '499 discloses a number of exemplary games that can be configured to include casino gaming haptics, including card games, dice games, roulette, checkers, among others. (Grant '499, ¶0058.) I will focus primarily on embodiments of casino haptics for card games such as poker and blackjack. (Grant '499, ¶¶0019, 0062-0064, Fig. 2.) Figure 2 shows an exemplary screen shot of a poker game:

Figure 2



(Grant '499, Fig. 2.) Figure 2 shows a touch-screen displaying a five-card poker game **201**. (Grant '499, ¶0019.) For purposes of my analysis, the claimed "**control gesture**" in Grant '499 corresponds to a user's motion to discard a playing card from the game – which I will refer to as Grant '499's "discard gesture." Grant '499 mentions that a user discards a playing card resulting in haptic feedback being provided to the user. (Grant '499, ¶¶0019-0020.)

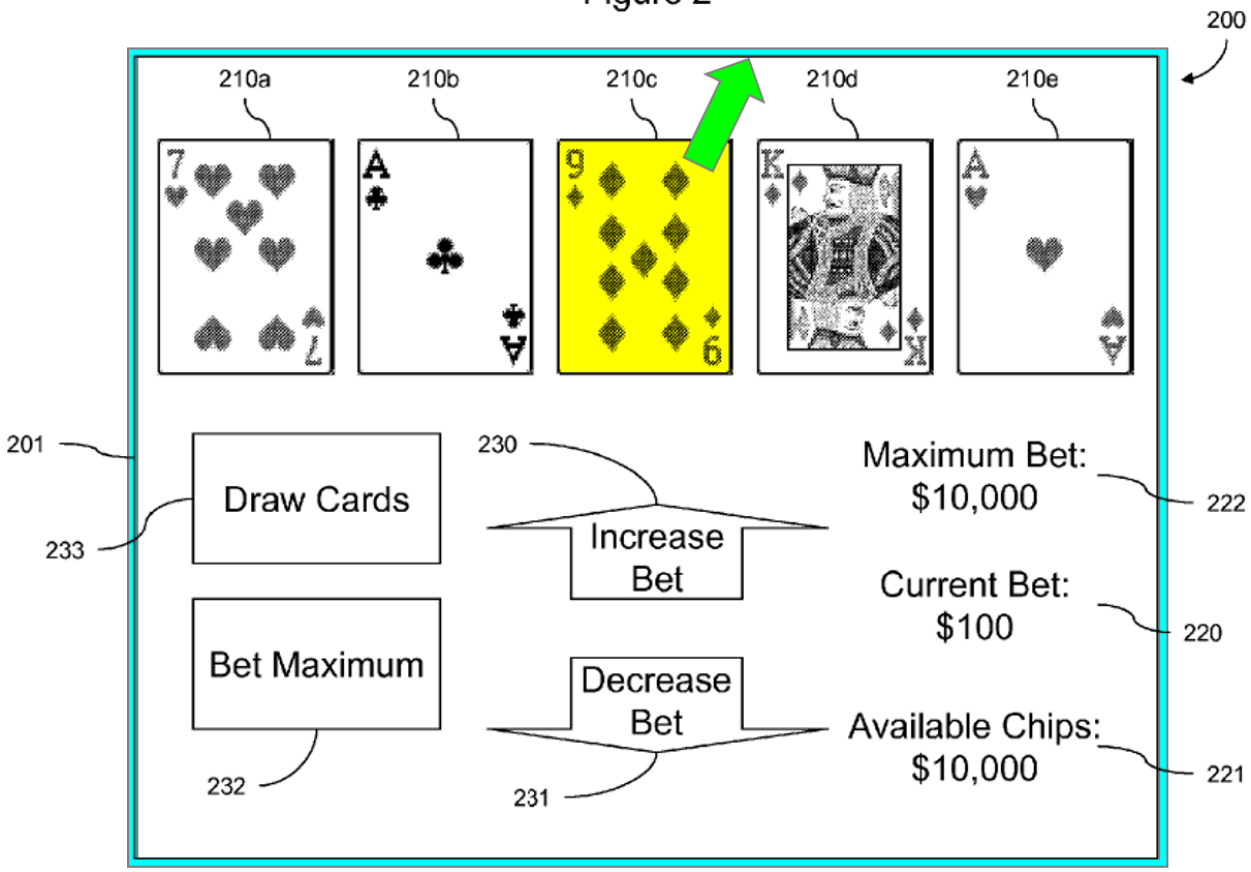
95. Grant '499 goes on to describe in more detail the steps required by the user to perform the discard gesture, and the haptic feedback provided to the user in

response to those steps. (Grant '499, ¶0064.) Grant '499 explains that the discard gesture has three required portions: **(1)** the user makes contact with a portion of the screen corresponding to a playing card in order to select the card, then **(2)** the user initiates a sliding motion to drag the selected card on the screen, and finally **(3)** the user continues dragging the card until it reaches the edge of the screen to discard the selected card. Referring back to Figure 2 above, Grant '499 explains the discard gesture:

> For example, in the embodiment shown in FIGS. 1 and 2, a user may touch the nine of diamonds **210***c*, and feel a light pop (e.g. a low magnitude, high frequency, short duration effect) to indicate that the card has been contacted. The user may then drag the card **210***c* to the edge of the screen **201** to discard the card. While the user is dragging the card, the system **100** may output a low magnitude, low frequency vibration to provide the tactile sensation of a card sliding across a felt surface. When the card reaches the edge of the screen, the system **100** may generate a strong pop (e.g. a high magnitude, high frequency, short duration) effect to indicate the card has been discarded.

(Grant '499, ¶0064 (highlighting added).) I have annotated Figure 2 below to illustrate the steps in this gesture using the highlighting colors above (*i.e.*, touch the playing card, start to drag the card, and continue dragging card to edge of screen):

Figure 2



(Fig. 2 (annotations added).) In this illustration, therefore, the user touches/selects the nine of diamonds card **210***c*, begins to drag that card toward the edge of the screen, and then continues dragging the card until it reaches the edge of the screen, which causes it to be discarded.

96. Grant '499's discard gesture qualifies as a "**control gesture**" because it provides a gesture that controls an aspect of the virtual card game (*e.g.*, by activating the command to discard a virtual playing card). As I will explain below, the discard gesture is consistent with the '806 patent's description of control gesture

as well as both parties' proposed constructions in the pending litigation.

97. The "**control gesture**" in Grant '499 also "**includes an initial portion, a first intermediate portion, and an ending portion**." As explained, the "**control gesture**" in Grant '499 includes "**an initial portion**," *i.e.*, the portion in which the user initiates contact with a virtual playing card, "**a first intermediate portion**," *i.e.*, the portion in which the user begins dragging the playing card in the direction of the edge of the screen, and "**an ending portion**" *i.e.*, the portion in which the user continues dragging until the card reaches the edge of the screen.

98. Grant '499 also discloses and renders obvious "**monitoring, on the one or more processors**," *e.g.*, processor **110**, the performance of this control gesture. This "**monitoring**" is evident in the fact that the system provides haptic feedback to the user as the user performs each portion of the discard gesture, including feedback that the motion was completed successfully. (Grant '499, ¶0064.) As noted earlier, Grant '499 teaches that processor **110** executes the associated game application and program code (Grant '499, ¶¶0018, 0024, 0056-0057) – and thus, a person of ordinary skill in the art would have understood and found it obvious the "**monitoring**" would have been performed by processor **110**. (*See also* Grant '499, ¶0005 ("processor configured to: …receive an input signal from the touch-sensitive input device associated with the contact [from a user]; determine an interaction

between the contact and the image…").)

99. My mapping of the discard gesture in Grant '499 to the claimed "**control gesture**" is entirely consistent with embodiments in the '806 patent. The '806 patent explains that the claimed "**initial portion**" may include "initiating contact with the touch-sensitive surface at one or more locations," which can specify "a pressure with which contact is initiated," among other factors. ('806, 7:49-57.) This is precisely what occurs in Grant '499 when the user initiates contact with the virtual playing card, as discussed.

100. The '806 patent further explains that the claimed "**first intermediate portion**" may include "motioning in a specific direction," among other actions. ('806, 7:65-8:5.) And the claimed "**ending portion**" can also include "motioning in a specific direction," as well as "contacting the touch-sensitive surface at one or more additional locations." ('806, 8:5-11.) This is precisely what occurs in Grant '499 when the user begins dragging the virtual playing card toward the edge of the screen ("**first intermediate portion**") and then continues dragging the card until it

reaches the edge of the screen ("**ending portion**").[3]

101. I note that the selection and dragging of a virtual playing card in Grant '499 can be used to perform functions other than discarding the card, such as rearranging the cards in the user's hand. (Grant '499, ¶0063.) But this does not preclude the discard gesture from qualifying as a "**control gesture**" under the '806 patent because nothing in the patent precludes a "**control gesture**" from having portions that are similar to portions used by another control gesture. ('806, 7:41-45 ("The gesture module **24** is configured to receive one or more output signals generated by user interface **14** indicating control inputs received from user **12**. Based on the received one or more output signals, gesture module **24** monitors performance

[3] I note that the '806 patent does not require that the "**ending portion**" of a control gesture include ceasing contact with a touch-sensitive display. The '806 patent identifies "ending contact at one or more locations on the touch-sensitive surface" as a mere example of an ending portion, and as explained in the text, also identifies "motioning in a specific direction" as another example of an ending portion. ('806, 8:5-11.) The discard gesture of Grant '499, as explained in the text, includes motioning in the direction of the edge of the screen as explained in the text.

of *one or more control* gestures by user **12**.").) The discard gesture and the rearrange gesture in Grant '499 qualify as distinct control gestures notwithstanding that they may have some similarities because the discard gesture serves a different function and has distinct characteristics from the rearrange gesture. (Grant '499, ¶¶0063-0064.) The discard gesture, for example, requires that the card be dragged until it reaches the edge of the screen, which is not part of the rearrange gesture.

102. Finally, the "**control gesture**" in Grant '499, *i.e.*, the discard gesture, satisfies each of the definitions proposed in the district court litigation and is consistent with the written description of the '806 patent. As noted in **Part III.A**, Petitioner has proposed that "**control gesture**" be construed as "*a gesture made by a user that is a single and discrete control input having separate portions. The separate portions must be performed in specific order and/or with a specific timing to effectively achieve the control input associated with the 'control gesture.' Performance of the separate portions, on their own, will not result in the control input associated with the 'control gesture' as a whole (e.g., a 'control gesture' is not merely a combination of other gestures, each associated with its own control input)*." As I noted for **Ground 1**, this definition mirrors the description in the written description. ('806, 5:7-16.)

103. Grant '499 satisfies this definition because, first, the discard gesture is

a "*single and discrete control input having discrete portions*." With respect to "*control input*," the '806 patent states that a touch sensitive surface – such as Poupyrev's display/input section **10** – is an example of a "control input device." ('806, 5:29- 38.) The '806 patent further explains that a control input device enables the system to receive a control input from the user. ('806, 7:41-43 ("The gesture module **24** is configured to receive one or more output signals generated by user interface **14** indicating control inputs received from user **12**.") (underlining added).) Thus, as applied to Grant '499, touch screen **102** is a device that enables a user to enter a control input in the form of a gesture in order to control the system. The discard gesture in particular, as explained, is a control input because it enables the user to control a virtual card game by discarding a card. (Grant '499, ¶¶0063-0064.)

104. And the discard gesture in Grant '499 is a separate and discrete control input that can only occur after completing each of its three discrete portions, *i.e.*, "**an initial portion**," "**a first intermediate portion**," and "**an ending portion**" as described. Next, each of these portions "*must be performed in specific order and/or with a specific timing to effectively achieve the control input associated with the 'control gesture*,'" because they must be performed at least in a specific order beginning with the selection of the virtual playing card, and continuing through the user initiating and then continuing movement of the playing card to the edge of the

screen, in order for the card to be discarded. (Grant '499, ¶0064 ("When the card reaches the edge of the screen, the system **100** may generate a strong pop (e.g. a high magnitude, high frequency, short duration) effect to indicate the card has been discarded.").)

105. Finally and for the same reasons, "[*p*]*erformance* of *the separate portions, on their own, will not result in the control input associated with the 'control gesture' as a whole (e.g., a 'control gesture' is not merely a combination of other gestures, each associated with its own control input)*," because discarding the virtual playing card only occurs in response to the user completing the discard gesture with all three of its portions, including an ending portion in which the card makes contact with the edge of the screen. For example, if the user simply selected a virtual playing card and then released it, or selected the playing card and dragged it but not far enough to reach the edge of the screen, the discard gesture will not have been completed and the card will not be discarded. Thus, Grant '499's discard gesture is also "*not merely a combination of other gestures, each associated with its own control input*." The discard gesture in the Grant '499 patent is instead a single control gesture having three required portions, each of which must be completed in sequence for a card to be discarded.

106. As also noted in **Part III.A** above, I am informed that Patent Owner

contends that "**control gesture**" should be given its plain and ordinary meaning, or alternatively, construed as "*a user manipulation having separate portions that must be performed in a specific order and/or with a specific timing*." This construction is nothing more than a subset of Petitioner's construction and is thus satisfied by Grant '499 for the reasons provided above; the discard gesture as noted is a user manipulation having three separate portions that must be performed in at least a specific order.

107. In fact, the discard gesture of Grant '499 closely resembles exemplary gestures described in the written description of the '806 patent. In one example, "user **12** may engage an area on user interface **14** that corresponds to ammunition and 'drag' the ammunition to section **34***b* to reload piece of virtual equipment **32**." ('806, 13:44-47.) In another example, a user can touch a target on a screen and trace a path from the target on the screen in order to initiate an attack on the target:

> The target at which a ranged attack is directed and/or the path of a projectile emitted as part of a ranged attack may be determined based on a control gesture. For example, if user interface includes a touch screen, the user performing a control gesture may contact a portion of the touch screen on which the target of the ranged attack is displayed (e.g., as part of the control gesture). Similarly, the user may trace on the touch screen a path of a projectile emitted during a ranged attack. The

> tracing of the path of the projectile may form at least part of the control gesture initiating the attack. The target and/or the path indicated by the control gesture may impact the determination of the corresponding haptic stimulation determined by stimulation module **26**.

('806, 12:4-16 (underlining added).) Although these examples involve combat-oriented games rather than games involving playing cards, they nevertheless disclose control gestures that are substantially similar to Grant '499 in that they also involve selection and movement of items using a touch sensitive display.

(c) "determining, on the one or more processors, haptic stimulation associated with performance of the control gesture to be generated for the user" (11[c])

(d) "wherein the haptic stimulation includes a first stimulation determined responsive to performance of the initial portion of the control gesture, and a second stimulation that is different from the first stimulation and is determined responsive to performance of the first intermediate portion of the control gesture; and" (11[d])

108. The determined "**haptic stimulation**" in Grant '499 corresponds to the haptic stimulation provided to the user in response to performance of the three portions of the discard gesture as described above. For the "**initial portion**," according to Grant '499, "a user may touch the nine of diamonds **210***c*, and feel a light pop (e.g. a low magnitude, high frequency, short duration effect) to indicate that the card has been contacted." (Grant '499, ¶0064.) This corresponds to the

"**first stimulation**," as recited in claim 11**[d]**.

109. For the "**first intermediate portion**," as explained in Grant '499, "[w]hile the user is dragging the card, the system **100** may output a low magnitude, low frequency vibration to provide the tactile sensation of a card sliding across a felt surface." (Grant '499, ¶0064.) This corresponds to the claimed "**second stimulation**." A person of ordinarily skill in the art would have understood and found it obvious that this second stimulation is "**different from the first stimulation**," as claimed, because it differs in at least its frequency and duration and is intended to convey a different tactile sensation.

110. And although not required by claim 11, for the "**ending portion**," Grant '499 explains that "[w]hen the card reaches the edge of the screen, the system **100** may generate a strong pop (e.g. a high magnitude, high frequency, short duration) effect to indicate the card has been discarded." (Grant, ¶0064.) This is separately discussed for claim 12 below.

111. A person of ordinary skill in the art would have understood and found it obvious that, in order for the Grant '499's system to generate the haptic stimulation, the system would first "**determine, on the one or more processors**" the haptic stimulation to generate. Grant '499 explains, for example, that its "processor [is] configured to: …determine an interaction between the contact [from

a user] and the image [associated with a casino game]; and generate an actuator signal *associated with the interaction*, the actuator signal configured to cause the actuator to generate a haptic effect." (Grant '499, ¶0005 (underlining and italics added); *see also id.*, ¶¶0026 ("generate an actuator signal associated with the interaction"), 0055 (processor "determines an interaction… [and] generates and transmits an actuator signal associated with the interaction").) Because the system in Grant '499 is capable of generating various types of haptic feedback, in order for the system to generate the correct feedback for a particular situation, it would have been obvious that the system (using its processor) would have to determine the appropriate haptic feedback associated with particular user contact.

(e) "generating, with the haptic device, the determined stimulation during performance of the control gesture." (11[e])

112. Claim 11**[e]** does not add anything that I have not already discussed in my analysis of the earlier portions of claim 11.

113. As explained above, the "**haptic device**" in Grant '499 corresponds to an actuator, such as actuator **103**. As noted, Grant '499 explains that "actuator **103**…may be commanded by the computer **101** to output haptic effects." (Grant '499, ¶0020.) For example, "when the player touches a card **230**a to be discard, the actuator may generate a haptic effect, such as a short duration high frequency

vibration (which may be referred to as a 'pop'), to indicate that the card **230**a has been selected." (Grant '499, ¶0020; *see also id.*, ¶0026 ("Computer **310** is further configured to generate an actuator signal associated with the interaction, the actuator signal configured to cause the actuator **330** to generate a haptic effect.").)

114. And as discussed previously, Grant '499 explains that the haptic stimulation associated with the discard gesture is generated "**during performance of the control gesture**." (Grant '499, ¶0064.) First, "a user may touch the nine of diamonds **210**c, and feel a light pop (e.g. a low magnitude, high frequency, short duration effect)." (Grant '499, ¶0064 (underlining added).) Next, "[w]hile the user is dragging the card, the system **100** may output a low magnitude, low frequency vibration to provide the tactile sensation of a card sliding across a felt surface." (Grant '499, ¶0064 (underlining added).) Then, "[w]hen the card reaches the edge of the screen, the system **100** may generate a strong pop (e.g. a high magnitude, high frequency, short duration) effect to indicate the card has been discarded." (Grant '499, ¶0064 (underlining added).)

2. Claim 12: "The method of claim 11, wherein the haptic stimulation associated with the control gesture includes a third stimulation different from the first stimulation and the second stimulation that is determined responsive to performance of the ending portion of the control gesture."

115. As explained in my analysis of claim 11 above, Grant '499's discard

gesture includes a "**third stimulation**" – for example, "a strong pop (*e.g*. a high magnitude, high frequency, short duration) effect to indicate the card has been discarded." (Grant '499, ¶0064.) This "**third stimulation**," as explained, is "**different from the first stimulation and the second stimulation**." In the exemplary embodiment, it is a "strong pop," whereas the first and second stimulations were a "light pop (e.g. a low magnitude, high frequency, short duration effect)" and a "low magnitude, low frequency vibration," respectively. (Grant '499, ¶0064.) And, as with the stimulations associated with the initial and first intermediate portions, Grant '499's "third stimulation" is "**determined responsive to performance of the ending portion of the control gesture**" – i.e., in response to the user contacting the edge of the screen with the playing card. (Grant '499, ¶0064 ("When the card reaches the edge of the screen, the system **100** may generate a strong pop (e.g. a high magnitude, high frequency, short duration) effect to indicate the card has been discarded.").)

3. Claim 15: "The method of claim 11, wherein the command input associated with the control gesture is a single, discrete command."

116. As explained in connection with claim 11**[b]**, "**the command input associated with the control gesture**" in Grant '499 corresponds to an instruction to the system to discard a playing card.

117. Grant '499's instruction to discard a playing card associated with the discard gesture "**is a single, discrete command**." Grant '499 makes clear that the instruction to discard a playing card is a distinct command, separate from other commands, and nothing in Grant '499 discloses or suggests that performing the discard gesture will result in another, or an additional, command. For example, Grant '499 explains that, once the discard gesture is completed, to input additional commands, other actions can be performed. (Grant '499, ¶0064 ("The user may then drag another card to be discarded, or select the draw cards button **233** to receive a card to replace the discarded card **210**c.").)

VI. NO SECONDARY CONSIDERATIONS OF NONOBVIOUSNESS

118. 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.

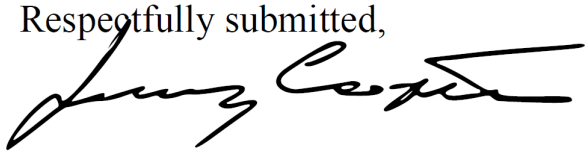
VII. CONCLUSION

119. 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.

120. 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: May 23, 2023

Respectfully submitted,



Jeremy Cooperstock
Paris, France

EXHIBIT A

CURRICULUM VITAE

Jeremy R. Cooperstock

Version as of December 22, 2022

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Biographical

Personal Data

Nationality	Canadian
Languages	English, French and Hebrew
Address	Department of Electrical and Computer Engineering, McGill University 3480 University Street, Montreal, QC, H3A 0E9, Canada
Telephone	(514) 398-5992
email	jer@cim.mcgill.ca

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)

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Awards and Distinctions

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) [C2]
2022	Finalist, Best Applications Paper Award, "Speaking Haptically: from Phonemes to Phrases with a Mobile Haptic Communication System", Transactions on Haptics [J2]
2019	Honorable Mention, "Detecting Perception of Smartphone Notifications using Skin Conductance Responses" (top 5% of papers), Human Factors in Computing Systems (CHI) [C31]
2019	San Diego Opera, Opera Hack award, Hamsafar! ($10,000, with 5 co-awardees)
2018	Best poster presentation award, "Enhanced Pressure-Based Multimodal Immersive Experiences", Augmented Human [CP9]
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 [J15]
2013	Best use of sound award, "The Walking Straight Mobile Application: Helping the Visually Impaired Avoid Veering, International Conference on Auditory Displays [C58]
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 [C69]
2010	Best paper award, "Design of a Vibrotactile Display via a Rigid Surface", Haptics Symposium [C78]
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 [C88]
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

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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 [C28, J2, C6], 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 [C27, C16]. While our results were achieved initially using a set of three actuators [C40, C37, C29, C19], we subsequently demonstrated equivalent recognition performance via only a single vibrotactile actuator, with a novel parameter encoding scheme [C18]. We further demonstrated achievement of the highest information transfer rates reported in the literature for such a single-actuator device [C13].

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 ([C31]), and led to a recent patent filing ([P2]). 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 [J13]. 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 [J21, C69, C60, C57]. 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 [C60].

Mobile Treatment Device for Amblyopia (2009-2012, in collaboration with ophthalmologist R. Hess) is a patented prototype Mobile Treatment Device for Amblyopia [P7] ("lazy eye"). Initial trials [J20], based on the popular Tetris game, provided highly promising early results [J27, J23], 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

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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 [J22] and the role of vibrotactile stimulation in perception of compliance [J28]. Our "Ecotile" prototype (patent [P4]) was showcased at numerous venues including SIGGRAPH, and led to related research involving limb modeling [C71, C55, C49], foot-water interaction [J15], and variable-friction walking interfaces [C65, C56, J6].

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 [J19].

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Academic Experience

Jan 2018–present	**McGill University, Montreal, QC** Full Professor, Electrical and Computer Engineering. Director, Shared Reality Lab Member, McGill Institute for Aerospace Engineering Member, International Laboratory on Learning Systems 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.

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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 Materiaux 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.

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Litigation and Expert Witness Experience

Parties I represented are marked by an asterisk.

Sep 2022–ongoing	**Apple* v. Taction Technologies, Inc** Involved in *Reexamination Requests* of U.S. Patent Nos. 10,659,885 and 10,820,117 in the United States Patent and Trademark Office.
Aug 2022–ongoing	**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	**iFIT Inc. f/k/a ICON Health & Fitness* v. Peloton Interactive** United States District Court, District of Delaware, Civil Action No. 20-cv-1386-RGA
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
Sep 2021–ongoing	**AmLaw 100 Firm*** Providing independent expert consulting services for an AmLaw 100 Firm on behalf of an owner of patents covering smartphone-based vehicle operation detection. Deposition testimony on expert report.
Jan 2021–ongoing	**GUI Global Products, Ltd. v. Apple*** United States District Court, Southern District of Texas, Case No. 4:20-cv-2652 and *Inter Partes* 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 report (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–ongoing	**Koss v. Apple*** Civil Action No. 6:20-cv-00665, Western District of Texas. Involved in *Inter Partes* 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	**ByteDance* and TikTok* v. Triller** *Inter Partes* Review of U.S. Patent No. 9,691,429 before the United States Patent and Trademark Office. Deposition testimony on expert report.
Sep 2020–ongoing	**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 *Inter Partes* Review. Deposition testimony on expert reports (5 depositions).

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Sep 2020–ongoing **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, *Inter Partes* 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 **Apple* v. Qualcomm**
Inter Partes Review, Case no. 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 **Samsung* v. Immersion**
Civil Action No. 2:2018-cv-00055 in the Eastern District of Texas and *Inter Partes* Review, case no. 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.

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).

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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

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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 over 5000 citations to date (Google Scholar) with approximately half of these since 2017, an h-index of 36, and i10-index of 105. HQP under my supervision (names in bold) are typically given first authorship on co-authored work.

Articles in Refereed Publications

[J1] **Nathan 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: https://doi.org/10.1371/journal.pdig.0000100. URL: https://journals.plos.org/digitalhealth/article?id=10.1371/journal.pdig.0000100.

[J2] **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. URL: https://ieeexplore.ieee.org/document/9337220. 🏆 Finalist, Best Applications Paper Award.

[J3] **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. URL: https://ieeexplore.ieee.org/document/8960637. Also presented at Haptics Symposium 2020.

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Refereed Conference Publications

[C1] **D. Marino**, **M. Henry**, **P. Fortin**, **R. Bhayana**, and J. R. Cooperstock. "I See What You're Hearing: Facilitating The Effect of Environment on Perceived Emotion While Teleconferencing." In: *Computer-Supported Cooperative Work and Social Computing (to appear)*. Minneapolis, MN: ACM, Oct. 2023.

[C2] **H. Lee**, **R. Jiang**, **Y. Yoo**, **M. Henry**, and J. R. Cooperstock. "The Sound of Hallucinations: Toward a more convincing emulation of internalized voices." In: *Human Factors in Computing Systems (CHI)*. New Orleans, LA: ACM, Apr. 2022. DOI: 10.1145/3491102.3501871. URL: https://dl.acm.org/doi/10.1145/3491102.3501871. Honorable Mention.

[C3] **J. Regimbal**, **J. R. Blum**, and J. R. Cooperstock. "IMAGE: A Deployment Framework for Creating Multimodal Experiences of Web Graphics." In: *Web4All 2022 - Accessibility in a Hybrid World*. virtual event, Apr. 2022. DOI: 10.1145/3493612.3520460. URL: https://dl.acm.org/doi/pdf/10.1145/3493612.3520460.

[C4] **P. Fortin** and J. R. Cooperstock. "Understanding Smartphone Notifications' Activity Disruption via In Situ Wrist Motion Monitoring." In: *Human Factors in Computing Systems (CHI), Late-Breaking Work (LBW) track*. New Orleans, LA: ACM, Apr. 2022. DOI: 10.1145/3491101.3519695. URL: https://dl.acm.org/doi/10.1145/3491101.3519695. acceptance rate: 36.1%.

[C5] **A. Rai**, **C. Ducher**, and J. R. Cooperstock. "Improved Attribute Manipulation in the Latent Space of StyleGAN for Semantic Face Editing." In: *International Conference on Machine Learning and Applications*. virtually online, Dec. 2021. URL: https://ieeexplore.ieee.org/document/9680017.

[C6] **D. Marino**, **M. F. de Vargas**, **A. Weill–Duflos**, and J. R. Cooperstock. "Conversing Using WhatsHap: a Phoneme Based Vibrotactile Messaging Platform." In: *World Haptics Conference*. Virtual Conference: IEEE, July 2021. DOI: 10.1109/WHC49131.2021.9517186. URL: https://ieeexplore.ieee.org/document/9517186. Acceptance rate: 55.7%.

[C7] **E. Waite**, **T. Fitz-Gerald**, **A. Sadaqa**, **Huaijin Shi**, **Pascal Fortin**, **A. Weill–Duflos**, and J. R. Cooperstock. "3D Printed Tactile Illusions and Demonstrations." In: *World Haptics Conference, Work in Progress Paper*. Virtual Conference: IEEE, July 2021. DOI: 10.1109/WHC49131.2021.9517237. URL: https://ieeexplore.ieee.org/document/9517237.

[C8] **M. Demers**, **P. Fortin**, **A. Weill–Duflos**, **Y. Yoo**, and J. R. Cooperstock. "Active Sampling for Efficient Subjective Evaluation of Tactons at Scale." In: *World Haptics Conference*. Virtual Conference: IEEE, July 2021. DOI: 10.1109/WHC49131.2021.9517257. URL: https://ieeexplore.ieee.org/document/9517257. Acceptance rate: 55.7%.

[C9] K. E. MacLean, V. Levesque, O. Schneider, P. Irani, A. Weill–Duflos, and J. R. Cooperstock. "CanHap 501: Learning Haptic UX Design in Remote Teams." In: *World Haptics Conference, Work in Progress Paper*. Virtual Conference: IEEE, July 2021. DOI: 10.1109/WHC49131.2021.9517152. URL: https://ieeexplore.ieee.org/document/9517152.

[C10] **N. J. A. Pollet**, **E. Uzan**, **P. B. Ruivo**, **T. Abravanel**, **A. Talhan**, **Y. Yoo**, and J. R. Cooperstock. "Multimodal Haptic Armrest for Immersive 4D Experiences." In: *World Haptics Conference, Work in Progress Paper*. Virtual Conference: IEEE, July 2021. DOI: 10.1109/WHC49131.2021.9517151. URL: https://ieeexplore.ieee.org/document/9517151.

[C11] **Y. Li**, **Y. Yoo**, **A. Weill–Duflos**, and J. R. Cooperstock. "Context-aware Automatic Haptic Effect Generation Algorithm for Improved Content Viewing Experience." In: *World Haptics Conference, Work in Progress Paper*. Virtual Conference: IEEE, July 2021. DOI: 10.1109/WHC49131.2021.9517148. URL: https://ieeexplore.ieee.org/document/9517148.

[C12] **Y. Li**, **Y. Yoo**, **A. Weill–Duflos**, and J. R. Cooperstock. "Towards Context-aware Automatic Haptic Effect Generation for Home Theatre Environments." In: *Virtual Reality Software and Technology*. Osaka, Japan: ACM, Dec. 2021. Acceptance rate 26%.

[C13] **Y. Yoo**, **J. Regimbal**, and J. R. Cooperstock. "Identification and Information Transfer of Multidimensional Tactons Presented by a Single Vibrotactile Actuator." In: *World Haptics Conference*. Virtual Conference: IEEE, July 2021. DOI: 10.1109/WHC49131.2021.9517169. URL: https://ieeexplore.ieee.org/document/9517169. Acceptance rate: 55.7%.

[C14] **A. Weill–Duflos**, **P. Fortin**, **F. Al-Taha**, and J. R. Cooperstock. "Haptic Augmentation of Audio and its Effects on Speech Perception." In: *International Workshop on Haptic and Audio Interaction Design*. Montreal, Canada, June 2020. URL: https://hal.archives-ouvertes.fr/hal-02901210.

[C15] A. Farooq, H. Tan, **A. Weill–Duflos**, J. R. Cooperstock, and R. Raisamo. "Embedded Haptic Waveguides to Improve Tactile Feedback: Designing a Custom 3D-Printed Surface to Enhance Signal Mediation." In: *Sensors*. Oct. 2020. URL: https://ieeexplore.ieee.org/document/9278770.

[C16] M. Gellert, N. Katzman, J. P. Klein, A. Frenkel, M. Klein, J. R. Cooperstock, J. J. Schlesinger, and Y. Bitan. "Comparing auditory and tactile cues to inform clinicians of patients' vital signs." In: *Annual Meeting of the Human Factors and Ergonomics Society*. Chicago, IL, USA, Oct. 2020.

[C17] **J. R. Blum**, J. Cauchard, and J. R. Cooperstock. "Habituation to Pseudo-Ambient Vibrotactile Patterns for Remote Awareness." In: *Haptics Symposium*. Washington DC, USA: IEEE, Mar. 2020. DOI: https://doi.org/10.1109/HAPTICS45997.2020.ras.HAP20.153.550dbcba. URL: https://ieeexplore.ieee.org/document/9086336/. Acceptance rate: 38%.

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[C18] **J. Regimbal**, **N. Radi**, **A. Weill–Duflos**, and J. R. Cooperstock. "Single-Actuator Simultaneous Haptic Rendering for Multiple Vital Signs." In: *HCI International*. Copenhagen, Denmark, July 2020.

[C19] **P. Alirezaee**, **A. Weill–Duflos**, J. Schlesinger, and J. R. Cooperstock. "Exploring the Effectiveness of Haptic Alarm Displays for Critical Care Environments." In: *Haptics Symposium*. Washington DC, USA: IEEE, Mar. 2020. URL: https://ieeexplore.ieee.org/document/9086328. Acceptance rate: 38%.

[C20] **P. Fortin**, **J. Blum**, **A. Weill–Duflos**, and J. R. Cooperstock. "Contact Force Estimation from Raw Photoplethysmogram Signal." In: *Sensors*. Oct. 2020. URL: https://ieeexplore.ieee.org/document/9278658.

[C21] **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: *Haptics Symposium (also appears in Transactions on Haptics)*. Washington DC, USA: IEEE, Mar. 2020. DOI: 10.1109/TOH.2020.2966969. URL: https://ieeexplore.ieee.org/document/8960637. Acceptance rate: 38%.

[C22] **P. Vyas**, **F. Al-Taha**, **J. R. Blum**, and J. R. Cooperstock. "HapToes: Vibrotactile Numeric Information Delivery via Tactile Toe Display." In: *Haptics Symposium*. Washington DC, USA: IEEE, Mar. 2020. DOI: https://doi.org/10.1109/HAPTICS45997.2020.ras.HAP20.34.8ad689d4. URL: https://ieeexplore.ieee.org/document/9086321. Acceptance rate: 38%.

[C23] **A. Weill–Duflos**, **F. Al-Taha**, **P. Fortin**, and J. R. Cooperstock. "BarryWhaptics: Towards Countering Social Biases Using Real-Time Haptic Enhancement of Voice." In: *World Haptics Conference*. Tokyo, Japan, June 2019. URL: http://srl.mcgill.ca/publications/2019-WHC-BarryWhaptic.pdf. Acceptance rate: 46%.

[C24] **E. Sulmont**, E. Patitsas, and J. R. Cooperstock. "Can You Teach Me To Machine Learn?" In: *Special Interest Group on Computer Science Education Technical Symposium*. Minneapolis, MN, Feb. 2019. URL: http://dl.acm.org/authorize?N682231.

[C25] **G. Yin**, M. Otis, **P. Fortin**, and J. R. Cooperstock. "Evaluating Multimodal Feedback for Accomplishing Assembly Tasks in a Virtual Environment." In: *Engineering Interactive Computing Systems*. Valencia, Spain: ACM SIGCHI, June 2019. URL: http://dl.acm.org/authorize?N682239.

[C26] **J. Blum** and J. R. Cooperstock. "Single-Actuator Vibrotactile Numeric Information Delivery in the Face of Distraction." In: *World Haptics Conference*. Tokyo, Japan, June 2019. URL: http://srl.mcgill.ca/publications/2019-WHC-Numeric.pdf. Acceptance rate: 46%.

[C27] N. Katzman, M. Gellert, J. J. Schlesinger, T. Oron-Gilad, J. R. Cooperstock, and Y. Bitan. "Evaluation of tactile cues for simulated patients' status under high and low workload." In: *International Meeting*. Seattle, WA, USA: Human Factors and Ergonomics Society (HFES), Oct. 2019. DOI: https://doi.org/10.1177/1071181319631285.

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[C28] **M. F. de Vargas**, **A. Weill–Duflos**, and J. R. Cooperstock. "Haptic Speech Communication Using Stimuli Evocative of Phoneme Production." In: *World Haptics Conference*. Tokyo, Japan, June 2019. URL: http://srl.mcgill.ca/publications/2019-WHC-Speech.pdf. Acceptance rate: 46%.

[C29] **P. Alirezaee**, J. Schlesinger, and J. R. Cooperstock. "Ergonomic Haptic Displays - Reducing Clinician Dependence on Patient Monitors and Auditory Alarms." In: *Human Factors and Ergonomics in Healthcare Symposium*. Chicago, IL, USA, Mar. 2019.

[C30] **P. Fortin**, **D. Huang**, and J. R. Cooperstock. "Exploring the Use of Fingerprint Sensor Gestures for Unlock Journaling: A Comparison with Slide-to-X." In: *Mobile HCI*. Taipei, Taiwan: ACM, Oct. 2019. URL: http://dl.acm.org/authorize?N684389.

[C31] **P. Fortin**, **E. Sulmont**, and J. R. Cooperstock. "Detecting Perception of Smartphone Notifications using Skin Conductance Responses." In: *Human Factors in Computing (CHI)*. Glasgow, Scotland: ACM, Apr. 2019. URL: http://dl.acm.org/authorize?N682230. Honorable mention, Acceptance rate: 24%.

[C32] **J. Anlauff**, **T. Kim**, and J. R. Cooperstock. "Feel-a-Bump: Haptic Feedback for Foot-based Angular Menu Selection." In: *Haptics Symposium*. San Francisco, CA: IEEE, Mar. 2018. URL: https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=8357172. Acceptance rate: 44%.

[C33] **P. Fortin**, **E. Sulmont**, and J. R. Cooperstock. "SweatSponse: Closing the Loop on Notification Delivery Using Skin Conductance Responses." In: *User Interface Software and Technology (UIST)*. Berlin, Germany: ACM, Oct. 2018. URL: http://dl.acm.org/authorize?N682232.

[C34] **T. Kim**, **H. Ju**, and J. R. Cooperstock. "Pressure or Movement? Usability of Multi-Functional Foot-Based Interfaces." In: *Designing Interactive Systems (DIS)*. Hong Kong: ACM, June 2018. URL: http://dl.acm.org/authorize?N682246. Acceptance rate: 23%.

[C35] E. Cupellini, J. R. Cooperstock, and M. Olivetti. "The Sound Motion Controller: a distributed system for interactive music performance." In: *Conference of the European Society for the Cognitive Sciences of Music*. Ghent, Belgium, July 2017.

[C36] **D. Horodniczy** and J. R. Cooperstock. "Free the Hands! Enhanced Target Selection via a Variable-Friction Shoe." In: *Human Factors in Computing Systems (CHI)*. Denver, CO, May 2017. URL: http://dl.acm.org/authorize?N682249. Acceptance rate: 25%.

[C37] D. M. Gay-Betton, **P. Alirezaee**, J. R. Cooperstock, and J. J. Schlesinger. "HAPTIC – Haptic Anatomical Positioning To Improve Clinical Monitoring." In: *Design & Semantics of Form & Movement (DeSForM)*. Delft-Eindhoven, Netherlands, Oct. 2017. URL: https://www.intechopen.com/books/proceedings-of-the-conference-on-design-and-semantics-of-form-and-movement-sense-and-sensitivity-desform-2017/haptic-haptic-anatomical-positioning-to-improve-clinical-monitoring.

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[C123] **S. Arseneau** and J. R. Cooperstock. "An Asymmetrical Diffusion Framework for Junction Analysis." In: *British Machine Vision Conference (BMVC)*. Edinburgh, UK, Sept. 2006. URL: http://srl.mcgill.ca/publications/2006-BMVC-Arseneau.pdf.

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[C126] **Z. Qi** and J. R. Cooperstock. "Wide-Baseline Image Mosaicing for Indoor Environments." In: *International Conference on Pattern Recognition (ICPR)*. Hong Kong, Aug. 2006. URL: http://srl.mcgill.ca/publications/2006-ICPR.pdf.

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[C128] **J. Yin** and J. R. Cooperstock. "A New Photo Consistency Test for Voxel Coloring." In: *Canadian Conference on Computer and Robot Vision*. Victoria, BC, Canada: IEEE Computer Society, May 2005, pp. 566–570. DOI: 10.1109/CRV.2005.9. URL: http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=1443180.

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[C130] **W. Sun** and J. R. Cooperstock. "Requirements for Camera Calibration: Must Accuracy Come with a High Price?" In: *IEEE Workshop on Applications of Computer Vision (WACV)*. Breckenridge, CO, USA, Jan. 2005. URL: http://srl.mcgill.ca/publications/2005-WACV-Sun.pdf.

[C131] J. R. Cooperstock, J. Roston, and W. Woszczyk. "Broadband Networked Audio: Entering the Era of Multisensory Data Distribution." In: *18th International Congress on Acoustics*. Kyoto, Japan, Apr. 2004. URL: http://srl.mcgill.ca/publications/2004-ICA.pdf.

[C132] **F. Rioux**, **F. Rudzicz**, and **M. Wozniewski**. "The Modellers' Apprentice – The Toolglass Metaphor in an Immersive Environment." In: *British HCI Group Annual Conference*. Leeds, UK, Sept. 2004.

[C133] **J. Yin** and J. R. Cooperstock. "Improving Depth Maps by Nonlinear Diffusion." In: *12th International Conference on Computer Graphics, Visualization and Computer Vision*. Plzen, Czech Republic, Feb. 2004, pp. 305–311. URL: http://srl.mcgill.ca/publications/2004-WSCG-diffusion.pdf.

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[C135] J. Usher, J. R. Cooperstock, W. Woszczyk, and J. R. Cooperstock. "A multi-filter approach to acoustic echo cancellation for teleconferencing." In: *75th Meeting of the Acoustical Society of America*. New York, May 2004.

[C136] W. Woszczyk, J. R. Cooperstock, J. Roston, and W. Martens. "Environment for immersive multi-sensory communication of music using broadband networks." In: *23rd Tonmeistertagung VDT International Audio Convention*. Leipzig, Germany, Nov. 2004. URL: http://srl.mcgill.ca/publications/2004-TONMEISTER.pdf.

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[C140] **J. Yao** and J. R. Cooperstock. "Arm Gesture Detection in a Classroom Environment." In: *IEEE Workshop on Applications of Computer Vision (WACV)*. Orlando, FL, USA, Dec. 2002, pp. 153–157. URL: http://srl.mcgill.ca/publications/2002-WACV.pdf.

[C141] **S. Arseneau** and J. R. Cooperstock. "Automated Feature Registration for Robust Tracking Methods." In: *IEEE International Conference on Pattern Recognition (ICPR)*. Vol. 2. Quebec City, QC, Canada, Aug. 2002, pp. 1078–1081. DOI: 10.1109/ICPR.2002.1048492. URL: http://doi.ieeecomputersociety.org/10.1109/ICPR.2002.1048492.

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[C143] J. R. Cooperstock and **S. Spackman**. "The Recording Studio that Spanned a Continent." In: *IEEE International Conference on Web Delivering of Music (WEDELMUSIC)*. Florence, Italy, Nov. 2001, pp. 161–167. DOI: 10.1109/WDM.2001.990172. URL: http://srl.mcgill.ca/publications/2001-WEDELMUSIC.pdf.

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[C145] **A. Xu** and J. R. Cooperstock. "Real Time Streaming of Multi-Channel Audio Data over Internet." In: *108th Audio Engineering Society Convention*. Paris, France, 2000, 14 pgs. URL: http://srl.mcgill.ca/publications/2000-AES.pdf.

[C146] **L. Hochstein**, **S. Lerner**, J. J. Clark, and J. R. Cooperstock. "Soccer-Swarm: A Graphical Framework for Soccer-Player Design." In: *International Symposium on Robotics*. Montreal, QC, Canada, May 2000, pp. 108–113. URL: http://srl.mcgill.ca/publications/2000-ISR.pdf.

[C147] **S. Arseneau**, **W. Sun**, **C. Zhao**, and J. R. Cooperstock. "Inter-layer Learning Towards Emergent Cooperative Behavior." In: *17th Annual Conference on Artificial Intelligence, American Association of Artificial Intelligence*. Austin, TX, USA, 2000, pp. 3–8. URL: http://srl.mcgill.ca/publications/2000-AAAI.pdf.

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[C151] J. R. Cooperstock. "From the Flashing 12:00 to a Usable Machine: Applying UbiComp to the VCR." In: *Human Factors in Computing Systems (CHI), Extended Abstracts*. Atlanta, GA, USA, Mar. 1997, pp. 281–282. URL: http://dl.acm.org/authorize?N06289. Acceptance rate: 24%.

[C152] J. R. Cooperstock and S. Kotsopoulos. "Why Use a Fishing Line When You Have a Net? An Adaptive Multicast Data Distribution Protocol." In: *USENIX*. San Diego, CA, USA, 1996, pp. 343–352. URL: http://srl.mcgill.ca/publications/1996-USENIX.pdf.

[C153] K. Yamaashi, J. R. Cooperstock, T. Narine, and W. Buxton. "Beating the Limitations of Camera-Monitor Mediated Telepresence with Extra Eyes." In: *Human Factors in Computing Systems (CHI)*. Vancouver, BC, Canada, May 1996, pp. 50–57. URL: http://dl.acm.org/authorize?N06280. Acceptance rate: 21%.

[C154] A. Chou, J. R. Cooperstock, R. El-Yaniv, M. Klugerman, and T. Leighton. "The Statistical Adversary Allows Optimal Money-Making Trading Strategies." In: *ACM-SIAM Symposium on Discrete Algorithms (SODA)*. San Francisco, CA, USA, Jan. 1995, pp. 467–476. URL: http://srl.mcgill.ca/publications/1995-SODA.pdf.

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[C157] J. R. Cooperstock, K. Tanikoshi, G. Beirne, T. Narine, and W. Buxton. "Evolution of a Reactive Environment." In: *Human Factors in Computing Systems (CHI)*. Denver, CO, USA, May 1995, pp. 170–177. URL: https://dl.acm.org/citation.cfm?id=223926. Acceptance rate: 29%.

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[C159] A. Gujar, S. Daya, J. R. Cooperstock, K. Tanikoshi, and W. Buxton. "Talking Your Way Around a Conference: A speech interface for remote equipment control." In: *IBM Center for Advanced Studies (CASCON)*. Toronto, ON, Canada, 1995, p. 289. URL: http://portal.acm.org/citation.cfm?id=781915.781941.

[C160] J. K. Tsotsos, S. Dickinson, M. Jenkin, E. Milios, A. Jepson, B. Down, E. Amdur, S. Stevenson, M. Black, D. Metaxas, J. R. Cooperstock, S. Culhane, F. Nuflo, G. Verghese, W. Wai, D. Wilkes, and Y. Ye. "The PLAYBOT Project." In: *IJCAI Workshop on AI Applications for Disabled People*. Montreal, QC, Canada, Aug. 1995.

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[C163] J. R. Cooperstock and E. Milios. "Adaptive Neural Networks for Vision-Guided Position Control of a Robot Arm." In: *IEEE Intelligent Control*. Glasgow, UK, 1992, pp. 397–403. DOI: 10.1109/ISIC.1992.225124. URL: http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=225124.

[C164] J. R. Cooperstock and E. Milios. "Neural Network Control for a Vision-Guided Mobile Robot Arm." In: *IASTED Control and Robotics*. Vancouver, BC, Canada, 1992, pp. 278–281.

Refereed Conference Publications (Posters)

[CP1] **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: *World Haptics Conference*. Virtual Conference: IEEE, July 2021.

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[CP2] J. Cooperstock and **J.R. Blum**. "Touch me like it matters: exploring location and encodings for explicit and implicit communication." In: *Haptics Symposium, Interactive Session associated with the Cross-Cutting Challenge on Using the Skin as a Medium of Communication*. Washington, DC, Mar. 2020.

[CP3] N. Katzman, M. Gellert, T. Oron-Gilad, J. R. Cooperstock, Y. Bitan, and J. J. Schlesinger. "Wearable haptic devices to monitor soldiers' physiology–discreet sensory input improves safety and monitoring in hostile low-light and high-noise conditions." In: *Military Health System Research Symposium*. Department of Defense, 2020. URL: https://mhsrs.amedd.army.mil/SitePages/Home.aspx.

[CP4] **P. Fortin**, **J. Blum**, and J. R. Cooperstock. "Towards Consistent Haptic Coupling with HaptiStrap: Doing Better than "Tight yet Comfortable"." In: *User Interface Software and Technology (UIST)*. New Orleans, USA: ACM, Oct. 2019. Acceptance rate: 48.8%.

[CP5] **F. Al-Taha**, **P. Fortin**, **A. Weill–Duflos**, and J. R. Cooperstock. "Reversing Voice-Related Biases Through Haptic Feedback." In: *User Interface Software and Technology (UIST)*. Berlin, Germany: ACM, Oct. 2018. URL: http://dl.acm.org/authorize?N682233.

[CP6] **F. Tordini**, A. Bregman, and J. R. Cooperstock. "Effects of global brightness on salience and auditory foreground perception." In: *Speech in Noise Workshop*. Glasgow, Scotland, Jan. 2018. URL: https://spin2018.eu/?p=program&id=66.

[CP7] **J. Blum** and J. R. Cooperstock. "Exploring the Limits of Vibrotactile Numeric Information Delivery." In: *Ubicomp*. Singapore: ACM, Oct. 2018. URL: http://dl.acm.org/authorize?N682245.

[CP8] **J. Blum**, J. R. Cooperstock, and J. Cauchard. "Pseudo-Ambience: Filling the Gap Between Notifications and Continuous Information Displays." In: *UbiTtention Workshop on Smart & Ambient Notification and Attention Management*. Singapore: ACM, Oct. 2018. URL: http://dl.acm.org/authorize?N682234.

[CP9] **T. Kim** and J. R. Cooperstock. "Enhanced Pressure-Based Multimodal Immersive Experiences." In: *Augmented Human*. Seoul, Korea: ACM, Feb. 2018. URL: http://dl.acm.org/authorize?N682247. Best poster presentation award, Acceptance rate: 34%.

[CP10] **P. Fortin**, **J. Blum**, and J. R. Cooperstock. "Raising the Heat: Electrical Muscle Stimulation for Simulated Heat Withdrawal Response." In: *User Interface Software and Technology (UIST)*. Quebec City, Canada: ACM, Oct. 2017. URL: http://dl.acm.org/authorize?N682248. Acceptance rate: 23%.

[CP11] **J. Anlauff**, J. Fung, and J. R. Cooperstock. "Modular Haptic Belt for Augmented Balance Feedback." In: *Intl. Society for Posture and Gait Research*. Seville, Spain, June 2015.

[CP12] **D. El-Shimy** and J. R. Cooperstock. "EmbodiComp: Embodied Interaction for Mixing and Composition." In: *Sound and Music Computing Conference (ICMC — SMC)*. Athens, Greece, Sept. 2014.

[CP13] **F. Tordini** and J. R. Cooperstock. "Auditory salience modeling via streaming: A behavioural view." In: *Milestones in Music Cognition: BKN 25*. Montreal, Canada, July 2014.

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[CP14] **D. Glesser**, F. Bérard, and J. R. Cooperstock. "Overcoming Limitations of the Trackpad for 3D Docking Operations." In: *Human Factors in Computing Systems (CHI), Extended Abstracts*. Paris, France: ACM, Apr. 2013. URL: http://dl.acm.org/authorize?N06273. Acceptance rate: 20%.

[CP15] **C. Côté**, **S. Arseneau**, and J. R. Cooperstock. "Telepresence with no Strings Attached: An Architecture for a Shared Reality Environment." In: *Second International Symposium on Mixed Reality (ISMR)*. Yokohama, Japan, Mar. 2001. URL: http://srl.mcgill.ca/publications/2001-ISMR.pdf.

[CP16] **S. Arseneau** and J. R. Cooperstock. "Automated Camera Tracking in a Real-World Environment." In: Montreal, QC, Canada, 2000.

[CP17] J. R. Cooperstock. "Rethinking the Remote Control." In: *HCI International, Conference on Human-Computer Interaction*. San Francisco, CA, USA, Aug. 1997, p. 116.

Book Chapters

[B1] **T. Kim**, **J. Blum**, **P. Alirezaee**, **A. Arnold**, **P. Fortin**, and J. R. Cooperstock. "Usability of Foot-Based Interaction Techniques for Mobile Solutions." In: *Mobile Solutions and Their Usefulness in Everyday Life*. Springer International Publishing AG, Jan. 2019, pp. 309–329. DOI: https://doi.org/10.1007/978-3-319-93491-4_16. URL: https://link.springer.com/chapter/10.1007/978-3-319-93491-4_16.

[B2] **M. Wozniewski**, Z. Settel, and J. R. Cooperstock. "Sonic Interaction via Spatial Arrangement in Mixed Reality Environments." In: *Sonic Interaction Design*. Ed. by K. Franinovic and S. Serafin. MIT Press, 2013, pp. 329–340. URL: http://xplorebcpaz.ieee.org/xpl/login.jsp?tp=&arnumber=6504636.

[B3] M. Marchal, **G. Cirio**, **Y. Visell**, F. Fontana, S. Serafin, J. R. Cooperstock, and A. Lécuyer. "Multimodal Rendering of Walking over Virtual Grounds." In: *Human Walking in Virtual Environments*. Ed. by Y. Visell, A. Lécuyer, F. Steinicke, and J. Campos. Springer Verlag, 2013, pp. 263–295. URL: http://www.springer.com/engineering/robotics/book/978-1-4419-8431-9.

[B4] **Y. Visell** and J. R. Cooperstock. "Interacting with augmented floor surfaces." In: *Human Walking in Virtual Environments*. Ed. by Y. Visell, A. Lécuyer, F. Steinicke, and J. Campos. Springer Verlag, 2013, pp. 377–399. URL: http://www.springer.com/engineering/robotics/book/978-1-4419-8431-9.

[B5] **Y. Visell**, **R. Rajalingham**, and J. R. Cooperstock. "A review of nonvisual signatures of human walking with applications to person tracking in augmented environments." In: *Walking with the senses: Perceptual techniques for walking in virtual environments*. Ed. by Y. Visell and F. Fontana. Logos Verlag, 2012, pp. 33–68.

[B6] **Y. Visell**, **S. Smith**, and J. R. Cooperstock. "Distributed human-computer interaction with augmented floor surface." In: *Walking with the senses: Perceptual techniques for walking in virtual environments*. Ed. by Y. Visell and F. Fontana. Logos Verlag, 2012, pp. 15–32.

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[B7] J. R. Cooperstock. "Human-Computer Interaction." In: *Wiley Encyclopedia of Computer Science and Engineering*. Ed. by B. W. Wah. Vol. 3. Wiley-Interscience, Mar. 2009, pp. 1529–1542. DOI: 10.1002/9780470050118.ecse524. URL: http://onlinelibrary.wiley.com/doi/10.1002/9780470050118.ecse524/abstract.

[B8] **F. Aubé** and **R. Shield**. "Modeling the Effect of Leadership on Crowd Flow Dynamics." In: *Cellular Automata*. Ed. by P. Sloot, B. Chopard, and A. Hoekstra. Vol. 3305. Lecture Notes in Computer Science. originally presented in International Conference on Cellular Automata for Research and Industry. Amsterdam: Springer Berlin / Heidelberg, Oct. 2004, pp. 601–611. URL: http://dx.doi.org/10.1007/978-3-540-30479-1_62.

Other Refereed Publications

[O1] **N. Hieda** and J. R. Cooperstock. *SharedFace2*. International Conference and Exhibition of Virtual Technologies and Uses: Laval Virtual ReVolution (refereed interactive demonstration). Laval, France, Apr. 2015.

[O2] **Y. Visell**, **G. Millet**, and J. R. Cooperstock. *Haptic Display via a Vibrating, Rigid Surface*. Demonstration in IEEE Haptics Symposium. Waltham, MA, USA, Mar. 2010.

[O3] **A. Law**, **J. Ip**, **B. Peck**, **Y. Visell**, P. Kry, and J. R. Cooperstock. *A Multimodal Floor for Virtual Environments*. Demonstration in SIGGRAPH Emerging Technologies. Aug. 2009.

[O4] **M. Wozniewski**, Z. Settel, and J. R. Cooperstock. *Ménagerie Imaginaire*. Artwork Performance in New Interfaces for Musical Expression (NIME). New York, NY, USA, June 2007.

Non-refereed Contributions

[N1] J. Cooperstock. "Situating UbiComp Education within or distinct from HCI?" In: *Ubiquitous Computing Education: Why, What, and How:* ed. by A. Girouard, A. L. Kun, A. Roudaut, and O. Shaer. Vol. 9. 6. Dagstuhl, Germany: Schloss Dagstuhl–Leibniz-Zentrum fuer Informatik, Mar. 2019. URL: http://drops.dagstuhl.de/opus/volltexte/2019/11460.

[N2] **E. Sheepy**, M. Orjuela-Laverde, and J. R. Cooperstock. "Encouraging active and collaborative learning in two engineering courses." In: *Supporting Active Learning and Technological Innovation in Studies of Education*. Montreal, Canada, June 2016.

[N3] J. R. Cooperstock and G. Lukács. *How to complain to airlines*. CBC Marketplace blog. Mar. 2014. URL: http://www.cbc.ca/marketplace/blog/plane-wrong-how-to-complain-to-airlines.

[N4] **F. Tordini** and J. R. Cooperstock. "Auditory salience modeling via streaming: A behavioural view." In: *Milestones in Music Cognition: BKN 25*. Montreal, Canada, July 2014.

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[N5] J. R. Cooperstock. "Overcoming Complexity in the Teaching and Learning Environment." In: *Materials Science and Technology*. Ralph Lloyd Harris Memorial Symposium. Montreal, Oct. 2013.

[N6] J. R. Cooperstock. *From Rehearsal to Performance: Ensemble Learning in Open Orchestra and Distributed Rehearsal for World Opera*. Presentation in Music Anywhere, Anytime: International Symposium on Synchronous Distance Learning. Oct. 2011.

[N7] **Benovoy, M.**, J. Cooperstock, and M. Levine. *Real-Time Facial Recognition*. Phase II Project Report for Department of National Defence. 2010.

[N8] M. Levine, **Benovoy, M.**, and J. Cooperstock. *An Automatic Real-Time Facial Recognition System*. Phase I Project Report for Department of National Defence. 2009.

[N9] **N. Bouillot**, E. Cohen, J. R. Cooperstock, A. Floros, N. Fonseca, R. Foss, M. Goodman, J. Grant, K. Gross, S. Harris, B. Harshbarger, J. Heyraud, L. Jonsson, J. Narus, M. Page, T. Snook, A. Tanaka, J. Trieger, and U. Zanghieri. "AES White Paper AESTD1003V1: Best Practices in Network Audio." In: *Journal of the Audio Engineering Society* 57.9 (Sept. 2009), pp. 729–741. URL: http://www.aes.org/e-lib/browse.cfm?elib=14839.

[N10] V. N. Salimpoor, **M. Benovoy**, G. Longo, J. R. Cooperstock, and R. J. Zatorre. *Qualifying the Chills Response: Differences between Transient and Prolonged Chills in Response to Music*. Presentation in Auditory Perception, Cognition, and Action Meeting. Chicago, IL, USA, 2008.

[N11] J. Cooperstock. "Plus de largeur du bande, s'il vous plaît." In: *L'interdiscplinarité dans les sciences et technologies de la musique (invited)*. Montreal: Association francophone pour le savoir (ACFAS), May 2006.

[N12] J. Cooperstock. "Integrating Communication with Interaction: Computer Vision Challenges for Interactive and Intelligent Environments." In: *Workshop on Computer Vision for Interactive and Intelligent Environments (invited)*. Lexington, KY, USA, Nov. 2005. URL: http://srl.mcgill.ca/publications/2005-CV4IIE.pdf.

[N13] J. Cooperstock, J. Roston, and Woszczyk. "Broadband Networked Audio: Entering the Era of Multisensory Data Distribution." In: *18th International Congress on Acoustics (invited)*. Kyoto, Apr. 2004.

[N14] **Cayouette, F.**, **Sud, D.**, **Patel, K.**, **Sarikaya, D.**, and J. Cooperstock. "McGill Reddogs Final Report." In: *Robocup*. 2002.

[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.

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Patents

[P1] **P. Fortin**, **J. Blum**, **Antoine Weill–Duflos**, and J. R. Cooperstock. "System and Method for Wearable Device Contact Force Estimation and Adjustment Feedback." provisional application US 05001770-936USPR (United States). 2021.

[P2] **P. Fortin**, S. Kim, and J. R. Cooperstock. "Closed-loop XR Stimulus Presentation and Perception Feedback using Multi-Channel Physiological Signals." application US 2020P00157WO (United States). 2021.

[P3] 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.

[P4] J. R. Cooperstock, **Y. Visell**, **A. Law**, and K. Franinovic. "Floor-based Haptic Communication System." US 9,041,521 (United States). May 2015.

[P5] 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.

[P6] J. R. Cooperstock, **G. Millet**, and **M. Otis**. "Floor-Based Variable Friction Display." provisional application US 61/577,148 (expired) (United States). 2011.

[P7] J. R. Cooperstock, **L. To**, and R. Hess. "A Tetris-style gaming approach to treat amblyopia." US 8,066,372 (United States). Nov. 2011.

[P8] J. Roston, J. R. Cooperstock, J. MacDougall, and **S. Spackman**. "Remote sign language interpretation system." US 60/463,332; CA 2,426,161;US 7,395,200 (United States). Feb. 2003.

[P9] **S. Spackman**, **S. Pelletier**, and J. R. Cooperstock. "High-resolution Video Synthesis." application 2,435,791 filed July 24, 2003 (expired) (Canada). 2003.

[P10] 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.

[P11] 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.

[P12] 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.

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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 mulitchannel 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."*

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Invited Talks

Invited Talks to Industry, Students, and the Public

[T1] "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.

[T2] "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.

[T3] "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.

[T4] "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.

[T5] "I Feel the Earth Move (Under My Feet): Haptic Interaction for Telepresence and Information Delivery", Information Systems, University of Haifa, November 7, 2018.

[T6] "What's around me? Audio augmented reality for blind users with a smartphone, Pint of Science, Montreal, May 15, 2018.

[T7] Presenter at Canadian National Institute for the Blind's TechnoVision+ Conference, Montreal, May 5, 2017.

[T8] "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.

[T9] "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.

[T10] "Is Humanity Smart Enough for AI?", McGill Science Outreach Program, Freaky Friday public outreach lecture, October 23, 2015.

[T11] "Delivering a Compelling User Experience in a Computer-Mediated Environment", HCIN 5300, Interactive Entertainment Technologies, Carleton University, March 7, 2014.

[T12] "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.

[T13] "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.

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[T14] "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.

[T15] "Telepresence doesn't quite cut it: Multimodal Challenges in Virtual and Shared Reality", Dawson College, First Choice Science speakers series, April 17, 2013.

[T16] "Dangerous AI or dangerous us?", Academia Week Artificial Intelligence event, Science Undergraduate Society, McGill University, January 24, 2013.

[T17] "They don't use Skype on the Holodeck", Department of Computer Science, University of British Columbia, July 4, 2012.

[T18] "But can the Holodeck do a good Shiraz?", School of Computer Science and IT, Royal Melbourne Institute of Technology, February 17, 2012.

[T19] "But can the Holodeck do a good Shiraz?", School of Information Technologies, University of Sydney, February 15, 2012.

[T20] "Distributed Music Performance and Latency Issues", School of Drama, Fine Art and Music, University of Newcastle (Australia), February 13, 2012.

[T21] "But can the Holodeck do a good Pinot noir?", Department of Computer Science, University of Otago, January 23, 2012.

[T22] "Shared Reality: Toward perceptually convincing computer-mediated environments", Department of Computer Science, University of Auckland, August 25, 2011.

[T23] "This is your brain on Shared Reality: Toward perceptually convincing computed-mediated environments", Vanier College, Science Week Presentation, March 24, 2011.

[T24] "This is your brain on Shared Reality: Toward perceptually convincing computed-mediated environments", Simula Lab, Oslo, May 15, 2009.

[T25] "This is your brain on Shared Reality: Toward perceptually convincing computed-mediated environments", Ambient Intelligence Group, CITEC, Bielefeld University, May 6, 2009.

[T26] "Distributed and Multimodal Interaction in Virtual and Augmented Reality Environments", McGill University, School of Physical and Occupational Therapy, November 25, 2008.

[T27] "Shared Reality: Effective Interaction for (Demanding) Distributed Tasks", University of Victoria, September 16, 2008.

[T28] "Bidirectional video communication for real-time applications", Institut für Telematik, University of Lübeck, Germany, May 15, 2008.

[T29] "Shared Reality: Effective Interaction for (Demanding) Distributed Tasks", Aalborg University, Esbjerg, Denmark, May 14, 2008.

[T30] "Distributed Multimodal Interaction", Bang & Olufsen, Struer, Denmark, May 13, 2008.

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[T31] "Distributed Musical Practice and Performance", Biology and Music Lecture, I Medici di McGill, April 28, 2008.

[T32] "Shared Reality: Effective Interaction for (Demanding) Distributed Tasks", Arts, Media and Engineering, Arizona State University, February 29, 2008

[T33] "From Videoconferencing to Shared Reality" Department of Electrical and Computer Engineering, University of British Columbia, October 4, 2007.

[T34] "Engaging Technolog(ies) for Effective Interaction" Department of Computer Science, Hebrew University of Jerusalem, April 19, 2005.

[T35] "Engaging Technolog(ies) for Effective Interaction" Intelligence, Agents, Multimedia Group, University of Southampton, UK, March 7, 2005.

[T36] "From Videoconferencing to Shared Reality" l'Institut de Recherche et Coordination Acoustique/Musique (IRCAM), Paris, November 25, 2004.

[T37] "From Videoconferencing to Shared Reality" Taiyuan University, Taiyuan, China, April 18, 2004.

[T38] "From Videoconferencing to Shared Reality" Tsighua University, Beijing, China, April 14, 2004.

[T39] "From Videoconferencing to Shared Reality" Beijing University, Beijing, China, April 14, 2004.

[T40] "From Videoconferencing to Shared Reality" Beihan University, Beijing, China, April 12, 2004.

[T41] "From Videoconferencing to Shared Reality" Advanced Telecommunications Research (ATR), Nara, Japan, April 9, 2004.

[T42] "From Videoconferencing to Shared Reality" Dept. of Industrial Engineering, Musashi Institute of Technology, April 5, 2004.

[T43] "High-fidelity telepresence" Graphics and Geometric Computing Seminar Series, Technion – Israel Institute of Technology, January 1, 2003.

[T44] "The Virtual Studio" Royal Conservatory of Music, Toronto, February 25, 2002.

[T45] "Building a Shared Reality" Department of Computer Science, University of Toronto, February 25, 2002.

[T46] "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.

[T47] "Robotics and Design" Round Table Panel, Centre Design UQAM, February 9, 2000.

[T48] "The Shared Reality Environment" Department of Electrical and Computer Engineering, Ecole Polytechnique, Montreal, May 28, 1999.

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Invited Talks in Scholarly Conferences and Workshops

[T49] Speaker in "Next Gen Health Powered By The Open Grid And Edge AI", IEEE Future Networks Forum, Montreal, October 14, 2022.

[T50] "Touch and feel when it isn't real: Integrating haptics into the XR experience", InterDigital Scientific Seminar series, December 4, 2020.

[T51] "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.

[T52] "Assistive Technology Research in the Shared Reality Lab", Conférence scientifique du CRIR-Institut Nazareth et Louis-Braille, September 25, 2019.

[T53] "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.

[T54] Speaker in "AR/VR panel", IEEE Multimedia Signal Processing Workshop, Montreal, September 23, 2016.

[T55] "Immersive multimedia and mobile interaction: Applications to new media, gaming, medicine, and beyond" Keynote speaker, Entertainment Technology Summit, Concordia University, Montreal, September 17, 2016.

[T56] "Leveraging video in public safety scenarios", Ninth Canadian Public Safety Interoperability Workshop (CITIG 9), Toronto, December 1, 2015.

[T57] "Future Cities (2040) – Mind: Human and Machine", Institute for the Public Life of Arts and Ideas, Symposium on Future Cities, March 13, 2015.

[T58] "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.

[T59] "Assisting the blind and treating amblyopia: Two more things you can do with your smartphone", 15e Symposium scientifique sur l'incapacité visuelle et la réadaptation (presented with J. Blum). University of Montreal, February 12, 2013.

[T60] "Revolutions in human-device interaction: How new paradigms impact user experience", International Conference on Consumer Electronics, Consumer Electronics Society, Las Vegas, January 12, 2013.

[T61] "Around the World in 80 ms." Panel presentation in Workshop of the Audio Engineering Society Convention, San Francisco, November 5, 2010.

[T62] "UltraVideo and Virtual Presence: A Video Perspective." Presentation on Teaching in Distributed Performance, Tromsø, Norway, October 15, 2010.

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[T63] "Future Interfaces for Audio." Panel presentation in Workshop of the Audio Engineering Society Convention, New York, October 10, 2009.

[T64] "World Opera Technologies and Tests", Danish Sound Technology Network, Aalborg University, June 8, 2009.

[T65] "The Montreal World Opera Experiments". Presentation at the World Opera Symposium, Struer, Denmark, May 12, 2009.

[T66] "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.

[T67] "New Technologies for Audio over IP". Panel presentation in Workshop of the Audio Engineering Society Convention, Munich, Germany, May 10, 2009.

[T68] "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.

[T69] "The Future of VC: Music Teaching and High Fidelity Video", Elevate 2008: Reaching New Heights in Educational Video-conferencing, Banff, August 27–28, 2008.

[T70] "Creating an immersive video space", International Symposium on The World Opera: When the Opera stage becomes worldwide, Tromsø, Norway, May 9, 2008.

[T71] "Multimodal Streaming and Distributed Audio Interaction", High Quality Audio over Networks (ANET II) Summit, Banff Centre, April 12, 2008.

[T72] "Music and Games: How Fun Applications Stimulate Core Technologies", Canadian University Software Engineering Conference, January 19, 2008.

[T73] "From Teleoperation to Teleimmersion: Design Challenges for Distributed Interaction", Canadian University Software Engineering Conference, January 19, 2007.

[T74] "CANARIE sur UCLP et ROADM, deux technologies qui changent le monde des télécoms", Round Table panel, RISQ Annual Conference, Quebec City, October 16, 2006.

[T75] "La recherche sur en ultra-videoconference", Panel on "Vitrine technopédagogique sur la vidéoconférence", RISQ Annual Conference, Quebec City, October 16, 2006.

[T76] "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.

[T77] "Low-Latency Ultra-Videoconferencing and Shared Reality" Interfaces Montreal, Rencontre du Génie numérique et des Affaires. Montreal, October 11, 2005.

[T78] "Shared Spaces" Asia-Pacific Advanced Networks (APAN) Conference, Taipei Aug. 22–27, 2005.

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[T79] "Engaging Technolog(ies) for Effective Interaction" Keynote speaker, World Conference on Educational Multimedia, Hypermedia and Telecommunications, Montreal, June 29, 2005.

[T80] "Broadband Distance Education in 2007: Views from the Demand Side" Invited Panelist. World Conference on Educational Multimedia, Hypermedia and Telecommunications, Montreal, June 29, 2005.

[T81] "Ultra-Videoconferencing and Intelligent Classrooms" Keynote speaker, Canadian Higher Education and Information Technology Conference, Montreal, June 28, 2005.

[T82] "From Videoconferencing to Shared Reality" Bell University Laboratories' Annual Conference, Toronto, November 3, 2004.

[T83] "History of Internet Audio Experiments at McGill" High Quality Audio over Networks (ANET) Summit, Banff Centre, August 20–22, 2004.

[T84] "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.

[T85] "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.

[T86] "The Development of Ultra VC Applications and Technology" Southeastern Universities Research Association Video Development Initative (SURA/ViDe) 4th Annual Digital Video Workshop. University of Alabama at Birmingham, April 25, 2002.

[T87] "High quality wide-screen SDI video and multichannel audio over CA*net3" CANARIE's 7th Advanced Networks Workshop, Toronto, November 28, 2001.

[T88] "Low-latency comes to videoconferencing: The Frères Jacques duet at a distance" RISQ 2001 Conference, Montreal, November 5, 2001.

[T89] Advanced Networking and the Arts: Innovations in Outreach, Collaboration, and Performance. Panel Discussion at Internet Global Summit INET 2001 Conference, Stockholm, June 6, 2001.

[T90] "The McGill–Calgary Advanced Learnware Network" CANARIE's 6th Advanced Networks Workshop, Montreal, November 29, 2000.

[T91] "Networks and Music Instruction" Panel Discussion with Pinchas Zukerman and Wieslaw Woszczyk, CANARIE's 6th Advanced Networks Workshop, Montreal, November 29, 2000.

[T92] "Tools for Distributed VR" Canadian Working Group on Virtualized Reality Systems, Montreal, November 28, 2000.

[T93] "Evolution of the Intelligent Classroom" Multicultural Perspectives on the use of Technology in Education. Montreal, October 2, 2000.

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[T94] The Brave New World of Ubiquitous Bandwidth" Internet Global Summit INET 2000 Conference, Yokohama, July 20, 2000.

[T95] "Multichannel Audio over the Internet: The Next Phase" RISQ 2000 Conference, May 31, 2000.

[T96] "Multichannel Audio over the Internet" CANARIE's 5th Advanced Networks Workshop, Toronto, November 29, 1999.

[T97] "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

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[M25] CJAD radio, Sept. 2, 2008

[M26] Cabling Networing 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 Nerdz, 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 Nerdz, Feb. 2000

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[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 québecois, 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

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Research Supervision

Research Professionals

Name	Period	Project title	Present Position
Singh, Jaydeep	Sep 2021–	web developer, IMAGE project	
Novack, Kaylee	Sep 2021–Apr 2022	medical doctor researcher on Avatar Therapy project	
Kuo, Cyan	Aug 2021–	Usability Research Lead, IMAGE project	
Patil, Gandharv	Jun 2021–Mar 2022	ML Research Lead, IMAGE project	
Grond, Florian	Apr 2021–	Audio Research Lead, IMAGE project	
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	CNRS, France
Dansereau, Don	Jun 2009 – Jan 2010	research associate under FRQNT grant	Senior Lecturer, University of Sydney
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	

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Name	**Period**	**Project title**	**Present Position**
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	programmer, Desjardins
Soukhodolski, I.	Oct 2005 – Dec 2007	web services programmer under Canarie IIP	Owner, W4 Technology
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., Montreal

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Post-doctoral Fellows

Name	Period	Project title	Present Position
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	
Talhan, Aishwari	Jan 2021–Dec 2022	Wearable Haptics	Research Scientist, 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
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

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Name	**Period**	**Project title**	**Present Position**
Millet, G.	Nov 2009 – Mar 2012	Natural Interactive Walking	Patent Examiner, EPO, The Hague
Bouillot, Nicolas	Sep 2007 – Dec 2011	Mobile Audio Interaction (NSERC New Media Initiative, 2007-2009)	
		Open Orchestra (Canarie NEP-2 Project)	Research Engineer, Societé des arts technologiques
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

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Ph.D. Students

Name	Period	Thesis title	Present Position
Conan, Corentin*	Sep 2022– present	Advanced Airspace Usability	
Astles, Samantha*	Sep 2022– present	Advanced Airspace Usability	
Shen, Lichao*	Oct 2021– present	Social telepresence	
Regimbal, J.*◇‡	Sep 2021– present	Audio-haptic authoring for information 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 Engineer, Google
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	Senior UX Research Manager, Miro
Benovoy, M.†	Oct 2007 – Aug 2010	Biosignals analysis	transferred to another group

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Name	**Period**	**Thesis title**	**Present Position**
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
Cayouette, F.[†]	2003–2006	human tracking (withdrew from program)	Programmer, Behaviour Interactive, Montreal
Arseneau, S.	2000–2006	Representing Junctions through Asymmetric Tensor Diffusion	Chief Engineer for R&D, Laser Shot, Houston

[*] McGill Engineering Doctoral Award recipient
[†] NSERC PGS D Scholarship recipient
[‡] 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:

- Liu, X., (Nov 2013-Dec 2015), visiting student from University of Electronic Science and Technology, China

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- Xie, M., (Sep 2012-Mar 2014), visiting student from Beijing University of Aeronautics and Astronautics, China
- Grond, F. (Jul-Dec 2010), visiting student from Bielefeld University, Germany
- Zambon, S.. (Jul-Oct 2010), visiting student from Verona University, Italy
- Cirio, G. (Jun-Aug 2010), visiting student from INRIA-IRISA, France
- Rizutti, C. (Sep-Oct 2008), visiting student from Università della Calabria, Italy
- Bossi, E. (Sep-Oct 2008), visiting student from Università della Calabria, Italy
- Pellerin, R. (Jun-Sep 2008), visiting student from Conservatoire Nationale des Arts et Métiers, France
- Cupellini, E. (Jul-Aug 2007), visiting student from Università della Calabria, Italy
- Usher, J. (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
- 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
- Department of Mechanical Engineering: Zahir Albadawi
- School of Computer Science: Paul Haroun, Wisam Al Abed

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Masters Students

Name	Period	Thesis title	Present Position
Bazin, Romain	Sep 2022–	TBD	
Quadros, Venissa Carol	Sep 2022–	TBD	
Aubet, Antoine	Sep 2022–	TBD	
Liu, Yujing	Sep 2021–	Graphical rendering strategies for avatar therapy	
Wilson, É.	Sep 2021–	Lightfield rendering techniques for XR musical interaction	
Duarte, Nathan$^{\diamond}$	Sep 2021–	Wearable sensor deployment for pandemic mitigation	
Henry, Max	Sep 2021–	Spatial-aware audio rendering for immersive telepresence	
Lewis-Lane, Jonathan	Sep 2021–	Wearable haptic feedback for real-time training tasks	
Akut, Rohan	Jan 2021–	Active learning for image labelling	
Gannavarapu, S.	Sep 2020–	Haptic rendering and perception	
Isran, Rayan	Sep 2020–	Haptic rendering and perception	
Kirby, Linnea	Sep 2020–	Multimodal feedback to guide body-movement	
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	Pipeline Technical Director, Double Negative
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	
Li, Yaxuan	Sep 2019 – May 2022	Towards Context-aware Automatic Multimodal Haptic Effect Generation for Home Theatre Environments	
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	
Girgis, Roger	Sep 2016 – Apr 2019	Assessing the Use of Deep Learning in Assisting Visually Impaired People with Outdoor Exploration	Ph.D. student, MILA
Kim, Taeyong	Sep 2016 – Aug 2019	Exploration of foot based interaction for menu control and virtual reality applications	HRI Researcher, Hyundai Robotics

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Name	**Period**	**Thesis title**	**Present Position**
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	
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	Visiting Researcher, Pola Art Foundation Fellow, Concordia University
Viswanathan, R.	Jan 2010 – Dec 2012	Testing the Two-Stream Hypothesis in an Immersive Virtual Environment	Developer, MontrealTel
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)	
Ip, Jessica	Sep 2008 – Mar 2011	Augmented Reality for Interactive Play in a Virtual and Physical Environment	iOS developer, Shopify, Toronto

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Name	**Period**	**Thesis title**	**Present Position**
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
Wozniewski, M.	2003-2006	A framework for interactive three-dimensional sound and spatial audio processing in a virtual environment	research engineer, Societé des arts technologiques, Montreal
Rudzicz, Frank*	2004-2006	CLAVIUS: Understanding Language Understaing in Multimodal Interaction	Professor, University of Toronto
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 Detecion in Front Projection Environments	Software Developer, Stingray Digital
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

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Name	**Period**	**Thesis title**	**Present Position**
Boussemart, Y.	2002-2005	Design and Implementation of Framework for Immersive Environments in a Shared Context	Chief Design Officer, QuantumBlack, UK
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

* FRQNT Graduate Scholarship recipient
† NSERC PGS M Scholar recipient
‡ McGill nominee for Northeastern Association of Graduate Schools Distinguished Thesis Award
◇ McCall MacBain Scholar

Additional Masters Supervisory Service

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

- 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
- Glesser, David (Feb-Jun 2012). visiting student from Ensimag, Grenoble, France
- Penin, O. (Jul-Aug 2011). visiting student from Paris-Sud 11, France

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- 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

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Funding

Individual Research Grants and Contracts

Date	Source	Amount	Title/Description
2023	MEDTEQ/ NSERC	$531,000	*Improving Intelligibility of Speech in Noisy Environments.* MEDTEQ Partenar-IA funding approved pending successful review of NSERC Alliance grant
2023	MEDTEQ/ HBHL	$282,188	*Haptic devices for conveying non-textual visual information on the internet for individuals with vision loss.* MEDTEQ Partenar-IA funding through the Ministère de l'Économie, de l'Innovation et de l'Énergie
2022	HBHL	$50,000	*Extending Internet Multimodal Access to Graphical Exploration.* CFREF Healthy Brains, Healthy Lives Neuro Commercialization Ignite Grant
2022	Meta	$30,000	Unrestricted gift
2021	Mitacs	$13,333	*Analyse et recherche d'optimisation d'un processus d'adaptation de contenu issu de la numérisation 3D à un contenu photo-réaliste et interactif.* Mitacs Accelerate – Intern: Chen, Hongjun
2021-2022	ISED	$608,594	*Enabling Access to Graphical Image Content Published via the Internet for People Who Are Blind, Deaf-Blind or Visually Impaired.* Innovation, Science and Economic Development Canada (ISED), Accessible Technology Program (Total project budget of $765,787)
2019-2021	NSERC/ MEDTEQ	$374,366	*Mixed-Reality Platform for Simulation and Synthesis of Multi-Modal Hallucinations with Applications to Schizophrenia Treatment.* Collaborative Research and Development Grant with Industrial Partners, iMD Research and IA Précision Santé Mentale
2019	NSERC	$25,000	*360 degree imaging for navigation assistance for the visually impaired.* Engage Grants Program with Industrial Partner, ImmerVision.
2019	Mitacs	$15,000	*Advanced sensor control implementations for energy optimization in commercial buildings using machine learning and data visualisation applied to building automation systems.* Mitacs Accelerate – Intern: Demers, Marc
2019	Mitacs	$6,000	*Facilitating Human Interaction with a Robotic Exercise Coach using Smart Objects.* Mitacs Globalink – Intern: Vyas, Preeti

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Date	Source	Amount	Title/Description
2018	Mitacs	$6,000	*Mobile Remote Implicit Communication.* Mitacs Globalink: Intern: Blum, Jeff
2018	NSERC	$25,000	*Educational wine recommendations from initially sparse data.* Engage Grants Program with Industrial Partner, Wineout Inc.
2017-2018	McGill	$7500	*Physiological confirmation of stimulus reception.* Faculty of Engineering TechAccelR Grant
2017-2020	NSERC	$631,650	*Wearable Haptics.* Collaborative Research and Development Grant with InterDigital Corporation
2017-2018	CIRA	$44,500	*Intelligent Agent for the Visually Impaired: Vision-based scene description and contextual awareness for Autour.* Canadian Internet Registry Authority .CA Community Investment Program
2017-2022	NSERC	$ 222,000	*Multimodal Influences on Perception and Action in Computer-Mediated Environments.* Discovery grant.
2017-2018	MSP	$177,673	*Social Media Monitoring Architecture.* Research Contract with Ministère de la Sécurité publique
2015	CIRA	$53,878	*What's Around Me? Conveying Environmental Awareness to the Visually Impaired Community.* Canadian Internet Registry Authority .CA Community Investment Program
2014-2015	Mitacs	$15,000	*Effect of Mobile Technologies in Emergency Response.* Mitacs Accelerate – Intern: Erfani-Joorabchi, Minoo
2014	NSERC	$25,000	*Haptic user experience delivered through the shoes.* Engage Grants Program with Industrial Partner, InterDigital Canada
2013-2014	NSERC	$137,474	*3D immersive projection infrastructure with full-body motion capture and analysis.* Research Tools and Instruments Grants
2012-2013	Mozilla	$50,000	*Real-Time Emergency Response.* Mozilla Ignite Development Challenge (in partnership with the National Science Foundation)
2012-2017	NSERC	$210,000	*Improved Shared Reality for Multi-Party, Multimodal Simulation and Interaction.* Discovery grant.
2012	Toyota	$30,000	*Haptic interaction with an augmented steering wheel.* Toyota Infotechnology Centre
2011	HP	$60,950	*Capturing attention via spatialized audio cues.* HP Labs Innovation Research Program (IRP)
2011	NSERC	$25,000	*Improved Parallax Barrier Autostereoscopic Display Software.* Engage Grants Program with Industrial Partner, Holoptick Technologies Inc.

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Date	Source	Amount	Title/Description
2010-2011	Google	$50,000	*A Spatialized Audio Map System for Mobile Blind Users.* Google Faculty Research Awards.
2010-2011	Honda	$30,000	*Facial Expression Recognition for Machines.* Honda Research Institute.
2010	UVic	$8,000	*NEPTUNE Pleora streamer.* University of Victoria software license
2008-2012	MDEIE	$367,195	*Natural Interactive Walking.* 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	*Un environment virtual pour la création de musique et de son à partir de systèmes chaotiques.* Support for International Research and Innovation Initiatives, Ministère du Développement économique, de l'Innovation et de l'Exportation.
2006-2009	NSERC	$317,785	*A pervasive multi-user augmented space for mobile immersive interaction with sound and music.* (additional funding for artist collaborator received from Canada Council for the Arts) New Media Initative STPGP 337999-06.
2006-2011	NSERC	$100,000	*Enhanced video for shared reality environments.* Discovery grant.
2004-2006	NSERC	$136,600	*Soundscape performance works via interactive environment for immersive audiovisual scene generation.* (additional funding for artist collaborator received from Canada Council for the Arts) New Media Initative NMIPJ 307934-04.
2002-2006	NSERC	$100,000	*Shared Reality Interaction over High Bandwidth Connectivity.* Discovery grant.
2000	LUB	$100,000	*Distributed Visualization Environment.* Laboratoire universitaire Bell Equipment Grant.
1999-2000	Petro-Canada	$20,500	*Interactive Web Tools for Critique of Presentation Skills and Evaluation of Student Learning.* Young Innovator Award.
1999-2002	FCAR	$45,000	*Augmenting an Electronic Classroom for Improved Instructor-Student Interaction.* New Researchers Award.
1999	FCAR	$15,700	*Augmenting an Electronic Classroom for Improved Instructor-Student Interaction.* Equipment Grant.
1999	AES	$25,000	*Multichannel audio over Internet.* Audio Engineering Society.

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Date	**Source**	**Amount**	**Title/Description**
1999	OSC	$15,000	*Timespace Exhibit.* Ontario Science Center contract.
1999	MFM	$10,000	*Intelligent Classroom tools.* McGill Faculty of Management.
1998-2002	NSERC	$76,000	*Reactive Hospital Environment.* Discovery research grant.
1998	FGSR	$20,000	McGill Graduate Studies and Research Development Fund

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Team Research Grants and Contracts

(Percentages refer to my portion.)

Date	Source	Amount	Title/Description
2023	Mitacs	$150,000 (75%)	*Avatar Care Provider for Seniors Residences* Mitacs Accelerate (with K. Moffatt)
2022-2025	CRIAQ	$800,000 (25%)	†NSERC Alliance with Consortium for Aerospace Research and Innovation of Québec (CRIAQ) *ADvanced Airspace Usability (ADAIR)* (with P. Doyon-Poulin (Poltechnique), Joon Chung (Ryerson), and 6 aerospace industrial partners)
2020-2021	CIRMMT	$1,500	*Agile Seed Funding for *Conveying paralinguistic cues and context while teleconferencing* (with students David Marino, Max Henry and Pascal Fortin)
2017-2018	SSHRC	$199,680 (10%)	†*Real time impact signalling and collective goods* Partnership Development Grant (with R. Janda and 6 co-investigators)
2016-2017	NAKFI	$100,000 (20%)	*Empathy Mirror* 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%)	†*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* Recherche en équipes (with M. Otis and 6 co-applicants)
2014	Mozilla	$20,000 (90%)	**Augmented Reality Tools for Improved Training of First Responders* Mozilla Gigabit Community Fund (with R. Dearden)
2011	CIRMMT	$10,000 (90%)	**Acoustic Sculptures* CIRMMT Strategic Innovation Fund Award (with A. Olmos and 3 others)
2010-2011	NSERC	$49,815 (90%)	**Novel Portable Treatment Device for Lazy Eye* Idea to Innovation (I2I) Booster (Phase Ib) (with R. Hess)
2009-2011	MSG	$200,000 (80%)	**Location-Based Spatialized Audio Interaction for the Blind and Visually Impaired* 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. Wozniewski and Z. Settel)
2010-2014	CHRP	$327,000 (?%)	*Computational and statistical tools for image guided neurosurgery of brain tumors* NSERC Collaborative Health Research Projects (with L. Collins and 7 others)

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Date	Source	Amount	Title/Description
2009-2010	CCSIP	$48,000 (4%)	**Digitally Merged Environments* California-Canada Strategic Initiatives Program (with S. Brown, UCSD and 20 co-applicants)
2009-2011	Canarie	$927,648 (40%)	*†Open Orchestra* Network-Enabled Platforms 2 (with J. Roston and W. Woszczyk)
2010-2014	NCE	$23,000,000 (2%)	*†GRAND: Graphics, Animation and New Media* Networks of Centres of Excellence (With K. Booth and 49 others)
2009	DND	$47,500	*†Video-Based Facial Recognition–Algorithm and Demonstration* Department of National Defence Contract (with M. Levine)
2008-2009	NSERC	$120,250 (90%)	**Novel Portable Treatment Device for Lazy Eye* Idea to Innovation (I2I) (with R. Hess)
2008-2010	Canarie	$1,397,758 (7%)	*NEPTUNE: A Platform to Create and Support Ocean Science Virtual Organizations* Network-Enabled Platforms (with B. Pirenne and J. Roston)
2008-2010	Canarie	$2,000,000 (18%)	*Health Services Virtual Organization* Network-Enabled Platforms (with R. Ellaway and 8 others)
2008-2010	NSERC	$196,000 (50%)	**3-D Visualization and gestural interaction with multimodal neurological data* Strategic Projects (with 5 others)
2006-2009	FRQNT	$146,550 (50%)	**Unités agenceables: Reseau d'Environnements Immersifs pour Collaboration à Distance* Recherche en équipes (with X.-W. Sha)
2005-2006	Canarie	$825,000 (50%)	*Undersea Window–High Definition Video Online* Intelligent Infrastructure Program. (with J. Roston)
2005-2006	SAT	$1,276,000 (1%)	*TOT2: Nouveau Territoires de la Création-Diffusion en Réseau* Heritage Canada New Media Research. (M. Savoie, PI)
2004-2006	Canarie	$568,971 (33%)	*Shared Spaces – High Definition Ultra-Videoconferencing* Advanced Applications Program. (with J. Roston)
2003-2004	SAT	$792,082 (1%)	*TOT1: Nouveau Territoires de la Création-Diffusion en Réseau* Heritage Canada New Media Research. (M. Savoie, PI)
2002-2005	IRIS	$573,000 (25%)	**Parallel Distributed Camera Arrays for Intelligent Environments* (with J. Clark, S. Fels, R. Vertegaal)
2002-2005	VRQ	$2,180,000 (20%)	*Real-time Communication Of High-res. Multi-sensory Content via Broadband Networks.* Valorisation-Recherche Quebec (with W. Woszczyk and others)
2001-2002	Canarie	$391,000 (30%)	*Remote Video Sign-Language Interpreting.* Advanced Networking Apps. Services & Technologies. (with J. Roston and others)

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Date	**Source**	**Amount**	**Title/Description**
2000-2002	Canarie	$808,000 (35%)	*McGill Advanced Learnware Project.* Advanced Networking Applications Services and Technologies. (with B. Pennycook)
2000-2003	LUB	$150,000 (50%)	**Distributed Shared Visualization Environment.* Laboratoire universitaire Bell. (with B. Ozell)
2000-2001	Royal Bank	$2,000 (80%)	**Improving Teaching through an Interactive Critiquing System.* Teaching Improvement Fund Award. (with R. Harris and J. Blatter)
1999-2002	CFI	$400,000 (50%)	†*The Shared Reality Environment.* New Opportunities Award. (with J. Clark)
1999-2000	Royal Bank	$10,000 (80%)	**Interactive Web Tools for Critique of Presentation Skills and Evaluation of Student Learning.* TIF (with R. Harris)

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

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Centre Research Grants

Date	Source	Amount	Title/Description
2022-2026	IILS	$400,000	FRQNT International Institute on Learning Systems, funded jointly by CNRS (France) and FRQNT (Quebec), Pablo Piantanida, PI, $100,000 per annum
2019-2025	FRQNT	$2,160,000	Regroupement Stratégique pour *Systémes cyberphysiques et intelligence machine matérialisée (REPARTI).* (with C. Gosselin and 49 others) $480,000 per annum.
2015	CFI	$4,366,723	Innovation Fund: *Live Expression "in situ": Musical and Audiovisual Performance and Reception* (with M. Wanderley and 9 others)
2014-2020	FRQSC/ FRQNT	$1,800,000	Regroupement Stratégique: *Centre Interdisciplinaire de Recherche en Musique, Médias et Technologie.* (with M. Wanderley and 23 others)
2013-2019	FRQNT	$2,160,000	Regroupement Stratégique pour *l'Étude des Environnements PARTagés Intelligents répartis (REPARTI).* (with D. Laurendeau and 34 others) $359,943 per annum.
2008-2014	FRQSC/ FRQNT	$1,800,000	Regroupement Stratégique: *Centre Interdisciplinaire de Recherche en Musique, Médias et Technologie.* (with S. McAdams and 23 others)
2007-2009	NSERC	$57,630	Major Resources Support: *Centre for Interdisciplinary Research in Music Media and Technology (CIRMMT).* (with S. McAdams and 8 others)
2006-2013	FRQNT	$1,530,000	Regroupement Stratégique pour *l'Étude des Environnements PARTagés Intelligents répartis (REPARTI).* (with D. Laurendeau and 23 others) $100,000 per annum allocated to CIM.
2002-2005	FCAR	$720,000	Regroupement Stratégique: *Réseau Québecois de Recherche en Réalité Artificiellle Distribuée (QUERRAnet).* (with F. Ferrie, R. Bergevin, P. Cohen, and others)
2001	CFI	$6,500,000	Major Facilities Award: *Centre for Integrated Research in Music Media and Technology.* (with W. Woszczyk and 11 others)
2000-2002	FCAR	$113,500	Centre de Recherches. (with F. Ferrie and 17 others)
2000	NSERC	$275,000	*Information Systems in Support of Intelligent Machine Research.* (with F. Ferrie and 17 others)

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Teaching

Courses Taught

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

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

*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*.

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Undergraduate Supervision

ECE Honors Undergraduate Projects (2 semesters)

Name	Year	Research topic
Bu, Bruce	2020	360^o 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
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

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Name	**Year**	**Research topic**
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
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^o imaging for navigation assistance
Johansen, Anthony	2020-2021	360^o imaging for navigation assistance
Gurkan, Mert	2020-2021	360^o imaging for navigation assistance
Warsi, Osman	2020-2021	360^o 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^o camera scene understanding
Ritch, David	2019	360^o camera scene understanding
Lam, Guillaume	2019	360^o camera scene understanding
Nasseem, Veronica	2019	360^o camera scene understanding
Amjad, Adeeb Ibne	2019	360^o camera supported intersection-crossing
Amarouche, Hakim	2019	360^o camera supported intersection-crossing
Tang, James	2019	360^o camera supported intersection-crossing
Commodari, Stefano	2019	360^o 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

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Name	**Year**	**Research topic**
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
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, Ghalia	2013–2014	Walking Straight
Redel, Josh	2012	Augmented Meeting Collaboration
Savchenko, Eugene	2010	3D interaction

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ECE Undergraduate Design Projects (1 semester)

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

*Co-supervised with James Clark
†Co-supervised with Paul Kry

Computer Science Undergraduate Projects (1 semesters)

Nejad, Namdar	2022	Utilizing Context to Improve Accessible Representations of Web Graphics
Li, Dailun	2022	Training and Testing an Open-Source French TTS Model

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

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Undergraduate Internships

Name	Year	Research project
Li, Hanzi	2022	(CS Intern) Internet Multimodal Access to Graphical Exploration (IMAGE)
Gutiérrez, Diego Macias	(Mitacs Globalink) Haptic dance shoes	
Cortes, Dafne Peña	(Mitacs Globalink) 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)
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^o 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

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Name	**Year**	**Research project**
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
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
Pavlasek, 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

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Name	**Year**	**Research project**
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
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

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Name	**Year**	**Research project**
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

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Service

University Service

Department Committees

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
2015-2022	Safety Committee (Chair in 2015-2017)
2014-2016	Grant Application Support Committee
2012-2022	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 Comittee
2001-2004	Information Technologies & Undergraduate Lab
2000-2002	Curriculum Committee
2000	Software Engineering subcommittee
2000-2007	Undergraduate Student Advisor

Other University Service

2014-2016	Elected Member of Council, McGill Association of University Teachers
2009-2013	Member, 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

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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

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

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Editorial Service

2021-ongoing	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	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

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

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Conference Review

2020	IEEE Virtual Reality
2018, 2020	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

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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

Consumer 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-present	created and maintained passenger rights website

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