

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

AMAZON.COM, INC.,
AMAZON.COM SERVICES LLC,
AMAZON WEB SERVICES, INC., and
TWITCH INTERACTIVE, INC.
Petitioner

v.

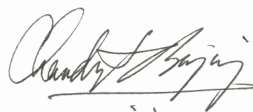
NL GIKEN INC.
Patent Owner

Inter Partes Review No.: IPR2024-01161

**DECLARATION OF DR. CHANDRAJIT BAJAJ
REGARDING CLAIMS 1-16
OF U.S. PATENT NO. 9,319,615**

I hereby declare under penalty of perjury under the laws of the United States of America that the following is true and correct, and that all statements made of my own knowledge are true and that all statements made on information and belief are believed to be true. I understand that willful false statements are punishable by fine or imprisonment or both under Section 1001 of Title 18 of the United States Code.

Date: __August 12, 2024__



Dr. Chandrajit Bajaj

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Exhibit No.	Description
1001	U.S. Patent No. 9,319,615 (the “ 615 patent ”)
1002	RESERVED
1003	File History of U.S. Patent No. 9,319,615
1004	U.S. Patent Publication No. 2004/0231003 (“ Cooper ”)
1005	U.S. Patent Publication No. 2001/005951 (“ Slotznick ”)
1006	U.S. Patent No. 4,754,268 (“ Mori ”).
1007	U.S. Patent No. 7,484,234 (“ Heaton ”).
1008	U.S. Patent App. Pub. No. 2002/0078442 (“ Reyes ”).
1009	U.S. Patent App. Pub. No. 2005/0160465 (“ Walker ”).
1010	RESERVED
1011	<i>NL Giken Inc. v. Amazon.com, Inc.</i> , 1:24-cv-00028, Dkt. 32 (D. Del. Jun. 18, 2024) (Scheduling Order).
1012	Douglas Blanks Hindman & Kenneth Wiegand, <i>The Big Three’s Prime-Time Decline: A Technological and Social Context</i> , Journal of Broadcasting & Electronic Media, 119 (March 2008).
1013	<i>NL Giken Inc. v. Amazon.com, Inc.</i> , 1:24-cv-00028, Dkt. 19-2 (D. Del. Mar. 18, 2024) (Amended Complaint Exhibit G).
1014	Lisa Moskowitz, <i>AOL 4.0: You’ve got tips</i> , June 23, 1998, CNN.com, http://www.cnn.com/TECH/computing/9806/23/aol.tips.idg/index.html (last visited Aug. 12, 2024) (“ CNN-AOL Article ”).
1015	U.S. Patent App. Pub. No. 2005/0021609 (“ Houghton ”).
1016	European Patent App. No. EP1120703 (“ Scott ”).
1017	U.S. Patent App. Pub. No. 2005/0130613 (“ Kutsuna ”).

CHART OF CLAIMS
[1.pre] A television set system comprising:
[1.a] a television function unit;
[1.b] a display arranged to display a broadcast program in accordance with the television function unit;
[1.c] a receiver arranged to receive, without request or acknowledgement, information of one definite broadcast program which can be displayed on the display and is identified by a channel selection of another television set in another place; and
[1.d] a manual controller arranged to change the display in response to a predetermined same manual operation from own motive of a viewer of the display on the basis of the information received by the receiver, the predetermined same manual operation from own motive having no influence on the channel selection of the another television set, but having influence solely on the change in the display of the own television set into the one definite broadcast program identified by the channel selection of the another television set with the information received by the receiver,
[1.e] wherein the information includes information of a broadcast program which is currently not displayed on the display, but can be displayed by a channel change, and
[1.f] wherein the manual controller is arranged to instantly carry out replacement of the currently displayed broadcast program with the one definite broadcast program identified by the channel selection of the another television set in response to the predetermined same manual operation, the same manual operation being universal regardless of the information and without any channel selecting operation,
[1.g] whereby same experience as that of a viewer of the another television set is possible from own motive of the viewer by means of the manual controller.
[2] The television set system according to claim 1, wherein the channel information of the another television set is converted into its own local channel number if it differs from that of the local channel number in an area where the another television set is located.
[3.pre] The television set system according to claim 1, wherein the manual controller is a remote controller including:

CHART OF CLAIMS
[3.a] an operating part including a plurality of keys each of which are assigned to predetermined functions, respectively, the plurality of keys including a predetermined key for replacing the currently displayed broadcast program by the one definite broadcast program identified by the channel selection of the another television set; and
[3.b] a signal transmitter arranged to transmit a control signal to the television function unit in response to the operation of the predetermined key in the operating part.
[4.pre] A broadcast program viewing system for viewing a broadcast program same as that identified by a program selection of another broadcast program viewing system in another place to share same experience of viewing same broadcast program, comprising:
[4.a] a display arranged to display a broadcast program;
[4.b.i] a receiver arranged to receive, without request or acknowledgement, information of one definite broadcast program which can be displayed on the display and is identified by the program selection of the another broadcast program viewing system,
[4.b.ii] the information including information of a broadcast program which is not currently not displayed on the display, but can be displayed by a channel change; and
[4.c.i] wherein the manual controller is arranged to instantly carry out replacement of the currently displayed broadcast program with the one definite broadcast program identified by the program selection of the another broadcast program viewing system in response to the same manual operation at the predetermined operating portion, the same manual operation being universal regardless of the information and without any program selecting operation.
[4.c.i] wherein the manual controller is arranged to instantly carry out replacement of the currently displayed broadcast program with the one definite broadcast program identified by the program selection of the another broadcast program viewing system in response to the same manual operation at the predetermined operating portion, the same manual operation being universal regardless of the information and without any program selecting operation.
[5] The broadcast program viewing system according to claim 4, wherein the broadcast program is television program transmitted from a broadcast station,

CHART OF CLAIMS
and wherein the program selection of the another broadcast program viewing system is a channel selection to identify a broadcast station.
[6] The broadcast program viewing system according to claim 4, wherein the broadcast program is television program data to be downloaded from a server station, and wherein the program selection of the another broadcast program viewing system is a code setting to download the selected broadcast program.
[7.pre] The broadcast program viewing system according to claim 4, wherein the manual controller is a remote controller including:
[7.a] an operating part including a plurality of operating portions each of which are assigned to predetermined functions, respectively, the plurality of operating portions including the predetermined operating portion; and
[7.b] a signal transmitter arranged to transmit a control signal to the display in response to the operation at the predetermined operating portion.
[8.pre] In a broadcast program viewing system for viewing a broadcast program same as that identified by a program selection of another broadcast program viewing system in another place in accordance with information of one definite broadcast program which can be viewed by the broadcast program viewing system and is identified by the program selection of the another broadcast program viewing system to share same experience of viewing same broadcast program, a remote controller comprising:
[8.a] a manual operating part including a plurality of manual operating portions each of which are assigned to predetermined functions, respectively, the plurality of operating portions including a predetermined operating portion to generate, in response to a same manual operation from own motive of a viewer, a control signal for carrying out replacement of a currently viewed broadcast program with the one definite broadcast program identified by the program selection of the another broadcast program viewing system, the same manual operation being universal regardless of the information and without any program selecting operation; and
[8.b.i] a signal transmitter arranged to wirelessly transmit the control signal in response to the same manual operation from own motive of the viewer at the predetermined operating portion to instantly carry out the replacement of the currently viewed broadcast program with the one definite broadcast program identified by the program selection of the another broadcast program viewing system

CHART OF CLAIMS

[8.b.ii] wherein the same manual operation from own motive having no influence on the program selection of the another broadcast program viewing system, but having influence solely on the replacement of the broadcast program of the own broadcast program viewing system into the one definite broadcast program identified by the program selection of the another broadcast program viewing system in accordance with the information,

[8.c] wherein the information includes information of a broadcast program which is not currently viewed, but can be viewed by a channel change, the information being without request or acknowledgement from the another broadcast program viewing system.

[9] The remote controller according to claim 8 further comprising a display.

[10] The remote controller according to claim 9, wherein the manual operating portions of the manual operating part include a phone call key.

[11] The remote controller according to claim 10, wherein the manual operating portions of the manual operating part include ten key.

[12] The remote controller according to claim 11 further comprising a speaker.

[13] The remote controller according to claim 12 further comprising a microphone.

[14] The remote controller according to claim 13, wherein the manual operating portions of the manual operating part include a menu key.

[15] The remote controller according to claim 13, wherein the manual operating portions of the manual operating part include a scroll key.

[16] The remote controller according to claim 13, wherein the manual operating portions of the manual operating part include a push-down operation key.

I, Chandrajit Bajaj, Ph.D., declare as follows:

1. My name is Chandrajit Bajaj, and I have been retained by counsel for Amazon.com Inc., Amazon.com Services LLC, Amazon Web Services, Inc., and Twitch Interactive, Inc. (collectively, “Petitioner”) to analyze U.S. Patent No. 9,319,615 (“’615 patent”) and to provide my opinions regarding the patentability of claims 1-16 of the ’615 patent.

2. I am being compensated at my normal consulting rate of \$725 per hour for my time. My compensation is not contingent on the outcome of this proceeding or of any proceedings relating to the ’615 patent.

I. BACKGROUND AND QUALIFICATIONS

A. Qualifications

3. The details of my education, work experience, research, patents, and publications are summarized in my curriculum vitae (“CV”), submitted as Appendix 1. I provide here a summary of some of the relevant information from my CV, as well as other relevant background information.

4. I am currently employed as a professor of computer science at the University of Texas at Austin. I hold the computational applied mathematics endowed Chair in Visualization. I am also the director of the Computational Visualization Center at UT Austin, which has been funded by the National Institutes of Health, the National Science Foundation, the Department of Energy,

and the Department of Defense. The center personnel include twelve researchers, scientists, post-graduate students, and staff.

5. I have a Bachelor of Technology degree in electrical engineering, which I obtained from the Indian Institute of Technology in Delhi (“IITD”) in 1980. I also have a Master of Science degree and a Doctorate in Computer Science from Cornell University, which I obtained in 1983 and 1984, respectively.

6. Prior to my employment at UT Austin, I was an assistant professor, then associate professor, and finally professor of computer sciences at Purdue University from 1984 until I resigned in 1997 and transferred to UT Austin. During this time, I was also the director of the Image Analysis and Visualization Center at Purdue. I was a visiting associate professor at Cornell from 1990-1991, and a visiting professor at University of California, San Diego Fall 2005 and University of Tokyo Spring 2006. I have also been invited for collaborative visits by several academic institutions and have presented numerous keynote presentations worldwide. I have been an editorial member of the SIAM Journal on Imaging Sciences, the ACM Transactions on Graphics, and continue my editorial role for ACM Computing Surveys. I’m also on the Editorial advisory board for the Journal of Graphical Models and Journal of Visualization.

7. I have spent the better part of my career, both at Purdue and UT Austin researching, designing, teaching, and using computer systems to:

(1) process and share audio, image, and video data streams; (2) model, simulate, optimize, and visualize natural and synthetic phenomena; and (3) combine computational imaging, geometry graphics processing, and machine learning. I am knowledgeable about and have continuously engaged in the development of hardware and software—including streaming, distributed and parallel data analysis algorithms over various sensor and computer networked environments.

8. In the 1970s, while majoring in electrical engineering at IITD with a minor in computer sciences, I was intimately involved in the design and fabrication of microprocessor-controlled circuits, including the development of microprocessor controller software. In the 1980s, while at Cornell, these past experiences led to graduate research in various signal and data processing, and a Ph.D. thesis in combinatorial and geometric optimization. In the early 1990s, I created three-dimensional collaborative multimedia networked environments that were fully navigable for multi-person computer communication, interaction, gaming, and simulation. In 1994, I co-authored several technical papers on such collaborative networked environments, including “SHASTRA - An Architecture for Development of Collaborative Applications,” *International Journal of Intelligent and Cooperative Information Systems*, 3(2):155-166,” and “Shastra: Multimedia Collaborative Design Environments,” *IEEE MultiMedia*, Vol. 1, No. 2, 39-49 (1994). The need for increasing interactivity without sacrificing interactivity

led me also to explore image processing and geometric modeling techniques such as surface reconstruction from computed tomography (“CT”) scans, point clouds, and texture mapping with data compression, such as described in my publications (“Multi-Component Heart Reconstruction from Volumetric Imaging,” *SPM '08: Proc. of ACM Symposium on Solid and Physical Modeling*, Stony Brook, NY, 193-202 (2008); “3D RGB Image Compression for Interactive Applications,” *ACM Transactions on Graphics*, Vol. 20, No. 1, 10-38 (2001); “Automatic Reconstruction of Surfaces and Scalar Fields from 3D Scans,” *SIGGRAPH '95: Proc. of ACM on Computer Graphics and Interactive Techniques*, 109-118 (1995)).

9. In the mid-2000s, I began to create 3D spatially-realistic computer graphics virtual environments of the nano-world. These virtual reality (VR) environments were populated with reconstructed models of interacting molecules and cells using a combination of different types of microscopy imagery, allowing a user to visually explore, interact, query, and learn form and function. My publication titled “From Voxel Maps to Models,” that appeared in an Oxford University Press book titled *Imaging Life: Biological Systems from Atoms to Tissues*, c. 15 (Gary C. Howard, William E. Brown & Manfred Auer eds.) (2014), is an example of my research in computational imaging and interrogative visualization. Over the course of my career, I have participated in the design and use of several computer systems, spanning handhelds, laptops, and graphics

workstations to PC/Linux clusters, as well as very large memory supercomputers for capturing, modeling, and displaying virtual and scientific phenomena. My experience with multimedia, compression, geometric design, computer modeling, imaging, interactive computer graphics, and scientific visualization encompasses the use of interactive technologies, such as 3D CAD systems, smart IR touch-screens (“world’s largest IPAD”), motion detection and gesture-based user interfaces, and multi-display walls, in many different fields, such as interactive games, healthcare (e.g., molecular, biomedical, and industrial diagnostics), oil and gas exploration, geology, cosmology, and military industries.

10. During this time at UT Austin, I also designed and implemented scalable solutions for inverse problems in various imaging and sensing modalities, as part of statistical search/scoring engines for various quantities of interest with uncertainty quantification. My ongoing research at UT Austin focuses on the computational mathematics foundations of statistical and dynamic machine learning, decision making—with learned dynamical systems for predictions—forecasting, and exploratory visualization. These deep and reinforcement learning AI algorithms are trained to discover new materials and emergent properties from collections, spanning computational biology, chemistry, physics, and the medical sciences, with applications in neuro-morphic and quantum computing. Complementing my research, I also teach an undergraduate course titled

“Geometric Foundations of Data Sciences” and a graduate course titled “Predictive Machine Learning.”

11. Additionally, I have courtesy appointments and supervise undergraduates, M.S., Ph.D., and post-doctoral students from several UT Austin departments, including electrical engineering, computer science, neuroscience, and mathematics departments. I currently serve on the editorial boards for the Journal in Visualization and ACM Computing Surveys. Additional details are listed in my CV. For example, I have authored approximately 170 peer-reviewed journal articles, 35 book chapters (which were also peer reviewed), and 163 peer-reviewed conference publications. I have written and edited four books on topics ranging from image processing, geometric modeling, and visualization techniques to algebraic geometry and its applications. I have given 227 invited speaker keynote, plenary, and seminar presentations. I am a fellow of the American Association for the Advancement of Science, a Fellow of the Institute of Electrical and Electronics Engineers (IEEE), a Fellow of the Society of Industrial and Applied Mathematics (SIAM), and also a Fellow of the Association of Computing Machinery (also known as ACM), which is the world’s largest education and scientific computing society. The Fellow member grade recognizes the top 1 - 2 % of members who have made outstanding contributions to the respective fields.

B. Technology Background

12. The technology of television has evolved since its early days using a mechanical system invented by Paul Nipkow in 1884. Televisions (TVs) rapidly became the most important form of communication and entertainment, a window on the world, requiring of the viewer only to switch to the right channel, at the right time, or for the non-discriminating viewer, to switch and experience simultaneous viewing of multiple channels (as in picture-in-picture) or elevate the viewer's gaming experience to new heights, offering crisp, high-resolution computer graphics and smooth animation. It was inevitable that the digital computer would be integrated with televisions as the programmable computer's ability to receive, process, and creatively depict information benefits from the display of text, color, motion, and sound that television offered. Television viewers similarly and increasingly benefitted from the personalized control and communication that is promised by integrated computer and television systems, with the ability to connect various input devices (e.g. mouse, joystick, trackball, keyboard) through USB and HDMI ports. Many possessed set-top boxes (STB), which provide such I/O ports as well. A STB is also known as a cable box receiver that generally contains a TV tuner input, and computer and electronic components, that turns the source signal into video content enhanced with computer graphics user menus or web-pages in a form that can then be displayed on the television

screen or other video display device. STBs are used in cable television, satellite television, over-the-air television and/or Internet Protocol Television systems (IPTV). Other uses of STBs included digital media players. Additionally, control and selection of all TV systems is typically provided by TV remotes that use a variety of technologies, including infrared (IR) light, radio frequency (RF), and LCD touch screens housed in a wireless device.

13. Transmission and reception involve the components of a television system that generate, transmit, and utilize the composite television signal, transmitted over the air or over a cable network. The picture signal generated as described above can be conveyed over short distances by wire or cable in unaltered form, but for broadcast over the air or transmission over cable networks it must be shifted to appropriately higher frequency channels. Such frequency shifting is accomplished in the transmitter, which essentially performs generation and modulation of very high frequency (VHF) or ultrahigh frequency (UHF) carrier signals for video and sound. After passing through a receiving antenna or cable input at the television receiver, they are shifted back to their original frequencies and applied to the receiver's display and speakers. When the band of frequencies in the picture signal is combined with the high-frequency broadcast carrier signal in the modulator of the transmitter, two bands of frequencies are produced above and below the carrier frequency. These are known as the upper and lower side bands,

respectively. The side bands are identical in frequency content; that is, both carry the complete picture signal information. One of the side bands is therefore superfluous and, if transmitted, would wastefully consume space in the broadcast spectrum. Therefore, the major portion of one of the side bands (that occupy frequencies below the carrier) is removed by a wave filter, and the other side band (occupying frequencies above the carrier) is transmitted in full. Complete removal of the superfluous side band is possible, but this would complicate receiver design; hence, a vestige of the unwanted side band is retained to serve the overall economy of the system. This technique is known as vestigial side-band transmission. It is universally employed in the television broadcasting systems of the world. In addition, the carrier for the sound transmission and its side bands is included within the channel. Since the band of frequencies needed to convey the sound is much narrower than that needed for the picture, it is feasible to include both sound-carrier side bands. To avoid mutual interference between sound and picture, the picture and sound side bands must not overlap. Moreover, some space must be allowed at the edge of the channel to avoid interference with the transmissions of stations occupying adjacent channels. These requirements are met in color television channels of the NTSC, PAL, and SECAM. In the United States, about two-thirds of homes obtain their broadcast television over coaxial cable systems. Coaxial cable has a bandwidth capable of carrying a hundred six-megahertz

television channels, but the signals decay quickly with distance. Hence, amplifiers are required periodically to boost the signals. Backbone trunks in a local cable network frequently use optical fiber to minimize noise and eliminate the need for amplifiers. Optical fiber has considerably more capacity than coaxial cable and allows more programs to be carried.

14. The receiver electronics housed in television systems contain input multi-frequency amplifiers designed for low noise amplification, amongst other circuitry and chips, and a channel-switching mechanism (the tuner). The tuner of the receiver connects the input amplifier to one of several individual circuits, each circuit tuned to its respective channel. The amplifier magnifies the signals of the incoming video and sound carriers and their side bands in the desired channel by about 10 times, and it discriminates by a similar amount against the transmissions of stations on other channels. From the tuner amplifier, the signals are passed to a superheterodyne mixer that transposes the frequencies of the sound and picture carriers to values better suited to subsequent amplification processes. The transposed frequencies, known as intermediate frequencies, remain the same no matter what channel the receiver is tuned to. In typical receivers, they are located in the band from 41 to 47 megahertz. Since the tuning of the intermediate-frequency amplifiers need not be changed as the channel is switched, they can be adjusted for maximum performance in this frequency range. In a digital television

receiver, the tuner contains chips that allow for either satellite signals (from the LNB for Sky or Freesat) or antenna signals for a Freeview receiver to be selected and then decoded to a stream of digital signals. Out of this stream you can select the single program that you want to watch by using the PID (program identity) number that is broadcast with the signal. Selecting the appropriate PID provides the digital signals for one particular program. Because cable transmissions are not available outside cities, no receivers are currently provided with cable reception. Once this digital stream has been selected, the coding actions are reversed so that the original signals can be retrieved. These signals are convertible to analog for use in the conventional audio and video sections of the receiver.

15. Receivers are commonly provided with manual controls for adjustment of the picture by the viewer. These controls are (1) the channel switch, which connects the required circuits to the radio-frequency amplifier and superheterodyne mixer to amplify and convert the sound and picture carriers of the desired channel; (2) a fine-tuning control, which precisely adjusts the superheterodyne mixer so that the response of the tuner is exactly centered on the channel in use; (3) a contrast control, which adjusts the voltage level reached by the picture signal in the video amplifiers, producing a picture having more or less contrast (greater or less range between the blacks and whites of the image); (4) a brightness control, which adjusts the average amount of current taken by the

picture tube from the high-voltage power supply, thus varying the overall brightness of the picture; (5) a horizontal-hold control, which adjusts the horizontal deflection generator so that it conforms exactly to the control of the horizontal synchronizing impulse signals; (6) a vertical-hold control, which performs the same function for the vertical deflection generator; (7) a hue (or “tint”) control, which shifts all the hues in the reproduced image or picture; and (8) a saturation (or “color”) control, which adjusts the magnitudes of the color-difference signals. An enhancement in televisions since the 1960s was a single touch-button control that sets the fine tuning and also adjusts the hue, saturation, contrast, and brightness to preset ranges. These automatic adjustments override the settings of the corresponding separate controls, which then function over narrow ranges only. Such refinements permit reception of acceptable quality by viewers who might otherwise be confused by the many maladjustments possible when ordinary manual controls are used. Most TV remote controls employ infrared radiations to send signals to the receiver. There are newer technologies that utilize RF (radio frequencies) and Bluetooth. These remote-control technologies have progressed from earlier models of the 1950s and ’60s that used electric wire, visible light, or ultrasound to control the power, channel selection, and audio volume. Today’s television sets have very few buttons; instead, their features are controlled through on-screen displays of parameters that are adjusted by wireless remote control and

some have a luminescent LCD screen that can be operated by touch. The app for mobile phones and tablets mimics the functions of a wireless mouse, keyboard, and touchpad, and also offers specialized TV remote control panels. The TV remote apps being designed for one-handed use and intuitive user selection operations.

C. Materials Considered

16. In preparing this declaration, I have reviewed and/or considered at least the documents cited in the List of Exhibits, and the documents referenced in this declaration. I have also reviewed the entire prosecution history of the '615 Patent.

II. LEGAL STANDARDS

A. Legal Standards for Prior Art

17. I understand that a patent or other publication must first qualify as prior art before it can be used to invalidate a patent claim.

18. I understand that a U.S. or foreign patent qualifies as prior art to an asserted patent if the date of issuance of the patent is prior to the invention of the asserted patent. I further understand that a printed publication, such as an article published in a magazine or trade publication, qualifies as prior art to an asserted patent if the date of publication is prior to the invention of the asserted patent.

19. I understand that a U.S. or foreign patent also qualifies as prior art to an asserted patent if the date of issuance of the patent is more than one year before

the filing date of the asserted patent. I further understand that a printed publication, such as an article published in a magazine or trade publication, constitutes prior art to an asserted patent if the publication occurs more than one year before the filing date of the asserted patent.

20. I understand that a U.S. patent qualifies as prior art to the asserted patent if the application for that patent was filed in the United States before the invention of the asserted patent.

B. Legal Standards for Anticipation

21. I understand that documents and materials that qualify as prior art can be used to invalidate a patent claim via anticipation or obviousness.

22. I understand that, once the claims of a patent have been properly construed, the second step in determining anticipation of a patent claim requires a comparison of the properly construed claim language to the prior art on a limitation-by-limitation basis.

23. I understand that a prior art reference “anticipates” an asserted claim, and thus renders the claim invalid, if all elements of the claim are disclosed in that prior art reference, either explicitly or inherently (i.e., necessarily present).

24. I understand that anticipation in an *inter partes* review must be shown by a preponderance of the evidence.

C. Legal Standards for Obviousness

25. I understand that even if a patent is not anticipated, it is still invalid if the differences between the claimed subject matter and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person of ordinary skill in the pertinent art.

26. I understand that a person of ordinary skill in the art provides a reference point from which the prior art and claimed invention should be viewed. This reference point prevents one from using his or her own insight or hindsight in deciding whether a claim is obvious.

27. I also understand that an obviousness determination includes the consideration of various factors such as (1) the scope and content of the prior art, (2) the differences between the prior art and the asserted claims, (3) the level of ordinary skill in the pertinent art, and (4) the existence of secondary considerations such as commercial success, long-felt but unresolved needs, failure of others, etc.

28. I understand that an obviousness evaluation can be based on a combination of multiple prior art references. I understand that the prior art references themselves may provide a suggestion, motivation, or reason to combine, but other times the nexus linking two or more prior art references is simple common sense. I further understand that obviousness analysis recognizes that market demand, rather than scientific literature, often drives innovation, and that a

motivation to combine references may be supplied by the direction of the marketplace.

29. I understand that if a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill.

30. I also understand that practical and common-sense considerations should guide a proper obviousness analysis, because familiar items may have obvious uses beyond their primary purposes. I further understand that a person of ordinary skill in the art looking to overcome a problem will often be able to fit together the teachings of multiple publications. I understand that obviousness analysis therefore takes into account the inferences and creative steps that a person of ordinary skill in the art would employ under the circumstances.

31. I understand that a particular combination may be proven obvious merely by showing that it was obvious to try the combination. For example, 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 because the result is likely the product not of innovation but of ordinary skill and common sense.

32. The combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results. When a work is available in one field of endeavor, design incentives and other market forces can prompt variations of it, either in the same field or a different one. If a person of ordinary skill can implement a predictable variation, the patent claim is likely obvious.

33. It is further my understanding that a proper obviousness analysis focuses on what was known or obvious to a person of ordinary skill in the art, not just the patentee. Accordingly, I understand that any need or problem known in the field of endeavor at the time of invention and addressed by the patent can provide a reason for combining the elements in the manner claimed.

34. I understand that a proposed obviousness combination does not need to be the preferred, or most desirable, combination available, in order to render a claim obvious. Instead, there must be something that suggests the desirability of the proposed combination, not necessarily something that suggests that the proposed combination is the most desirable combination available.

35. Similarly, I understand that for purposes of obviousness, when a motivating benefit comes at the expense of another benefit, that does not nullify the proposed obviousness combination or modification. Likewise, a proposed

obviousness combination does not fail merely because it may be inferior to other systems used for the same use.

36. I also understand that a determination of obviousness based on teachings from multiple references does not require an actual, physical substitution of elements between the multiple references. Likewise, the test for obviousness is not whether the features of a secondary reference may be bodily incorporated into the structure of the primary reference. Instead, the test is whether a claim is rendered obvious by the teachings of the prior art as a whole.

37. I understand that a claim can be obvious in light of a single reference, without the need to combine references, if the elements of the claim that are not found explicitly or inherently in the reference can be supplied by the common sense of one of skill in the art.

38. I understand that secondary indicia of non-obviousness may include: (1) a long felt but unmet need in the prior art that was satisfied by the invention of the patent; (2) commercial success of processes covered by the patent; (3) unexpected results achieved by the invention; (4) praise of the invention by others skilled in the art; (5) taking of licenses under the patent by others; (6) deliberate copying of the invention; (7) failure of others to find a solution to the long felt need; and (8) skepticism by experts.

39. I also understand that there must be a relationship between any such secondary considerations and the invention. I further understand that contemporaneous and independent invention by others is a secondary consideration supporting an obviousness determination.

40. In sum, my understanding is that prior art teachings are properly combined where a person of ordinary skill in the art having the understanding and knowledge reflected in the prior art and motivated by the general problem facing the inventor, would have been led to make the combination of elements recited in the claims. Under this analysis, the prior art references themselves, or any need or problem known in the field of endeavor at the time of the invention, can provide a reason for combining the elements of multiple prior art references in the claimed manner.

41. I understand that obviousness in an *inter partes* review must be shown by a preponderance of the evidence.

III. THE '615 PATENT

A. Overview of the '615 Patent

42. The '615 patent issued from U.S. Patent Application No. 14/145,935, filed January 1, 2014, and claims foreign priority to Japanese Application No. 2006-106109, filed April 7, 2006. '615 patent EX1001, cover. I have been told to assume that the '615 patent's priority date is no earlier than April 7, 2006.

43. The '615 patent relates to “a television system, television set with communication function and a remote controller for an appliance, such as a television set.” '615 patent EX1001, 1:16-18. One of the objects of the invention is “to provide a television set which can transmit information to the outside for various purposes.” '615 patent EX1001, 1:50-52. For example, the '615 patent discloses a “television display [that] is automatically changed in response to the receipt of the information from a predetermined outside counterpart.” '615 patent EX1001, 2:65-3:1. Information that can be sent between television sets includes information indicating the program or network each television is currently displaying. '615 patent EX1001, 3:12-21. Based on this information, users can manually operate the TV system to cause an instantaneous change in what is currently displayed on their television set (*e.g.*, the channel, network, and program) to the programming their counterpart is watching. '615 patent EX1001, 3:31-38 (“the television set is so designed that the controller is arranged to make it possible to replace the broadcast program displayed in accordance with the television function unit by another broadcast program identified by the channel selection of the other television”). In this manner, the '615 patent’s system allows users to share “the same experience or to check the broadcast program which the other family is watching.” *Id.*

B. Overview of the '615 Patent's File History

44. During prosecution, the Examiner issued Office Actions rejecting the pending claims under 35 U.S.C. §102 and 35 U.S.C. §103. EX1003, 190-202, 160-174, 142-153, 115-130, 64-76. In response, Applicant amended the claims, adding the following limitations:

- “the predetermined same manual operation from own motive having no influence on the channel selection of the another television set, but having influence solely on the change in the display of the own television set into the broadcast program identified by the channel selection of the another television set with the information received by the receiver.” EX1003, 142-153, 176-185.
- “the same manual operation being universal.” EX1003, 102-112.
- the receipt by the receiver of information of one definite broadcast program is performed “without request or acknowledgement.” EX1003, 54-60.

45. Then, the Examiner issued an Advisory Action on July 24, 2015. EX1003, 49-52. The Examiner indicated that the amendment in response to the second final Office Action did not preclude or exclude the existing hand shake process between TVs. *Id.* (“[t]he ‘hand shake’ is the process of receiving the control signal from another TV conveying the channel that is presently being

viewed, to the receiver TV and is interpreted by the examiner as an existing process in the instant application claim language, and it is not clear that instant application has a way around it, or even if it can prevent it”). The Examiner made a suggested amendment to further prosecution. EX1003, 51 (“one TV without the request or acknowledgment from the other TV, sending its currently viewed channel to the other TV”). In response, the Applicant filed a request for continued examination to have the response to the second final Office Action entered. EX1003, 37-38. The Examiner issued a Notice of Allowance on December 10, 2015. EX1003, 20-21.

C. Person of Ordinary Skill in the Art

46. In my opinion, a person of ordinary skill in the art at the time of the alleged invention of the '615 patent (April 7, 2006) (“POSITA”) would have had a bachelor’s degree in electrical or computer engineering or a comparable field of study, plus approximately two to three years of professional experience with television and digital display systems, distributed multimedia communications, and networked computer systems, or other relevant industry experience. Additional education could substitute for professional experience, and industry experience could substitute for formal education.

D. Claim Construction Under 37 C.F.R. §42.104(b)(3)

47. Below are claim constructions that, in my opinion, would have been their ordinary and customary meaning according to a POSITA (person of ordinary skill in the art in question at the time of the invention in April 2006).

1. “a television function unit” (claims 1, 3)

48. In my opinion, the plain meaning of “television function unit” includes a unit that performs a function of a television as of the priority date. Such functions include receiving broadcast and/or cable television signals via a tuner, processing such signals, and tuning to a particular channel. *See, e.g.*, ’615 patent EX1001, 6:37-44 (conventional television set has a tuner), Fig. 1 (showing tuner), Abstract (channel change).

2. “remote controller” (claims 3, 7, 8)

49. In my opinion, the plain meaning of “remote controller” includes a device or mechanism for controlling something from a distance.

3. “without any channel selecting operation” (claim 1)

50. In my opinion, the phrase “without any channel selecting operation” includes an action occurring without the user performing a channel selection (*e.g.*, channel 1, channel 2, etc.). ’615 patent EX1001, 26:11-33. In other words, the replacement of the currently displayed broadcast program with the one definite broadcast program is performed by an operation that does not include the user

manually selecting a channel (e.g., channel 1, channel 2, etc.), but instead selecting a program (e.g., *Friends*, *Cheers*, etc.).

4. “without any program selecting operation” (claims 4, 8)

51. In my opinion, the phrase “without any program selecting operation” includes an action occurring without the user manually performing a program selection (e.g., *Friends*, *Cheers*, etc.). ’615 patent EX1001, 26:11-33.

5. “the same manual operation being universal” (claims 1, 4, 8)

52. In my opinion, this term includes performing the same manual operation (e.g., clicking on a link on the display using a remote) to replace the currently displayed channel or broadcast program with a program identified by the another television set regardless of the program being watched by the another television set. ’615 patent EX1001, 11:62-12:9; EX1003, 108-110 (“[t]he amendment [‘the same manual operation being universal’] is supported by the original specification, paragraph [0097]”) (citing ’615 patent EX1001, 11:62-12:9). For example, if the another television set is watching *Friends*, the same manual operation (e.g., clicking on a link) will replace the current displayed broadcast program with *Friends*. ’615 patent EX1001, 11:62-12:9, Fig. 2.

6. “the predetermined same manual operation from own motive having no influence on the channel selection of the another television set” (claims 1, 4, 8)

53. In my opinion, “no influence on the channel selection of the another television set” includes not triggering an instantaneous channel change on the other

television. This construction is supported by the embodiments in the specification.

'615 patent EX1001, Fig. 11, 11:50-12:9, 24:46-27:28.

7. **“a predetermined key for replacing the currently displayed broadcast program by the one definite broadcast program identified by the channel selection of the another television set” (claim 3)**

54. In my opinion, the claimed “predetermined key” includes a key that is configured to interact with the TV system to cause at least the predefined operation of replacing the currently displayed broadcast program by the one definite broadcast program identified by the channel selection of the other television set. EX1001 26:34-39.

E. Patent Owner’s Infringement Contentions

55. I have reviewed Patent Owner’s contentions for the '615 patent that were attached to the Amended Complaint from the litigation between Patent Owner and Petitioner in the *NL Giken Inc. v. Amazon.com, Inc.*, which are attached at EX1013. I have been informed that no other infringement contentions have yet been provided by Patent Owner in that litigation.

IV. GROUND 1: CLAIMS 1-8 ARE OBVIOUS BASED ON COOPER AND THE KNOWLEDGE OF A POSITA

A. Overview of Cooper

56. U.S. Patent App. Pub. No. 2004/0231003 (“Cooper”) was filed on June 21, 2004, and published on November 18, 2004. Cooper EX1004, cover page.

I have been informed that Cooper is prior art under 35 U.S.C. §102(a), (b), and (e) (pre-AIA).

57. Cooper discloses communicating to a user the television programs and/or networks being watched by other users using an interface (*e.g.*, a buddy list) that presents a list of users alongside distinct identifiers indicating the program and/or network each user is watching. Cooper EX1004, Abstract; ¶60 (“In addition to showing whether users on the list are currently logged on to the server, the enhanced buddy-list shows the TV show or network 1110 each listed buddy 1108 is watching”).

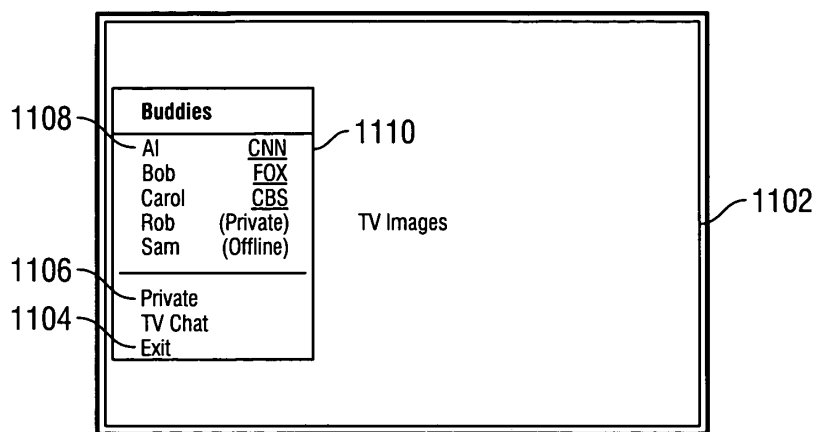


FIG. 11

Cooper EX1004, Fig. 11. The TV show and/or network 1110 each listed buddy 1108 is watching is displayed via a selectable link. Cooper EX1004, ¶60 (“TV show and/or network 1110 can be displayed as a link”). Cooper’s television is coupled to a set-top box that receives TV signals and supports network

communication, granting users the ability to watch TV programming and engage with server-based content, such as buddy list 1110. Cooper EX1004, ¶¶38-42.

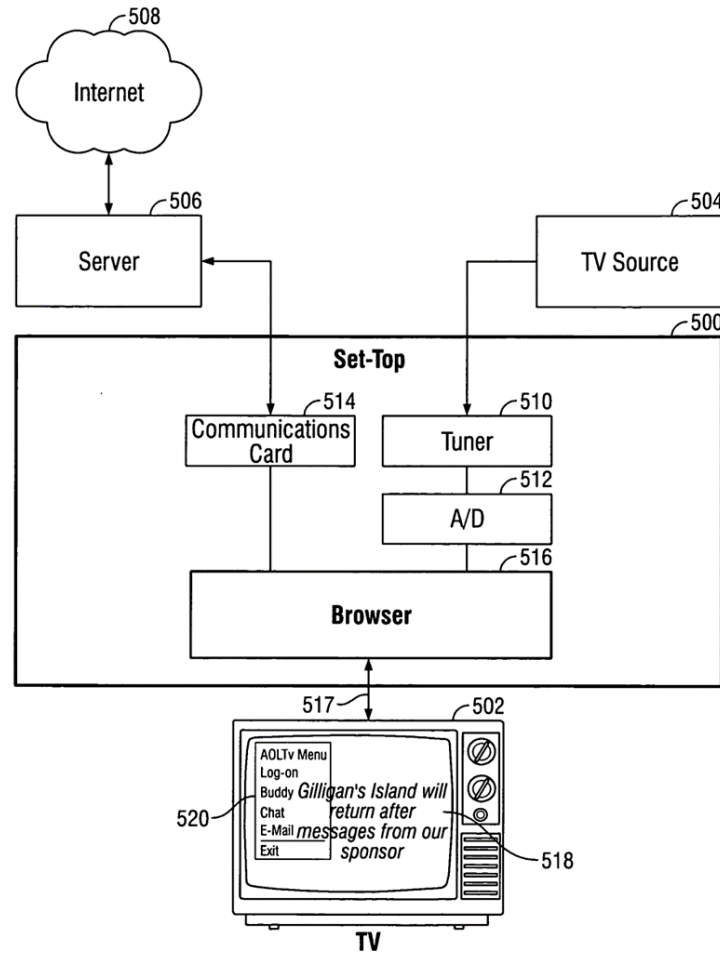
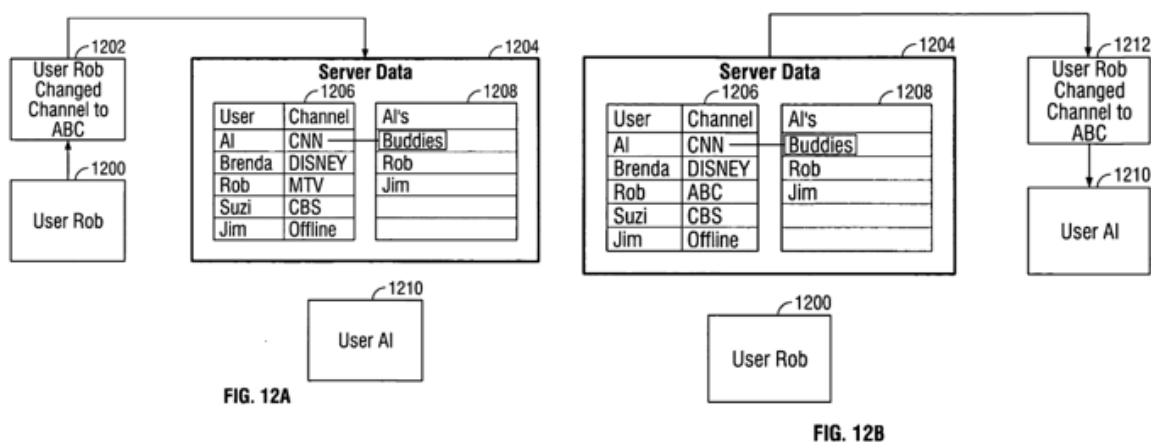


FIG. 5

Cooper EX1004, Fig. 5.

58. Cooper allows for users to receive up-to-date information regarding what their buddies are currently viewing. Server 506 maintains the server data 1204 that is “used to provide the enhanced buddy list functions.” Cooper EX1004, ¶61. The server data 1204 includes “a list 1206 of logged-in users and the TV

shows and/or network that each user is currently watching.” *Id.* As users change channels, data 1202 is generated. For example, as shown in Figures 12A-B, when user “Rob” changes his channel in a first location from MTV to ABC, or from *Cheers* to *Friends*, the data—ABC or *Friends*—is generated and sent to the server, which updates server data 1204 after it receives the data indicating that Rob changed what he is currently watching.



Cooper EX1004, Fig. 12A-B (user Rob 1200 and data 1202), ¶61 (“when a user changes channels, set-top box software transmits a message to the server including the name of the show and/or the network the user is presently viewing.”), ¶61 (“the server 1204 updates the user list 1206 to reflect the new viewing information.”). The server then sends the updated server data (message 1212) to a second user (e.g., Al) that is friends or buddies with the first user (Rob). *Id.* (“server also transmits a message 1212 to each logged-in user that included the channel-changing user in his or her list”), *see also* ¶63 (“the server broadcasts 1410 the

change to each logged-in user who included the channel changing user in their buddy list”), Fig. 14 (element 1410). Al is thus provided with an update to what Rob is watching via his buddy list. If Al would like to view what Rob is watching or what any of Al’s other buddies are watching, Al can select the link corresponding to the program in the buddy list 1110. Cooper EX1004, ¶60 (“By selecting the link, a user can watch the same show a friend is watching”), ¶50 (“user selection of a link 704 causes set-top box software to determine tuning information corresponding to the link ... [and] tunes ... the set-top box to the determined tuning channel”), Fig. 7 (element 704).

59. Furthermore, Cooper’s television system is a “web TV” system where the set-top box includes computer components that allow users to watch TV and view web pages and graphics menus. *See, e.g.*, Cooper EX1004, ¶11, ¶40, ¶¶60-63. Thus, Cooper discloses use of an input/output device, such as a mouse, to interact with the system to watch TV and view web pages.

60. In my opinion, Cooper is analogous art to the ’615 patent. Cooper is from the same field of endeavor as the ’615 patent. They are both patents in the field of television systems. In addition, Cooper is reasonably relevant to the problem the patent is concerned with, as shown in my analysis below in section IV.B.

61. Based on my review of the prosecution history (EX1003), Cooper appears to have not been considered during prosecution of the '615 patent.

B. Claim 1

62. In my opinion, Cooper discloses and renders this claim obvious.

1. [1.pre] A television set system comprising:

63. Cooper discloses *a television set system*—the receiver set-top box 500, essentially having the same basic components as the general-purpose computer illustrated in Fig 1, and including tuner 510, network communication card 514, network server 506, browser 516, television 502, input device (*e.g.*, mouse 103), etc. collectively is a television set system. Cooper EX1004, ¶1, ¶3, ¶11, ¶¶38-40; Figs. 1, 5-6.

64. Thus, in my opinion, Cooper discloses the preamble.

2. [1.a] a television function unit;

65. Cooper discloses *a television function unit* (collectively tuner 510 and analog-to-digital converter 512, shown in red). *See, e.g.*, Cooper EX1004, ¶11, ¶¶38-39, Figs. 1, 5-6; §III(D)(1) (construction of *a television function unit*).

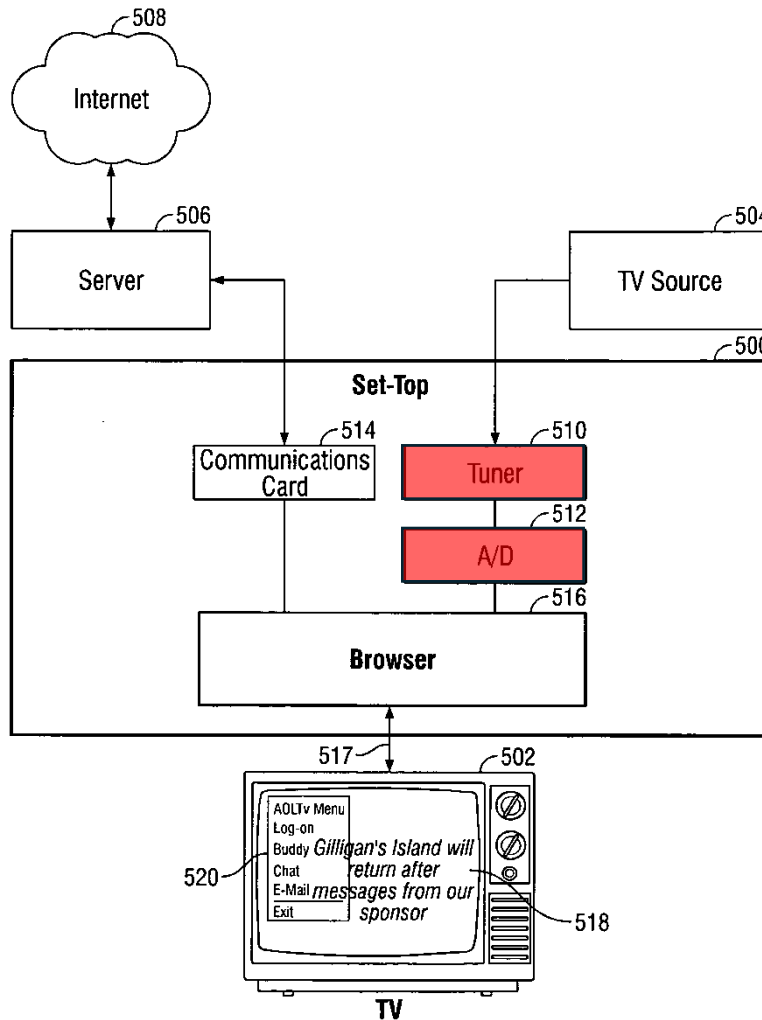


FIG. 5

Cooper EX1004, Fig. 5. Collectively, Cooper’s tuner 510 and analog-to-digital converter 512 perform functions of a television, such as receiving broadcast and/or cable television signals via a tuner, processing such signals, and tuning to a particular channel. *See, e.g.*, Cooper EX1004, ¶38 (“set-top box 500 receives TV signals from a TV source 504 such as cable, satellite, or conventional TV provider”), Fig. 5 (illustrating that tuner 510 is the component of set-top box 500 that receives the TV signals from TV source 504), ¶38 (“box 500 includes a tuner

510 to select a TV channel for viewing”), ¶38 (“box 500 can include an analog-to-digital converter 512 to permit digital processing of the TV images regardless of the TV source”), ¶11.

66. Accordingly, in my opinion, Cooper discloses this limitation.

67. Additionally, in my opinion, a POSITA would have understood that conventional televisions, such as television 502, would include a tuner and analog-to-digital converter, substantially similar to tuner 502 and analog-to-digital converter 512. Thus, in my opinion, Cooper’s television 502 independently discloses a “television function unit.”

**3. [1.b] a display arranged to display a broadcast program
accordance with the television function unit;**

68. In my opinion, Cooper discloses this limitation.

69. Cooper discloses *a display* (display in television 502) *arranged to display a broadcast program* (e.g., “TV show”) *in accordance with the television function unit* (§IV(B)(2) (limitation 1.a)). *See, e.g.,* Cooper EX1004, ¶11, ¶14, ¶¶38-40, ¶¶44-45, Figs. 5, 10.

70. Cooper describes a set-top box 500 (including television function unit, shown in red, *see* §IV(B)(2) (limitation 1.a)) that outputs a broadcast program (e.g., “TV show”) for viewing on the television’s display (shown in green). Cooper EX1004, ¶14.

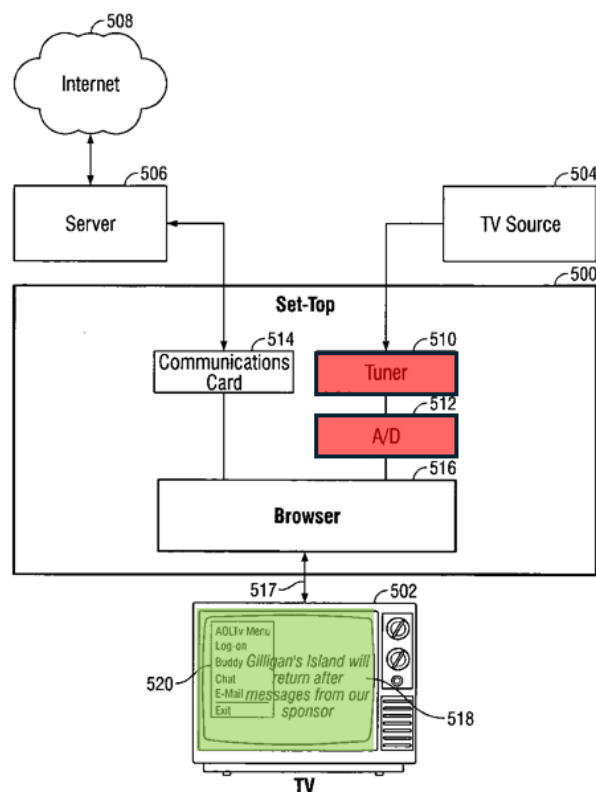


FIG. 5

Cooper EX1004, Fig. 5. Cooper discloses a set-top box receiving a broadcast program. Cooper EX1004, ¶11 (“set-top box ... includes a TV tuner for receiving broadcast and/or cable TV signals”), ¶38 (“set-top box 500 receives TV signals”). Cooper discloses the TV display showing the broadcast program received by the set-top box. Cooper EX1004, ¶40 (“box 500 constructs a display that can include information ... from the TV source 504 ... [and] ... sends the constructed display to a TV 502 or monitor”), ¶14 (“The user interface may also display television programming (e.g., a TV show).”).

71. Thus, in my opinion, Cooper discloses this limitation.

72. Additionally, in my opinion, a POSITA would have understood that conventional televisions, such as television 502, would include a screen arranged to display broadcast programs from the internal tuner and/or analog-to-digital converter. §IV(B)(2) (limitation 1.a). Thus, Cooper's television 502 independently discloses this limitation.

4. **[1.c] a receiver arranged to receive, without request or acknowledgement, information of one definite broadcast program which can be displayed on the display and is identified by a channel selection of another television set in another place;**

73. In my opinion, Cooper discloses and renders this limitation obvious.

74. Cooper discloses *a receiver arranged to receive information* (set-top box 500 with tuner 510, shown in pink, and network communication card 514, shown in blue). *See, e.g.*, Cooper EX1004, ¶11, ¶¶39-50, ¶52; Figs. 5, 7. “The box 500 constructs a display that can include information received from the server 506 and/or from the TV source 504. The box 500 sends the constructed display [through browser 516] to a TV 502 or monitor via an output port 517.” Cooper EX1004, ¶40.

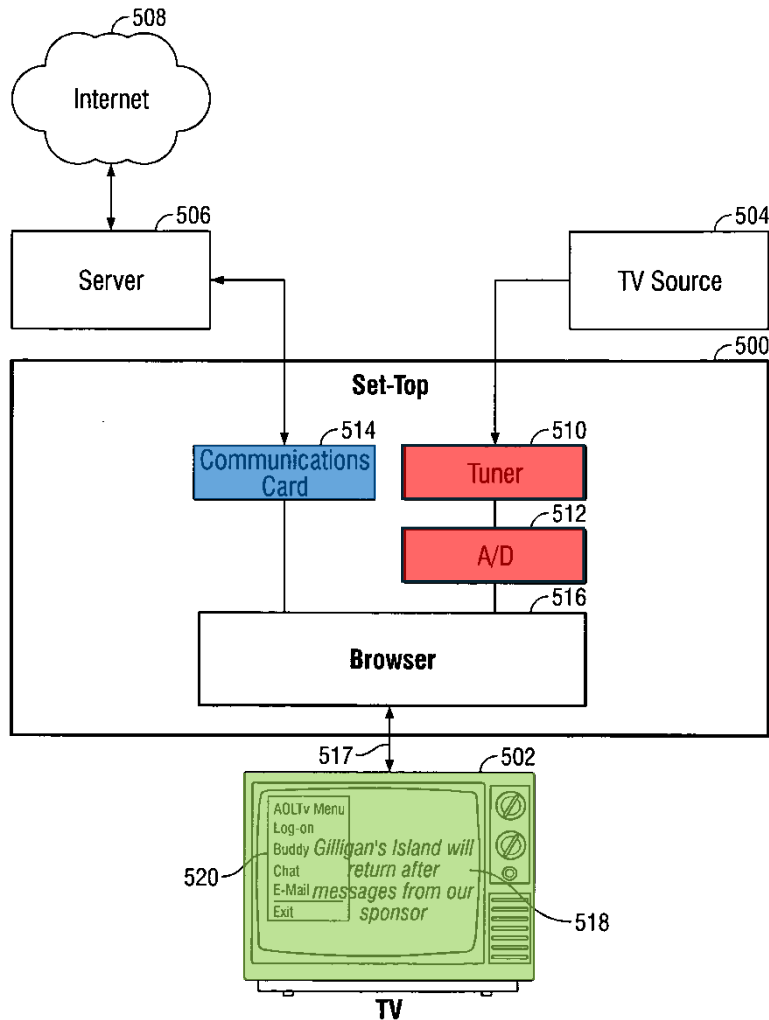


FIG. 5

Cooper EX1004, Fig. 5. Set-top box 500 is in communication with server 506, TV source 504, and TV set 502. Cooper EX1004, Fig. 5. “The box 500 includes a network communication card 514 to communicate with a network server 506 such as an ISP.” Cooper EX1004, ¶39.

75. The receiver is arranged to receive *information* (data 1202/1212) of *one definite broadcast program* (show or network) which can be displayed on the *display* (display in TV 502). See §IV(A); §IV(B)(3) (limitation 1.b); Cooper

EX1004, ¶¶60-63; Figs. 11, 12A-B, 14. The enhanced buddy list 1208 “shows the TV show and/or network 1110 each listed buddy 1108 is watching.” §IV(A); Cooper EX1004, ¶¶60-61, Fig. 11. The “TV show and/or network 1110 can be displayed as a link.” Cooper EX1004, ¶60. The server (*e.g.*, server 506) maintains the server data 1204 which is “used to provide the enhanced buddy list functions.” Cooper EX1004, ¶61. The server data 1204 includes “a list 1206 of logged-in users and the TV shows and/or network that each user is currently watching.” Cooper EX1004, ¶61. Data 1202 is generated when user “Rob” changes his channel in a first location and includes the information “ABC” and/or the TV show name—which is information of one definite broadcast program. Cooper EX1004, ¶61 (“when a user changes channels, set-top box software transmits a message to the server including the name of the show and/or the network the user is presently viewing.”), ¶60 (“the enhanced buddy-list shows the TV show or network 1110 each listed buddy 1108 is watching” and “the TV show and/or network 1110 can be displayed as a link”). The server updates server data 1204 when the server receives data 1202 indicating that a user (Rob) changed what they are currently watching. Cooper EX1004, ¶61 (“when a user changes channels, set-top box software transmits a message to the server including the name of the show and/or network the user is presently viewing”); *see also* Fig. 12A (user Rob 1200 and data 1202). The server then sends the updated server data (message 1212) to a second user

(User A1) that is friends or buddies with the first user (Rob). *Id.* (“server also transmits a message 1212 to each logged-in user that included the channel-changing user in his or her list”), ¶63 (“the server broadcasts 1410 the change to each logged-in user who included the channel changing user in their buddy list”), Fig. 14 (element 1410). The updated server data received by User A1, via A1’s set-top box, constitutes the “information of one definite broadcast program which can be displayed on the display,” as data 1202/1212 is used to update a user’s buddy list and the buddy list can display the show or network each users’ buddies are currently watching.

76. Cooper discloses that the links can be the specific program (*e.g.*, television show or movie) or the network each buddy is watching. For example, although Figures 11-12 show the buddy list including links that reference networks (*e.g.*, CNN, FOX, CBS), the viewing information in the buddy list can also take the form of the *specific show* each buddy is watching. Cooper EX1004, ¶60 (“the enhanced buddy-list shows the TV show or network 1110 each listed buddy 1108 is watching” and “the TV show and/or network 1110 can be displayed as a link”), ¶63 (“[v]iewers can turn off this feature if they do not want others to see the name of the TV show they are watching”).

77. The information of the one definite broadcast is *displayed on the display*. Cooper’s buddy list 1110 can be displayed over TV program 1102

displayed via TV 502. Cooper EX1004, ¶60 (“FIG. 11 shows a set-top box display that includes a TV program 1102 and a TV-enhanced buddy list 1110”).

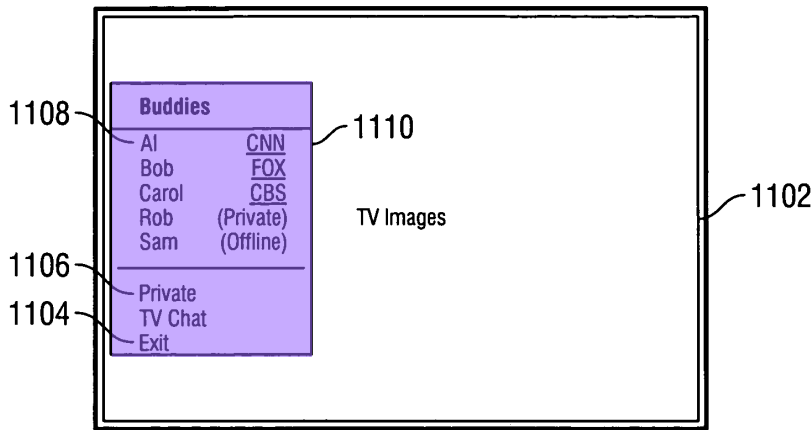


FIG. 11

EX1004, Fig. 11A (buddy list 1110 annotated purple). The buddy list 1110 can be updated such that it reflects the current show each buddy is watching.

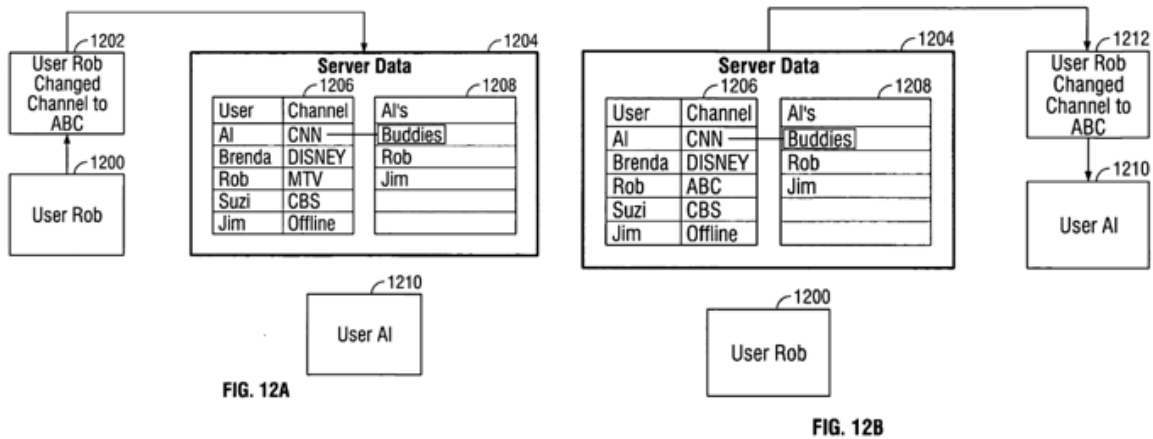


FIG. 12A

FIG. 12B

Cooper EX1004, Figs. 12A-B, ¶61 (“the server 1204 updates the user list 1206 to reflect the new viewing information [and] ... transmits a message 1212 to each logged-in user that included the channel-changing user in his or her list”), ¶62

(“[t]he server responds by sending the set-top box TV viewing information for each member of the user’s buddy list”), ¶63 (“FIG. 14 shows a process for updating the buddy list information initially transmitted” and “the server broadcasts 1410 the change to each logged-on user who included the channel changing user in their buddy list”).

78. The one definite broadcast program is *identified by a channel selection of another television in another place*. Cooper EX1004, Fig. 6. User Rob’s changing of channels triggered the message 1212 sent from server 506 to User Al. Cooper EX1004, ¶53, ¶61. In my opinion, a POSITA also would have understood that it was well-known for television users to change their television by channel selection. Cooper also discloses that users can be located in different places. Cooper EX1004, Fig. 6 (User A is in DC and User B is in Boston), ¶¶42-43 (“a set-top box 600a in Washington, D.C. sending a message 600 to a set-top box 600b in Boston via the server 506”).

79. In my opinion, Cooper discloses and renders obvious *without request or acknowledgement*. See, e.g., Cooper EX1004, ¶¶39-42, ¶¶44-50; Figs. 5-7. The limitation “without request or acknowledgement” is a qualifier for “receive ... information of one definite broadcast program ... identified by a channel selection of another television set in another place.” Accordingly, the limitation “without request or acknowledgement” is not a qualifier on other

operations, such as an initial set up to establish a relationship between the claimed “television set system” and the “another television set in another place.” Any statement to the contrary would result in a system that would allow any individual to tune into any other person’s television set without consent. Furthermore, “without request or acknowledgement” also does not mean that no handshake process occurs between televisions. EX1003, 51 (“[t]he ‘hand shake’ is the process of receiving the control signal from another TV conveying the channel that is presently being viewed, to the receiver TV and is interpreted by the examiner as an existing process in the instant application claim language, and it is not clear that instant application has a way around it, or even if it can prevent it”), 55 (adding the limitation “without request or acknowledgement” to what became claim 1). With this understanding in mind, Cooper does not mention any “request or acknowledgement” with respect to receipt of a “message” or information 1202/1212 corresponding to what a buddy is watching. In my opinion, a POSITA would have understood and found it obvious that no “request or acknowledgement” is required to implement the buddy list updating process in Cooper.

80. Thus, in my opinion, Cooper discloses and renders obvious this limitation.

5. [1.d] a manual controller arranged to change the display in response to a predetermined same manual operation from own motive of a viewer of the display on the basis of the information received by the receiver, the predetermined same manual operation from own motive having no influence on the channel selection of the another television set, but having influence solely on the change in the display of the own television set into the one definite broadcast program identified by the channel selection of the another television set with the information received by the receiver,

81. In my opinion, Cooper discloses and renders this limitation obvious.

82. Cooper discloses *a manual controller* (mouse 103). Cooper EX1004, ¶3, ¶11. Cooper discloses that a “set-top box essentially has the same basic components as the general-purpose computer illustrated in FIG. 1, except that it also includes a TV tuner for receiving broadcast and/or cable TV signals.” Cooper EX1004, ¶11.

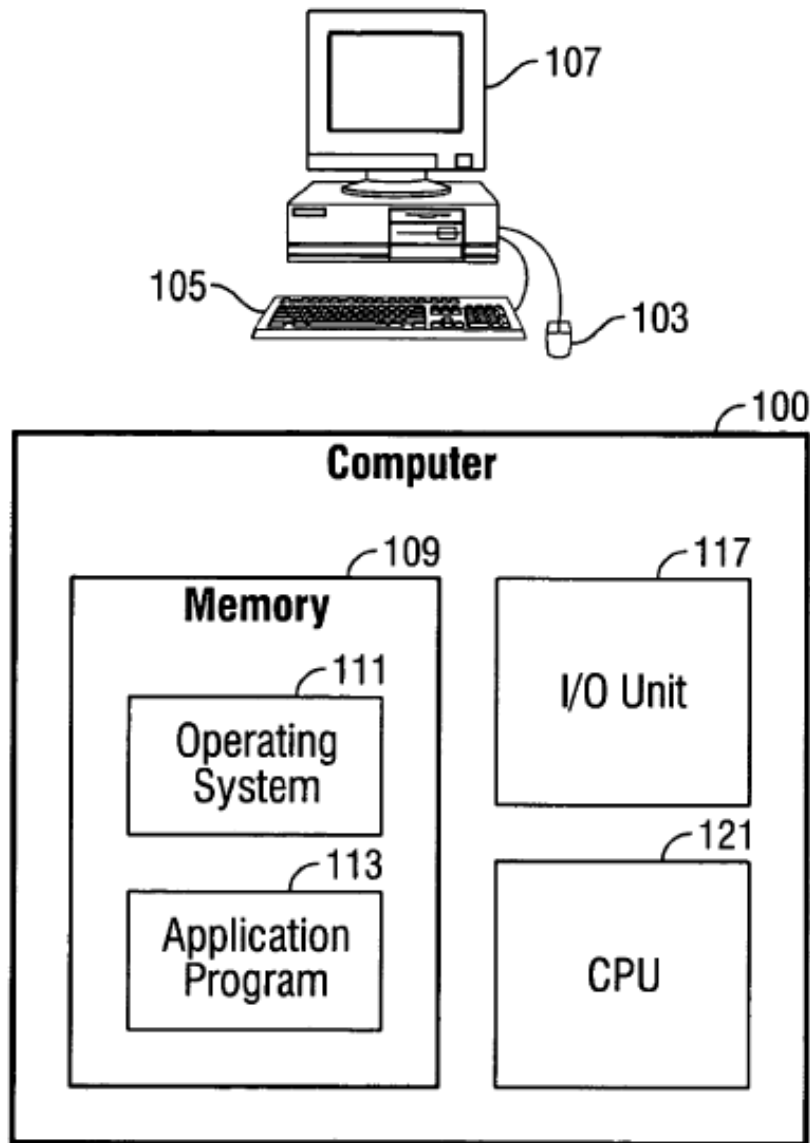


FIG. 1
(Prior Art)

Cooper EX1004, Fig. 1. Figure 1 illustrates a computer system that includes various input/output devices such as “mouse 103, keyboard 105.” Cooper EX1004, ¶3, Fig. 1. In this manner, the set-top box allows users “either to watch TV or to view web pages and otherwise ‘surf’ the Internet.” Cooper EX1004, ¶11.

83. Cooper discloses that the manual controller is *arranged to change the display in response to a predetermined same manual operation* (selection of user Rob's link with a mouse button) *from own motive of a viewer of the display on the basis of the information received by the receiver*. After the viewer's display shows a message/link indicating a channel change occurred on another computer (*see* §IV(B)(4) (limitation 1.c)), the viewer clicking on the link will cause the viewer's display to be updated to show the program/channel/network indicated in the message/link. Cooper EX1004, ¶60 (“[b]y selecting the link, a user can watch the same show a friend is watching”), ¶50 (“user selection of a link 704 causes set-top box software to determine tuning information corresponding to the link ... [and] tunes ... the set-top box to the determined tuning channel”), Fig. 7 (element 704, annotated green below).

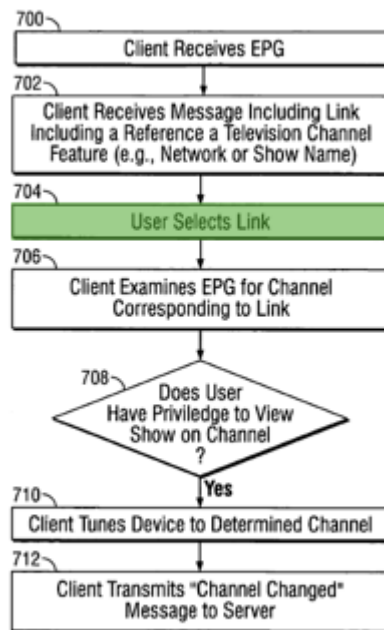
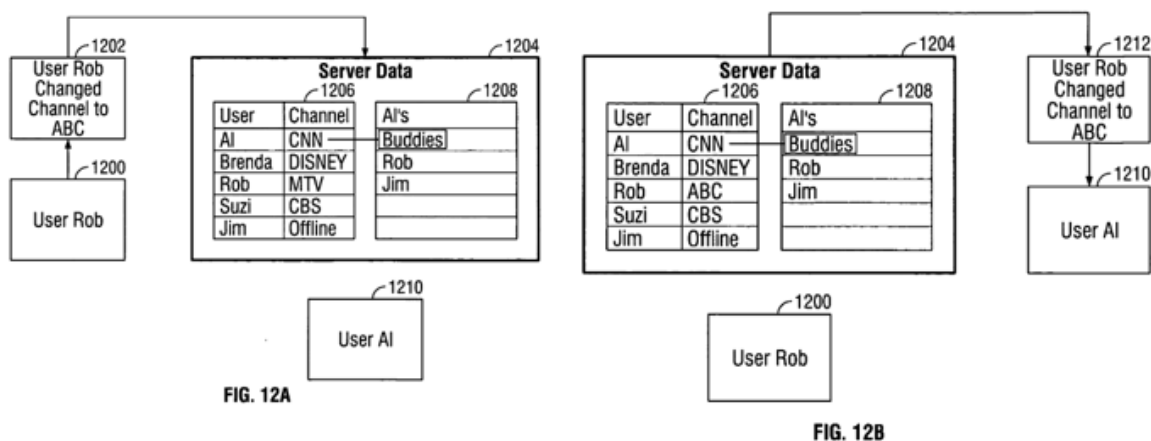


FIG. 7

Cooper EX1004, Fig. 7. In my opinion, a POSITA would have understood that each viewer in Cooper uses the manual controllers (*e.g.*, mouse 103) to choose to select the link (own motive of a viewer of the display) on the basis of the information received by the receiver. EX1003, 149-150.

84. In my opinion, Cooper discloses and renders obvious the *same manual operation*. For example, Cooper discloses that Al's manual operation—clicking the mouse button on Rob's link—changes Al's TV to the program/channel/network corresponding to Rob's link depending on the information received by the receiver regarding what Rob is watching. Cooper EX1004, ¶¶60-61. When Rob changes program/network/channel from MTV to

ABC, then the User AI's server is updated, and that same manual operation performed by User AI changed AI's TV's current viewing channel to ABC.



Cooper EX1004, Fig. 12A-B. Thus, Cooper discloses that the same manual operation (*i.e.*, a clicking of a link) will change AI's TV to the program/channel/network corresponding to the selected link on the basis of the information received by the receiver.

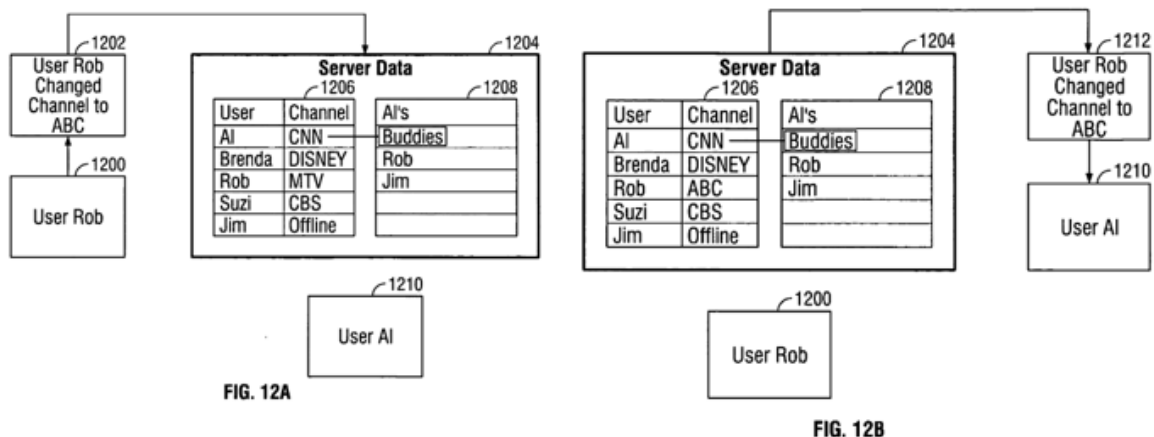
85. In my opinion, Cooper discloses and renders obvious *the predetermined same manual operation from own motive having no influence on the channel selection of the another television set, but having influence solely on the change in the display of the own television set into the one definite broadcast program identified by the channel selection of the another television set with the information received by the receiver. See §III(D)(6) (construction of influence limitation).* None of the embodiments of Cooper mention that selection by a user of a buddy link to watch the same program as the buddy will have any

“influence ... on another television set,” *i.e.*, the buddy’s television set, such as changing the buddy’s television to a different channel without any input from the buddy. In my opinion, a POSITA would have understood and found obvious that no such “influence” is required to implement Cooper. The sole “influence” disclosed in Cooper is to change the viewer’s television set to display the definite broadcast program from the link, as any change to the other television set would disrupt **the other** user’s viewing experience. Cooper EX1004, ¶29, ¶42, ¶48, ¶50, ¶56, ¶60, Fig. 7. Therefore, in my opinion, a POSITA would have understood that the change in display of the viewer’s television set would **not** trigger an automatic channel change for the other television set. Thus, the user’s selection of a buddy link influences only that user’s television set and **not** the television set of the buddy.

86. Thus, in my opinion, Cooper discloses and renders obvious this limitation.

6. **[1.e] wherein the information includes information of a broadcast program which is currently not displayed on the display, but can be displayed by a channel change, and**

87. In my opinion, Cooper discloses and renders this limitation obvious. As shown in Figure 12A, user Rob is originally watching MTV, and user Al is originally watching CNN.



Cooper EX1004, Fig. 12A-B. After Rob changed his channel to ABC, AI receives a notification that Rob's channel was changed. Cooper EX1004, ¶¶60-61, Fig. 12A-B. Cooper discloses the notification includes information about a definite broadcast program. *See* §IV(B)(4) (limitation 1.c). AI can then select the link in his buddy list corresponding to Rob's viewing of ABC, which will change AI's display from CNN to ABC. Cooper EX1004, ¶¶60-61, Fig. 12A-B.

88. Thus, in my opinion, Cooper discloses and renders obvious this limitation.

7. **[1.f] wherein the manual controller is arranged to instantly carry out replacement of the currently displayed broadcast program with the one definite broadcast program identified by the channel selection of the another television set in response to the predetermined same manual operation, the same manual operation being universal regardless of the information and without any channel selecting operation,**

89. In my opinion, Cooper discloses and renders this limitation obvious.

90. In Cooper, the viewer uses a mouse to click a link on the display, which instantly changes the user's TV's display (current channel or current viewing program) to the linked broadcast program (§IV(B)(4) (limitation 1.c)). Cooper EX1004, ¶43 (“Unlike traditional links that cause a browser to load specified files or an Internet URL (Universal Resource Locator) when selected, the links 618 in the message 600 can change the channel of the set-top box.”). In my opinion, a POSITA would have understood that clicking a link as disclosed in Cooper would instantly change or replace the current channel/network/program displayed on the user TV with the channel/network/program selected by the other user (on the another TV set). Similar to how clicking the button on the remote control changes the display in the '615 patent, clicking Cooper's buddy link changes the channel/network/program that is displayed, and the user does not perform any channel search or selection operation.

91. The clicking of a mouse button to select a link on the display *is universal regardless of the information and without any channel selecting operation*. See §III(D)(5) (construction of *universal*). In my opinion, a POSITA would have understood that use of a mouse to manually click a link is a “universal” manual operation that will trigger *replacement* of what program/channel/network the user is currently watching with the other user's program/channel/network, regardless of the precise channel number of the other user's TV and without any

channel search and selection operation. For example, if user Al clicks Rob's link in buddy list 1110, the same manual operation, *i.e.*, clicking the link, will perform the function of replacing what channel/network/program Al is currently viewing with programming corresponding to the selected link. Because the same manual operation of selecting the link will trigger the same function (replacement of the current programming) regardless of whether the link points to a specific TV show, channel, or network, the manual operation is "universal," *i.e.*, the same link-clicking action.

92. The clicking of a mouse to select a link on a display is *without any channel selecting operation*. See §III(D)(3) (construction of *without any channel selecting operation*). Continuing with the above example, when user Al clicks Rob's link (which displays the programming Rob is watching, *i.e.*, *Friends* or *Cheers*), user Al is not making a channel selecting operation but is instead performing a program selection operation.

93. Thus, in my opinion, Cooper discloses and renders obvious this limitation.

8. [1.g] whereby same experience as that of a viewer of the another television set is possible from own motive of the viewer by means of the manual controller.

94. Cooper discloses this limitation. *See* §IV(B)(5) (limitation 1.d);

Cooper EX1004, ¶60 (“[b]y selecting the link, a user can watch the same show that a friend is watching” to have the same viewing experience as that of the friend).

95. Thus, in my opinion, Cooper discloses this limitation.

- C. **Claim 2 - The television set system according to claim 1, wherein the channel information¹ of the another television set is converted into its own local channel number if it differs from that of the local channel number in an area where the another television set is located.**

96. In my opinion, Cooper discloses and renders this claim obvious.

97. As I explain above in Section IV(B), Cooper discloses and renders obvious *the television set system according to claim 1*. *See* §IV(B) (claim 1).

98. Cooper discloses that the *channel information of the another television set (e.g., NBC 10, Boston user)* is converted into its own local channel number (*e.g., NBC 28 for the DC user*) *if it differs from that of the local channel number in an area where the another television set is located*. Cooper EX1004, ¶¶44-48, Fig. 6. Cooper acknowledges that networks may have different channels depending on the geographic location each user is located. *See, e.g.,* Cooper

¹ The limitation “the channel information” lacks antecedent basis in claim 1.

EX1004, ¶44 (“different geographic locations may offer a given TV network on different channels. For example, an NBC affiliate in Boston may be on channel ‘10’ while the D.C. NBC affiliate broadcasts on channel ‘28.’”). To account for this, set-top box 500 is able to identify the correct channel corresponding to the channel information included in the link. Cooper EX1004, ¶45 (“To account for these variations, set-top box software ... can determine a channel corresponding to a link based on a wide variety of channel features ... by using an electronic programming guide (EPG)”), ¶47 (“set-top box 500B can use the EPG information to select a channel corresponding to a particular link from the shows currently available from the TV source”), ¶48 (“message also includes a link 618 referring to the FOX network” and “[s]election of this link and the ensuing lookup of ‘FOX’ in the ‘channel name’ column of the EPG 602B tunes to the Boston set-top box 500B to channel ‘11’”), Fig. 6 (EPG 602a in DC shows FOX as being channel 29; EPG 602B in Boston shows FOX as being channel 11).

99. Thus, in my opinion, Cooper discloses this limitation.

D. Claim 3

100. In my opinion, Cooper discloses and renders this claim obvious.

1. [3.pre] The television set system according to claim 1, wherein the manual controller is a remote controller including:

101. As I explain above in Section IV(B), Cooper discloses and renders obvious “*The television set system according to claim 1.*” See §IV(B) (claim 1).

102. Cooper further discloses that *the manual controller (e.g., mouse) is a remote controller.* See §IV(B)(5) (limitation 1.d). The mouse in Cooper is a remote controller because the mouse controls the set-top box at a distance. See §III(D)(2) (construction of “remote controller”); Cooper EX1004, ¶11 (“A set-top box essentially has the same basic components as the general-purpose computer illustrated in FIG. 1”), Fig. 1 (mouse 103).

103. A POSITA would have understood that wireless mice were well-known in the art. See, e.g., Mori EX1006, Fig. 4. In my opinion, a POSITA also would have found it obvious to implement the Cooper’s mouse as a wireless mouse. In my opinion, a POSITA would have found it obvious, would have had a reasonable expectation of success, it would have been within the skill of a POSITA, and that it would maintain all the disclosed functionality of Cooper to implement the mouse of Cooper as a wireless mouse to click links in the buddy list displayed on the TV via the set-top box.

104. Thus, in my opinion, Cooper discloses and renders obvious the preamble.

2. **[3.a] an operating part including a plurality of keys each of which are assigned to predetermined functions, respectively, the plurality of keys including a predetermined key for replacing the currently displayed broadcast program by the one definite broadcast program identified by the channel selection of the another television set; and**

105. Cooper discloses and renders obvious that the mouse includes *an operating part* (portion of mouse that includes buttons or switches) *which are assigned to predetermined functions, respectively* (e.g., right click/left click). See §IV(B)(5) (limitation 1.d). In my opinion, a POSITA would have understood and found it obvious that a wireless mouse has a plurality of buttons with predetermined functionality, *i.e.*, a left click performs a selection operation within a menu while a right click opens a context menu for selection. *See, e.g., Mori* EX1006, Fig. 4 (switches 14, 15), 3:19-21 (“the radio signal R comprises command signals generated in response to actuation of switches 14, 15”). On Windows OS machines, that is the traditional way that the mouse button works. In my opinion, a POSITA would have reasonably expected the mouse to operate as most commonly expected. In my opinion, a POSITA would have found it obvious, it would have had a reasonable expectation of success, it would have been within the skill of a POSITA, and it would maintain all the disclosed functionality of Cooper to implement the mouse of Cooper to have a left mouse button to click links in the buddy list displayed on the TV via the set-top box.

106. The switches 14, 15 include a *predetermined key* (e.g., left switch 14) *for replacing the currently displayed broadcast program by the one definite broadcast program identified by the channel selection of the another television set.* As I describe above, operation of the left switch of a mouse traditionally performs a selection operation. *See* §IV(D)(2). Additionally, as I further describe above, selection of a link in a buddy list replaces what the user is currently viewing with the programming corresponding to the selected link. *See* §§IV(B)(5)-(7) (limitations 1.d-1.f). Because the left key is programmed to perform a selection operation, it was predetermined that the left switch 14 would perform the function of replacing the currently displayed program with the program of the other television when the user uses the left switch 14 to select the link. *See* §III(D)(7) (construction of this limitation).

107. Thus, in my opinion, Cooper discloses and renders obvious this limitation.

3. [3.b] a signal transmitter arranged to transmit a control signal to the television function unit in response to the operation of the predetermined key in the operating part².

108. Cooper discloses and renders obvious that the mouse includes *a signal transmitter arranged to transmit a control signal to the television function unit in response to the operation of the predetermined key in the operating part*. See §IV(D)(2). In my opinion, a POSITA would have understood and found it obvious for the mouse in Cooper to include a signal transmitter to transmit a control signal in response to operation of one of its keys (i.e., buttons), such as the predetermined key, otherwise a mouse would be inoperable. Likewise, in my opinion, a POSITA would have understood and found it obvious for a wireless mouse to include a signal transmitter to transmit a control signal in response to operation of one of its keys, such as the predetermined key, otherwise the wireless mouse would be inoperable. *See, e.g., Mori EX1006, 3:9-12* (“The radio signal R is transmitted from the mouse 9 by means of a transmitting antenna 13 associated with transmitter circuitry 10 contained within the mouse 9.”). Therefore, Cooper renders this limitation obvious.

² In my opinion, the plain meaning of “transmit” includes both direct transmission and indirect transmission.

E. Claim 4

109. In my opinion, Cooper discloses and renders this claim obvious.

1. **[4.pre] A broadcast program viewing system for viewing a broadcast program same as that identified by a program selection of another broadcast program viewing system in another place to share same experience of viewing same broadcast program, comprising:**

110. Cooper discloses the preamble. See §IV(B) (claim 1). The “broadcast program viewing system” corresponds to the “television set system” of claim 1 and the “another broadcast program viewing system” corresponds to the “another television set system” of claim 1.

2. **[4.a] a display arranged to display a broadcast program;**

111. Cooper discloses this limitation. *See* §IV(B)(3) (limitation 1.b).

3. **[4.b.i] a receiver arranged to receive, without request or acknowledgement, information of one definite broadcast program which can be displayed on the display and is identified by the program selection of the another broadcast program viewing system**

112. Cooper discloses and renders obvious this limitation. *See* §IV(B)(4) (limitation 1.c). This limitation is substantially similar to limitation 1.c; however, rather than recite “is identified by the channel selection,” limitation 4.b.i recites “is identified by the program selection.” In my opinion, a POSITA would have understood that when a user stops changing their channel, they have made a program selection. Thus, when Rob changes his channel from MTV to ABC, Rob has made a program selection of whatever program is airing on ABC.

113. Further, Cooper discloses that set-top boxes receive electronic programming guides (EPGs), which is essentially “an electronic version of a TV guide.” Cooper EX1004, ¶46. As shown in Fig. 6 (reproduced below), the EPG includes show titles 610 (annotated red).

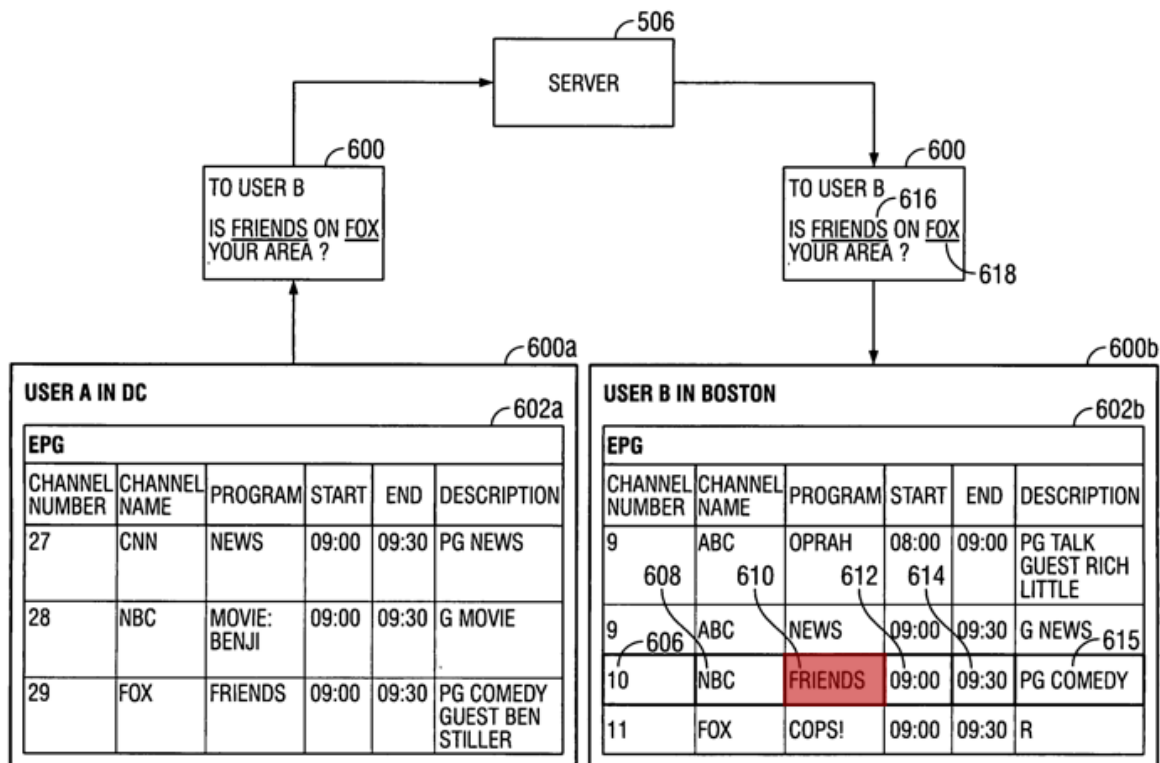


FIG. 6

Cooper EX1004, Fig. 6. Accordingly, User B in Boston makes a program selection by interacting with EPG 602b and selecting “FRIENDS.” As discussed above, this program selection is provided to server 506 for updating each user’s buddy list. In my opinion, a POSITA would have understood that it was well-known for users to

use an EPG to select a television program. Thus, in my opinion, Cooper discloses and renders obvious this limitation.

4. **[4.b.ii] the information including information of a broadcast program which is not currently not displayed on the display, but can be displayed by a channel change; and**

114. Cooper discloses and renders obvious this limitation. *See* §IV(B)(6) (limitation 1.e);

5. **[4.c.i] a manual controller having a predetermined operating portion to change the display in response to a predetermined same manual operation from own motive of a viewer of the display on the basis of the information received by the receiver, the predetermined same manual operation from own motive having no influence on the program selection of the another broadcast program viewing system, but having influence solely on the change in the display of the own broadcast program viewing system into the one definite broadcast program identified by the program selection of the another broadcast program viewing system with the information received by the receiver**

115. Cooper discloses and renders obvious this limitation. *See* §§IV(B)(5)-(7) (limitations 1.d-f). This limitation is substantially similar to limitations 1.d-1.f, but further requires the manual controller to have “a predetermined operating portion.” The mouse is a manual controller that has *a predetermined operating portion*. *See* §IV(D)(2) (limitation 3.a). Thus, in my opinion, Cooper discloses and renders obvious this limitation.

6. [4.c.ii] wherein the manual controller is arranged to instantly carry out replacement of the currently displayed broadcast program with the one definite broadcast program identified by the program selection of the another broadcast program viewing system in response to the same manual operation at the predetermined operating portion, the same manual operation being universal regardless of the information and without any program selecting operation.

116. Cooper discloses and renders obvious this limitation. See §§IV(B)(5)-(7) (limitations 1.d-f); §III(D)(4) (construction of *without any program selecting operation*). This limitation is substantially similar to limitations 1.d-1.f, but recites “without any program selecting operation” instead of “without any channel selecting operation.” As I describe above, Cooper discloses that the links in the buddy list can reference either the specific show or the specific network each buddy is watching. Cooper EX1004, ¶60 (“the enhanced buddy-list shows the TV show or network 1110 each listed buddy 1108 is watching” and “the TV show and/or network 1110 can be displayed as a link”), ¶63 (“[v]iewers can turn off this feature if they do not want others to see the name of the TV show they are watching”). Thus, when user Al clicks and selects user Rob’s link that indicates Rob is viewing “ABC,” Al is not making a program selection but is instead making a network/channel selection.

117. The clicking of a mouse button to select a link on the display is *universal regardless of the information and without any channel selecting operation*. §III(D)(5) (construction of *universal*). In my opinion, a POSITA would

have understood that use of a mouse to manually click a link is a “universal” manual operation that will trigger *replacement* of what program/channel the user is currently watching with the identified another user’s program/channel, regardless of the channel change information and without any channel search and selecting operation.

F. Claim 5 - The broadcast program viewing system according to claim 4, wherein the broadcast program is television program transmitted from a broadcast station, and wherein the program selection of the another broadcast program viewing system is a channel selection to identify a broadcast station.

118. In my opinion, Cooper discloses and renders obvious this claim.

119. As I explain above in Section IV(B), Cooper discloses and renders obvious *the broadcast program viewing system according to claim 4. See §IV(E) (claim 4).*

120. Cooper further discloses that *the broadcast program* (the show AI is watching) is [a] *television program transmitted from a broadcast station*. In my opinion, a POSITA would have understood that ABC, CBS, and NBC are well-known broadcast television stations transmitting broadcast programs. *See, e.g., EX1012, 1* (“the Big Three broadcast television networks, ABC, CBS, and NBC”). Further, Cooper explicitly states that its TV tuner is able to receive broadcast signals or cable signals. *See, e.g., Cooper EX1004, ¶11* (“TV tuner for receiving broadcast and/or cable TV signals”). The buddy list reveals that users are

watching broadcast stations. *See, e.g.,* Cooper EX1004, Fig. 12A (Suzi is watching broadcast station CBS). Thus, Cooper teaches the currently viewed program as a broadcast program from a broadcast station.

121. Cooper also discloses that *the program selection of the another broadcast viewing system is a channel selection (e.g., Rob selecting the program on ABC by changing the channel from MTV to ABC) to identify a broadcast station (ABC)*. Rob's changing his TV channel from MTV to ABC triggered message 1202 from Rob's set-top box to server 1204, which resulted in message 1212 from server 1204 to Al's set-top box. *See* §§IV(B)(3)-(7) (limitations 1.b-f). In my opinion, a POSITA would have understood that ABC is a broadcast station. Thus, the channel selection of Rob (the another broadcast program viewing system) identifies a broadcast station.

122. Thus, in my opinion, Cooper discloses and renders obvious this claim.

G. Claim 6 - The broadcast program viewing system according to claim 4, wherein the broadcast program is television program data to be downloaded from a server station, and wherein the program selection of the another broadcast program viewing system is a code setting to download the selected broadcast program.

123. In my opinion, Cooper discloses and renders this claim obvious.

124. As I explain above in Section IV(E), Cooper discloses and renders obvious *the broadcast program viewing system according to claim 4*. *See* §IV(E) (claim 4).

125. Cooper discloses that the *broadcast program is a television program to be downloaded from a server station*. Cooper EX1004, ¶¶44-48, Fig. 6. Cooper discloses its set-top box system, a special-purpose computer, as part of a “web TV” system. Cooper EX1004, ¶11. Cooper also discloses that users of its integrated computer systems “can access electronic content or other resources either stored locally ... or remotely at one of more server systems 200”. Cooper EX1004, ¶4, Fig. 2. Although Cooper does not explicitly state that one of its web TV functions is to download a television program, in my opinion, a POSITA would have understood that web TV systems, such as Cooper’s set-top box system, were well-known at the time of filing to allow users to select broadcast programming for download from servers (e.g., via streaming) for viewing. Cooper EX1004, ¶5 (“In practice, a server system 200 typically will not be a single monolithic entity, but rather will be a network of interconnected server computers” and “One such server system is “America Online [AOL] 4.0”), Fig. 5 (AOLTv); *see also, e.g.*, Walker EX1009, ¶1 (“[t]his invention relates to ... interactive television systems that provide broadcast television programming and streaming media programming”), ¶10 (“interactive television systems are provided that allow a user to request playback control functions while viewing broadcast television programs on the user equipment”), ¶58 (“Video-on-demand content and video recorded using a network-based video recorder arrangement may be stored on server 56 or server 36

or at service provider 50 and may be provided to the user equipment when requested by users”), ¶76 (“user television equipment may be based on a WebTV box, a personal computer television (PC/TV), or any other suitable television equipment arrangement” and “[i]f desired, the functions of components such as set-top box 60, digital video recorder 66, a WebTV box, or PC/TV or the like may be integrated into a television or personal computer or other suitable device”), ¶87 (“[v]ideo recording functions may be provided by storing copies of television programs and other video content on a remote server ... or other network-based equipment such as equipment at a service provider such as service provider 50”), ¶144 (“[u]ser equipment 18 may receive such content in the form of a real-time video stream or a file download and the interactive television application may play back the received content”); CNN-AOL ARTICLE EX1014 (AOL 4.0 allowed users to “search and navigate Web sites and AOL Channels in the same way, and you can move quickly from a Web page to an AOL Channel and back again.”). Thus, in my opinion, a POSITA would have found it obvious to implement Cooper such that the broadcast program is to be downloaded (e.g., streamed from a server). A POSITA could have done so using the streaming disclosed in Walker, or any other well-known streaming technique (*e.g.*, America Online 4.0 EX1014), and by streaming the selected television program to the user when a user clicks on the link of the television program in the buddy list. *See* §§IV(E)(3)-(6) (limitations 4.b.i-

4.c.ii). Doing so would have been within the skill of a POSITA, would have led to predictable results, would have had a reasonable expectation of success, and would have been fully compatible with Cooper. Motivation to do so arises from 1) a desire for the Cooper web TV system to have the typical functionality of streaming archived TV programing; 2) a desire to increase the programming available to a user; 3) a desire to enable the user to watch programming on demand. All such motivations would have been within the knowledge of a POSITA, as additionally confirmed by Walker. Walker EX1009, ¶5 (streaming was accepted functionality).

126. Cooper renders obvious that *the program selection of the another broadcast program viewing system is a code setting to download the selected broadcast program*. In my opinion, “a code setting”³ includes any encoded setting on the user’s computer used to download a program. In my opinion, a POSITA that was implementing the “web TV” disclosure of Cooper would have found it obvious for the remote user to download (*e.g.*, via streaming) the recorded broadcast program via a code setting when he or she selects a prerecorded broadcast program available for download, described above. Cooper EX1004, ¶11 (“a special purpose computer referred to as a ‘set-top box’ has been developed and used in connection with standard television (TV) sets for viewing web pages on the

³ This term is not a term of art and is not defined or explained in the specification.

Internet Users of such ‘web TV’ systems can make dual usage of their TV sets—that is, either to watch TV or to view web pages and otherwise ‘surf’ the Internet.”). “One such server system is “America Online [AOL] 4.0.” *See* Cooper EX1004, ¶5. Also, AOL 4.0 allowed users to “search and navigate Web sites and AOL Channels in the same way, and you can move quickly from a Web page to an AOL Channel and back again.” *See* CNN-AOL ARTICLE EX1014. Users downloading programs via streaming from a media server was well-known at the time. CNN-AOL ARTICLE EX1014; *see also, e.g.*, Walker EX1009, ¶1 (“[t]his invention relates to ... interactive television systems that provide broadcast television programming and streaming media programming”), ¶10 (“interactive television systems are provided that allow a user to request playback control functions while viewing broadcast television programs on the user equipment”), ¶58 (“Video-on-demand content and video recorded using a network-based video recorder arrangement may be stored on server 56 or server 36 or at service provider 50 and may be provided to the user equipment when requested by users”), ¶76 (“user television equipment may be based on a WebTV box, a personal computer television (PC/TV), or any other suitable television equipment arrangement” and “[i]f desired, the functions of components such as set-top box 60, digital video recorder 66, a WebTV box, or PC/TV or the like may be integrated into a television or personal computer or other suitable device”), ¶87

("[v]ideo recording functions may be provided by storing copies of television programs and other video content on a remote server ... or other network-based equipment such as equipment at a service provider such as service provider 50"), ¶144 ("[u]ser equipment 18 may receive such content in the form of a real-time video stream or a file download and the interactive television application may play back the received content"). In my opinion, a POSITA would have been motivated to implement Cooper such that a remote user downloaded (*e.g.*, streamed) a recorded broadcast program via a code setting such as a link that specified the streaming protocol, using any well-known streaming method or protocol at the time. Doing so would have been within the skill of a POSITA, would have led to predictable results, and would have had a reasonable expectation of success, and would have been fully compatible with Cooper. Motivation to do so includes the motivations identified above for the first half of this claim. Additional motivation includes using a generally accepted and user-friendly method of letting a user select a show for download such as a link.

127. Thus, Cooper renders obvious this claim.

H. Claim 7

128. In my opinion, Cooper discloses and renders obvious this claim. *See* §IV(D) (claim 3).

1. [7.pre] The broadcast program viewing system according to claim 4, wherein the manual controller is a remote controller including:

129. In my opinion, Cooper discloses and renders obvious the preamble.

130. As I explain above in Section IV(E), Cooper discloses and renders obvious *the broadcast program viewing system according to claim 4*. See §IV(E) (claim 4). As I explain above in Section IV(D)(1), Cooper discloses and renders obvious *wherein the manual controller is a remote controller*. §IV(D)(1) (limitation 3.pre).

2. [7.a] an operating part including a plurality of operating portions each of which are assigned to predetermined functions, respectively, the plurality of operating portions including the predetermined operating portion; and

131. In my opinion, Cooper discloses and renders obvious this limitation. See §IV(D)(2) (limitation 3.a). Cooper discloses the *plurality of operating portions* each of which are assigned to predetermined functions, for the same reasons Cooper discloses the “keys” in limitation 3.a, including the predetermined operating portions with predetermined functions.

3. [7.b] a signal transmitter arranged to transmit a control signal to the display in response to the operation at the predetermined operating portion⁴.

132. In my opinion, Cooper discloses and renders obvious a set-top box TV set system including *a signal transmitter arranged to transmit control signal to the display in response to the operation at the predetermined operating portion. See §IV(D)(3) (limitation 3.b).* In my opinion, a POSITA would have understood that the mouse transmits control signals that has an impact on the display, *i.e.*, clicking the left mouse key on top of the hyperlink activates the hyperlink on the display. Thus, the mouse includes a signal transmitter that sends a control signal to the display (through the STB).

133. Thus, in my opinion, Cooper discloses and renders obvious this limitation.

I. Claim 8

134. In my opinion, Cooper discloses and renders obvious this claim. *See §§IV(B), (D)-(E) (claims 1, 3-4).*

⁴ The plain meaning of “transmit” includes both direct transmission and indirect transmission (*i.e.*, remote controller to set-top box to display).

1. **[8.pre] In a broadcast program viewing system for viewing a broadcast program same as that identified by a program selection of another broadcast program viewing system in another place in accordance with information of one definite broadcast program which can be viewed by the broadcast program viewing system and is identified by the program selection of the another broadcast program viewing system to share same experience of viewing same broadcast program, a remote controller comprising:**

135. Cooper discloses the preamble. *See* §§IV(B)(1), (B)(4)-(5), (E)(1), (3)-(4), (D)(1), (H)(1) (limitations 1.pre, 1.c-d, 4.pre, 4.b.i-b.ii, 3.pre, 7.pre); *see also* §§IV(B), (D)-(E) (claims 1, 3-4). Specifically, here is my mapping to my prior analysis to this claim:

In a broadcast program viewing system for viewing a broadcast program same as that identified by a program selection of another broadcast program viewing system in another place (**4.pre, 1.pre**) in accordance with information of one definite broadcast program which can be viewed by the broadcast program viewing system and is identified by the program selection of the another broadcast program viewing system to share same experience of viewing same broadcast program (**4.b.i-b.ii, §IV(B)(4) (limitation 1.c)**), a remote controller (**1.d, 3.pre, 4.c.i-c.ii**) comprising:

a manual operating part including a plurality of manual operating portions each of which are assigned to predetermined functions, respectively, the

plurality of operating portions including a predetermined operating portion **(3.a, 4.c.i, 7.a)** to generate, in response to a same manual operation from own motive of a viewer, a control signal for carrying out replacement of a currently viewed broadcast program with the one definite broadcast program identified by the program selection of the another broadcast program viewing system **(1.f, 3.b, 4.c.ii, 7.b)**, the same manual operation being universal regardless of the information and without any program selecting operation **(1.f, 4.c.ii, 7.a)**; and

a signal transmitter arranged to wirelessly transmit the control signal in response to the same manual operation from own motive of the viewer at the predetermined operating portion to instantly carry out the replacement of the currently viewed broadcast program with the one definite broadcast program identified by the program selection of the another broadcast program viewing system **(1.f, 3.a, 3.b, 4.c.ii, 7.a, 7.b)**, wherein the same manual operation from own motive having no influence on the program selection of the another broadcast program viewing system, but having influence solely on the replacement of the broadcast program of the own broadcast program viewing system into the one definite broadcast program identified by the

program selection of the another broadcast program viewing system in accordance with the information (1.d, 4.c.i),

wherein the information includes information of a broadcast program which is not currently viewed, but can be viewed by a channel change, the information being without request or acknowledgement from the another broadcast program viewing system (1.e, 4.b.i-b.ii).

136. Thus, in my opinion, Cooper discloses and renders obvious the preamble.

2. **[8.a] a manual operating part including a plurality of manual operating portions each of which are assigned to predetermined functions, respectively, the plurality of operating portions including a predetermined operating portion to generate, in response to a same manual operation from own motive of a viewer, a control signal for carrying out replacement of a currently viewed broadcast program with the one definite broadcast program identified by the program selection of the another broadcast program viewing system, the same manual operation being universal regardless of the information and without any program selecting operation; and**

137. In my opinion, Cooper discloses and renders obvious this limitation. *See* §§IV(B)(1), (5)-(7), (D)(2)-(3), (E)(5)-(6), (H)(2)-(3) (limitations 1.pre, 1.d-f, 3.a-b, 4.c.i-c.ii, 7.a-b); §III(D)(4)-(5) (constructions of *without any program selecting operation* and *universal*); *see also* §§IV(B), (D)-(E), (H) (claims 1, 3-4, 7).

3. **[8.b.i] a signal transmitter arranged to wirelessly transmit the control signal in response to the same manual operation from own motive of the viewer at the predetermined operating portion to instantly carry out the replacement of the currently viewed broadcast program with the one definite broadcast program identified by the program selection of the another broadcast program viewing system,**

138. In my opinion, Cooper discloses and renders obvious this limitation.

See §§IV(B)(7), (D)(2)-(3), (E)(5)-(6), (H)(2)-(3) (limitations 1.f, 3.a-b, 4.c.i-c.ii, 7.a-b); *see also* §§IV(B), (D)-(E), (H) (claims 1, 3-4, 7).

4. **[8.b.ii] wherein the same manual operation from own motive having no influence on the program selection of the another broadcast program viewing system, but having influence solely on the replacement of the broadcast program of the own broadcast program viewing system into the one definite broadcast program identified by the program selection of the another broadcast program viewing system in accordance with the information,**

139. In my opinion, Cooper discloses and renders obvious this limitation.

See §§IV(B)(5), (E)(5) (limitations 1.f, 4.c.i); *see also* §§IV(B), (E) (claims 1, 4).

5. **[8.c] wherein the information includes information of a broadcast program which is not currently viewed, but can be viewed by a channel change, the information being without request or acknowledgement from the another broadcast program viewing system.**

140. In my opinion, Cooper discloses and renders obvious this limitation.

See §§IV(B)(6), (E)(3) (limitations 1.e, 4.b.i); *see also* §§IV(B), (E) (claims 1, 4).

* * *

141. To the extent it is asserted that the portions of Cooper that I have cited above relate to different, incompatible embodiments (which they do not), in my opinion, it would have been obvious to a POSITA to combine such embodiments into a single system for providing the ability to share and watch another user's broadcast program at least because such embodiments are described in the same prior art reference, are fully compatible with each other, and could be combined with minimal effort to achieve predictable results.

142. To the extent it is asserted that Cooper does not disclose any limitation of the challenged claims, in my opinion, such limitation would have nonetheless been obvious to a POSITA in light of Cooper and a POSITA's knowledge. Practicing any limitation of the challenged claims in light of Cooper would have been within the knowledge and skill of a POSITA, would have required minimal effort, would have yielded predictable results, would have been fully compatible with the Cooper system, and would have been a mere design choice. Motivation to do so arises from at least common sense and the disclosures of Cooper set forth above.

V. GROUND 2: CLAIMS 1-16 ARE OBVIOUS BASED ON COOPER AND SLOTZNICK AND THE KNOWLEDGE OF A POSITA

A. Overview of the Prior Art References

1. Cooper

143. My explanation of the Cooper reference is above and herein incorporated by reference into Ground 2. *See* §IV(A).

2. Slotznick

144. U.S. Patent Application Ser. No. 09/880,168 (“Slotznick”) was filed on June 13, 2001, and published as US2001/0055951 on December 27, 2001. Slotznick EX1005, cover page. I have been informed that Slotznick is prior art under 35 U.S.C. §102(a), (b), (e) (pre-AIA).

145. Slotznick describes a “TV Phone” input/output device that functions as both a wireless phone and a TV remote control for interacting with a television. Slotznick EX1005, ¶13 (“[t]he present invention combines a wireless phone with a TV remote (referred to below as ‘TV Phone’ or a ‘television device’)).⁵ In addition to the conventional features associated with a wireless phone and TV remote, Slotznick’s TV Phone can function like a mouse to interact with web elements shown on a user’s TV. Slotznick EX1005, ¶35 (“TV phone can operate as

⁵ In my opinion, a POSITA would have understood that Slotznick’s discussion of items 101 and 321 describe the same phone.

a pointing device (*e.g.*, a 3D mouse) with respect to the display on a nearby TV which has the requisite devices for communicating with the TV Phone”), ¶35 (“the TV Phone can be used as a pointing device to navigate the page and click on links”), ¶35 (the selection of links “trigger ... the retrieval of a web page or other information”), ¶121 (“the TV phone acts as an input device (*e.g.*, a mouse ...)”), ¶133 (“user can input information to the WebTV device ... by clicking on hyperlinks”).

146. In my opinion, Slotznick is analogous art to the ’615 patent. Slotznick is from the same field of endeavor as the ’615 patent. They are both patents in the field of television systems. In addition, Slotznick is reasonably relevant to the problem the patent is concerned with, as shown in my analysis below in section V.B.

147. Based on my review of the prosecution history (EX1003), Slotznick appears to have not been considered during prosecution of the ’615 patent.

B. Motivation to Combine Slotznick with Cooper

148. In my opinion, a POSITA would have been motivated to combine the TV Phone of Slotznick with Cooper because Cooper describes interacting with a television set system including a set-top box, using input/output devices that include a mouse, and Slotznick describes an input/output device that includes

functions of a conventional mouse for interacting with a television set system potentially including a set-top box, as described above. *See* §V(A)(1)-(2).

149. Accordingly, in my opinion, a POSITA would have been motivated by the teachings of Slotznick to modify Cooper to substitute Cooper's input device with Slotznick's TV Phone. Such a combination involves a simple substitution of one known element (Slotznick's TV Phone) for another (Cooper's conventional mouse) to obtain predictable results (e.g., controlling the Set-Top Box (STB) with the TV Phone using a set of functionality that mirrors a traditional remote control, like being able to change a channel, adjust the volume, etc.). Slotznick EX1005, ¶130 ("TV phone 321 also can be used as a remote control for the Television Receiver 303" and "TV remove control circuitry 334 [of TV phone 321] transfers its data to a wireless transmitter 335 which sends that data to a wireless receiver 315 in the Television Receiver 303," which data includes "data for changing a channel, increasing or decreasing volume of audio, powering the system on and off, or the like"), ¶130 ("wireless receiver 315 receives data ... in the same manner it receives data from a standard TV remote control device").

150. Additionally, in my opinion, a POSITA would be motivated by the teachings described in Slotznick to substitute its input device with Slotznick's TV Phone because such substitution is obvious to try. Slotznick EX1005, ¶18 ("present invention allows a natural verbal and aural interactivity without breaking up the

expected linearity of TV programming” and “without major telecommunications infrastructure upgrades”), ¶12 (the TV Phone provides a wireless means of interacting with the TV and removes the need for a solid surface in order to operate).

151. Accordingly, in my opinion, a POSITA would have had a reasonable expectation of success in making the proposed combination given the teachings of Cooper and Slotznick. Such a combination would have required minimal modifications to Cooper to use Slotznick’s remote, and thus would have been well within the skillset of a POSITA. The proposed combination would not have required undue experimentation and would have yielded the predictable result. Slotznick’s TV Phone as a remote control would have been fully compatible with Cooper’s television set system. Moreover, changing remote controls for a given TV system would have been well-known to a POSITA and was commonplace. For example, universal remote controls were commonplace.

152. To the extent it is argued that the portions of Cooper or Slotznick that I have cited to below relate to different, incompatible embodiments (which they do not), in my opinion, it would have been obvious to a POSITA to combine such embodiments into a single system for providing the ability to share and watch another user’s broadcast program at least because such embodiments are described

in the same prior art reference, are fully compatible with each other, and could be combined with minimal effort to achieve predictable results.

C. Claim 1

153. In my opinion, Cooper in view of Slotznick discloses and renders this claim obvious. *See* §IV(B) (claim 1).

1. [1.pre] A television set system comprising:

154. In my opinion, Cooper in view of Slotznick discloses and renders the preamble obvious. *See* §IV(B)(1) (limitation 1.pre).

2. [1.a] a television function unit;

155. In my opinion, Cooper in view of Slotznick discloses and renders this limitation obvious. *See* §IV(B)(2) (limitation 1.a).

**3. [1.b] a display arranged to display a broadcast program
accordance with the television function unit;**

156. In my opinion, Cooper in view of Slotznick discloses and renders this limitation obvious. *See* §IV(B)(3) (limitation 1.b).

**4. [1.c] a receiver arranged to receive, without request or
acknowledgement, information of one definite broadcast
program which can be displayed on the display and is
identified by a channel selection of another television set in
another place;**

157. In my opinion, Cooper in view of Slotznick discloses and renders this limitation obvious. *See* §IV(B)(4) (limitation 1.c).

5. **[1.d] a manual controller arranged to change the display in response to a predetermined same manual operation from own motive of a viewer of the display on the basis of the information received by the receiver, the predetermined same manual operation from own motive having no influence on the channel selection of the another television set, but having influence solely on the change in the display of the own television set into the one definite broadcast program identified by the channel selection of the another television set with the information received by the receiver,**

158. In my opinion, Cooper in view of Slotznick discloses and renders this limitation obvious.

159. In my opinion, Cooper in view of Slotznick discloses and renders obvious *a manual controller* (Slotznick's TV Phone 101) *arranged to change the display* (Cooper's TV 502) *in response to a predetermined same manual operation* (pushing a button on Slotznick's TV Phone 101 to select a link in the buddy list of Cooper) *from own motive of a viewer of the display on the basis of the information* (link) *received by the receiver* set-top box (including tuner and network communication card 514). *See* §IV(B)(5) (limitation 1.d).

160. As described above, Cooper discloses that its television system (*e.g.*, set-top box 500 and television 502) can be controlled by various input/output devices such as a mouse. *See* §IV(B)(5) (limitation 1.c). Slotznick discloses an input/output device for TV systems in the form of TV Phone 101. Slotznick EX1005, Fig. 1C (element 101), ¶121 ("the TV phone acts as an input device (*e.g.*, a mouse, pointing device) to a WebTV-type device connected to the display

screen.”). The TV phone 101 is controlled via manual inputs. Slotznick EX1005, ¶59 (“the selection of a special or specified button initiates an enhanced function the phrase, ‘selection of a button’ includes selecting a single button, selecting a plurality of specified buttons that must be pressed in a specific sequence”), ¶64 (“[t]he telephone device includes a button which facilitates communication between the telephone device and the remotely located entity, and a wireless receiver”), Fig. 1C (element 115 is an example button on TV Phone 101), ¶122 (describing the various buttons on TV Phone 101). The TV Phone 101 is operable to select a link shown on a TV. Slotznick EX1005, ¶35 (“the TV phone can be used as a pointing device to navigate the page and click on links”), ¶133 (“[t]he user can input information to the WebTV device (*e.g.*, ‘by clicking on hyperlinks or by typing e-mail’) using the keyboard 365 or the TV remote 367”), ¶134 (“[i]nput to the remote control module in the TV phone 321 ... and the keypad in the TV phone 321 ... control the WebTV device in the same way as the TV remote 367 ... and keyboard 365”). Thus, at least one button from buttons 113, 115, 119, and 121 is used to select a link displayed to the user. Slotznick EX1005, Fig. 1A (“Person pushes a button ...such as the TV Phone button 113 ... [and the] phone automatically ... goes to the web site address emitted by the object or the device connected to the object”), ¶35 (“the TV Phone can be used as a pointing device to navigate the page and click on links”), ¶121.

161. In my opinion, a POSITA would be motivated by the teachings of Slotznick to modify Cooper to substitute its television system input device with Slotznick's TV Phone. §V(B) (Motivation to combine). Accordingly, Cooper in view of Slotznick yields a system in which a user changes the display in response to the user performing a predetermined operation on the TV Phone (*i.e.*, pushing a button on the TV Phone to click a link in their buddy list). Thus, in my opinion, Cooper in view of Slotznick discloses and renders this limitation obvious.

6. **[1.e] wherein the information includes information of a broadcast program which is currently not displayed on the display, but can be displayed by a channel change, and**

162. In my opinion, Cooper in view of Slotznick discloses and renders this limitation obvious. *See* §IV(B)(6) (limitation 1.e).

7. **[1.f] wherein the manual controller is arranged to instantly carry out replacement of the currently displayed broadcast program with the one definite broadcast program identified by the channel selection of the another television set in response to the predetermined same manual operation, the same manual operation being universal regardless of the information and without any channel selecting operation,**

163. In my opinion, Cooper in view of Slotznick discloses and renders this limitation obvious. *See* §IV(B)(7) (limitation 1.f).

8. **[1.g] whereby same experience as that of a viewer of the another television set is possible from motive of the viewer by means of the manual controller.**

164. In my opinion, Cooper in view of Slotznick discloses and renders this limitation obvious. *See* §IV(B)(8) (limitation 1.g).

D. Claim 2- The television set system according to claim 1, wherein the channel information⁶ of the another television set is converted into its own local channel number if it differs from that of the local channel number in an area where the another television set is located.

165. In my opinion, Cooper in view of Slotznick discloses and renders this claim obvious.

166. As I explain above in Sections IV(B) and V(C), Cooper discloses and renders obvious *the television set system according to claim 1*. See §IV(C) (claim 2); §V(C) (claim 1).

E. Claim 3

167. In my opinion, Cooper in view of Slotznick discloses and renders this claim obvious. See §IV(D) (claim 3).

1. [3.pre] The television set system according to claim 1, wherein the manual controller is a remote controller including:

168. As I explain above in Sections IV(B) and V(C), Cooper discloses and renders obvious *the television set system according to claim 1*. See §IV(C) (claim 2); §V(C) (claim 1).

169. In my opinion, Cooper in view of Slotznick discloses and renders obvious that *the manual controller (e.g., TV Phone) is a remote controller*. See §V(C)(5) (limitation 1.d). Slotznick's TV Phone is a remote controller. Slotznick

⁶ The limitation "the channel information" lacks antecedent basis in claim 1.

EX1005, ¶13 (“[t]he present invention combines a wireless phone with a TV remote (referred to below as a ‘TV Phone’ or a ‘telephone device’”), ¶32 (“[w]hen such a TV phone-enabled cell phone is in the presence of a TV phone set-top box ... these cell phones act as a TV phone and a TV remote”), ¶130 (“TV phone 321 also can be used as a remote control for Television Receiver 303”), ¶134 (“TV Phone 321 ... and the keypad in the TV Phone 321 ... control the WebTV device in the same way as the TV remote 367 ... and keyboard 365”), ¶12 (“[c]urrent technology for computer pointer devices no longer requires that a cable connect the pointer device (*e.g.*, mouse or track ball) to the computer ... current technology enables the pointer device to communicate with the computer in a wireless manner (*e.g.*, by using a Microsoft wireless mouse)”). Therefore, in my opinion, Cooper in view of Slotznick discloses and renders the preamble obvious.

2. **[3.a] an operating part including a plurality of keys each of which are assigned to predetermined functions, respectively, the plurality of keys including a predetermined key for replacing the currently displayed broadcast program by the one definite broadcast program identified by the channel selection of the another television set; and**

170. In my opinion, Cooper in view of Slotznick discloses and renders obvious that the remote controller includes *an operating part* (front portion of the TV Phone) *including a plurality of keys* (buttons 113, 115, 119, 121), *each of which are assigned to predetermined functions, respectively.*

171. Slotznick's TV Phone 101 includes a front portion that includes elements for operating the TV Phone 101. Slotznick EX1005, ¶122 ("FIG. 1C shows the hand unit of a TV Phone 101"). The front portion includes a plurality of buttons 113, 115, 119, and 121, each of which are assigned to predetermined functions. Slotznick EX1005, ¶122 ("Some of its features are similar to those of a standard wireless telephone such as ... an alphanumeric keypad 119, a control keypad with SEND and RECEIVE keys 121, a power on and off switch 107"), ¶122 ("[s]pecial features of the TV phone are ... a special TV Phone button 113 ... [and] a special TV Internet button 115"). Slotznick discloses the ability to preprogram a button to perform an "enhanced function." Slotznick EX1005, ¶59.

172. In my opinion, Cooper in view of Slotznick discloses *the plurality of keys including a predetermined key for replacing the currently displayed broadcast program by the one definite broadcast program identified by the channel selection of the another television set*. As established above for limitation 1.d, at least one button from buttons 113, 115, 119, and 121 is used to select a link displayed to the user. §V(C)(5) (limitation 1.d). Additionally, as established above, selection of a link in a buddy list causes the user's channel to change to the selected programming. §§IV(B)(5)-(7) (limitations 1.d-1.f). Because one of buttons 113, 115, 119, or 121 is programmed to perform a selection operation, it is predetermined that one of button 113, 115, 119, or 121 would replace the currently

displayed program with the remote television's program (the one definite broadcast program identified by the channel selection of the another television) when the user presses the button to select the link corresponding to the remote television's program.

173. To the extent it is argued that the predetermined key must be programmed to perform the replacement function, in my opinion, a POSITA would have understood that preprogramming a TV remote button to perform enhanced functions, such as simultaneous viewing, was well-known in the art and obvious to try. *See, e.g.*, Slotznick EX1005, ¶59; Kutsuna EX1017, Fig. 2 (item 34), [0013-15, 17-18, 134-143, 153-154, 193, 386]; EX1003, 88-95.

174. Therefore, in my opinion, Cooper in view of Slotznick discloses and renders this limitation obvious.

3. [3.b] a signal transmitter arranged to transmit a control signal to the television function unit in response to the operation of the predetermined key in the operating part.⁷

175. In my opinion, Cooper in view of Slotznick discloses and renders obvious that the TV Phone includes *a signal transmitter* (wireless transmitter) *arranged to transmit a control signal* (a command to select the link) *to the*

⁷ In my opinion, the plain meaning of “transmit” includes both direct transmission and indirect transmission.

television function unit in response to the operation of the predetermined key (§V(E)(2)) in the operating part. See §V(C)(5) (limitation 1.d). Slotznick's TV Phone wirelessly transmits commands to the TV system via, for example, its wireless transmitter. Slotznick EX1005, ¶12 (“[c]urrent technology for computer pointer devices no longer requires that a cable connect the pointer device (e.g., mouse or track ball) to the computer ... current technology enables the pointer device to communicate with the computer in a wireless manner (e.g., by using a Microsoft wireless mouse”), ¶122 (“[s]pecial features of the TV phone are an antenna 103 for communicating with the TV or set-top box and a special TV phone button 113”), ¶130 (“TV phone 321 also can be used as a remote control for the Television Receiver 303”), ¶130 (“TV remote control circuitry 334 transfers its data to a wireless transmitter 335 [in the TV phone 321] which sends that data to a wireless receiver 315 in the Television Receiver 303”), Fig. 3 (wireless transmitter 335 in TV phone 321). Thus, when a user pushes one of buttons 113, 115, 119, or 121, or a pre-programmed button, see (§V(E)(2)), to select a link, a signal indicating the select command is wirelessly transmitted from TV Phone 321 to the set-top box or TV via wireless receiver 315.

176. Therefore, in my opinion, Cooper in view of Slotznick discloses and renders this limitation obvious.

F. Claim 4

177. In my opinion, Cooper in view of Slotznick discloses and renders this claim obvious. *See* §IV(E) (claim 4), §V(C) (claim 1).

1. **[4.pre] A broadcast program viewing system for viewing a broadcast program same as that identified by a program selection of another broadcast program viewing system in another place to share same experience of viewing same broadcast program, comprising:**

178. In my opinion, Cooper in view of Slotznick discloses and renders obvious the preamble. *See* §V(C)(1), §V(C)(4) (limitations 1.pre and 1.c).

2. **[4.a] a display arranged to display a broadcast program;**

179. In my opinion, Cooper in view of Slotznick discloses and renders this limitation obvious. *See* §V(C)(3) (limitation 1.b).

3. **[4.b.i] a receiver arranged to receive, without request or acknowledgement, information of one definite broadcast program which can be displayed on the display and is identified by the program selection of the another broadcast program viewing system**

180. In my opinion, Cooper in view of Slotznick discloses and renders this limitation obvious. *See* §V(C)(4) (limitation 1.c).

4. **[4.b.ii] the information including information of a broadcast program which is not currently not displayed on the display, but can be displayed by a channel change; and**

181. In my opinion, Cooper in view of Slotznick discloses and renders this limitation obvious. *See* §V(C)(6) (limitation 1.e).

5. **[4.c.i] a manual controller having a predetermined operating portion to change the display in response to a predetermined same manual operation from own motive of a viewer of the display on the basis of the information received by the receiver, the predetermined same manual operation from own motive having no influence on the program selection of the another broadcast program viewing system, but having influence solely on the change in the display of the own broadcast program viewing system into the one definite broadcast program identified by the program selection of the another broadcast program viewing system with the information received by the receiver**

182. In my opinion, Cooper in view of Slotznick discloses and renders this limitation obvious. *See* §IV(E)(5), §V(C)(5)-(7), §V(D)(2) (limitations 1.d-f, 3.a, 4.c.i); §III(D)(4) (construction of *without any program selecting operation*).

6. **[4.c.ii] wherein the manual controller is arranged to instantly carry out replacement of the currently displayed broadcast program with the one definite broadcast program identified by the program selection of the another broadcast program viewing system in response to the same manual operation at the predetermined operating portion, the same manual operation being universal regardless of the information and without any program selecting operation.**

183. In my opinion, Cooper in view of Slotznick discloses and renders this limitation obvious. *See* §IV(E)(6), §V(C)(5)-(7) (limitations 1.d-f, 4.c.ii); §III(D)(4) (construction of *without any program selecting operation*).

- G. Claim 5 - The broadcast program viewing system according to claim 4, wherein the broadcast program is television program transmitted from a broadcast station, and wherein the program selection of the another broadcast program viewing system is a channel selection to identify a broadcast station.**

184. In my opinion, Cooper in view of Slotznick discloses and renders this claim obvious. *See* §IV(F) (claim 5).

- H. Claim 6 - The broadcast program viewing system according to claim 4, wherein the broadcast program is television program data to be downloaded from a server station, and wherein the program selection of the another broadcast program viewing system is a code setting to download the selected broadcast program.**

185. In my opinion, Cooper in view of Slotznick discloses and renders this claim obvious. *See* §IV(G) (claim 6).

I. Claim 7

186. In my opinion, Cooper in view of Slotznick discloses and renders this claim obvious. *See* §V(E)-(F) (claims 3-4).

- 1. [7.pre] The broadcast program viewing system according to claim 4, wherein the manual controller is a remote controller including:**

187. In my opinion, Cooper in view of Slotznick discloses and renders the preamble obvious. *See* §IV(E)(1) (limitation 4.pre); §V(F) (claim 4).

2. **[7.a] an operating part including a plurality of operating portions each of which are assigned to predetermined functions, respectively, the plurality of operating portions including the predetermined operating portion; and**

188. In my opinion, Cooper in view of Slotznick discloses and renders this limitation obvious. *See* §V(E)(2) (limitation 3.b).

3. **[7.b] a signal transmitter arranged to transmit a control signal to the display in response to the operation at the predetermined operating portion.⁸**

189. In my opinion, Cooper in view of Slotznick discloses and renders this limitation obvious. *See* §IV(H)(3), §V(E)(3) (limitations 7.b, 3.c).

J. Claim 8

190. In my opinion, Cooper in view of Slotznick discloses and renders this claim obvious. *See* §V(C), (E)-(F) (claims 1, 3-4).

⁸ In my opinion, the plain meaning of “transmit” includes both direct transmission and indirect transmission (i.e., remote controller to set-top box to display).

2. **[8.pre] In a broadcast program viewing system for viewing a broadcast program same as that identified by a program selection of another broadcast program viewing system in another place in accordance with information of one definite broadcast program which can be viewed by the broadcast program viewing system and is identified by the program selection of the another broadcast program viewing system to share same experience of viewing same broadcast program, a remote controller comprising:**

191. In my opinion, Cooper in view of Slotznick discloses and renders this preamble obvious. *See* §§V(C)(1), (C)(4)-(5), (E)(1), (F)(1), (F)(3)-(4), (I)(1) (limitations 1.pre, 1.c-d, 3.pre, 4.pre, 4.b.i-b.ii, 7.pre); *see also* §§V(C), (E)-(F), (I) (claims 1, 3-4, 7).

3. **[8.a] a manual operating part including a plurality of manual operating portions each of which are assigned to predetermined functions, respectively, the plurality of operating portions including a predetermined operating portion to generate, in response to a same manual operation from own motive of a viewer, a control signal for carrying out replacement of a currently viewed broadcast program with the one definite broadcast program identified by the program selection of the another broadcast program viewing system, the same manual operation being universal regardless of the information and without any program selecting operation; and**

192. In my opinion, Cooper in view of Slotznick discloses and renders this limitation obvious. *See* §§V(C)(1), (5)-(7), (E)(2)-(3), (F)(5) (limitations 1.pre, 1.d-f, 3.b-c, 4.c); *see also* §§(V)(C), (E), (F) (claims 1, 3-4, 7).

4. **[8.b.i] a signal transmitter arranged to wirelessly transmit the control signal in response to the same manual operation from own motive of the viewer at the predetermined operating portion to instantly carry out the replacement of the currently viewed broadcast program with the one definite broadcast program identified by the program selection of the another broadcast program viewing system,**

193. In my opinion, Cooper in view of Slotznick discloses and renders this limitation obvious. *See* §§V(C)(7), (E)(2)-(3), (F)(5)-(6), (I)(2)-(3) (limitations 1.f, 3.a-b, 4.c.i-c.ii, 7.a-b); *see also* §§V(C), (E), (F), (I) (claims 1, 3-4, 7).

5. **[8.b.ii] wherein the same manual operation from own motive having no influence on the program selection of the another broadcast program viewing system, but having influence solely on the replacement of the broadcast program of the own broadcast program viewing system into the one definite broadcast program identified by the program selection of the another broadcast program viewing system in accordance with the information,**

194. In my opinion, Cooper in view of Slotznick discloses and renders this limitation obvious. *See* §§V(C)(7), (F)(5) (limitations 1.f, 4.c.i); *see also* §§V(C), (F) (claims 1, 3, 4).

6. **[8.c] wherein the information includes information of a broadcast program which is not currently viewed, but can be viewed by a channel change, the information being without request or acknowledgement from the another broadcast program viewing system.**

195. In my opinion, Cooper in view of Slotznick discloses and renders this limitation obvious. *See* §§V(C)(6), (F)(3) (limitations 1.e, 4.b.i); *see also* §§V(C), (F) (claims 1, 4).

K. Claim 9 - The remote controller according to claim 8 further comprising a display.

196. In my opinion, Cooper in view of Slotznick discloses and renders this claim obvious.

197. As I explain above in Section V(J), Cooper in view of Slotznick discloses and renders obvious *the remote controller according to claim 8. See* §V(J) (claim 8).

198. Slotznick discloses that the remote controller includes *a display* (LCD panel 111). *See, e.g.,* Slotznick EX1005, ¶122 (“Some of its [TV Phone 101] features are similar to those of a standard wireless telephone such as ... an LCD panel 111”), ¶147 (“[t]he data may be displayed on a small LCD screen 111 on the TV phone”), ¶153 (“shown the phone number in the LCD screen 111 (or other display screen) of the TV Phone 321”), Fig. 1C (element 111).

199. Thus, in my opinion, Cooper in view of Slotznick discloses and renders this claim obvious.

L. Claim 10 - The remote controller according to claim 9, wherein the manual operating portions of the manual operating part include a phone call key.

200. In my opinion, Cooper in view of Slotznick discloses and renders this claim obvious.

201. As I explain above in Section V(K), Cooper in view of Slotznick discloses and renders obvious *the remote controller according to claim 9. See* §V(K) (claim 9).

202. Slotznick discloses *the manual operating portions* (buttons 113, 115, 119, 121, and 329) *of the manual operating part* (front of TV Phone 101) *include a phone call key* (special button 329 and button 113). Slotznick's TV Phone 321 includes a special button 329 that is pressed to make a phone call. Slotznick EX1005, ¶145 ("pressing the special button 329 causes the autodialer 327 to make the phone call"). Slotznick's TV Phone 101 also includes a "button 113" that places a phone call. Slotznick EX1005, ¶122, Fig. 1A (the phone "dials the telephone number" upon pushing button 113); *see also* Slotznick EX1005, ¶13 ("the viewer clicks a button on the TV Phone and the call is automatically placed").

203. Therefore, in my opinion, Cooper in view of Slotznick discloses and renders this limitation obvious.

M. Claim 11 - The remote controller according to claim 10, wherein the manual operating portions of the manual operating part include ten key.

204. In my opinion, Cooper in view of Slotznick discloses and renders this claim obvious.

205. As I explain above in Section V(L), Cooper in view of Slotznick discloses and renders obvious *the remote controller according to claim 10*. See §V(L) (claim 10).

206. Slotznick discloses *the manual operating portions* (buttons 113, 115, 119, 121, and 329) *of the manual operating part* (front of TV Phone 101) *include ten key* (the ten numeric keys of alphanumeric keypad 119). See, e.g., Slotznick EX1005, ¶122 (“[s]ome of its [the TV Phone 101] features are similar to those of a standard wireless telephone such as ... an alphanumeric keypad 119”), Fig. 1C (element 119, showing ten keys numbered 0 through 9). In my opinion, in the context of the ’615 patent, ten key 78 for channel selection includes at least the keys numbered 0 to 9 from Figure 18. ’615 patent EX1001, Fig. 18, 38:42-46.

207. Therefore, in my opinion, Cooper in view of Slotznick discloses and renders this limitation obvious.

N. Claim 12 - The remote controller according to claim 11 further comprising a speaker.

208. In my opinion, Cooper in view of Slotznick discloses and renders this claim obvious.

209. As I explain above in Section V(M), Cooper in view of Slotznick discloses and renders obvious *the remote controller according to claim 11*. See §V(M) (claim 11).

210. Slotznick discloses the *remote controller* (TV Phone) includes a *speaker* (speaker 109). *See, e.g.*, Slotznick EX1005, ¶122 (“[s]ome of its [the TV Phone 101] features are similar to those of a standard wireless telephone such as ... a speaker 109”), Fig. 1C (element 119), ¶147 (“data may be ... delivered to the user via a voice or audio interface using a speaker 109”). Therefore, in my opinion, Cooper in view of Slotznick discloses and renders this limitation obvious.

O. Claim 13 - The remote controller according to claim 12 further comprising a microphone.

211. In my opinion, Cooper in view of Slotznick discloses and renders this claim obvious.

212. As I explain above in Section V(N), Cooper in view of Slotznick discloses and renders obvious *the remote controller according to claim 12*. *See* §V(N) (claim 12).

213. Slotznick discloses the *remote controller* (TV Phone) includes a *microphone* (microphone 117/323). *See, e.g.*, Slotznick EX1005, ¶122 (“[s]ome of its [the TV Phone 101] features are similar to those of a standard wireless telephone such as microphone 117”), Fig. 1C (element 117), ¶129 (“the user may talk through the microphone 323 of the TV phone 321”), ¶132 (“commands and data entries can be accomplished by speaking into the microphone 332”).

214. Therefore, in my opinion, Cooper in view of Slotznick discloses and renders this limitation obvious.

P. Claim 14 - The remote controller according to claim 13, wherein the manual operating portions of the manual operating part include a menu key.

215. In my opinion, Cooper in view of Slotznick discloses and renders this claim obvious.

216. As I explain above in Section V(O), Cooper in view of Slotznick discloses and renders obvious *the remote controller according to claim 13. See §V(O) (claim 13).*

217. In my opinion, Cooper in view of Slotznick discloses and renders obvious that *the manual operating portions (buttons) of the manual operating part (front of TV Phone) include a menu key.* Slotznick discloses that the TV phone is a remote control for the television. *See §V(C)(5) (limitation 1.d).* Slotznick's TV Phone also includes buttons for controlling the TV. *See §V(C)(5) (limitation 1.d), §V(E)(3) (limitation 3.b).* Although Slotznick does not explicitly state that one of its buttons is a menu key, in my opinion, a POSITA would have known that a menu button was a well-known and standard button on remote controls.

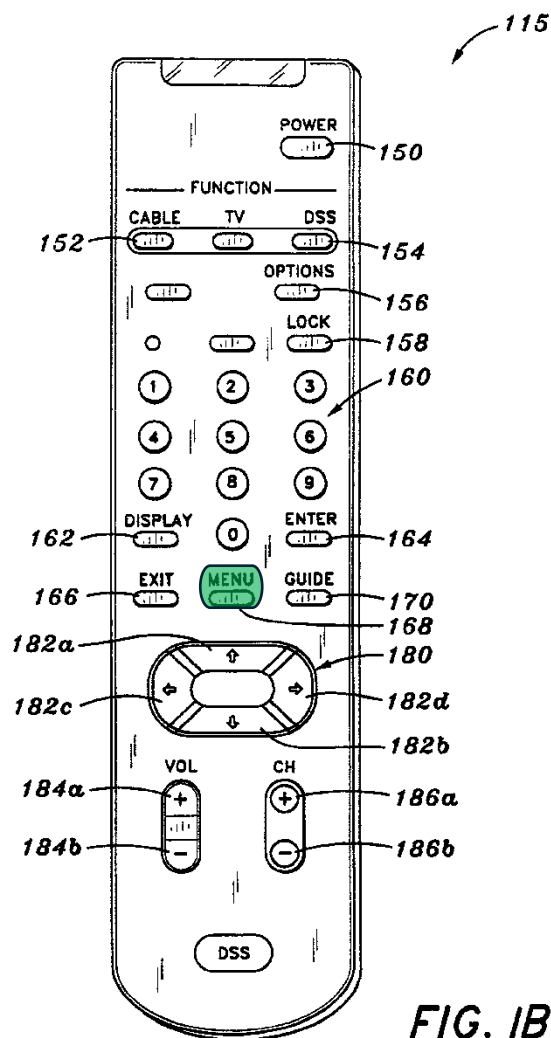


FIG. 1B

Reyes EX1008, Fig. 1B (menu key 168, annotated green), ¶124 (“MENU key 168”).

218. In my opinion, a POSITA would have included a menu key in the TV Phone by including a button with a predefined menu function, or by programming one of the existing keys (there are three at the bottom of Fig. 1C) that are blank to be the menu key. In my opinion, doing so would have been within the skill of a

POSITA, would have led to predictable results, and would have had a reasonable expectation of success. Doing so would have been fully compatible with the TV Phone. Motivation to do so arises from Slotznick's disclosure that it has all the common functions of a TV remote, which commonly included menu keys, as established above. Additional motivation arises from Reyes's disclosure of menu key 168 in its TV remote. Additional motivation arises from the knowledge of a POSITA, who would have known that TVs and Set-Top Boxes often had menus, such as for settings and options, that a user would need to access. More motivation arises from Cooper's disclosure in Fig. 5 of an "AOLTV Menu." Cooper EX1004, Fig. 5; *see also, e.g.*, Houghton EX1015, ¶84 ("AOLTV, a Web-based TV service offered by America Online"). A menu key would be desirable to let the user access this menu with a key press.

219. Therefore, in my opinion, Cooper in view of Slotznick discloses and renders this limitation obvious.

Q. Claim 15 - The remote controller according to claim 13, wherein the manual operating portions of the manual operating part include a scroll key.

220. In my opinion, Cooper in view of Slotznick discloses and renders this claim obvious.

221. As I explain above in Section V(O), Cooper in view of Slotznick discloses and renders obvious *the remote controller according to claim 13*. See §V(O) (claim 13).

222. In my opinion, Cooper in view of Slotznick discloses and renders obvious that *the manual operating portions (buttons) of the manual operating part (front of TV Phone) include a scroll key*. Slotznick discloses that the TV Phone is a remote control for the television. See §V(C)(5). Slotznick's TV Phone also includes buttons for controlling the TV. See §V(C)(5) (limitation 1.d), §V(E)(3) (limitation 3.b). Although Slotznick does not explicitly state that one of its buttons is a scroll key, in my opinion, a POSITA would have known that a scroll button is a standard button on remote controls. See Reyes EX1008, ¶24 ("scroll buttons 182a-d").

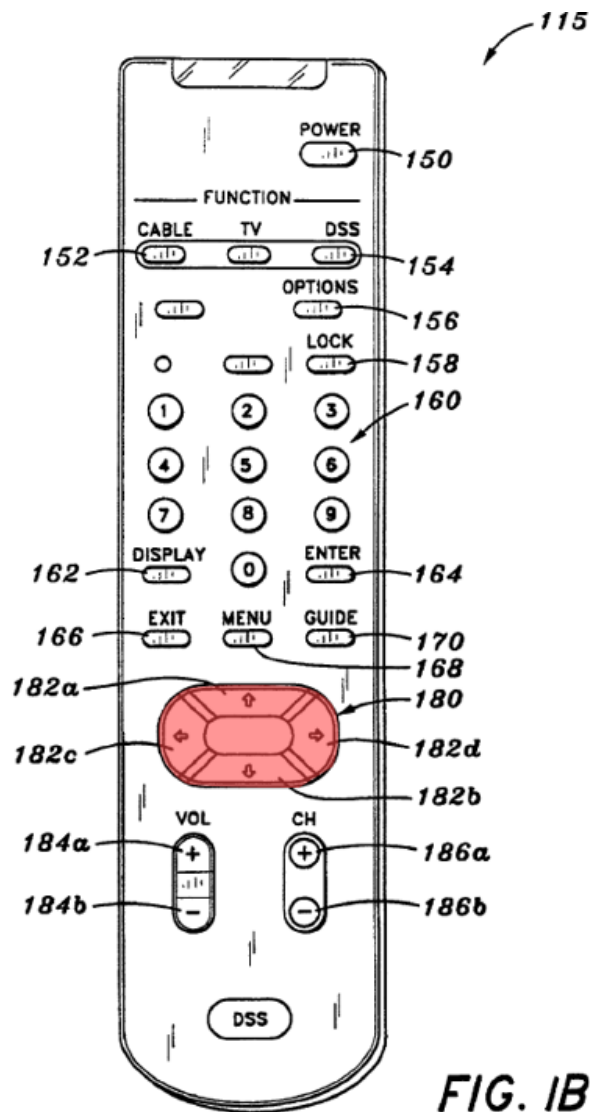


FIG. 1B

Reyes EX1008, Fig. 1B (shown above with buttons 182a-d annotated red). A POSITA would have been motivated to incorporate the remote control scroll buttons of Reyes or Heaton with the remote control of Slotznick because all of them describe remote control devices with design variations for interacting with a television set system.

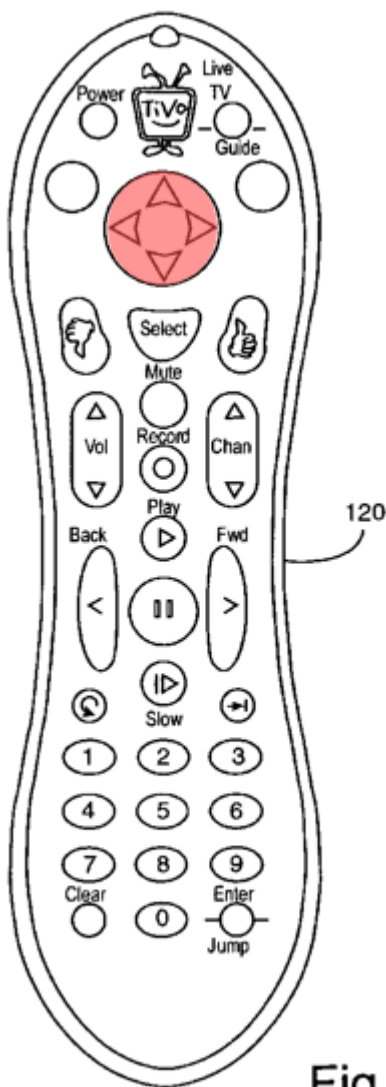


Fig. 7

Heaton EX1007, Fig. 7 (showing similar keys, annotated red). Additionally, in my opinion, a POSITA would have included a scroll key in the TV Phone by including a button with a predefined scroll function, or by programming one of the existing keys (including the up/down button shown in Fig. 1C) to be the scroll key. Doing so would have been within the skill of a POSITA, would have led to predictable results, and would have had a reasonable expectation of success. Doing so would have been fully compatible with the TV Phone. Motivation to do so arises from

Slotznick's disclosure that it has all the common functions of a TV remote, which commonly included scroll keys, as established above. Additional motivation arises from the knowledge of a POSITA, who would have known that TVs and STBs often had menus, such as for settings and options, that a user would need to access. A scroll key would be desirable to let the user scroll through EPGs (Electronic Programming Guides, which Cooper discloses) using a button. Similar motivation comes from Houghton, which discloses scrolling through an EPG. Houghton EX1015, ¶13. Additional motivation comes from Scott, which discloses using up and down keys on a remote to scroll a web page. Scott EX1016, ¶¶92-94.

223. Therefore, in my opinion, Cooper in view of Slotznick discloses and renders this limitation obvious.

R. Claim 16 - The remote controller according to claim 13, wherein the manual operating portions of the manual operating part include a push-down operation key.

224. In my opinion, Cooper in view of Slotznick discloses and renders this claim obvious.

225. As I explain above in Section V(O), Cooper in view of Slotznick discloses and renders obvious *the remote controller according to claim 13. See §V(O) (claim 13).*

226. In my opinion, Cooper in view of Slotznick discloses and renders obvious that *the manual operating portions (buttons) of the manual operating part*

(front of TV Phone) *include a push-down operation key*. Slotznick discloses that the TV Phone is used as a remote control for the television. *See* §V(C)(5) (limitation 1.d). Slotznick discloses that a user “pushes” the keys of the TV Phone. Figs. 1A-B. In my opinion, a POSITA would have understood that one operates the TV Phone keys by pushing them down. *See, e.g.*, Fig. 1C. Additionally, Slotznick discloses a push-down arrow key (annotated yellow below).

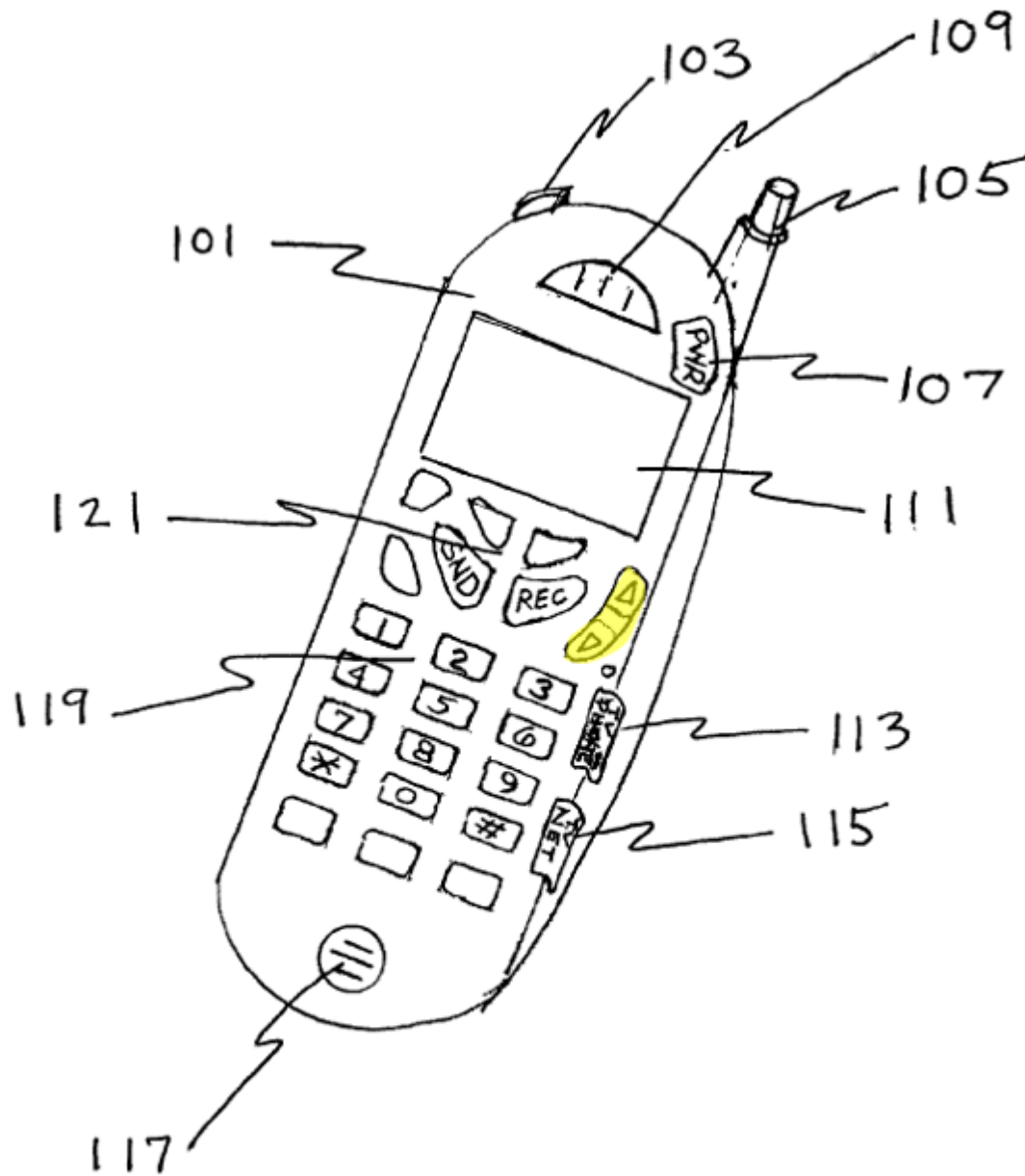


Fig. 1C

Slotznick EX1005, Fig. 1C.

227. Therefore, in my opinion, Cooper in view of Slotznick discloses and renders this limitation obvious.

VI. SECONDARY CONSIDERATIONS

228. I am not aware of any relevant information related to secondary considerations of obviousness. For example, I am not aware of any attempt to commercialize the claimed technology in a product or through licensing. To the extent Patent Owner comes forward with any such information, I will consider it.

VII. AVAILABILITY FOR CROSS-EXAMINATION

229. 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 the case and that cross-examination will take place within the United States. If cross-examination is required of me, I will appear for cross-examination within the United States during a time as mutually agreed between the parties.

VIII. RIGHT TO SUPPLEMENT

230. I reserve the right to supplement my opinions in the future to respond to any arguments that the Patent Owner raises. This declaration represents only those opinions that I have formed to date. I reserve the right to revise, supplement, and/or amend my opinions stated herein based on new information that becomes available to me and on my continuing analysis of the materials already provided.

IX. CONCLUSION

231. I may utilize the documents cited and/or listed herein, or portions of those documents, as exhibits at any hearing or trial in this proceeding. I may further prepare and use exhibits that summarize portions of my testimony or key terms or concepts presented therein, or other demonstrative exhibits, at any hearing or trial in this proceeding.

232. I reserve the right to supplement my testimony and this report in response to any judicial determinations, in response to the arguments expressed by the Patent Owner or the opinions of the Patent Owner's experts in this proceeding, and/or in light of additional evidence or testimony brought forth at trial or otherwise brought to my attention after the date of my signature on the cover page.

APPENDIX 1

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PERSONAL

Born April 19, 1958

Married, 2 sons, 1 daughter

United States Citizen

EDUCATION

1980 B.TECH. (Electrical Engineering), Indian Institute of Technology, Delhi

1983 M.S. (Computer Science), Cornell University

1984 Ph.D. (Computer Science), Cornell University

PROFESSIONAL EXPERIENCE

- Assistant Professor of Computer Sciences, Purdue University, 1984-89
- Associate Professor of Computer Sciences, Purdue University, 1989-93
- Visiting Associate Professor of Computer Sciences, Cornell University, 1990-91
- Professor of Computer Sciences, Purdue University, 1993-97
- Director of Image Analysis and Visualization Center, Purdue University, 1996-97
- Visiting Professor of Computer Science, University of California, San Diego Fall 2005
- Visiting Professor of Computer Science, University of Tokyo, Spring 2006
- Comp. Appd. Math. Chair of Visualization, Oden Institute, University of Texas at Austin, 1997- Present
- Professor of Computer Sciences, University of Texas at Austin, 1997- Present
- Director of Computational Visualization Center, Oden Institute, University of Texas at Austin, 1997- Present

HONORS, AWARDS & MEMBERSHIP IN PROFESSIONAL SOCIETIES

- National Science Talent Scholarship, 1975. Dean's Honor Roll, IIT Delhi, 1975-1980
- Scholastic Merit Award, (B. Tech. DGPA of 10.00/10.00)
- Member of National Science Foundation (NSF) Panels on Advanced Computational Research, Geometric, Symbolic and Numeric Computing, Major Research Instrumentation, 1990 – 2006
- Frame Technology Excellence in Publishing Award, 1993
- Purdue University, Provost's Research Center Initiation Award, 1994
- Association of Computing Machinery, Student Chapter, Appreciation Certificate 2001
- Member of National Institute of Health, Special Emphasis Study Sections, 2001, 2004
- Association of Computing Machinery, Recognition of Service Award, 2002
- University of Texas, Faculty Research Award 2004, Dean Research Assignment Award 2004
- Member of the Austrian Science Foundation (FWF), Scientific Evaluation Committee 2005 - Present
- Best paper award at Computer Aided Design (CAD) 2006
- Invited Jacques Morgenstern Colloquium INRIA- Sophia Antipolis, France, 2006, William Mong Distinguished Colloquium, Hong Kong University, 2012, Barrs Distinguished Colloquium, U of Florida, 2013

- Elected Member of Sigma Xi and Upsilon Pi Epsilon Honor Societies. Member of Association of Computing Machinery (ACM), Institute of Electrical and Electronic Engineers (IEEE), Biophysical Society, Society of Industrial and Applied Mathematics (SIAM), American Association for Advancement of Sciences (AAAS).
- Panel Member of the National Academy of Sciences, Vietnam Education Foundation, 2006, 2007
- Member of the NSF-CISE Board of Visitors, 2004, ETH Zurich, CS Dept Evaluation Committee (2004), INRIA Evaluation Committee 2007
- Chair Search Committee, King Abdullah University of Science and Technology (KAUST) Center Director 2008
- Member of Consolider Scientific Committee of the Spanish Ministerio de Ciencia e Innovacion, 2008, 2009
- Member of the NIH-NCRR National Biomedical Computation Resource Advisory Committee, 2006 – Present
- American Association for the Advancement of Science- Fellow - 2008
- Member of Mol. Structure Function (MSFD), Study Section, National Institute of Health, 2008 – 2010
- Chairperson of Mol. Structure Function (MSFD) Study Section, National Institute of Health, 2011 – 2014
- The 2010 Visions of Computing Lecture Series, UT-CS Austin, November 2010
- University of Texas-ICES-Moncrief Grand Challenge Faculty Research Award, 2009, 2012, 2016
- Fellow of the University of Texas Institute for Cellular and Molecular Biology (ICMB) 2009
- Fellow of The American Association for the Advancement of Science (AAAS), 2008 –, Association for Computing Machinery (ACM), 2009- , 2010-, Institute of Electrical and Electronic Engineers (IEEE), 2013 –; Fellow of the Society of Industrial and Applied Mathematics (SIAM) Aug, 2016 –
- Best Paper Award at ACM Symposium on Solid and Physical Modeling, 2010, Haifa, Israel
- Program Co-Chair, SIAM/ACM Geometric and Physical Modeling Conference, Orlando, Florida – 2011
- JSPS fellowship program researcher award- 2012- Invitation for Excellent Researchers from Other Countries to JAPAN
- Conference Co-Chair of Pacific Graphics 2016, Okinawa Institute of Science and Technology (OIST), Naha, Okinawa, Japan, October 2016
- Keynote Addresses at SIAM Computational Science (2000), Pacific Computer Graphics (2002), Volume Graphics (2004), EuroGraphics (2004), Computational Algebra (2004), Cyberworlds (2005), Institute of Mathematics and its Applications –IMA (2007), HSEMB Conference (2007), CAD Conference (2009), Physics/Biology Interface (2009), CompImage (2010), ACM Solid Physical Modeling (2010), Symposium on Geometry Processing (2011), IEEE Pacific Vis (2012), Intl Conf. On Contemporary Computing (2012), Advances in Comp. Mechanics, (2013), 22nd Meshing Roundtable (2013), NSF CyberBridges Workshop (2013), MBI-OSU Large Data Visualization Workshop (2014), Banff EM Workshop (BIRS) (2014), Computer Methods in Biomechanics and Biomedical Engineering, Imaging and Visualization, CMBBE (2015), Innovative Modelling Techniques for Predictive Medicine (2015), "Statistical Bio-Modeling for Predictive Medicine", UT Austin/Portugal CoLab-Advanced Computing research, Innovative Modeling Techniques for Predictive Medicine Workshop, 2015, IST, Lisbon, Portugal, Workshop on Mathematical Modeling and Analysis of Protein Cages, OIST, Jan 16, 2016, Invited Speaker, Cryo-EM Workshop, August 8-9, 2018, New York, New York. ChinaGraph, November 9-11, 2018, Guangzhou, China, International Conference on Machine Learning and Data Science (ICML & DS 2018), December 21-22, 2018, Invited Speaker, "Spatio-Spectral Tensor Super-resolution" New York University, NY, January 24, 2019, Invited Speaker, "Spatio-Spectral Tensor Super-resolution" Stony Brook University, NY, January 25, 2019, Invited Speaker "Spatio-Spectral Tensor Super-Resolution with Chemical Priors" SIAM Conference on Computational Science and Engineering, February 25–March 1, 2019, Spokane, Washington "Are Spline Kernels Useful", University of Chicago, May 15-May 19, 2019, "Learning to Sample and Sampling to Learn", Amazon, Seattle, June 8-16, 2019, "Computation, Mathematics, and Statistics for Visual Search Applications", University of Peking- Beijing, China, July 2019, "Computation, Mathematics, and Statistics for Visual Search Applications", July 1-13, 2019, University of Peking-Beijing, China, ALBERT: A digital Pathology Electronic Assistant, August 2-4, 2019, UT Southwestern Medical center- Dallas and Univ of Oklahoma [Plenary] Statistical Deep Learning for Automatic 2D and 3D Cytotyping of tumor tissue-. Cold Spring Harbor- Asia conference, Shanghai, China, September 4, 2019, "Learning to Sense, Model. And Predict". Shanghai Jai Tong University- Shanghai, China, September 6, 2019, [Plenary] "Learning the Koopman Operator for Dynamic Simulations", Workshop on Digital Twins, University of Luxembourg, September 9-13, 2019, "Deep Learning Koopman Operator for Dynamic Data", Georgia Tech at Atlanta, Ga. Sept 17, 18, 2019, "Deep Learning for Static and Dynamic Data" Colloquium talk, NYU Data Sciences, Sept 27, 2019, "Deep Learning Koopman Modes for Dynamic Data" Colloquium talk, Princeton University, Sept 30, 2019, Learning to Correct Form and Function with Reinforcement, The 2nd TBSI Workshop on Learning Theory (TBSI-WOLT'20) July 20-22, 2020, Deep Learning to Correct Form and Function with Reinforcement, New Jersey Institute of Tech, December 9, 2020, Hyderabad, India, Numerical Geometry, Grid Generation and Scientific Computing, Moscow, November

2020, [Keynote] - “Learning Rank-Ordered Intelligent Search Policies with Minimal Uncertainty” Emerging Techniques in Computational Intelligence, Co-Sponsored by the IEEE Computational Intelligence Society, Ecole Centrale School of Engineering, Mahindra University, Hyderabad, India, August 25-27, 2021, Babuska Oden Institute Workshop, October 11, 2021- Can Computers Self-Learn to Model, Verify, Validate and Predict?- Albuquerque, NM for Prof. Ivo Babuška 95th birthday, Invited Speaker, “Learning Optimal Control with Stochastic Models of Hamiltonian Dynamics”, Applied Geometry for Data Sciences-, Chongqing University of Technology-Mathematical Science Research Center- July 25-29 2022, Keynote Speaker, “Learning Optimal Control with Stochastic Models of Hamiltonian Dynamics”, Second International Conference on Emerging Techniques in Computational Intelligence, August 25-27, 2022, Mahindra University, Hyderabad, India, Colloquium Seminar Talk, “Learning Optimal Control with Stochastic Models of Hamiltonian Dynamics”, BITS-Pilani, Goa, August 2022, Colloquium Seminar Talk, “Learning Optimized Shape for Function: *Balancing Optimal Control and Reduced Hamiltonians*” U of Toronto, Computer Science, Nov 2022, Alan Turing Workshop, Scientific Machine Learning Research Highlights, Jan 2023; Keynote, Emerging Techniques in Computational Intelligence, Hyderabad, India, Sept 2023; Keynote at Confluence Jan, 2024 Amity University, Noida, India

- Invited Presentations at BIRS, Dagstuhl, Oberwolfach (various years)
- Collaborative Teaching Grant Award (Dr. D. Briscoe) for BIO-(In)formatic Architecture Modeling in Architectural Design (ARC350R/ARC386M/CS378, Spring 2016, Funded by Learning Sciences, Provost Teaching Fellows.
- Member of BIMOS Scientific Advisory Board, Berlin Germany 2015 –
- Society for Industrial and Applied Mathematics- Fellow-2016
- Pioneer Award on Solid Modeling from Solid Modeling Association, July, 2016
- Distinguished Alumni Award, Indian Institute of Technology, Delhi, Aug, 2016
- Moncrief Grand Challenge Faculty Award, Institute for Computational Engineering and Sciences, 2014, 2016
- Member of Scientific Advisory board, Indian Institute of Technology, Delhi, 2018 –
- Honored with a Bountiful Tree at Trees for Tigers, Panna Tiger Reserve, Madhya Pradesh, India for delivering the talk during the IEEE CS-BITS GOA APPCAIR joint Webinar Series- 2021
- BIMoS-Scientific Advisory Board, 2023
- Honorary Professorship bestowed at Indian Institute of Technology, Delhi, India- Jan 2024
- Honorary Professorship bestowed at Amity University- Noida, India- Jan 2024
- Received Gift of 1.2K for travel expenses from Rom Rhone International Professional Development Fund from CNS, Jan. 2024 for his Keynote presentation at Amity Universities in India

EDITORIAL BOARDS

- ACM Computing Surveys (CSUR)- 2016-
- International Journal of Computational Geometry and Applications- 2005-
- Committee member of Multidisciplinary Mid-Term Review Panel(CIHR) [2021]
- Editor, Chapman and Hall ICRC Mathematical and Computational Imaging Sciences Series, 2009-Present
- Editorial advisory board member of Lecture Notes in Computational Vision and Biomechanics, Springer Verlag, 2010-Present
- Editorship for Natural Sciences and Engineering Research Council (NSERC) [2021]
- Editorship for Humanities Research Council (SSHRC) – [2020]
- CFREF- (Canada First Research Excellence Fund) Review Panel for York University- [2021]
- Editorial Computing Survey (CSUR)- 2020 -
- Editorial Member of Springer Nature Journal of Visualization 2015 -

ACADEMIC ACTIVITIES

My current research is on the computer science and computational mathematics foundations of statistical and dynamic machine learning, decision making, with learned dynamical systems for predictions, forecasting

and exploratory visualization. The machine learned, geometric and topological optimization algorithms see applications in the physical, chemical, health and medicine (eg. Parkinson's and Pancreatic Cancer), and moreover neuro-morphic and quantum computing. I revisit some of my past research in modeling multi-scale form and function, through the lens of inferential data sciences,. My current research projects include (a) forward and inverse optimization problems in microscopy, spectroscopy, electro-magnetic and electro-optical wide spectrum imaging; (b) generative shape and new material design for spatially realistic and phenomenological models; (c) learning from nature and generating models and mechanisms with accelerated and emergent properties. I teach an undergraduate course titled "Geometric Foundations of Data Sciences" and a graduate course titled "Predictive Machine Learning". I have courtesy appointments and supervise undergraduates, M.S. and Ph.D. students from several UT departments, including biomedical and electrical engineering, neuroscience, and mathematics.

The following is a link to my most cited publications :

[http://scholar.google.com/citations?user=gyL3CZ0AAAAJ"&user=gyL3CZ0AAAAJ](http://scholar.google.com/citations?user=gyL3CZ0AAAAJ)

JOURNAL PUBLICATIONS

1. C. Bajaj (1985). "Geometric Optimization and the Polynomial Hierarchy", *Lecture Notes in Computer Science*, 176-195.
2. C. Bajaj (1986). "Proving Geometric Algorithm Non-Solvability: An Application of Factoring Polynomials", *Journal of Symbolic Computation*, 2(1):99-102
3. S. Abhyankar, C. Bajaj (1987). "Automatic Parameterization of Rational Curves and Surfaces I: Conics and Conicoids", *Computer Aided Design*, 19(1):11-14
4. S. Abhyankar, C. Bajaj (1987). "Automatic Parameterization of Rational Curves and Surfaces II: Cubics and Cubicoids", *Computer Aided Design*, 19(9):499-502
5. M. Atallah, C. Bajaj (1987). "Efficient Algorithms for Common Transversals", *Information Processing Letters*, 25(2):87-91
6. C. Bajaj (1987). "Geometric Optimization and the Polynomial Hierarchy", *Theoretical Computer Science*, 54(1):87-102
7. S. Abhyankar, C. Bajaj (1988). "Automatic Parameterization of Rational Curves and Surfaces III: Algebraic Plane Curves", *Computer Aided Geometric Design*, 5(4):309-321
8. M. Wu, C. Bajaj, C. Liu (1988). "Face Area Evaluation Algorithm for Solids", *Computer Aided Design*, 20(2):75-82
9. C. Bajaj, T. Moh (1988). "Generalized Unfoldings for Shortest Paths in Euclidean 3-Space", *International Journal of Robotics Research*, 7(1):71-76
10. C. Bajaj, M. Kim (1988). "Generation of Configuration Space Obstacles: The Case of Moving Spheres", *IEEE Journal of Robotics and Automation*, 4(1):94-99
11. C. Bajaj (1988). "The Algebraic Degree of Geometric Optimization Problems", *Discrete and Computational Geometry*, 3(1):177-191
12. C. Bajaj, C. Hoffmann, R. Lynch, J. Hopcroft (1988). "Tracing Surface Intersections", *Computer Aided Geometric Design*, 5(4):285-307
13. S. Abhyankar, C. Bajaj (1989). "Automatic Parameterization of Rational Curves and Surfaces IV: Algebraic Space Curves", *ACM Transactions on Graphics*, 8(4):325-334
14. C. Bajaj, M. Kim (1989). "Generation of Configuration Space Obstacles: The Case of Moving Algebraic Curves", *Algorithmica*, 4(1):157-172
15. C. Bajaj, M. Li (1989). "Geometric Optimization and D^P-Completeness", *Discrete and Computational Geometry*, 4(1):3-13. Abstract appears in *Zentralblatt fur Mathematik*.
16. C. Bajaj (1990). "Rational Hypersurface Display", *Computer Graphics*, 24(2), 117-127
17. C. Bajaj, M. Kim (1990). "Convex Hulls of Objects bounded by Algebraic Curves", *Algorithmica*, 6(1):533-553
18. C. Bajaj, M. Kim (1990). "Generation of Configuration Space Obstacles: The Case of Moving Algebraic Surfaces", *International Journal of Robotics Research*, 9(1):92-112
19. C. Bajaj, T. Dey (1990). "Polygon Nesting and Robustness", *Information Processing Letters*, 35(1):23-32

20. C. Bajaj, T. Dey (1990). "Robust Computations of Polygon Nesting", *International Workshop on Discrete Algorithms and Complexity*, 33-40
21. J. Johnstone, C. Bajaj (1990). "Sorting Points along an Algebraic Curve", *Siam Journal on Computing*, 19(5):925-967
22. C. Bajaj, I. Ihm (1992). "Algebraic Surface Design with Hermite Interpolation", *ACM Transactions on Graphics*, 11(1):61-91
23. C. Bajaj, T. Dey (1992). "Convex Decomposition of Polyhedra and Robustness", *Siam Journal on Computing*, 21(2):339-364
24. T. Dey, K. Sugihara, C. Bajaj (1992). "Delaunay Triangulations in Three Dimensions with Finite Precision Arithmetic", *Computer Aided Geometric Design*, 9(6):457-470
25. T. Dey, C. Bajaj, K. Sugihara (1991). "On Good Triangulations in Three Dimensions", *International Journal of Computational Geometry and Applications*, 2(1):75-95
26. C. Bajaj, I. Ihm (1992). "Smoothing Polyhedra using Implicit Algebraic Splines", *Computer Graphics*, 26(2):79-88.
27. C. Bajaj, J. Canny, T. Garrrity, J. Warren (1993). "Factoring Rational Polynomials over the Complexes", *Siam Journal on Computing*, 22(2):318-331
28. C. Bajaj, I. Ihm, J. Warren (1993). "Higher-Order Interpolation and Least-Squares Approximation Using Implicit Algebraic Surfaces", *ACM Transactions on Graphics*, 12(4):327-347
29. V. Anupam, C. Bajaj, D. Schikore, M. Schikore (1994). "Distributed and Collaborative Visualization", *IEEE Computer*, 27(7):37-43
30. C. Bajaj, G. Xu (1994). "NURBS Approximation of Surface/Surface Intersection Curves", *Advances in Computational Mathematics*, 2(1):1-21
31. V. Anupam, C. Bajaj (1994). "SHASTRA - An Architecture for Development of Collaborative Applications", *International Journal of Intelligent and Cooperative Information Systems*, 3(2):155-166
32. V. Anupam, C. Bajaj (1994). "SHASTRA: Multimedia Collaborative Design Environment", *IEEE Multimedia*, 1(2):39-49
33. C. Bajaj, F. Bernardini, G. Xu (1995). "Automatic Reconstruction of Surfaces and Scalar Fields from 3D Scans", *Computer Graphics*, ACM SIGGRAPH 1995 pp 109-118
34. C. Bajaj, A. Royappa (1995). "Finite Representations of Real Parametric Curves and Surfaces", *International Journal of Computational Geometry and Applications*, 5(3):313-326
35. C. Bajaj, J. Chen, G. Xu (1995). "Modeling with Cubic A-patches", *ACM Transactions on Graphics*, 14(2):103-133
36. C. Bajaj, E. Coyle, K. Lin (1996). "Arbitrary Topology Shape Reconstruction from Planar Cross Sections", *Graphical Models and Image Processing*, 58(6):524-543
37. C. Bajaj, G. Xu (1997). "Piecewise Rational Approximation of Real Algebraic Curves", *Journal of Computational Mathematics*, vol. 15(1):55-71
38. C. Bajaj, F. Bernardini, G. Xu (1997). "Reconstructing Surfaces and Functions on Surfaces from Unorganized Three-Dimensional Data", *Algorithmica*, 19(1):243-261
39. C. Bajaj, G. Xu (1997). "Spline Approximations of Real Algebraic Surfaces", *Journal of Symbolic Computation, Special Issue on Parametric Algebraic Curves and Applications*, 23(23):315-333
40. C. Bajaj, R. Holt, A. Netravali (1998). "Rational Parameterizations of Nonsingular Real Cubic Surfaces", *ACM Transactions on Graphics*, 17(1):1-31
41. E. Sacks, C. Bajaj (1998). "Sliced Configuration Spaces for Curved Planar Bodies", *International Journal Of Robotics Research*, 17(6):639-651
42. C. Bajaj, D. Schikore (1998). "Topology Preserving Data Simplification with Error Bounds", *Journal on Computers and Graphics*, 22(1):3-12
43. L. Moriarty, B. Duerstock, C. Bajaj, K. Lin, R. Borgens (1998). "Two and Three Dimensional Computer Graphics Evaluation of the Subacute Spinal Cord Injury", *Journal of Neurological Sciences*, 155(2):121-137
<http://tinyurl.com/PMID9562256>, PMID: 9562256, PMC Journal in Process
44. C. Bajaj, C. Baldazzi, S. Cutchin, A. Paoluzzi, V. Pascucci, M. Vicentino (1999). "A programming approach for complex animations. Part I. Methodology", *Computer Aided Design*, 31(11):695-710
45. C. Bajaj, G. Xu (1999). "A-Splines: Local Interpolation and Approximation Using Gk- Continuous Piecewise Real Algebraic Curves", *Computer Aided Geometric Design*, 16(6):557-578
46. F. Bernardini, C. Bajaj, J. Chen, D. Schikore (1999). "Automatic Reconstruction of 3D CAD Models from Digital Scans", *International Journal on Computational Geometry and Applications*, 9(4-5):327-369
47. C. Bajaj, J. Chen, R. Holt, A. Netravali (1999). "Energy Formulations of A-Splines", *Computer Aided Geometric Design*, 16(1):39-59

48. C. Bajaj, V. Pascucci, G. Zhuang (2002). "Single Resolution Compression of Arbitrary Triangular Meshes with Properties", *Computational Geometry: Theory and Applications*, 14(1-3):167-186
49. C. Bajaj, E. Coyle, K. Lin (1999). "Tetrahedral Meshes from Planar Cross Sections", *Computer Methods in Applied Mechanics and Engineering*, 179(1-2):31-52
50. B. Duerstock, C. Bajaj, V. Pascucci, D. Schikore. K. Lin, R. Borgens (2000). "Advances in three-dimensional reconstruction of the experimental spinal cord injury", *Computerized Medical Imaging and Graphics*, 24(6):389-406, <http://tinyurl.com/PMID11008186>, PMID: 11008186, PMC Journal in Process
51. C. Bajaj, I. Ihm, S. Park (2000). "Compression-Based 3D Texture Mapping for Real-Time Rendering", *Graphical Models*, 62(6):391-410
52. C. Bajaj, A. Royappa (2000). "Parameterization in Finite Precision", *Algorithmica*, 27(1):100-114
53. G. Xu, C. Bajaj, W. Xue (2000). "Regular algebraic curve segments (I)-Definitions and characteristics", *Computer Aided Geometric Design*, 17(6):485-501
54. G. Xu, C. Bajaj, C. Chu (2000). "Regular Algebraic Curve Segments (II) - Interpolation and Approximation", *Computer Aided Geometric Design*, 17(6):503-519
55. C. Bajaj, I. Ihm, S. Park (2001). "3D RGB Image Compression for Interactive Applications", *ACM Transactions on Graphics*, 20(1):10-38
56. G. Xu, H. Huang, C. Bajaj (2001). "C1 Modeling with A-patches from Rational Trivariate Functions", *Computer Aided Geometric Design*, 18(3):221-243
57. C. Bajaj, G. Xu (2001). "Regular Algebraic Curve Segments (III) - Applications in Interactive Design and Data Fitting", *Computer Aided Geometric Design*, 18(3):149-173
58. H. Pfister, B. Lorensen, C. Bajaj, G. Kindlmann, W. Schroeder, L. Avila, K. Raghu, R. Machiraju, J. Lee (2002). "The Transfer Function Bake-off", *IEEE Computer Graphics and Applications*, 21(3):16-22
59. C. Bajaj, S. Schaefer, J. Warren, G. Xu (2002). "A Subdivision Scheme for Hexahedral Meshes", *The Visual Computer*, 18(5):343-356
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61. C. Bajaj, G. Xu, R. Holt, A. Netravali (2002). "Hierarchical Multiresolution Reconstruction of Shell Surfaces", *Computer Aided Geometric Design*, 19(2):89-112
62. B. Duerstock, C. Bajaj, R. Borgens (2003). "A Comparative Study of the Quantitative Accuracy of Three-Dimensional Reconstructions of Spinal Cord from Serial Histological Sections", *Journal of Microscopy*, 210(2):138-148, <http://tinyurl.com/PMID12753096>, PMID: 12753096, PMC Journal In Process
63. W. Blanke, C. Bajaj (2003). "Active Visualization in a Multidisplay Immersive Environment", *Computers & Graphics*, 27(5):681-691
64. C. Bajaj, G. Xu (2003). "Anisotropic Diffusion of Surfaces and Functions on Surfaces", *ACM Transactions on Graphics*, 22(1):4-32
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69. C. Bajaj, Z. Yu, M. Auer (2003). "Volumetric Feature Extraction and Visualization of Tomographic Molecular Imaging", *Journal of Structural Biology*, 144(1-2):132-143, doi:10.1016/j.jsb.2003.09.037, <http://tinyurl.com/PMID14643216>, PMID: 14643216, PMC Journal In Process
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40. "Parallel Multi-PC Volume Rendering System", (with S. Park, A. Thane), *CS & ICES Technical Report, University of Texas at Austin, 2002*
41. "Progressive Tracking of Isosurfaces in Time-Varying Scalar Fields", (with A. Shamir, B. Sohn), *CS & ICES Technical Report, University of Texas at Austin, 2002*
42. "A Geometric Feature Detection Approach to Particle Picking in Electron Micrographs", (with Z. Yu), *Technical Report TR-03-30, 2003*

43. "Interactive Symbolic Visualization of Semi-automatic Theorem Proving", (with S. Khandelwal, J Moore, V. Siddavanahalli), *Technical Report TR-03-37, Department of Computer Sciences, The University of Texas at Austin, August 2003*
44. "Level-set Based Volumetric Anisotropic Diffusion for 3D Image Denoising", (with Q. Wu, G. Xu), *ICES Technical Report 03-10, The University of Texas at Austin, 2003*
45. "An Adaptive Irregularly Spaced Fourier Method for Protein-Protein Docking", (with J. Castrillon-Candas, V. Siddavanahalli), *Technical Report TR-05-34, Department of Computer Sciences, The University of Texas at Austin, July 11, 2005*
46. "Nonequispaced Fourier Transforms for Protein-Protein Docking", (with J. Castrillon-Candas, V. Siddavanahalli), *ICES Technical Report TR-05-44, The University of Texas at Austin, 2005*
47. "Surface Smoothing and Quality Improvement of Quadrilateral/Hexahedral Meshes with Geometric Flow", (with Y. Zhang, G. Xu), *ICES Technical Report TR-05-18, the University of Texas at Austin, 2005*
48. "Fast Error-Bounded Surfaces and Derivatives Computation for Volumetric Particle Data", (with V. Siddavanahalli), *ICES Technical Report TR-06-03, the University of Texas at Austin, 2006*
49. "Patient-Specific Vascular NURBS Modeling for Isogeometric Analysis of Blood Flow", (with Y. Zhang, Y. Bazilevs, S. Goswami, T.J.R. Hughes), *ICES Technical report TR-06-07, the University of Texas at Austin, 2006*
50. "Smooth Surface Constructions via a Higher Order Level Set Method", (with G. Xu, Q. Zhang), *ICES Technical Report TR-06-18, the University of Texas at Austin, 2006*
51. "Fast Algorithms for Molecular Interface Triangulations and Solvation Energy Computations", (with V. Siddavanahalli, W. Zhao), *ICES Technical Report TR-07-06, the University of Texas at Austin, 2007*
52. "An Algebraic Spline Model of Molecular Surfaces", (with W. Zhao, G. Xu), *ICES Technical Report TR-07-07, the University of Texas at Austin, 2007*
53. "Spatially Realistic Human Heart Finite Element Models From Medical Imaging", (with S. Goswami), *ICES Technical Report TR-08-01, the University of Texas at Austin, 2008*
54. "Resolution Adaptive Spline Modeling for Rapid Poisson Boltzmann Molecular Electrostatics", (with A. Chen), *CS Technical Report TR-08-12, the University of Texas at Austin, 2008*
55. "F3Dock: A Fast, Flexible and Fourier Based Approach to Protein-Protein Docking", (with R. Chowdhury, V. Siddahanavalli), *CS Technical Report TR-08-01, The University of Texas at Austin, 2008*
56. "Packing Grids for Rapid Protein Interfaces", (with R. Chowdhury), *CS Technical Report TR-08-02, The University of Texas at Austin, 2008*
57. "Fast Molecular Solvation Energetics and Forces Computation", (with W. Zhao), *ICES Technical Report TR-08-20, The University of Texas at Austin, 2008*
58. "Spatically Realistic Human Heart Finite Element Models from Medical Imaging", (with S. Goswami), *ICES Technical Report TR-08-01, The University of Texas at Austin, 2008*
59. "CUDA Accelerated Multi-Domain Volumetric Image Segmentation and Using a Higher Order Level Set Method", (with O. Sharma, F. Anton, Q. Zhang), *ICES Technical Report TR-09-23, The University of Texas at Austin, 2009*
60. "Efficient and Higher-Order Fast Multipole Boundary Element Method for Poisson Boltzmann Electrostatics", (with A. Chen), *ICES Technical Report TR-09-20, The University of Texas at Austin, 2009*
61. "Stable Mesh Decimation", (C. Bajaj, A. Gillette, Q. Zhang), Oct 8, 2009, arXiv:0910.1402
62. "Complementary Space for Enhanced Uncertainty and Dynamics Visualization", (C. Bajaj, A. Gillette, S. Goswami, B. J. Kwon, J. Rivera), Oct 20, 2009, arXiv:0910.4084
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66. "On a Nanoscopically-Informed Shell Theory of Single-Wall Carbon Nanotubes", (C. Bajaj, A. Favata, P. Podio-Guidugli), Nov 19, 2011, arXiv:1111.4574
67. "Quadratic Serendipity Finite Elements on Polygons Using Generalized Barycentric Coordinates", (A. Rand, A. Gillette, C. Bajaj), Jul 20, 2012, arXiv:1012.3929
68. "Interpolation Error Estimates for Mean Value Coordinates over Convex Polygons", (A. Rand, A. Gillette, C. Bajaj), Sep 18, 2012, arXiv:1111.5588, (PMCID: PMC37667007)
69. "Construction of Scalar and Vector Finite Element Families on Polygonal and Polyhedral Meshes", (A. Gillette, A.

- Rand, C. Bajaj), May 27, 2014, arXiv:1405.6978
70. "On Low Discrepancy Samplings in Product Spaces of Motion Groups", (C. Bajaj, A. Bhowmick, E. Chattopadhyay, D. Zuckerman), Nov 28, 2014, arXiv:1411.7753
 71. "On the construction of general cubature formula by flat extensions", (Marta Abril Bucero (INRIA Sophia Antipolis), C. Bajaj, B. Mourrain (INRIA Sophia Antipolis)), Jun 9, 2015, arXiv:1506.00085, Linear Algebra and its Applications, Special Issue, August 1, 2016, Vol 502, pp. 104-125, Structured Matrices: Theory and Applications, <http://dx.doi.org/10.1016/j.laa.2015.09.052>, (PMCID: PMC4995016)
 72. "Characterization and Construction of a Family of Highly Symmetric Spherical Polyhedra with Application in Modeling Self-Assembling Structures", (M. Rasheed, C. Bajaj), Jul 30, 2015, arXiv:1507.08374
 73. "Quantifying and Visualizing Uncertainties in Molecular Models", (M. Rasheed, N. Clement, A. Bhowmick, C. Bajaj), Aug 17, 2015, arXiv:1508.03882,
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 82. C. Bajaj A. Roy, H. Zhang- Invariance-based Multi-Clustering of Latent Space Embeddings for Equivariant Learning July 25, 2021- <https://arxiv.org/abs/2107.11717>
 83. C. Bajaj, L. McLennan, T. Andeen, A. Roy, Robust Learning of Physics Informed Neural Networks October 26, 2021, <https://arxiv.org/abs/2110.13330>,
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 85. Bajaj C, Nguyen M, Learning Optimal Control with Stochastic Models of Hamiltonian , November 2021, ArXiv, <http://arxiv.org/abs/2111.08108>
 86. S. Chockchowwat, C. Bajaj, Probabilistic PolarGMM: Unsupervised Cluster Learning of Very Noisy Projection Images of Unknown Pose, arXiv:2206.12959- June 2022, <https://arxiv.org/abs/2206.12959>
 87. C. Bajaj, T. Heo, R. Avlur, Learning Generative Embeddings using an Optimal Subsampling Policy for Tensor Sketching, Sept 2022, <https://arxiv.org/abs/2209.00372>
 88. C Bajaj, OB Vaidya, Y Wang, A Particle-based Sparse Gaussian, Process Optimizer, arXiv, November 2022, *arXiv:2211.14517v1*, <https://doi.org/10.48550/arXiv.2211.14517>
 89. C. Bajaj, C. Li, M. Nguyen, Solving the Side-Chain Packing Arrangement of Proteins from Reinforcement Learned Stochastic Decision Making, Dec 2022, ArXiv, 2212.03320, <http://arxiv.org/abs/2212.03320>
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 91. C. Bajaj. M. Nguyen, Robust Learning of Noisy Time Series Collections Using Stochastic Process Models with Motion Codes, Feb. 2024, ArXiv, <https://arxiv.org/abs/2402.14081>
 92. C. Bajaj, M. Nguyen, DPO: Differential reinforcement learning with application to optimal configuration search., April 2024, ArXiv, <https://arxiv.org/abs/2404.15617>

RESEARCH GRANTS & CONTRACTS

1. 8/1/86 - 1/31/89 "Automating Robots for Intelligent Manufacturing", (\$81,000), National Science Foundation, MIP-8521356

2. 9/1/86 - 6/30/88 "Experimental Laboratory for Electronic Prototyping and Geometric Modeling", (\$117,000), National Science Foundation, CCR-8612590, (with M. Atallah, C. Hoffmann)
3. 7/1/87 - 6/30/88 "Algorithmic Robotics: Geometric Modeling and Motion Planning", (\$10,200), Purdue Research Foundation, David Ross Grant
4. 1/1/88 - 6/30/88 "Algebraic Methods in Solid Modeling", (\$26,500), Computer Aided Manufacturing - International, Contract No. H928/C
5. 7/1/88 - 6/30/89 "Algorithmic Robotics: Geometric Modeling and Motion Planning", (\$10,200), Purdue Research Foundation, David Ross Grant
6. 10/1/88 - 9/31/89 "An Experimental Laboratory for Computational Algebraic Geometry", (\$75,000), Defense University Research Instrumentation Program, DAAL03-88-G-0068, (with S. Abhyankar)
7. 1/1/88 - 6/30/90 "Computational Algebraic Geometry and Geometric Modeling", (\$150,000), Army Research Office/ Cornell MSI, DAAG29-85-C-0018, (with S. Abhyankar)
8. 7/15/88 - 9/31/90 "Modular Algorithms in Computational Algebraic Geometry", (\$217,000), Office of Naval Research, N00014-88-0402, (with S. Abhyankar)
9. 8/14/89 - 8/13/90 "Surface Fitting using Algebraic Surfaces", (\$10,200), Purdue Research Foundation, David Ross Grant
10. 5/15/89 - 9/31/91 "Algorithmic Algebraic Geometry", (\$160,000), National Science Foundation, DMS-8816286, (with S. Abhyankar)
11. 8/14/90 - 8/13/91 "Polyhedral Decomposition Algorithms", (\$10,200), Purdue Research Foundation, David Ross Grant
12. 7/1/91 - 12/31/91 "Efficient Algorithms and Data Structures for Geometric Design", (\$30,000), Air Force Office of Scientific Research, AFOSR-91-0276
13. 7/15/90 - 9/31/92 "Solving and Visualizing Systems of Algebraic Equations", (\$102,000), National Science Foundation, CCR-9002228
14. 11/16/91 - "Distributed and Collaborative Geometric Design", (\$30,000), American Telephone and Telegraph, AT & T 730-1398-3000
15. 1/1/92 - 12/31/92 "Efficient Algorithms and Data Structures for Geometric Design", (\$62,984), Air Force Office of Scientific Research, AFOSR-91-0276
16. 8/14/92 - 8/13/93 "Collaborative Geometric Design", (\$9,900), Purdue Research Foundation, David Ross Grant
17. 1/1/93 - 12/31/93 "Shape Optimization in a Distributed and Collaborative Modeling Environment", (\$30,000), NASA Langley Research, NAG-1-1473
18. 9/1/91 - 8/31/94 "Algorithmic Algebraic Geometry", (\$367,035), National Science Foundation, DMS-9101424, (with S. Abhyankar)
19. 8/14/93 - 8/13/94 "Collaborative Geometric Design", (\$9,900), Purdue Research Foundation, David Ross Grant
20. 9/1/91 - 8/31/94 "Algorithmic Algebraic Geometry", (\$4,000), National Science Foundation, REU - DMS-9101424
21. 4/1/93 - 3/31/94 "Geometric and Solid Modeling with Algebraic Surfaces", (\$10,000), National Science Foundation, REU - CCR-9222467
22. 2/1/93 - 1/31/95 "Efficient Algorithms and Data Structures for Geometric Design", (\$179,441), Air Force Office of Scientific Research, F49620-93-1-0138
23. 4/1/93 - 3/31/96 "Geometric and Solid Modeling with Algebraic Surfaces", (\$222,665), National Science Foundation, CCR-9222467
24. 10/1/93 - 9/30/96 "Efficient Algorithms and Data Structures for Geometric Design", (\$119,750), Air Force Office of Scientific Research, AASERT F49620-93-1-0138
25. 10/1/93 - 9/31/96 "Modeling and Visualization for Polymers, Surfaces and Biomolecules", (\$248,491), Air Force Office of Scientific Research, F49620-94-1-0080
26. 1/1/94 - 12/31/96 "Modeling and Simulation in a Reconfigurable Distributed Virtual Environment", (\$375,000), Office of Naval Research, N00014-94-1-0370
27. 11/1/94 - 10/31/96 "A Collaboratory for Distributed Virtual Environments", (\$150,000), Army Research Office, DAAH04-95-1-0008
28. 8/14/95 - 8/13/96 "Deformable Modeling", (\$9,900), Purdue Research Foundation, Davis Ross Grant
29. 4/14/95 - 4/13/96 "High Performance Networks & Visualization", (\$150,00), National Science Foundation, CDA-9422038, (with J. Rice, E. Houstis, D. Marinescu, V. Rego)
30. 6/1/95 - 12/31/97 "Modeling and Simulation in a Reconfigurable Distributed Virtual Environment", (\$100,778), Office of Naval Research, AASERT N00014-94-1-0370
31. 12/16/95 - "3D FAX", (with A. Chaturvedi), (\$25,000), American Telephone and Telegraph, AT & T 730-1398-3000

32. 1/1/96 - "Center on Image Analysis and Data Visualization", \$100,000 per year, Purdue University
33. 3/1/96 - 2/28/97 "Repetitive Contact Modeling, Analysis & Visualization", (\$139,760), National Science Foundation, CDA-9529499, (with B. Hillberry, and E. Sacks)
34. 8/14/96 - 8/13/97 "Deformable Modeling", (\$9,900), Purdue Research Foundation, Davis Ross Grant
35. 6/1/96 - 5/31/97 "Distributed Analysis and Visualization of Spinal Cord Injuries", (\$39,800) per year, Canadian Spinal Research Organization, Award No: 3409670
36. 6/1/96 - 2/28/97 "Flexible Constraint Management in CSCW", (\$26,500), National Institute of Standards and Testing, NIST grant No: 60NANB4D1645
37. 3/1/97 - 2/28/98 "Interrogative Virtual Reality", (\$126,818), Office of Naval Research N0014-97-1-0398
38. 4/1/97 - 12/31/97 "Visualization of Scalar, Vector and Tensor Field Data", (\$126,882), Air Force Office of Scientific Research, F 49620-97-1-0278
39. 6/1/97 - 4/30/98 "Prostate Image Characterization", (\$13,475), Indiana Center for Advanced Research, Award No: 6712868
40. 8/1/98 - 7/31/00 "Modeling and Visualization with Algebraic Surfaces and Splines", (\$150,000), National Science Foundation, CCR-9732306
41. 8/25/98 - 8/24/00 "Data Intensive, Display Intensive Visualization", (\$400,000), Sandia National Labs and Lawrence Livermore National Labs BD-4485
42. 7/1/98 - 6/3/00 "Data Intensive Visualization", (\$113,328), National Aeronautics and Space Administration NCC2-5276
43. 9/1/98 - 8/31/01 "Multiscale Physics-Based Simulation of Fluid Flow for Energy and Environmental Applications", (\$1,700,000) National Science Foundation, DMS-9873326 (with J. Wheeler, T. Arbogast, S. Bryant, Dawson)
44. 2/24/99 - 9/30/00 "Structural Simulation Using Multiresolution Material Models", (\$400,000) Sandia National Labs (with T. Oden, I. Babuska, G. Rodin)
45. 10/1/99 - 9/30/00 "Interaction Environments", (\$105,000) National Partnership for Advanced Computing Infrastructure (NSF-NPACI)
46. 10/15/99 - 9/30/02 "Terascale Data Visualization", (\$593,536) National Science Foundation ACI-9982297
47. 1/1/00 - 12/31/01 "MetaBuffer: Combining Realtime Parallel Graphics and Multiresolution VR Display", (\$161,040) Texas Higher Education Coordinating Board (with Donald Fussell)
48. 6/1/00 - 5/31/03 "Interrogative Synthetic Environments", (\$51,000) National Science Foundation INT-9987409
49. 10/1/00 - 9/30/01 "Interaction Environments", (\$308,000) National Partnership for Advanced Computing Infrastructure (NSF-NPACI)
50. 9/1/00 - 3/31/04 "Formal Methods Visualization", (\$493,177) National Science Foundation CCR-9988357 (with J. Moore)
51. 06/30/99 to 06/29/02 "Research in the Area of Computational and Applied Mathematics", (\$12,402), Lucent Technologies
52. 10/01/01 – 09/30/02 "Interaction Environments", (\$316,000), National Partnership for Computational Infrastructure (NSF-NPACI) Sub Contract from SDSC
53. 10/01/01 to 09/31/04 "Data Intensive and Display Intensive Computing", (\$400,000), Lawrence Livermore National Laboratory
54. 10/1/02- 9/30/05 "ITR: Large Scale Simulations of Emulsions", (\$400,000) National Science Foundation, ACI: 0220037 (with G. Rodin, R. Bonnecaze)
55. 10/01/02 – 09/30/03 "Interaction Environments", (\$315,000), National Partnership for Computational Infrastructure (NSF-NPACI) Sub Contract from SDSC
56. 9/1/03 to 8/31/04 "4D Deformable Anatomy Models for Radiation Therapy" (\$19,000) Whitaker-Biomed (with L. Dong)
57. 10/01/03 – 04/30/05 "Interaction Environments", (\$275,000). National Partnership for Computational Infrastructure (NSF-NPACI) Sub Contract from UCSD-SDSC
58. 9/15/03 – 8/30/07 "ITR: Subnanometer Structure Based Fold Determination of Biological Complexes", (\$2,250,000) National Science Foundation, EIA: 032550 (with Wah Chiu and Andrej Sali)
59. 09/1/03 – 08/31/08 "Mastadon: A High Throughput Simulation Infrastructure", (\$1,238,471) National Science Foundation (with R. Mikkulainen, D. Burger, K. McKinley and V. Ramachandran)
60. 06/1/04 – 05/31/08 "Towards a Computational Center for Biomolecular Complexes", (\$2,263,996) National Institutes of Health, P20-RR020647, (with W. Chiu (Baylor College of Medicine), H. Baker (Rutgers University), A. Olson (The Scripps Research Institute))
61. 04/1/05 – 03/31/2010 "Hierarchical Methods for Bio-Molecular Complexes", (\$718,065) National Institutes of Health, R01-GM074258

62. 10/01/05 – 09/30/10 “A Dynamic Data Driven System for Laser Treatment of Cancer”, (\$805,930), National Science Foundation, CNS-0540033, (with T. Oden (PI), K. Diller, J. Browne)
63. 03/1/06 – 02/28/10 “A New Approach to Rapid Protein-Protein Docking”, (\$850,000) National Institutes of Health, R01-GM07308
64. 09/01/06 – 08/31/09 MRI: “Acquisition of a High Performance Computing System for Online Simulation”, National Science Foundation Equipment Grant (\$800,000), CNS-0619838, (with O. Ghattas, T. Oden, J. Boisseau, M. Wheeler)
65. 08/15/06 – 08/14/07 UT- Austin, Texas Institute for Drug Diagnostics Development – TI3D, (\$100,000), Post-Doctoral Student Grant
66. 03/01/07 – 02/28/13 “Software Maintenance for Biomolecular Complexes”, (\$900,000), National Institutes of Health, R01-EB004873
67. 09/01/09 – 08/31/12 “Advanced Computing: Patient Specific Cardiovascular Modeling and Analysis”, with T. Hughes of UT and Adelia Sequeira, et al, of Portugal, (\$175,000), Portuguese Science and Technology Foundation
68. 09/01/12 - 08/31/13 "Collaborative Research: Conceptualizing an Institute For Using Inter-domain Abstractions to Support Inter-disciplinary Applications", National Science Foundation OCI-1216701, (\$1,170,737), with S. Midkiff, D. Padua, K. Pingali, M. Kulkarni, R. Elber, J. Caruthers, A. Prakash, P. H Geubelle, J. Hart, V. Pai.
69. 04/01/14 – 09/30/16 “Global Optimization and Fourier Studies with application to Higher Order Meshing”, Sandia National Labs Contract #1439100, (\$498,000)
70. 08/01/15 – 08/31/21 “Mathematical Chemical Imaging with Uncertainty Quantifications”, BioMath (NSF/NIH) R01-GM117594-01, -02, -03 (\$1,539,212) with Pradeep Ravikumar (UT Austin) and Rohit Bhargava (UIUC)
71. 08/01/15 – 08/31/19 “Mathematical Chemical Imaging with Uncertainty Quantifications”, BioMath (NSF/NIH) Supplement, 5R01GM117594 (\$35,750)
72. 06/01/2016 - 08/31/2017 “Virtual Surgical Atlas: Medical Modeling of the Pediatric Skull”, Dell Medical School, (\$75,140) with Dr. Raymond J. Harshbarger, III, MD, Dell Medical School, Seton Family of Hospitals, OSP# 201602388, Project# CR-14-051
73. 08/15/15 – 12/31/17 “A-MOP – Algorithms for Macro-Molecular Pocket Identification”, INESC-ID/University of Lisboa (Portugal)(UTAP-EXPL/QEQ-COM/0019/2014), (\$14,935)
74. 06/06/2016 - 12/31/2017 “Polar Sampling and Optimization of Protein-Ligand Cocrystal Structures”, NIH of General Medical Sciences, Small Business Technology Transfer Program, GFREE BIO, LLC, Grant No: 1R41GM116300-01, (\$224,934) with Charles Reynolds (GFREE BIO)
75. 09/30/2020-05/31/2024- Intelligent Machine Learning for Real- Time Processing of Hyperspectral Video Streams- Army Futures Command-DOD-ARMY- Project Number W911NF1920333, PO7 (\$1,873,000.00)
76. 2/1/2021-01/31/2022 A Deep Learning Framework for Event Based Anomaly Detection- IFML-UT Austin, Univ of Wash, Wichita State and Microsoft- \$50,000 (direct costs).
77. 7/1/2021-6/30/2023 “Deep Learning of Pancreas MRI to Predict Progression of T1D” with Jack Virostko, (UT) NIH- 1R03DK12997901 (\$317,000)
78. 9/1/2021-8/31/2022. “Development of advanced machine (deep) learning algorithms to rapidly detect and accurately estimate the percentage of melanocytes expressing Mart1-Ki67 in borderline melanocytic lesions, and PDL1-in tumor cells, using double staining with tumor specific makers”, with Phyu Aung(MDACC), MD Anderson Cancer Center (MDACC)- (\$50,000 direct costs) .
79. 1/1/2023-1/31/2024 Michael J Fox Foundation- AI towards Eradication of Parkinson’s Disease- \$300,132.40
80. 5/1/2022 - In-Kind gift from Jim Holland/Backcountry.com, \$200,000, intended for use in conjugation with AI for Eradication of Parkinson’s Disease

MULTIMEDIA

1. A. Abdelkader, C. Bajaj, M. Ebeida, A. Mahmoud, S. Mitchell, J. Owens, A. Rushdi “VoroCrust Illustrated: Theory and Challenges”. 2018 , pp. 77:1-77:4, 99

PATENTS

1. Encoding Images of 3-D Objects with Improved Rendering Time and Transmission Process. August 2002, US Patent 6438266

PROGRAM COMMITTEE MEMBER

1. Fourth Annual ACM Symposium on Computational Geometry, Urbana-Champaign, Illinois (1988)
2. HICCS Conference, Emerging Technologies - Simulation and Modeling, Kona, Hawaii (1991)
3. Seventh Annual ACM Symposium on Computational Geometry, New Hampshire (1991)
4. Third IEEE Workshop on Enabling Technologies for Concurrent Engineering, West Virginia (1994)
5. Graphics Interface 1995, Quebec City, Canada (1995)
6. Pacific Graphics 1995, 1996, 1997, 1998, 1999, 2000
7. Implicit Surfaces 1995, 1996
8. Eurographics 1995, 1996
9. IEEE Workshop on Enabling Technologies for Concurrent Engineering, West Virginia (1995, 1996)
10. Workshop on Algorithms and Data Structures (WADS) (1995)
11. Computer Graphics International (1996, 1997, 1998, 1999, 2000)
12. Workshop on Algorithms and Data Structures (WADS), Halifax, Canada 1997
13. IEEE Visualization Conference 1997, 1999
14. Fifth Intl. Conference on Computer-Aided Design and Computer Graphics, Shenzhen, China, December 1997
15. ACM Symposium on Computational Geometry (Theory) Minneapolis, MN, June 1998
16. IMA Math of Surfaces VIII, Birmingham, UK, August 1998
17. ACM SIGGRAPH, 1999
18. Chair, Intl. Symposium on Symbolic and Algebraic Computation (ISSAC) St. Andrew, Scotland, UK, 2000
19. Chair, ACM Annual Symposium on Computational Geometry (Applied Track) 2002
20. Program Committee Chair, ACM Annual Symposium on Computational Geometry, (Applied Track), 2002
21. Co-Chair of Visualization of Large Biomolecular Complexes Workshop, UCSD-Scripps, San Diego, 2006
22. Chair of an NIH Workshop on the Molecular-Cell Project, Austin, TX, 2006
23. International Computer Vision, Graphics and Image Processing (ICVGIP) 2006
24. 5th Workshop on Volume Graphics, (VG 2006), Boston MA
25. Pacific Conference on Computer Graphics and Applications, (PG 2007), Maui, Hawaii
26. Special Year on Algebraic Geometry at the IMA, 2006-2007
27. Geometric Modeling and Processing Conference, (GMP 2008), Hang Zhou, China.
28. ACM Symposium on Solid Modeling and Applications, (SPM 2008), Stony Brook, NY
29. Pacific Graphics, (PG 2008), Tokyo, Japan
30. International Conference on Cyberworlds, (Cyberworlds 2008), Hang Zhou, China
31. Workshop "Medical Imaging Systems", (EUROMEDIA 2008), Porto, Portugal
32. SIAM/ACM Joint Conference on Geometric and Physical Modeling, San Francisco, 2009
33. Geometric Modeling and Processing (GMP), Castro Urdiales, Spain, 2010
34. UT Austin - Portugal Summer School and Workshop, (CoLab 2010), Coimbra, Portugal
35. Ohio State University, Mathematical BioSciences Institute Workshop on "Analysis and Visualization of Large Collections of Imaging Data", (with P. Keller, M. Maggioni, A. Tanenbaum), Columbus, Ohio, February 2014
36. Chair of the PhD Admissions Committee, and Member of the Promotions Committee, Computer Science, 2015
37. Mathematics of Soft Matter Minisymposium, Okinawa Institute of Science and Technology (OIST), Okinawa, Japan, January 2016
38. Invited International Member of K1-Centre Consortium review team, "Competence K-1 Center in VrVis Visual Computing, The Austrian Research Promotion Agency, Vienna, Austria, June 2016
39. Member of BIMOS Scientific Advisory Board to assist with further design and development of the BIMOS Program, Berlin, Germany, June 20-21, 2016
40. NIH BD2K Trainee Selection Committee for Computational Sciences, Engineering, Mathematics and Computer Science, 2016
41. Budget Council 2016, Computer Science
42. Member, Selection Panel for Simons Foundation, Simons Investigators in the Mathematical Modeling of Living Systems (MMLS) internal competition, Vice President for Research, September 2016
43. Program Co-Chair, Pacific Graphics 2016, 25th Pacific Conference on Computer Graphics and Applications, (with T. Ertl, T Nishita), Okinawa Institute of Science and Technology (OIST), Okinawa, Japan, October 2016
44. Member, International Program Committee for the 2017 Symposium on Solid and Physical Modeling (SPM 2017), Berkeley, CA, USA, June 19-21, 2017 (see: Member, International Program Committee for the 2017 Symposium on Solid and Physical Modeling (SPM 2017), Berkeley, CA, USA, June 19-21, 2017 (see: <https://s3pm.icsi.berkeley.edu/s3pm/>)

45. Member, International Program Committee for the 2017 Symposium on Visualization (SOV 2017), Bangkok, Thailand, SIGGRAPH ASIA 2017 (<https://sa2017.siggraph.org/attendees/symposium-on-visualization>)
46. Berlin International Graduate School in Model and Simulation based Research- Scientific Advisory Board 2019, November 25th and 26th, 2019.
47. Data Science Faculty Recruiting committee- December 5, 2019
48. Ad Hoc Committees- 2019/20- Press
49. Ad Hoc Committee- 2019/20Vouga
50. CNS committee- 2019- NTT P&T committee
51. CSEM Admissions committee- 20-21
52. Moncrief recruiting committee- 20-21
53. CSEM Data Science Chair Recruiting Committee - 20-21
54. CS Student Assessment committee- 20-21
55. Committee member of the multidisciplinary Mid-Term Review Panel-Canadian Institute of Health Research(CIHR), (Natural Sciences and Engineering Research Council(NSERC) and Humanities Research Council(SSHRC)- April 21-23, 2021
56. Chair the CFREF Review Panel for York University(Spring 2021)
57. Faculty Mentor for CSE Certification program-2021
58. Advisory Board- Advances in Data-driven Computing and Intelligent Systems (ADCIS) March 2022
59. Faculty Evaluation Committee- 2022-2023

ORGANIZER

1. Special Course on Computational Algebraic Geometry and Geometric Modeling, Fifteenth Annual ACM SIGGRAPH Conference on Computer Graphics and Interactive Techniques, Atlanta, Georgia, 1988
2. Minisymposium on Computational Algebraic Geometry and Geometric Modeling, SIAM Conference on Geometric Design, Tempe, Arizona, 1989
3. Conference on Algebraic Geometry and its Applications, Purdue University, 1990
4. (Co-organizer), Special Course titled Unifying Parametric and Implicit Representations of Surfaces for Computer Graphics, Seventeenth Annual ACM SIGGRAPH Conference on Computer Graphics and Interactive Techniques, Dallas, Texas, 1990
5. Special Session on Algebraic Surfaces in Modeling and Visualization, IMACS 94, Atlanta, Georgia, 1994
6. Special Course titled "Representations of Geometry for Computer Graphics", Annual ACM SIGGRAPH Conference on Computer Graphics and Interactive Techniques, Orlando, Florida, 1994
7. (Co-Organizer with G. Farin, H. Edelsbrunner), Workshop on Voronoi Diagrams, Triangulations and Splines, Arizona State University, Feb 19 - 21, 1997
8. NIH Workshop on Visualization of Large Biomolecular Complexes, (with A. Olson) August, 2006, The Scripps Research Institute, San Diego, August 2006
9. Minisymposia on Geometry and Analysis, (with T. Hughes), World Congress in Computational Mechanics, Los Angeles, July 2006
10. Minisymposia on Geometry and Analysis, (with T. Hughes and Y. Bazilevs), US National Congress in Computational Mechanics, San Francisco, July 2007
11. MAA/AMS Workshop on Molecular Structure and Function, (with A. Gillette), Washington, DC, Jan 2009
12. COLAB UT-Portugal, Workshop on Biomedical Imaging and Visualization, (with L. Caffarelli, A. Gillette), Austin, Texas, March-April, 2009
13. Ohio State University, Mathematical BioSciences Institute Workshop on "Analysis and Visualization of Large Collections of Imaging Data", (with P. Keller, M. Maggioni, A. Tanenbaum), Columbus, Ohio, February 2014
14. Program Co-Chair, Pacific Graphics 2016, 25th Pacific Conference on Computer Graphics and Applications, (with T. Ertl, T. Nishita), Okinawa Institute of Science and Technology (OIST), Okinawa, Japan, Jan 2016
15. Co-Organizer, Mathematics of Soft Matter Minisymposium, (with E. Fried, P. Podio-Guidugli), Okinawa Institute of Science and Technology (OIST), Okinawa, Japan, January 2016

OTHER ACADEMIC ACTIVITIES

1. NSF panel member in Numeric and Symbolic Computation, for Small Business Industrial Research Grants, 1989

2. External Ph.D. examiner, Department of Computer Science, 1991
3. Invited panel member, "Toward Multimedia Computing" in the International Conference on Software and Knowledge Engineering, 1992
4. NSF panel member in Numeric, Symbolic and Geometric Computation, for Small Business Industrial Research Grants, 1993
5. IEEE Multimedia Technical Committee Member, 1993 - 1995
6. NSF panel member in Numeric, Symbolic and Geometric Computation, for Small Business Industrial Research Grants, 1994
7. NSF site visitor as part of an NSF-CISE Infrastructure team, 1995
8. MPEG-4 SNHC Geometric Compression Sub-Committee, 1996
9. Associate editor, ACM Transactions on Graphics, 1996 – 2005
10. Associate editor, SIAM Journal on Imaging Sciences, 2007 – 2011
11. Associate editor, International Journal of Computational Geometry and Applications, 1996 - *Present*
12. NSF panel member in New Technologies, 1998
13. Site visit team for Accelerated Strategic Computing Initiatives (ASCI), 1999
14. NSF panel member in Numeric, Symbolic and Geometric Computation, 1999
15. NSF panel member in Experimental Systems, 1999, 2000
16. NSF panel member in Advanced Computational Research, 2000
17. Associate editor, ACM Computing Surveys, 2003 – *Present*
18. Review Panel member, Austrian Science Foundation, 2006
19. Educational Panel Member for the Vietnam Education Foundation research fellowship committee, 2006-2007
20. KAUST Center Director Search Committee, 2008
21. Review Panel member, Austrian Science Foundation, 2008
22. CONSOLIDER Committee, 2008- 2012
23. Member of NIH Molecular Structure Function (MSFD) Computational BioPhysics Study Section, 2009 –2014
24. Member of National Biomedical Computation Resource(NBCR) Advisory Committee, 2010 - *Present*
25. Austrian Science Foundation, 2010
26. Editor, Chapman and Hall ICRC Mathematical and Computational Imaging Sciences Series, 2009 –*Present*
27. Editorial advisory board member of Lecture Notes in Computational Vision and Biomechanics, Springer Verlag, 2010 – *Present*
28. Advisory Board Member, Berlin International Graduate School in Model and Simulation Based Research (BIMoS at Technische University Berlin, Berlin, Germany 2015- *Present*
29. “Computer Science Vs. Cancer”, Invited UT Computer Science Alumni Talk, Oct 29, 2015, University of Texas at Austin
30. Invited reviewer for K1-Centre Consortium, “Competence Center in Polymer Engineering and Science (PCCL-K1), for The Austrian Research Promotion Agency, Consortium hearing June 15, 2016, Vienna, Austria
31. Invited guest speaker for 2016 USACM Conference on Isogeometric Analysis and Meshfree Methods, Oct 10-12, 2016
32. NIH BD2K Trainee Selection Committee for Computational Sciences, Engineering, and Mathematics and Computer science, 2016
33. Third Annual Research Retreat of the Joint Center for Computational Oncology- November 9, 2022 in the Avaya Auditorium in POB- University of Texas at Austin
34. Alan Turing Workshop- London, UK, January 22, 2023

COURSES TAUGHT AT PURDUE UNIVERSITY

1. CS414 Introduction to Numerical Analysis, Spring 1987
2. CS435 Computer Graphics, Fall 1993, Fall 1994, Fall 1995, Spring 1996, Fall 1996
3. CS482 Introduction to Design and Analysis of Algorithms, Spring 1986
4. CS484 Introduction to Theory of Computation, Spring 1985
5. CS541 Files and Database Structures and Systems, Fall 1984
6. CS572 Introduction to Artificial Intelligence, Spring 1989, Spring 1993
7. CS574 Advanced Computer Graphics, Fall 1989
8. CS580 Design and Analysis of Algorithms, Fall 1985, Spring 1992
9. CS584 Theory of Computation and Computational Complexity, Spring 1988, Spring 1994
10. CS586 Algorithmic Robotics, Fall 1991, Fall 1992, Spring 1996

11. CS590R Geometric Modeling and Motion Planning, Fall 1986, Spring 1988, Fall 1988
12. CS590Z Introduction to Scientific Data Visualization, Spring 1994, Spring 1997

ADMINISTRATIVE POSITIONS AT THE UNIVERSITY OF TEXAS

1. GSSC CAM Admissions Committee (TICAM), 1997-2000
2. CAM Research Fellowship Committee (TICAM), 1997-2002
3. Chair and Infrastructure Committee (TICAM), 1997-2000
4. Festivals and Publicity Committee (CS), 1997-1999
5. HPPC Vision and Strategy Task Force Committee (UT Vice President for Research), 1998-2000
6. Chair Committee (CS), 1998-2000
7. Graduate Admissions Committee (CS), 1998-2000
8. Chair Recruiting Committee (CS), 2000-2001
9. Faculty Evaluation Committee (CS), 2000-2002 (Chair, 2001-2002)
10. Chair Recruiting Committee (TICAM), 2000-2002
11. Computational Applied Mathematics, GSSC (TICAM), 2000-2002
12. CISE Committee (CS), 2004-2007
13. Faculty Recruitment Committee for Imaging Resources Center, 2005-2006
14. Search Committee for ICES Chair in Life Sciences, Chair, 2005-2006
15. ICES Advisory Board, 2005 – 2008
16. JTO Fellowship Award Committee (ICES), 2005 - 2008
17. CAM Graduate Studies Committee (ICES), 2006-2007
18. ICES Board of Advisers, 2008
19. GSC (CS), 1997 - Present
20. GSSC (ICES), 1997- Present
21. GSC (EE), 2000 - Present
22. GSC (Biomed), 2004 - Present
23. GSC (ICMB), 2005 - Present
24. GSC (Neurosciences), 2007 - Present
25. GSC (Mathematics), 2007 - Present
26. Neurosciences Graduate Curriculum Committee (Neurobiology), 2007 - Present
27. Faculty Recruiting Committee (CS), 2007 - 2008
28. Master Admissions Committee (CS), 2008 - 2010
29. Institute of Neurosciences Executive Committee, 2008 - 2012
30. SBES/Moncrief Search Committee on Molecular Sciences, 2009 - 2010
31. SBES/Moncrief Search Committee on Cardiovascular Engineering, 2009 - 2010
32. ICES Core Course B Curriculum Committee, 2009 – 2010
33. VP of Research representative to UT's International Oversight Committee, 2010-2011
34. Member of the Hamilton Book Awards Committee, 2013-2014
35. Doctoral Admissions Committee, 2013-2014, 2015-2016
36. Interdisciplinary Hiring Ad Hoc Committee, 2014-2015
37. Faculty Promotions Committee, Computer Science, 2015-2016, 2016-17
38. Moncrief Data Analytics Search Committee, 2016-17
39. Ad Hoc Budget Council for Alex Huth, 8/2017 -2018
40. CS Peer Evaluation for Etienne Vouga, April 2017
41. BD2KT32 Admissions Committee, Spring 2017
42. TOTAL High Performance Computing Group - Campus Visit Feb. 2
43. Computer Sceince, Engineering & Mathematics (CSEM) Admissions Committee 2017-2018

COURSES TAUGHT AT THE UNIVERSITY OF TEXAS

1. CS395T, Graphics, Modeling, Visualization, Fall 1998, Spring and Fall 1999, Spring and Fall 2000, Spring 2002
2. CS395T, Physically Based Geometric Modeling, Fall 2002
3. CS395T Multi-Scale Bio-Modeling and Visualization, Fall 2005, Fall 2006

4. CS354/BME 345, Intro. to Computer Graphics, Fall 1999, Spring 2001, Fall 2003, Spring 2004, Fall 2005, Fall 2006, Fall 2007, Fall 2008, Spring 2010, Fall 2010, Fall 2013, Spring 2014
5. CS384G/CAM 395T, Computer Graphics, Spring and Fall 1999, Fall 2000, Fall 2007, Fall 2008
6. CS384R, Geometric Bio-Modeling and Visualization, Fall 2007, Fall 2008, Fall 2010, Fall 2013
7. CSE 383M/CS 395T, "Statistical and Discrete Methods for Scientific Computation / Bioinformatics" Spring 2015
8. ARC350R/ARC386M/CS378 "BIO-(In)formatic Architecture Modeling in Architectural Design", Spring 2016
9. CS378 Geometric Foundations of Data Sciences, Fall 2017
10. CS383M Statistical and Discrete Methods for Data Analysis, Spring 2018
11. CS378 Geometric Foundations of Data Science, Fall 2018
12. Fall 2018 C S 399W Dissertation (Graduate)
13. Fall 2018 CSE 370 Individual Reading & Research (Undergraduate)
14. Fall 2018 CSE 392 Geometric Fndtns Of Data Sci (Graduate)
15. Fall 2018 CSE 698A Thesis (Graduate)
16. Fall 2018 M 392C Geometric Fndtns Of Data Sci (Graduate)
17. Spring 2019 C S 379H Computer Science Honors Thesis (Undergraduate)
18. Spring 2019 C S 395T Comp Stat Appl In Data Sci (Graduate)
19. Spring 2019 C S 399W Dissertation (Graduate)
20. Spring 2019 CSE 370 Individual Reading & Research (Undergraduate)
21. Spring 2019 CSE 383M Stat/Discrete Meths Sci Comput (Graduate)
22. Spring 2019 CSE 698B Thesis (Graduate)
23. Spring 2019 E E 697C Research Problems (Graduate)
24. Spring 2019 M 393C Stat/Discrete Mthd Sci Comp (Graduate)
25. Spring 2019 SDS 389R Graduate Research (Graduate)
26. Summer 2019 C S W379H Computer Science Honors Thesis (Undergraduate)
27. Summer 2019 CSE W390 Individual Research (Graduate)
28. Fall 2019 CS 379H Computer Science Honors Thesis
29. Fall 2019 CS 399W Dissertation
30. Fall 2019 EE 398R- Master's Report-Se-
31. Fall 2019 CSE 370- Individual Reading and Research
32. Spring 2020 CSE 370F- Undergraduate Research & Writing
33. Spring 2020-CS 378-Geometric Fndtns of Data Sci
34. Spring 2020- CS395T-Machine Learn in Data SCIS
35. Spring 2020-M 392C Geometric Fndtns of Data Sci
36. Spring 2020-M 393C Stat/Discrete Mthd Sci Comp
37. Spring 2020-CSE 383M Stat/Discrete Meths Sci Compu
38. Spring 2020- CS 395T- Comp Stat Appl In Data Sci
39. Spring 2020- CS 399W- Dissertation
40. Spring 2020- CSE 370 Undergrad Reading and Research
41. Spring 2020- CS 390 Individual Reading(Grad)
42. Spring 2020-PHY 341 Geometric Foundations of Data Science
43. Spring 2020- M375- Conference course (undergraduate)
44. Summer 2020 CSE 370- Individual Reading and Research(undergrad)
45. Summer 2020 CSW 395- Conference Course
46. Summer 2020 CSE S370- Individual Reading and Research
47. Fall 2020- CSE 390-Individual Reading
48. Fall 2020- CSE 392- Foundations of Predictive Machine Learning
49. Fall 2020- CSE 392- Geometric Foundations of Data Science-Wb
50. Fall 2020- M-392C- Geometric Foundations of Data Science
51. Fall 2020- M-392C- Foundations of Predictive Machine Learning
52. Fall 2020- Phy 341- Geometric Foundations of Data Science
53. Fall 2020- SDS 379R- Undergraduate research
54. Spring 2021- CSE 390-Individual Reading
55. Spring 2021- CSE 392- Foundations of Predictive Machine Learning
56. Spring 2021- CSE 392- Geometric Foundations of Data Science-Wb
57. Spring 2021- M-392C- Geometric Foundations of Data Science
58. Spring 2021- M-392C- Foundations of Predictive Machine Learning

59. Spring 2021- Phy 341- Geometric Foundations of Data Science
60. Spring 2021- SDS 379R- Undergraduate research
61. Spring 2021- CSE 398R- Master's Report
62. Summer 2021- CSE W 390- Individual Research
63. Spring 2022- CSE 392 - Geometric Foundations of Data Sciences and Predictive Machine Learning
64. Spring 2022- CS 378- Geometric Foundations of Data Sciences and Predictive Machine Learning
65. Spring 2022- M 392C- Geometric Foundations of Data Sciences and Predictive Machine Learning
66. Fall 2023- CSE 392 - Geometric Foundations of Data Sciences and Predictive Machine Learning(66015)
67. Fall 2023- CS 378- Geometric Foundations of Data Sciences and Predictive Machine Learning(53050)
68. Fall 2023- M-392C- Geometric Foundations Of Data Science(55895)
69. Fall 2023-CS 395T -Predictive Machine Learning (53235)
70. Fall 2023-CSE 392-Predictive Machine Learning (66020)
71. Fall 2023-M393C- Predictive Machine Learning (55935)
72. Spring 2025 CSE 392 Predictive Machine Learning (60359)
73. Spring 2025 CS 395 T (50070)- crosslisted with the above
74. Spring 2025 CSE 392 Geometric Fdtns of Data Sci (60358)
75. Spring 2025 CS 378 (49888)- cross listed with the above

Ph.D. STUDENTS

Completed Ph.D. Students (Chair)

1. Myung-Soo Kim, December 1988, (Professor Seoul National University, Seoul, Korea)
2. Tamal Dey, August 1991, (Professor Ohio State University, USA)
3. Insung Ihm, August 1991, (Professor Sogang National University, Seoul, Korea)
4. Andrew Royappa, December 1992, (Professor Mississippi State University, USA)
5. Vinod Anupam, June 1994, (Senior Research Scientist, Google Inc, Mountain View, USA)
6. Jindong Chen, December 1995, (Senior Research Scientist, Google Inc, Mountain View, USA)
7. Fausto Bernardini, December 1996, (Senior Research Scientist, IBM Research Yorktown Heights, USA)
8. Kwun-nan Lin, December 1996, (Private Entrepreneur, Taipei, Taiwan)
9. Dan Schikore, August 1997, (Senior Research Scientist, CEI International, North Carolina, USA)
10. Peinan Zhang, December 1997, (Research Scientist, SUN Microsystems, California, USA)
11. Guozhong Zhang, May 1999, (Research Scientist, Intel Research, Portland, USA)
12. Steve Cutchin, August 1999, (Director, San Diego Super Computer Visualization Center,)
13. Valerio Pascucci, May 2000, (Professor, University of Utah, Salt Lake City, UT)
14. Susan Evans, August 2001, (Research Scientist, Xerox Corporation, California, USA)
15. William Blanke, December 2001, (Professor University of Fiji, Fiji Island)
16. Xiaoyu Zhang, December 2001, (Professor of California State University, California,)
17. Bong-Soo Sohn, August 2005, (Professor of Kyungpook National University, Daegu, Korea)
18. Yongjie Zhang, August 2005, (Assistant Professor at Carnegie Mellon University)
19. Zeyun Yu, August 2006, (Assistant Professor, University of Wisconsin, Milwaukee, WI)
20. Sangmin Park, December 2006 (Research Scientist, Siemens Research Center, Princeton, NJ)
21. Vinay Siddahanavalli, December 2006 (Research Scientist, Google Inc, Mountain View, CA)
22. Wenqi Zhao December 2008 (Research Instructor, Bowling Green University)
23. Shun Chuan "Albert" Chen, December 2009 (Research Scientist, Google Inc, Mountain View, CA)
24. Andrew Gillette, May 2011 (PostDoc, University of California, San Diego, CA)
25. Radhakrishna Bettadapura August 2012 (Research Scientist at Strand Life Sciences)
26. John Edwards, May 2013 (Postdoctoral Fellow, University of Utah)
27. Muhibur Rasheed, August 2014 (Research Scientist at CD-Adapco, Austin, Texas)

Ph.D. Students in Progress (Chair-Supervisor/Graduated)

Nathan Clement, 2015- Graduated Summer 2023

Yi Wang- CSEM ,PhD- 2018-present-

Ryan Farrell(Operational Research and Industrial Engineering)- Fall 2021-

Minh Nguyen- Fall 2021 - PhD-Math- Graduated Spring 2024- Completed May 2024

Taemin Heo- CS- 2021 Masters- Computational Science Certificate-Graduated- Dec 2022

Luke McLennan- CSEM- Fall 2022

Aaron Dominick (1st year PhD-Biomed Engineering) March 2022- Summer 2022- Research rotations

Ph.D. Students (Committee Member)

Jeff Manning, ECE-2017 – 2020- Graduated Spring 2020-

Xiangru Huang, CS Fall 2019 -

Jiong Zhang- CSE-Spring 2019-

Dilin Wang, CS- 2018 -2020- Graduated Summer 2020

Shu-Wei Tsao-Physics- Spring 2020-

Therese Eileen Paoletta- Physics- Spring 2021

Jong Won Ma-CE- Spring 2021

Sumit Sinha-PhD-Fall 2020- Present- Physics and Machine Learning

Avik Roy-PhD- Graduated Summer 2021- Physics- physics informed deep learning

Ryan Hartigan- Fall(Nov. 2023-dissertation defense)

Sui-Wei Tsao-(Oct 2023-dissertation defense)

Ziheng Chen- March 28, 2024(defense) (committee member)

Elzbieta Polak- April 29th 2024 defense- (Committee Member)

Eboni Williams- May 14, 2024(committee member)

POST-DOCTORAL STUDENTS

Completed Post-Docs

Dr. Sanghun Park 1998-2000 (Currently Professor at Dongguk University, Seoul, Korea)

Dr. Ariel Shamir 1999-2001 (Currently .Professor at Herziliya University, Israel)

Dr. Julio Castrillon-Candas 2003-2005

Dr. Yongjie Zhang 2005-2007 (Currently Professor at Carnegie Mellon University)

Dr. Samrat Goswami, 2006 – 2008 (Currently at CAD , Boston)

Dr. R. Inkulu, 2007 – 2008

Dr. Wenqi Zhao, 2008 – 2009 (Currently Assoc. Professor at Michigan State University)

Dr. Cliff Rumsey, 2008 – 2010

Dr. Rezaul Chowdhury, 2007 – 2010 (Currently Asst. Professor at StonyBrook University)

Dr. Alex Rand, 2009 – 2012 (Currently Research Scientist at CD Adapco, Austin, Texas)

Dr. Qin Zhang, 2008 – 2012 (Currently Research Scientist at Houston)

Dr. Deukhyun Cha, 2010 – 2013 (Currently Research Scientist at Houston)

Dr. Ahmad Rushdi 2014 – 2016 (Currently Research Scientist at Sandia National Lab.)

Dr. Muhibur Rasheed 2014-2015 (Currently Research Scientist at CD-Adapco, Austin, Texas)

Dr. Tianming Wang 2018-2020 (Currently Asso. Prof in Southwestern Univ of Finance and Econ in Chengdu of China)

Dr. Ahmed Abdelrazek (Sept 2020-May 2022)

Dr. Mohamed Abouhawwash(Research Fellow) Oct 2021-August 2022

Dr. Taemin Heo- Jan 2023- May 2024

PostDoc Students in Progress

Completed MS STUDENTS

Katherine Clarridge, (BME), May 2006

Alex Mollere, (CSEM), May 2009

Jesse Sweet, (Math), May 2008

Bharadwaj Subramaniam, (CSEM), May 2010

Yu Lu (Physics) Dec 2018

Haoran Zhang 2019-2020

Richard Matthews- Fall 2020- CS- Master's thesis
 Akshay Varanasi (CSEM), 2018-2019
 Taemin Heo- CS- 2021 Masters- Computational Science Certificate-Graduated- now in PhD program
 Chase Tessmer - CSEM--Spring 2019 –Summer 2021
 Shijing Zhong- CSE-Spring 2020-
 Michael Andrew Davis- ECE-Fall 2019-
 Yunhao Yang-Masters- Fall 2020- CS/Math- to graduate in May 2022

MS Students in Progress

Yorick Sanders- Masters 2020-2021- Computer Science-
 Rochan Avlur-Masters-Spring '21 Computer Science-
 Sean Zanyk McLean- Master's Fall 2021- Aug 2022- CSEM
 Shubham Bhardwaj- MS-CS-2022
 Yashwi Shah- CS- Fall- 2022
 Jinpeng (George) Zhai- CS- Fall 2022

UNDERGRADUATE RESEARCH STUDENTS (Chair)

Undergraduate Students

Nona Sirakova (CS) August 2012
 David Moench (CS), August 2014
 Suchith Vuppala (CS), May 2014
 Pragati Prasad (CS), August 2014
 Holim Lee (CS) <date>
 Huijin Kim (CS) <date>
 Chetan Kumar, (BME) <date>
 Keerthana Kumar (CS) <date>
 Chand John (CS) <date>
 Balaz Kustar (Mathematics) Independent study-August 2019-Turing Scholar Thesis
 Benny Meltzer (Math) Graduated- Dec 2019
 Supawit Chockchowwat (CS) Graduated-May 2020- Turing Scholar. now in University of Illinois PhD Program
 Andrew Davis (ECE) Dec 2019, Demetrius Rowland (ECE), Dec 2019,
 Minghan Yu(Math)- 2020, Binglin Zhang(Math) 2020, Eshani Kaul(CS)- 2020, Shijing Zhong- 2020
 Yunhao Yang- 2020 (Summer Moncrief Student), Tarun Thummala(CS), Tyler Parker (CSEM) May 2020, Matt Hall-
 2020, Abhijit Raman- 2020, Aditya Gadiyar- 2020, Benjamin Beal(CS) , David Benny, Jonathan Randall-(CS), Kevin
 Jin- Conrad Li(CS), Nithin Anumala(CS), Pranav Eswaran(CS), Kevin Jin, Shamira Kabir, Shikhar Gupta(CS), Yuhua
 Zheng, Tyler Miller, Conrad Li- (CS), Benjamin Beal-(CS), Joshua Prupes, Nithin Anumala-2020, Pranav Eswaran-2
 Ryan Bethke-(CS and Spanish), William Gross(CS), Abhishek Dayal(CS/Math), Shikhar Gupta(CS), Eshani Kaul,
 Arman Maesumi, Theodore Morales(CS), Mingkan Zhu, Abrar Anwar(CS), Binglin Zhang
 Harrison White(ME), Nikhil Ajjarapu(CS)-AFC, Edward Zhou(Math)
 Luke McLennan(Moncrief Summer Intern), Omatharv Vaidya, Yash Totlani, Sumit Sinha(physics), Vineet Yang,
 Edward Zhou(Math), Soumil Chopra(Biomedical engineering), Zachary Endres, Yunhao Zheng, Akash Suruvu, Arian
 Ghatate(HS), Dangyan Zhang, Krishna Reddy(CS), Priyansh Kedia(UG-India), Thomas Ghorbania, Sebastian
 Rutherford, Supawit Chockhowat, Amrutha Srinivasan(Biomedical Engineering), Trevor Nguyen(CS-Turing)-grad
 date- May 2022) George Zhai, Trung Nguyen, Pronoma Banerjee(summer 2023), Qing Zhu- Summer 2022, Alexey
 Izmailov(ai7275) Moncrief, Michael Zhang(mz22388)- Moncrief, Shreyash Sinha(ss227874)- 2023- summer intern,
 Aditya Sai(undergrad-summer 2023), Abhiram Muddukuri (acm5234-2023)

MEMBER OF MS/PhD Committee

Peter March of ME, (Ph.D. chair Dr. Delbert Tesar)
 Darlan Girao of Math, (Ph.D. Chair Dr. Alan Reid)
 Yul Young Park, INS (Ph.D. chair Dr. Dan Johnston)
 Ming Ming Wu, Neurobiology (Ph.D. Chair Dr. Harold Zakon)

Rui Mao, CS (Ph.D. Chair Dr. Dan Miranker)
 Matthew Alden, CS, (Ph.D. chair Dr. Risto Mikkulainen)
 Ligang Long, Math, (Ph.D. chair Dr. Dr. Cameron Gordon)
 Ann M. Clemens, Neuroscience (Ph.D. Chair Dr Daniel Johnston)
 James Delfeld, Math. (Ph.D. Chair Dr. Ronald Hadani)
 Itamar Gal (Ph.D. Chair Dr. Rachel Ward)
 Jeff Manning (Ph.D. Chair Ross Baldick, ECE), 2019
 Jiong Zhang (Ph.D. Chair Inderjit Dhillon, CS), 2018
 Madeline Folkerts (MS. Supervisor, BME), 2018

Oden Institute/Computational Visualization Center Visitors

June 2024- Angelos Mantazafaris, INRIA, Sophia Antipolis Méditerranée
 June 2024- Bernard Mourrain- INRIA, Sophia Antipolis
 May 9-16- JTO- Sudhir Ghorpada- Indian Institute of India(Bombay)
 Nov. 3, 2023- Yang Li- Tsinghua University
 Sept 27, 2023- JPL(Jet Propulsion Lab) Hallie Abarca Gengl and Erik Ferguson
 July 15, 2023- Jan 2024- Harsha Honnappa- Purdue
 June 1- August 2024- Pronoma Banerjee- BITS- Pilani
 Nov 7-13, 2022- Jan Christopher Cohrs
 October 27,28 2022- Zhi Galil- Guest Speaker- Georgia Tech
 2022/23 J-1 visitor- Omathrav Vaidya- BITS- Pilani August 15 2022- August 14 2023
 2022: Yuehaw Khoo- JTO Oden Faculty Fellow- June 6-June 20
 18-19: Dr. Krzysztof Gajowniczek, Warsaw University of Life Sciences (Spring 2019)
 18-19: Dr. Bong-Soo Sohn, Chung-Ang University, (JTO, 2019)
 18-19- Benjamin Berkels and Bong-Woo Sohn.O
 17-18 Ruslan Akhmetvaleev, Moscow (Fulbright 2018)
 17-18: Dr. Chand John, Stanford University, (Summer 2018)
 17-18: Bernard Mourrain, Gerrit Welper, Paolo Podio-Guidugli, Bong Soo Sohn, Abel Gomes
 16-17: Gerrit Welper, Benjamin Berkels
 15-16: Bernard Mourrain, Paolo Podio-Guidugli, Eliot Fried, Tamal Dey
 14-15: Gitta Kutyniok, Bernard Mourrain, Antje Vollrath, John Edwards
 13-14: Rohit Bhargava, Jaydeep Bardhan
 12-13: Antje Vollrath, Bernard Mourrain, Laureano Gonzalez-Vega, Paolo Podo-Guidugli, Antonio Di Carlo, Andrea Micheletti, Paolo Podio-Guidugli, Charles Reynolds
 11-12: Wenping Wang, Andrew Gilette, Michael Holst, Paolo Cermelli, Paolo Podio-Guidugli, Yunrong Zhu
 10-11: Ozan Oktem, Antje Vollrath, Wenping Wang
 09-10: Guoliang Xu, Paolo Podio Guidugli, Luciano Teresi, Sergey Bereg
 08-09: Laureano Gonzalez-Vega, Alberto Paoluzzi, Ozan Oktem, Amabile Tatone, Xiaoyu Zhang, Guoliang Xu, Zeyun Yu, Paolo Podio-Guidugli, Antonio DiCarlo
 07-08: Insung Ihm, Na Lei, Annie Raoult, Yoel Shkolnisky, Carlos Oscar Sanchez Sorzano, Guoliang Xu, Zeyun Yu
 06-07: Alberto Paoluzzi, Sanghun Park, Jorg Peters, Ulrich Reif, Theofanis Strouboulis, Luciano Teresi, Guoliang Xu
 05-06: Alberto Paoluzzi, Vladik Kreinovich, Denis Zorin, Tao Ju, David Goodsell, Bong Soo Sohn, Tomoyuki Nishita, Guoliang Xu
 04-05: Guoliang Xu, Karol Miller, Shigeru Owada, Xiaoyu Zhang, Insung Ihm, Alberto Paoluzzi

SUPERVISION/TRAINING OF SUMMER INTERNS

Andre, Nuno (2010), Ana Jantadarna (2011), Thomas Kelleher (2012,2013), Bruno Araújo, José Ricardo Ribeiro , Joao Silva and Tiago Martins , Bruno da Silva, Jorge Oliveira (2014), Filip Drowsdowski (2014), Jialin Wu (2016), Amisha Jhanji (2016), Abinav Chandar (2016), Zachary Walters (2016 with Dr. Danelle Briscoe, Architecture), KAUST Gifted Summer Research Program, July 12 - August 11, 2016: Rawan Al Yahya, Sara Alshaik Hussain, Khuzam Al Shubbar (2016); Young Min Kim Visiting Research Scholar (June 28, 2016-February 28, 2018); Moncrief Undergrad Summer Intern-Stephen Davis Owen (June 5-Aug 11, 2017); Xiaolong Zhang, Visiting Researcher Scholar, China; Arjun Karpur,

(2017); Zhou Lu (Peking math, June 27, 2017) Summer internship; Zihao Wei (July, 2017) Summer internship; Yufeng Zhang (USTC math, July, 2017); Xi Ye (2017); Mythreya Kuricheti (2018); Abhilash Karpurapu (2018), Aditya Gupta (2018), Jahnvi Vikrama (2018); Maryam Aljeshi (2018); Mohammad Subah (2018); Khalid Aldawood (2018); Simiao Zuo, Moncrief; Charles K. Tusa, Moncrief (2018), Yukang Cao (2019), Luke McLennan (Moncrief) (2021), Kai Chang (Moncrief) (2022) Alexey Izmailov (2023) Moncrief, Michael Zhang (2023) Moncrief, Aditya Sai (summer 2023)

INVITED CONFERENCE/WORKSHOP/ PLENARY/KEYNOTE PRESENTATIONS

1. "Applying Galois Methods to Geometric Optimization Problems", SIAM Conference on Geometric Modeling and Robotics, Albany, New York, July 1985
1. "Generalized Unfoldings for Shortest Paths", SIAM Conference on Geometric Modeling and Robotics, Albany, New York, July 1985
2. "Efficient Generation of Conguration Spaces", Army Robotics Workshop, Rennselear, Troy, New York, June 1986
3. "Automatic Rational Parameterization of Curves and Surfaces", Army Robotics Workshop, Rennselear, Troy, New York, June 1986
4. "The Parameterization of Rational Curves and Surfaces", Computers and Mathematics Conference, Stanford, California, July 1986
5. "Geometric Modeling Research, Computer Aided Manufacturing", International, Geometric Modeling Group, San Jose, California, January 1987
6. "Genus is a Birational Invariant", Midwest Theory Conference, University of Illinois, Urbana, Illinois, April 1987
7. "Algorithmic Implicitization and Parameterization: The Known and the Unknown", Research Conference on Geometric Design, Detroit, Michigan, May 1987
8. "Algebraic Methods in Geometric Modeling, Computer Aided Manufacturing", International Geometric Modeling Group, Boston, Massachusetts, May 1987
9. "Geometric Modeling Research", Tata Research and Development Center, Pune, India, June 1987
10. "Geometric Modeling and Robotics", Computer Maintenance Corporation, Hyderabad, India, June 1987
11. "Motion Planning with Algebraic Objects", First International Conference on Industrial and Applied Mathematics, ICIAM'87, Paris, France, June 1987
12. "Genus is a Birational Invariant: Parameterizing Algebraic Space Curves", SIAM Conference on Applied Geometry, Albany, New York, July 1987
13. "Convex Decompositions and Gaussian Approximations of Curved Objects", SIAM Conference on Applied Geometry, Albany, New York, July 1987
14. "Algorithms for Algebraic Curve and Surface Parameterization" workshop on Algebraic Computational Geometry, Bellairs Research Institute of McGill University, Holetown, Barbados, 1988
15. Workshop on Algorithmic Aspects of Geometry and Algebra, Mathematical Sciences Institute, Cornell University, Ithaca, NY, 1988
16. [KEYNOTE]Invited Keynote speaker, Third IMA Conference on the Mathematics of Surfaces, Keble College, Oxford University, 1988
17. ONR Workshop on Geometric Design, Moscow, Idaho, 1989
18. Special Session on "Mathematical Questions in Computational Geometry", American Mathematical Society, Boulder, Colorado, 1989
19. Workshop on Practical Issues in Computational Geometry, DIMACS, Princeton University, Princeton, 1990
20. Workshop on Algebraic Issues in Computational Geometry, DIMACS, Princeton University, Princeton, 1990
21. I.CO. GRAPHICS'91 Conference in Milan, Italy, February 1991
22. Special Year on Symbolic Computation at the Nankai Institute of Mathematics, Tianjin, China, April 1991
23. Dagstuhl-Seminar on Algorithmic Geometry, Saarbrücken, West Germany, October 1991
24. Curves and Surfaces in Computer Vision and Graphics II, SPIE Conference, Boston, MA, November 1991
25. "Multivariate Interpolation and Approximation", Presentation, 7th Texas Approximation Theory Conference, Austin, Texas, January 1992
26. "Experiments in Distributed and Collaborative Design", DARPA workshop on Manufacturing, Salt Lake City, Utah, January 1992
27. "Algebraic Surface Design and Finite Element Meshes", Presentation, NASA Workshop on Software Systems for Surface Modeling and Grid Generation, Langley Research Center, Hampton, Virginia, April 1992
28. "Parameterization in Finite Precision", Presentation, Graphics Interface '92, Vancouver, British Columbia, Canada, May 1992

29. "Multimedia Computing (What now in User Interfaces)", Invited Presentation at a Panel, Fourth International Conference on Software Engineering and Knowledge Engineering, Capri, Italy, June 1992
30. "Implicit Algebraic Splines and Applications", Tenth Army Mathematics Conference, West Point, New York, June 1992
31. "Generalized Hermite Interpolation for Algebraic Varieties", Invited Presentation, International Workshop on Mathematics Mechanization, Institute of System Sciences, Beijing, China, July 1992
32. International Workshop on Algebraic Approaches to Geometric Reasoning, RISC-LINZ, Austria, August 1992
33. International Conference on Computer Graphics, Bombay, India, February 1993
34. Dagstuhl-Seminar on Computational Geometry, Saarbrücken, West Germany, March 1993
35. "Virtual Reality and Virtual Environments", ONR Workshop, Research Triangle Park, North Carolina, May 1993
36. Siggraph 1993 Course on Implicit Surfaces, Anaheim, California, August 1993
37. Minisymposia at 1993 SIAM Conference on Geometric Design, Tempe, Arizona, November 1993
38. International Conference on Computer Aided Geometric Design, Penang, Malaysia, July 1994
39. Workshop on "Human-Computer Interaction and Virtual Environments", University of Virginia, Hampton, VA, May 1995
40. "Mathematics of numerical analysis: real number algorithms", SIAM, Park City Utah, July 1995
41. Annual Pacific Graphics Conference, Seoul, Korea, August 1995
42. Minisymposium on Surface-on-Surfaces at the Geometric Design Conference, Nashville, Tennessee, November 1995
43. "Modeling Surfaces and Associated Fields" Dagstuhl-Seminar on Geometric Modeling, Schloss Dagstuhl, West Germany, May 1996
44. Invited Talk on "High Performance Scientific Computing" (C3AD), Brazil, July 1. 1996
45. Course on "Representations of Geometry", SIGGRAPH 96, New Orleans, July 1996
46. Course on "Implicit Surfaces", SIGGRAPH 96, New Orleans, July 1996
47. Canadian Conference on Computational Geometry, Ottawa, Canada, August 1996
48. IMA Conference on the Mathematics of Surfaces, Dundee, Scotland, UK, September 1996
49. "Progressive Compression of Arbitrary Triangular Meshes", Conference on Hierarchical Methods in Computer Graphics, Dagstuhl-Seminar on Scientific Visualization, Schloss Dagstuhl, West Germany, May 1997
50. Minisymposium on Reverse Engineering, Conference on Computer Aided Geometric Design, Lillehammer, Norway, July 1997
51. IMACS conference on Problem Solving Environments Berlin, Germany, August 1997
52. The Laredo Course on Applications of Symbolic Computing, Laredo, Spain, September 1997
53. Tutorial at Eurographics '97, Budapest, Hungary, September 1997
54. "Hierarchical Free Form Modeling Using A-patches", Dagstuhl Germany, Workshop on Hierarchical Methods in Computer Graphics, Dagstuhl Germany, November 1998
55. Conference on Computer Aided Geometric Design, , ETH Zurich, "Multi Resolution Modeling & Visualization", July 1998
56. The Conference on New Themes in Computer Aided Geometric Modeling, Tel-Aviv, Israel, February 1998
57. "Freeform Modeling on Vector Fields for Interrogative Visualization", Oberwolfach Germany, Conference on Free Form Surfaces, at the Mathematisches Forschungsinstitut Oberwolfach Seminar, June 1998
58. NSF Large Data Visualization Workshop, Salt Lake City, UT, "Terascale Visualization", May 1999
59. "Vector Topology in Geometric Modeling and Visualization", Symbolic Numeric Computation Conference, Hagenberg, Austria, August 1999
60. Conference on Algebra and Algebraic Geometry with Applications, "Abhyankar Festschrift", Purdue University, Lafayette, Indiana, June 2000
61. [Keynote] "Higher Performance Visualization", First SIAM Conference on Computational Science & Engineering, Washington, DC, September 2000
62. Panel Presentation, "The Transfer Function Bake-Off Challenge", IEEE Visualization Conference, Salt Lake City, UT, October 2000
63. Panel Presentation "The Next Steps in Scalable Visualization", NPACI, All Hands Meeting, San Diego, CA, February 2001
64. UC San Diego - Advisory Member of Dr. Mark Ellisman's National Center on Microscopy Research, San Diego, CA, April 2001
65. "Subdivision Based Finite Element Solution of Anisotropic Diffusion Equations", IMA Workshop on Geometric Modeling, Minneapolis, MN, April 2001
66. "Scalable Rendering on COTS Clusters", IMA Workshop on Computer Graphics, Minneapolis, MN, May 2001

67. "Remote Visualization", TEXGRAPH 01, Houston, TX, May 2001
68. "Anisotropic Diffusion in 3D Image Processing", IPAM Workshop on Geometric Diffusion and Image Processing, Los Angeles, CA, May 2001
69. "Geometry Processing and Visualization in Hierarchical Modeling in Heterogeneous Materials", Sandia National Lab, Project Grantee Workshop, Albuquerque, NM, May 2001
70. "High Performance Visualization Techniques", WSCG2002 Conference, Plzen, Czech Republic, February 2002
71. "Algebraic Geometry of Molecular CAD", Symbolic Computation Workshop, Catania, Italy, March 2002
72. "Algebraic Geometry Computation and Applications", Workshop, Hefei, China, April 2002
73. "Active Visualization", Eurographics Workshop on Virtual Environments, Barcelona, Spain, May 2002
74. "Molecular Modeling and Visualization" Gordon Conference on Diffraction Methods, Connecticut, July 2002
75. "Molecular Modeling and Visualization" IUCR World Congress on Crystallography, Geneva, Switzerland, August 2002
76. [Keynote] "Volumetric Filtering Modeling and Visualization for Nano-Medicine", Eurographics 2003, Granada, Spain
77. "Quantitative Visualization of Static and Dynamic Macromolecular Complexes", Workshop on Visualization of Large Macromolecular Complexes, Berkeley, CA, October 2003
78. Invited Altenberg Lecture "Visual Representations in Biology", Konrad Lorenz Institute of Theoretical Biology, Vienna, Austria. February 2004
79. Invited McGovern Lecture "Image Processing and Visualization for Structural Biology", University of Texas Health Sciences, Houston. February 2004
80. Invited Presentation, "Cubic A-Patches and Twenty Seven Lines on a Cubic", Algebraic Geometry and Geometric Modeling Workshop, Science Research Institute, Berkeley, California. April 2004
81. Invited Talk, "Flexible Chain Complex Models for Cryo-EM Maps and Atomic Macromolecular Structures", Scripps Research Institute, San Diego. April 2004
82. "Quality Meshing of Large Biomolecular Complexes", Japan Society of Industrial and Applied Mathematics, Tokyo. September 2004
83. "Ultrastructure Elucidation from 3D Electron Microscopy at the Gordon Conference in 3D Electron Microscopy, New London, New Hampshire, July 2005
84. Invited Presentation on "Ultrastructure Elucidation from 3D Electron Microscopy", Computational Structural Biology, Data Mining Workshop, Stanford University, Stanford, August 2005
85. Invited Talk on "Visualization of Large Biomolecular Complexes", Workshop, UCSD-Scripps, September, 2005
86. Invited Colloquium on "Geometric and Signal Processing of 3D Electron Microscopy", Courant Institute, New York University, October 2005
87. Invited Jacques Morgenstern Colloquium on "Geometric and Signal Processing for Biomolecular Interactions ", INRIA- Sophia Antipolis, France, April, 2006
88. Invited Talk on "Geometric and Signal Processing for 3D Electron Microscopy", The IMA Workshop on Imaging Science, Minneapolis, May 2006.
89. Invited Minisymposium on "Efficient Computation of Molecular Surfaces, Energetics, Forces", Minisymposium at World Congress on Computational Mechanics, Los Angeles, July 2006
90. Invited Talk on "Static and Time Dependent Meshing from Imaging", Annual Meeting of the National Bio-Medical Center, San Diego, August, 2006.
91. VEF Review, Hanoi, Invited Talk on "Computer Science Research in Computational Biology", September 2006
92. Invited Talk on "Algebraic Geometric Methods in Engineering", IMA Conference, Minneapolis, September 2006
93. [Keynote] "In Silico Methods in Cellular Engineering", 24th Annual HSEMB Conference, Houston, February 2007
94. Invited Colloquium on "Applications of Approximation Theory", International Conference in Approximation Theory, San Antonio TX, March 2007
95. Invited Talk on "Flexibility of Virus Capsids Via Elastic Models", NRP Workshop on "Mathematical Models for Materials Science", Rome, March 2007
96. Invited Minisymposium Presentation on "Automatic Structure Interpretation of single particle Cryo-Electron Microscopy: From Images to Psuedo-Atomic Models" 2007 IEEE International Symposium on Biomedical Imaging, from Nano to Macro, Washington, DC, March 2007, <http://tinyurl.com/PMC2678009>, PMCID: PMC2678009
97. Invited Talk on "Fast Algorithms for Protein-Protein Energetic Interactions", Workshop on Macro-Molecules and Proteins, Lincei Academy, Rome, March 2007
98. [Keynote] "Molecular Structure and Properties Elucidation from 3D Electron Microscopy" at the Multi-Scale Imaging "Gulliver" Workshop, LBNL, Berkeley, CA, May 2007.

99. Invited Talk on “Algebraic Splines for Molecular Modeling”, IMA Annual Workshop, St. Paul, Minnesota, May 2007
100. Invited Talk on “Visualizing Physical Phenomena Using Interactive Media”, Gordon Research Center, Smithfield Rhode Island, July 2007
101. [Keynote] “Cardiovasculature Modeling and Visualization”, USNCCM 9th Annual Congress, San Francisco, July 2007
102. Invited Minisymposium Presentation “Viral Capsids as Deformable Shells”, for Tinsley Oden’s 70th Birthday Minisymposium, USNCCM 9th Annual Congress, San Francisco, July 2007
103. Invited Minisymposium Talk on “Algebraic Splines and Analysis”, USNCCM 9th Annual Congress, San Francisco, July 2007
104. Invited Minisymposium Presentation on “Union of Algebraic Spline Models”, SIAM Conference on Geometric Design, San Antonio, November 2007
105. Invited Talk “Molecular Electron Microscopy to Biophysical Modeling and Analysis”, Workshop on Image Analysis Challenges in Molecular Microscopy, IPAM-UCLA, Los Angeles, January 2008
106. [Plenary] “Geometric Flow for Quality Surface/Volumetric Modeling”, 1st Workshop on Computational Engineering and Fluid Dynamics, Lisbon, Portugal, July 2008
107. [Plenary] “Modeling Two Phase Flow Dynamics for Deformable Interfaces in Biology”, 1st Workshop on Computational Engineering and Fluid Dynamics, Lisbon, Portugal, July 2008
108. Invited Minisymposium Talk, “Multiscale Molecular Modeling for Drug Discovery”, SIMAI Conference, Rome Italy, September 2008
109. Invited Minicourse on “Computational Structural Biology”, Chinese Academy of Sciences, Beijing, February 2009
110. Invited talk, “Mathematics/Computer Sciences and Art”, Dean’s Advisory Council, March 2009
111. Invited talk, “Characterizing Electromagnetic Molecular Interaction Force Fields Using the Hodge Decomposition”, ACE (Advanced Computational Electromagnetics) 2009, Rome, April 2009
112. Invited Minicourse on “Molecular Modeling for Simulations”, University of Cantabria, Santander, Spain, May 2009
113. [Keynote] “Spatially Realistic CAD from Multi-Scale Bio-Imaging”, CAD Conference, Reno, NV, July 2009
114. Invited Plenary talk, “Variational Higher-Order Level-Set Methods for Image Segmentation”, Image Segmentation in Materials Science Conference, Pittsburgh, PA, November 2008
115. Invited talk, “Discovering Nature’s Gadgets and Gizmos”, at Workshop in Honor of John Hopcroft’s 70th Birthday, Cornell University, Ithaca, New York, October, 2009
116. [Keynote] “Nature’s Forces for Molecular Recognition: models and Computation”, at the International Conference on Physics/Biology Interface, Saha Institute of Nuclear Physics, Kolkata, India, December 2009
117. Invited talk “Cohomology Stability Criteria for Mixed Finite Elements”, Conference celebrating the 60th birthday of Tomas Recio, Castro Urdiales, Spain, May 2010
118. [Keynote] “Spatially Realistic Multiscale Modeling from Electron Microscopy”, CompIMAGE 2010, Buffalo, NY, May 2010
119. Invited Workshop Talk, “Computational Analysis of Protein Interactions for Drug Discovery”, 2nd Collaboration Meeting on Applications of Theoretical Physics Methods in Biology, ECT Institute, Trentino, Italy, June 2010
120. Invited talk, “Algebra and Geometry of Algebraic Finite Elements”, Conference on Algebra and Algebraic Geometry with Applications: Celebration of the 80th Birthday of Professor Shreeram Abhyankar, Purdue University, July 2010
121. Invited colloquial talk, “Solubility by Radicals and Monodromy of Riemann Surfaces”, Conference celebrating the 82th birthday of Prof. Abhyankar, Pune University, December 2012
122. [Keynote] “Computational Mathematics for Protein-Protein Interactions”, ACM/SIAM Solid Physical Modeling Conference, 2010, Haifa, Israel, August 2010
123. Invited talk, “Computational Analysis of Protein Interactions for Drug Discovery”, 2010 Austin-Portugal International Collaboratory for Emerging Technologies (COLAB), Lisbon, Portugal, September 2010
124. Invited talk, “Computational Analysis of Protein Interactions for Drug Discovery”, Meeting on Modeling of Protein Interaction (MPI), Lawrence, Kansas, October 2010
125. Invited Plenary speaker at the 2010 Visions of Computing Lecture Series, Computer Science UT Austin, November 2010
126. Invited participant and presenter, “Computational Analysis of Protein Interactions for Drug Discovery”, the National Academies Keck Futures Initiative Conference on Seeing the Future with Imaging Science, Irvine, CA, November 2010
127. Invited talk, “Variational Methods for 3D Reconstruction in Electron Microscopy”, Sampling and Reconstruction: Applications and Advances workshop at the Banff International Research Station for Mathematical Innovation and Discovery (BIRS), Vancouver, British Columbia, Canada December 2010

128. Invited talk, "Variational Geometry and Differential Topology Approaches to Structure Modeling from 3D EM Maps", Workshop on Structural Biology, Pacific Symposium on Biocomputing, Waimea, HI, January 2011
129. Invited talk, "Computational Molecular Biology, Modeling, and Visualization", IAMCS Visualization in Biomedical Computation Conference, Texas A&M University, College Station, Texas, February 2011
130. Invited talk "Geometric Modeling and Analysis of Protein Complexes Using Algebraic Splines", Conference held on Geometric Modeling at Schloss Dagstuhl Leibniz-Zentrum Fur Informatik, Dagstuhl, Germany, May 2011
131. [Keynote] "Computational Molecular Biology: Drug Discovery", Ninth Eurographics Symposium on Geometry Processing (SGP-2011), Lausanne, Switzerland, July 2011
132. Invited talk, "Automating the Visualization of Biological Machines", IEEEJ Autumn Conference on Basic and New Development in Visual Computing, University of Tokyo – Komaba Campus, September 2011
133. Invited SIAM minisymposium presentation, "Quality Hexahedral Reparameterization", SIAM Geometric Design and Solid /Physical Modeling Conference, Orlando, Florida, October 2011
134. Invited SIAM minisymposium presentation, "Harmonic Analysis for Protein-Protein Docking", SIAM Geometric Design and Solid /Physical Modeling Conference, Orlando, Florida, October 2011
135. Invited SIAM minisymposium presentation, "Computational Challenges in Bio-Nano-Technology", SIAM Geometric Design and Solid /Physical Modeling Conference, Orlando, Florida, October 2011
136. [Keynote] "Quantitative Visualization in the Computational Biological Sciences", IEEE Pacific Visualization 2012, Songdo, Korea, February 2012
137. Biomedicine in 4D Conference "Statistical Verification and Validation of Drug Targets using 3DEM", Oregon Health and Science University, March 2012.
138. "Automating the Visualization of Biological Machines", Experimental Biology 2012, San Diego, California, April 2012
139. Invited *William Mong Distinguished Lecture*, "Computational Challenges in Accelerated Drug Discovery", Hong Kong University, Hong Kong, May 2012
140. "Variational Methods in Molecular Electron Tomography", SIAM Conference on Imaging Science, Philadelphia, Pennsylvania, May 2012
141. [Keynote] "Quantitative Visualization in the Biological Sciences", International Conference on Contemporary Computing, IC3, New Delhi, India, August 2012
142. "Enhancing Visualization of Multi-scale Biophysical Simulations", Conference on Computational Physics, Kobe, Japan, October 2012
143. "Images to Function: Multiscale Modeling of Electrophysiology in the Hippocampus", Turning Images to Knowledge: Large-Scale 3D Image Annotation, Management, and Visualization, Janelia Farm, Virginia, October 2012
144. "Multi-Protein Docking", Modeling of Protein Interactions MPI 2012, University of Kansas, Lawrence, Kansas, November 2012
145. "Images to Function: Multi-scale Modeling of Electrophysiology in the Hippocampus", Modeling and Simulations of Physiological Systems, Technico Lisboa, Lisbon, Portugal, December 2012
146. "Computational Science Challenges for the 3D Virtual Cell", University of California, San Diego, California, December 2012
147. "Geometric Modeling Tales Born from Two Sciences: Algebra & Geometry", *Algebraic Geometry and Geometric Modeling* workshop at the Banff International Research Station for Mathematical Innovation and Discovery (BIRS), Vancouver, British Columbia, Canada, January 2013
148. "Modeling, Analysis and Validation of Molecular Interactions from Electron Microscopy", Advanced Imaging Methods Workshop, UC Berkeley, California, January 2013
149. [Keynote] "The Geometry and Analysis of Biological Machines", Advances in Computational Mechanics, Celebrating the 70th Birthday of Thomas J.R. Hughes, February 2013
150. "Modeling Analysis and Validation of Molecular Interactions from X-ray and Electron Microscopy", Mathematical Challenges in Biomolecular/Biomedical Imaging and Visualization Workshop, Mathematical Biosciences Institute, Ohio State University, February, 2013
151. [Keynote] "Data Enabled Molecular Modeling, Uncertainty Quantification and Visualization," 2013 NSF CyberBridges Workshop, July 2013
152. [Keynote] "Multi-domain Meshing Challenges for Scalable Biophysical Simulations," 22nd International Meshing Roundtable Conference, October 2013
153. Invited Distinguished Speaker, "Multi-domain Meshing Challenges for Scalable Biophysical Simulations," Barr Systems Distinguished Lecture Series, University of Florida, Gainesville, Florida, October 2013

154. Invited Distinguished Speaker, “Automated Prediction of Molecular Assemblies with Quantified Uncertainty,” Carnegie Mellon University, November 2013
155. “Automated Prediction of Molecular Assemblies,” 2nd Zing Conference on Protein and RNA Structure Prediction, December 2013
156. Invited Distinguished Speaker, “Automated Prediction of Molecular Assemblies with Quantified Uncertainty,” Colloquium Seminar at the University of Virginia, January 2014
157. “Computational Topology, Geometry, and Analysis for Quantitative Relationships Between Biological Form and Function from 3D Electron Microscopy,” MBI-OSU, Analysis and Visualization of Large Collections of Imaging Data Workshop, April 2014
158. “Imaging and Modeling in Electron Microscopy—Recent Advances”, Banff International Research Station, Workshop, May 2014
159. “Macro-molecular Map and Model Refinement Techniques for Electron Microscopy”, Workshop on Imaging and Modeling in Electron Microscopy: Recent Advances, Banff International Research Station for Mathematical Innovation and Discovery, May 2014
160. [Keynote] Okinawa Institute of Science, Technology Workshop on Quasi-Symm. Assemblies (Jan 2015)
161. [Keynote] “Chemical Imaging and Visualization with Uncertainty Quantification” Computer Methods in Biomechanics and Biomedical Engineering Imaging and Visualization, CMBBE (Sep 2015), Montreal, Quebec, Canada
162. Invited Banquet talk, “Nature’s Meshes, Models and Simulations”, 24th Intl. Meshing Roundtable IMR 2015, Sandia Nat’l Laboratories, The Bullock Texas State History Museum, University of Texas, Austin, Texas, October 13, 2015
163. Invited Alumni Banquet Lecture, “Computer Science versus Cancer”, Computer Science Alumni, University of Texas at Austin, Austin, TX, October 29, 2015
164. “Scalable Global Optimization Problems in Imaging and Geometry Processing”, Workshop for Joint Research Exchange between University of Aachen (AICES) and University of Texas (ICES), Aachen, Germany, Nov 5-6, 2015
165. [Plenary] “Statistical Bio-Modeling for Predictive Medicine”, UT Austin/Portugal CoLab-Advanced Computing Research, Innovative Modeling Techniques for Predictive Medicine Workshop, Nov 9-13, 2015, IST, Lisbon, Portugal
166. Invited Colloquium Speaker, “Scalable Geometric Optimization with Applications to Prediction of Assemblies”, TU Berlin (Technische Universität Berlin), June 21, 2016, Berlin, Germany
167. “Disk Density Tuning of a Maximal Random Packing”, The International Geometry Summit 2016 (IGS), Solid and Physical Modeling (SPM), Technische Universität Berlin, June 22, 2016, Berlin, Germany
168. “Algebra and Geometry of Reproducing Hilbert Space Kernels” at Banff International Research Station-Casa Matematica Oaxaca, Computational Algebra and Geometric Modeling Workshop, Aug 7-12, 2016, Oaxaca, Mexico
169. “Reproducing Kernel Hilbert Spaces for Geometry and Material Sciences”, Geometry and Material Sciences (GEMS) at Okinawa Institute of Science and Technology, Oct 15-18, 2017, Okinawa, Japan
170. “Modern Computer Science”, Convocation 2016, Indian Institute of Technology Delhi, Nov 2-12, 2017, New Delhi, India
171. “Multi-Scale Machine Learning for Bio-Image Processing”, 14th Annual Advanced Imaging Methods (AIM) Workshop, Jan 24-27, 2017, Berkeley Cancer Research Laboratory, San Francisco, CA
172. “Multiscale and High Dimensional Techniques for Time Data Analysis”, First Annual Tissue and Microenvironment (TIME) Day at the University of Illinois at Urbana-Champaign, May 15, 2017, Urbana, IL
173. “Sampling and Optimization in Infrared Spectroscopy”, Multiscale and High-Dimensional Problems Conference, March 26-April 2, 2017, Oberwolfach, Germany
174. “Sampling and Optimization for High Dimensional Big Data”, Dagstuhl Seminar on Geometric Modelling, Interoperability and New Challenges, May 28-June 2, 2017, Schloss Dagstuhl, Saarbrücken, Germany
175. “Sampling and Optimization for High Dimensional Big Data”, INRIA Institut National De Recherche En Informatique Et En Automatique, June 2-9, 2017, Nice, France
176. “Optimized Polygonal Meshes for Quadratic Serendipity Finite Elements”, ADMOS 2017 Adaptive Meshing Methods and Applications Mini-symposium, June 25-29, 2017, Verbania, Italy
177. “The Holy Grail for Interactive Simulations”, BIRS-CMO Workshop 17w5008, Geometry and Computation for Interactive Simulation, Sep 24-29, 2017, Banff International Research Station for Mathematical Innovations and Discovery (BIRS) of Casa Matematica Oaxaca (CMO), Oaxaca, Mexico
178. “Mathematics of Heterogeneous Cryo-EM”, BIRS-CMO Workshop 17w5055, Mathematical Advances in Electron Microscopy, Oct 15-20, 2017, Banff International Research Station for Mathematical Innovations and Discovery (BIRS) of Casa Matematica Oaxaca (CMO), Oaxaca, Mexico

179. [Distinguished Speaker], "Classification Problems with FTIR", Berlin International Graduate School in Model and Simulation based Research (BIMoS), Technische Universitat Berlin, Germany.
180. "The Promise of Infrared Spectroscopy", ICMLDS 2017 (International Conference on Machine Learning and Data Science), Dec 14-15, 2017, Bennett University Campus in Greater Noida, Delhi, India
181. "The Promise of Infrared Spectroscopy" National Conference on Computational Vision, Pattern Recognition, Image Processing and Graphics, December 16-20, 2017, Delhi, India
182. "Learning Models with Data using Optimization" Models & Data, February 22-23, 2018, Columbia, South Carolina
183. "Promise of Infrared Imaging" University of Tokyo, February 27-March 3, 2018, Tokyo, Japan
184. "The Promise of Machine Learning for Infrared Spectroscopy", TIME Workshop. University of Illinois at Urbana-Champaign, March 30, 2018, Urbana-Champaign, Illinois
185. "Sampling Conditions for Conforming Voronoi Meshing by the Vorocrust Algorithm" Symposium on Computational Geometry (SOCG 2018), June 2018, Budapest, Hungary
186. "Sparse G1 Spline Manifold and Salient Feature Map Approximation with Topological Accuracy" Curves and Surfaces, June 27-July 2, 2018, Arcachon, France
187. Texas Imaging Symposium, October 30, 2018, The University of Texas, Austin, Texas
- 188.[Keynote] "Making the Invisible Visible" ChinaGraph, November 9-11, 2018, Guangzhou, China
- 189."Deep Learning for Infrared Spectroscopy" Colloquium, Tsinghua University, Beijing, China, Nov 13, 2018
- 190."Deep Learning for Infrared Spectroscopy" Colloquium, Peking University, Beijing, China, Nov 14, 2018
- 191."Mathematics of Infrared Spectroscopy", Colloquium, Academia Sinica, Beijing, China, Nov 15, 2018
- 192.[Keynote] "Unsupervised Super Resolution Hyperspectral Imaging" International Conference on Machine Learning and Data Science (ICML & DS 2018), December 21-22, 2018, Hyderabad, India
193. Invited Speaker, Cryo-EM Workshop, August 8-9, 2018, New York, New York.
194. Invited Speaker, "Spatio-Spectral Tensor Super-resolution" New York University, NY, January 24, 2019
195. Invited Speaker, "Spatio-Spectral Tensor Super-resolution" Stony Brook University, NY, January 25, 2019
196. Invited Speaker "Spatio-Spectral Tensor Super-Resolution with Chemical Priors" SIAM Conference on Computational Science and Engineering, February 25-March 1, 2019, Spokane, Washington
197. Colloquium "Are Spline Kernels Useful", University of Chicago, May 15-May 19, 2019
198. Invited Lecture "Learning to Sample and Sampling to Learn", Amazon, Seattle, June 8-16, 2019
199. "Computation, Mathematics, and Statistics for Visual Search Applications", University of Peking- Beijing, China, July 2019
200. "Computation, Mathematics, and Statistics for Visual Search Applications", July 1-13, 2019, University of Peking- Beijing, China
201. ALBERT: A digital Pathology Electronic Assistant, August 2-4, 2019, UT Southwestern Medical center- Dallas and Univ of Oklahoma.
- 202.[Plenary] "Statistical Deep Learning for Automatic 2D and 3D Cytotyping of tumor tissue". Cold Spring Harbor-Asia conference, Shanghai, China, September 4, 2019
- 203."Learning to Sense, Model. And Predict". Shanghai Jai Tong University- Shanghai, China, September 6, 2019
- 204.[Plenary] "Learning the Koopman Operator for Dynamic Simulations", Workshop on Digital Twins, University of Luxembourg, September 9-13, 2019
205. Colloquium Seminar Talk "Deep Learning Koopman Operator for Dynamic Data", Georgia Tech at Atlanta, Ga. Sept 17, 18, 2019
206. Colloquium Seminar Talk "Deep Learning for Static and Dynamic Data", NYU Data Sciences, Sept 27, 2019
207. Colloquium Seminar Talk "Deep Learning Koopman Modes for Dynamic Data", Princeton University, Sept 30, 2019
208. [Keynote] "Learning to Correct Form and Function with Reinforcement", The 2nd TBSI Workshop on Learning Theory (TBSI-WOLT'20) July 20-22, 2020
209. Invited Speaker "Deep Learning to Correct Form and Function with Reinforcement", New Jersey Institute of Tech, December 9, 2020
210. Invited Speaker "Learning Robust Delaunay/Voronoi (Primal-Dual) Meshes with Minimal Uncertainty", NUMGRID-2020 – Moscow, November 20, 2020
211. Invited Speaker, "Learned Stochastic Decision Making with Applications to Protein Folding", IEEE- CS- BITS APPCAIR seminar- June 11, 2021
- 212.[Keynote] - "Learning Rank-Ordered Intelligent Search Policies with Minimal Uncertainty" Emerging Techniques in Computational Intelligence, Co-Sponsored by the IEEE Computational Intelligence Society, Ecole Centrale School of Engineering, Mahindra University, Hyderabad, India, August 25-27, 2021

213. Invited Speaker, Babuska Oden Institute Workshop, October 11, 2021- Can Computers Self-Learn to Model, Verify, Validate and Predict?- Albuquerque, NM for Prof. Ivo Babuška 95th birthday
214. Invited Speaker, “Learning Optimal Control with Stochastic Models of Hamiltonian Dynamics”, Applied Geometry for Data Sciences-, Chongqing University of Technology- Mathematical Science Research Center- July 25-29 2022
215. [Keynote], “Learning Optimal Control with Stochastic Models of Hamiltonian Dynamics”, 2nd. Intl. Conference on Emerging Techniques in Computational Intelligence, August 2022, Mahindra University, Hyderabad, India
216. Invited Distinguished Colloquium Talk, “Learning Optimal Control with Stochastic Models of Hamiltonian Dynamics”, BITS-Pilani, Goa, August 2022.
217. Invited Colloquium Seminar Talk, “Learning Optimized Shape for Function: *Balancing Optimal Control and Reduced Hamiltonians*” U of Toronto, Computer Science, Nov 2022.
218. Invited Talk “Principled Physics Inspired Learning” Alan Turing Workshop, Scientific Machine Learning Research Highlights, Jan 23-26 2023
219. Invited Colloquium, CUNY, “Time Series Analysis on Motion Codes” May 8-12, 2023
220. Invited Talk, 60th Birthday Tamal Dey Festschrift, “SOCG for Machine Learning” 39th International Symposium on Computational Geometry (SoCG 2023), June 12-15 2023,
221. [Plenary Talk] Conference on Intelligent Visual Computing - Title of talk: “Can Computers be programmed to Learn Hamiltonians”?- July 12-14, 2023
222. Invited Colloquium Talks “Learning Dynamics with Optimal Stochastic Control” in Keio University, Osaka University and Kyushu University -July 15 -22, 2023
223. Invited Colloquium Talk “Learning Dynamics with Optimal Stochastic Control” Indian Institute of Technology (IIT), Delhi, August 10, 11.
224. [Keynote] “Learning to Model our Dynamic Environment”, Emerging Techniques in Computational Intelligence international conference, Hyderabad, India, Sept 21-23, 2023.
225. Invited Talk at Advances in Computational Mechanics- Conference Celebrating 80th Birthday of Prof. Tom Hughes, “Learning to Model our Dynamic Environment”, October 22-25, 2023- AT&T Conference Center, UT, Austin
226. Distinguished Colloquium “ Interdisciplinary Approaches to Computational Dynamic Modeling”, Oct 30, 2023, Distinguished speaker series, organized by Society for Industrial and Applied Mathematics (SIAM) JUIT Student Chapter, Jaypee University of Information Technology (JUIT), Solan, HP, India.
227. [Keynote]: “Lessons from Nature and Scientific AI with Responsibilities to Nature”, 14th International Conference on Cloud Computing, Data Science & Engineering (Confluence) 2024, January 18, 19.
www.amity.edu/aset/confluence2024, Amity University, New Delhi, India