UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Yamaha Corporation of America
Petitioner

v.

Black Hills Media, LLC
Patent Owner

Patent No. 8,050,652
Issue Date: November 1, 2011
Title: METHOD AND DEVICE FOR AN INTERNET RADIO CAPABLE OF OBTAINING PLAYLIST CONTENT FROM A CONTENT SERVER

Inter Partes Review No. _____

DECLARATION OF V. MICHAEL BOVE, JR.

I, V. Michael Bove, Jr., make this declaration in connection with the proceeding identified above.

I. INTRODUCTION

1. I have been retained by counsel for Yamaha Corporation of America ("Yamaha") as a technical expert in connection with the proceeding identified above. I submit this declaration in support of Yamaha's Petition for *Inter Partes* Review of United States Patent No. 8,050,652 ("the '652 patent").

2. I am being paid at an hourly rate for my work on this matter. I have no personal or financial stake or interest in the outcome of the present proceeding.

II. QUALIFICATIONS

3. I am employed as a Principal Research Scientist at the Massachusetts Institute of Technology, where I am also currently head of the Object-Based Media group at the Media Laboratory, co-director of the Center for Future Storytelling, and co-director of the consumer electronics working group CE2.0. I was also co-founder of and technical advisor to WatchPoint Media, Inc., an interactive television products and services company with offices in Lexington, Massachusetts and London, England, which is now part of Ericsson. I currently serve as technical advisor to One Laptop Per Child, creators of an inexpensive laptop computer for children in developing nations.

4. I hold an S.B. in Electrical Engineering, an S.M. in Visual Studies, and a Ph.D. in Media Technology, all from the Massachusetts Institute of Technology. I have authored over ninety journal and conference papers on distributed media, interactive media, and digital media. I have supervised over fifty graduate theses, and since 1990 have taught a graduate subject at MIT called Signals, Systems, and Information for Media Technology. I am a Fellow of the Society of Photo-Instrumentation Engineers, a member of the Board of Editors of the Journal of the Society of Motion Picture and Television Engineers, and a member of a number of other professional organizations including the Optical Society of America, the Association for Computing Machinery, and the Institute of Electrical and Electronic Engineers. I am a named inventor on seventeen U.S. patents. I served as General Chair of the 1996 ACM Multimedia Conference and of the 2006 IEEE Consumer Communications and Networking Conference (CCNC'06). Attached as Appendix A is a copy of my curriculum vitae.

III. MATERIALS CONSIDERED

5. In preparing this declaration, I have reviewed, among other things, the following materials: (a) the '652 patent and its prosecution history; (b) U.S. Patent No. 6,587,127 ("Leeke"); (c) PCT Application No. PCT/US99/01001 ("Qureshey"); (d) U.S. Patent No. 6,502,194 ("Berman"); (e)

reference material relating to the Lansonic DAS-750 ("Lansonic"); and (f) the Petition for *Inter Partes* Review of the '652 patent to which my declaration relates.

IV. DEFINITIONS AND STANDARDS

6. I have been informed and understand that claims are construed from the perspective of one of ordinary skill in the art at the time of the claimed invention, and that during *inter partes* review, claims are to be given their broadest reasonable construction consistent with the specification.

7. I have also been informed and understand that the subject matter of a patent claim is obvious if the differences between the subject matter of the claim 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 having ordinary skill in the art to which the subject matter pertains. I have also been informed that the framework for determining obviousness involves considering the following factors: (i) the scope and content of the prior art; (ii) the differences between the prior art and the claimed subject matter; (iii) the level of ordinary skill in the art; and (iv) any objective evidence of non-obviousness. I understand that the claimed subject matter would have been obvious to one of ordinary skill in the art if, for example, it results from the combination of known elements according to known methods to yield predictable results, the simple substitution of one known element for another to obtain predictable results, use of a known technique to improve

similar devices in the same way or applying a known technique to a known device ready for improvement to yield predictable results. I have also been informed that the analysis of obviousness may include recourse to logic, judgment and common sense available to the person of ordinary skill in the art that does not necessarily require explication in any reference.

8. In my opinion, a person of ordinary skill in the art pertaining to the '652 patent would have at least a bachelor's degree in computer science or electrical engineering, and at least one year of practical experience with networked multimedia.

9. I have been informed that the relevant date for considering the patentability of the claims of the '652 patent is November of 2000. Based on my education and experience in the fields of networked digital media and consumer electronics, I believe I am qualified to provide opinions about how one of ordinary skill in the art in 2000 would have interpreted and understood the '652 patent and the prior art discussed below.

V. THE '652 PATENT

10. The claims of the '652 patent are directed to a system and method for a networked electronic device that receives and plays digital audio from sources including Internet radio and a content source with a playlist. The device

receives information enabling the device to obtain the songs in the playlist from a remote source and then plays the songs.

VI. CLAIM CONSTRUCTION

11. I have been asked to provide my opinion on two claim terms: "playlist assigned to the electronic device" and "wherein ones of the plurality of songs are not stored on the electronic device," by discussing what one of ordinary skill in the art at the time of the patent filing would regard as their broadest reasonable interpretation consistent with the specification. In each case my opinion agrees with the position taken in Yamaha's Petition for *Inter Partes* Review.

A. "playlist assigned to the electronic device"

12. The term "playlist assigned to the electronic device" appears in independent claims 1, 21, and 42.

13. My opinion is that one of ordinary skill in the art would understand "playlist assigned to the electronic device" to be a list of songs that is to be transferred to a particular device selected by the user.

14. First, the normal grammatical reading of "assigned to" in my opinion refers to a designation of something to a particular entity, such as for example assignment of a project to a particular person. This normal understanding is consistent with the written description contained in the '652 patent. Discussion

of the assignment of playlists to devices occurs in a number of places, including, but not limited to, 4:50-5:3, 21:40-23:5, 24:44-60, and 28:11-30:26. The process is also illustrated in FIG. 17C (specifically, elements 1761 and 1762), and FIGS. 19B and 19C1 (element 1906). In each of these places, the assignment is initiated by the user, and is made to a specific user-selected device. It is notable that the menu selection in FIG. 17C and discussed in 24:50-53 is "Make Available On," designating a particular device to which the playlist will become available, rather than simply "Make Available," "Export," or some equivalent non-directed language.

B. "wherein ones of the plurality of songs are not stored on the electronic device"

15. Independent claims 1, 21, and 42 contain the term "wherein ones of the plurality of songs are not stored on the electronic device."

16. It is my opinion that this claim limitation simply describes a situation in which the storage in the electronic device does not already contain all the songs in the playlist at the time that the playlist is received. It implies by its language that the device contains memory that can store songs and excludes a situation in which the device does not contain local storage for songs. Otherwise, the statement that ones of the songs are not stored on the device becomes a tautology. If the device has no memory for storing songs it is of course a fact that

not only “ones,” but rather *all* songs in every instance will not be stored on the device. In my opinion such reading does not make sense, when considered in connection with the '652 specification.

17. While the “Summary of the Invention” section beginning at 3:57 briefly describes two possible implementations that do not contain enough song storage to hold all the songs on the playlist, in my opinion these are not relevant to any assignment of a playlist to a device, as recited in claims 1, 21, and 42. More specifically, one implementation is storage-less: “the network-enabled audio device comprises speakers, an AC power line, and a network line,” (3:61-62) which one of ordinary skill in the art would understand as a networked remote output for another music player, not itself a device to which a playlist could be assigned. The other implementation in that discussion (two sentences beginning at 4:4-9) has a limited amount of memory: “In one embodiment, the network-enabled audio device does not have any storage space other than memory. This embodiment provides for a low-cost system that can play songs from playlists stored on the IPAN Manager or on the PC’s storage space without having to store the audio files locally.” I understand this implementation to be a variation of the previous one with the addition of a small amount of buffer memory; again, the playlist is not “assigned” to the device but instead resides on another device which

simply uses this device for output. Therefore, I believe that these isolated statements have nothing to do with assigning playlists.

18. In contrast, other parts of the '652 patent specification include extensive discussion of assignment of playlists and, in those discussions, the devices to which playlists are assigned need to have enough memory to store the playlists and songs. Discussion in the specification of assigning playlists to "network-enabled audio devices" (21:40-22:15) describes devices to which playlists can be assigned as, "[e]ach network-enabled audio device 1510 has a storage space 1512 for network-enabled audio device IPAN software 1526, a playlist 1528, and associated URL's and songs within the playlist. Similarly, each network-enabled audio device 1520 has a storage space 1522 for network-enabled audio device IPAN software 1526, a playlist 1528, and associated URL's and songs within the playlist." The detailed discussion at 22:36-58, 24:44-25:2 and 28:11-30:26 is similar. Thus devices to which playlists are assigned need to have enough memory to store the playlists and songs.

VII. ANALYSIS OF PRIOR ART

A. Leeke

19. I have been asked as to my opinion as to whether claims 1, 2, 4, 6, 7, 10, 11, 13, 14, 21, 22, 24, 25, 28, 31, 32, 34, 35, 42, 43, 45, 47, 48, 52, 53, 55, and 56 of the '652 patent would have been obvious to one of skill in the art in light

of the Leeke reference, if the claim term "playlist assigned to the electronic device" is construed as requiring user selection of a specific device (as discussed in Section VI above). Initially, it is my opinion that each of the elements of these claims are disclosed in Leeke as set forth in the claim chart contained in the '652 petition under a broad construction of this term and the claims are anticipated under such construction. Under the narrower construction, it is my opinion that the claims would have been obvious in view of Leeke.

20. In conjunction with this issue, I note that the Leeke reference states at 20:35-42 that playlists can be transferred between users and to plural access points of one user. In my opinion, in view of this disclosure it would have been obvious that a playlist can be assigned to a device by making a selection of a specific device. This is especially so in view of the disclosure of virtual smart cards and the statement that playlists can reside on the storage device of the server as indicated at 17:23-33.

B. Qureshey In Combination With Berman

21. I have been asked as to my opinion regarding whether it would have been obvious to one of ordinary skill in the art to combine the audio-on-demand aspect of the Berman reference with the system disclosed in the Qureshey reference. I do so find.

22. Both these references relate to the field of consumer electronics products, and both describe networked home audio devices that obtain audio from remote sources via the Internet. One of ordinary skill in the art would have understood that the same network interface could be used for connecting to audio-on-demand as well as Internet radio services (this would indeed be the case around the time of the alleged invention whereby a PC could access both services through a Web browser) and that the changes needed to add audio-on-demand to an Internet radio receiver (or Internet radio functionality to an audio-on-demand player) would, for the most part, only involve modifying the user interface software to allow selecting between the functions, and programming additional server addresses into the system.

23. I have reviewed the claim charts in the '652 petition and it is my opinion that each of the elements of the claims are disclosed in Qureshey and Berman as set forth in the charts. In view of this and my opinion in paragraph 21 regarding the obviousness of combining the features of Qureshey and Berman, it is my opinion that claims 1-4, 6-8, 10, 13, 21, 22, 24-29, 31, 42-45, 47-50, and 52 would have been obvious.

C. Qureshey In Combination With Berman And Leeke

24. I have reviewed the claim charts in the '652 petition with respect to claims 11, 32, and 53 and it is my opinion that each of the elements of the

claims are disclosed in Qureshey and Berman as set forth in the charts. In view of this and my opinion in paragraph 21 regarding the obviousness of combining the features of Qureshey and Berman, it is my opinion that claims 11, 32, and 53 would have been obvious in view Qureshey and Berman in view of Leeke. Leeke discloses the provision of supplemental information in response to a request. In my opinion it would have been obvious to one of ordinary skill in the art to provide supplemental information in Berman in response to a request, as such is simply applying a known technique to a known device.

D. Lansonic

25. I have been asked as to my opinion on whether claims 1, 2, 3, 4, 6, 7, 10, 21, 22, 24, 25, 27, 28, 29, 31, 42, 43, 44, 45, 47, 48, and 52 of the '652 patent would have been obvious to one of ordinary skill in the art in view of Lansonic if each Web page constitutes a single reference. As a preliminary matter, it is my opinion that all of the elements of the claims are disclosed in the Web pages as set forth in the claim charts in the '652 petition. If the multiple Web pages making up the Lansonic disclosure do not constitute a single reference, it is my opinion that one of ordinary skill in the art would have immediately understood that all the pages were describing features of a single device, and would have found it obvious to consider the multiple disclosed features as part of a single device that would

render claims 1, 2, 3, 4, 6, 7, 10, 21, 22, 24, 25, 27, 28, 29, 31, 42, 43, 44, 45, 47, 48, and 52 obvious.

26. I note that claims 1, 21, and 42 recite "receiv[ing] information from the central system enabling the electronic device to obtain the ones of the plurality of songs from at least one remote source." I have been asked as to my opinion as to Lansonic on whether, when playing songs stored on a remote device by selecting a playlist, the selected playlist contains information enabling the device to obtain the songs from the remote source. It is my opinion that in order for the device to play songs on a playlist that are stored on a remote device, the playlist necessarily has information enabling the device to obtain the songs from the remote source. If such information were not there, the device would not be able to obtain the remotely stored songs. Therefore, one of ordinary skill in the art would have recognized that such information would be present in Lansonic.

27. I have further been asked to address the wireless remote control of claims 8, 26, and 49. Claims 8 and 26 depend from claims 1 and 21, respectively, and require that the networked audio device "receive input from a wireless remote control having a navigation shuttle," while claim 49 depends from claim 42 and requires "receiving input from a wireless remote control that enables navigating the playlist." I note first that the idea of using a remote control to navigate through a list of songs was well-known at the time of the alleged invention, having been in

use for many years in compact disc players. Moreover, it would be logical that the remote control would provide the same operability as the QuickSpin dial that is on the unit itself. Such operability includes navigation of playlists. It is therefore my opinion that claims 8, 26, and 49 would have been obvious to one of ordinary skill in the art at the time of the claimed invention.

E. White

28. I have been asked to provide my opinion as to whether claims 1-4, 6, 7, 13, 21, 22, 24, 25, 27, 28, 34, 42-45, 47, and 48 would have been obvious to one of ordinary skill in the art in view of U.S. Patent No. 7,187,947 to White *et al.* ("White"). White discloses numerous embodiments that include various features. It is my opinion that each of the elements of the claims is disclosed in White as set forth in the claim chart contained in the '652 Petition. It is also my opinion that it would have been obvious to one of ordinary skill in the art that the features of the various embodiments could be implemented in a single device, as it is apparent that such features could be combined as deemed necessary or desirable. In view of this, it is my opinion that the above-identified claims would have been obvious in view of White.

* * *

I declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and that these statements were made with knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code.

Dated: September 18, 2013

V. Michael Bove, Jr.

Last updated June 2013

Massachusetts Institute of Technology
School of Architecture and Planning Personnel Record

Victor Michael Bove, Jr.
Media Arts and Sciences Program

Date of Birth

23 December 1960

Citizenship

United States of America

Education

M.I.T., S.B. Electrical Engineering, June 1983

M.I.T, S.M. Visual Studies, September 1985

M.I.T., Ph.D. Media Technology, June 1989

Title of Thesis for Most Advanced Degree

V. M. Bove, Jr., *Synthetic Movies Derived from Multi-Dimensional Image Sensors*, Ph.D. thesis, M.I.T., June 1989.

Principal Fields of Interest

Applications of machine analysis to media-related applications (adding intelligence to live interpersonal communications and authored content), advanced user interfaces for consumer electronics, novel imaging hardware (in particular holographic television)

Non-M.I.T. Experience

R.C.A. Microcomputer Products Division, Summer Student Employee, May 1980-Aug. 1980

Co-Founder and Technical Advisor, WatchPoint Media, Inc., 1999-2003

History of M.I.T. Appointments

Technical Assistant, May 1983-Sept. 1983

Graduate Research Assistant, Sept. 1983-April 1989

Postdoctoral Research Associate, April 1989-July 1989

Assistant Professor of Media Technology, July 1989-July 1993

Associate Professor of Media Technology, July 1993-July 1997

Principal Research Scientist, MIT Media Laboratory, July 1997-present

Consulting Record

Aware, Inc., July-Sept. 1991

Bell Northern Research, August 1991, August-Sept. 1995

Plaza Investment Managers, Inc., July-August 1992

World Book Publishing (encyclopedia revisions), March 1993

Van Nostrand Reinhold (book manuscript reviewing), April 1994-present

Analog Devices, Inc., July-August 1994

Blackside Productions, Inc. (consultant for the TV series "Breakthrough: People of Color in American Science"), October-December 1994

Axiom Venture Partners, Nov. 1995-March 1996

Data Translation Inc./Kenyon and Kenyon (consultant on patent case), March 1996

Naval Undersea Warfare Center, June 1996

Copyright Clearance Center, Inc., Sept. 1996-Sept. 1997

Artech House Publishers (book manuscript reviewing), 1996-2002

Research Grants Council of Hong Kong (proposal evaluator), Feb. 1997-present

Hughes Electronics (expert witness before International Trade Commission), Feb. 1997-July 1997

Mercury Computer, May 1997

Thomson Consumer Electronics (expert witness before International Trade Commission), June 1997-August 1998

Swedish Research Council for Engineering Sciences (proposal evaluator), August 1997

Texas Instruments, 1998-2003

Cirrus Logic, Inc., Dec. 1998-Jan. 2000

Ezenia!, Inc., Jan. 1999-Aug. 2000

Thomson Consumer Electronics (expert witness), Nov. 2000-Feb. 2002; 2007-2008.

Intel, Jan. 2001-April 2001

Bain and Co., Jan. 2001-April 2001

DirecTV, Inc. (expert witness), 2002-2009

DRTV Systems Ltd., April 2002

Pause Technology (expert witness), 2003

Polycom (expert witness), 2003

Forney Corporation (expert witness), 2003-2005

IPIX Corp. (expert witness), 2005

Motorola, Inc. (expert witness), 2006-2008, 2011-present

Scientific Atlanta (expert witness), 2006-2008

Technical Advisor, One Laptop Per Child, 2006-present

Technical Advisor, TDVision Systems, 2006-present

Eastman Kodak (expert witness), February 2007-January 2008

EchoStar (expert witness), 2007-2008

Funai (expert witness), 2007-2010

Kyocera Sanyo Telecom and Palm, Inc. (expert witness) 2009-2010

Thomson Licensing, 2010

Research in Motion, Ltd. (expert witness), 2011-present

Twentieth Century Fox Home Entertainment (expert witness), 2011-2012

HTC, (expert witness), 2011-present

Department and Institute Committees, Other Assigned Duties

School of Architecture and Planning Committee on Academic Computing Needs, 1989-1990

Freshman advisor and seminar leader, 1990-present

The Tech advisory board, 1991-present

Independent Activities Period Policy Committee, 1991-1994, 1995-1997

Media Arts & Sciences Program IAP Coordinator, 1992-present

Media Arts & Sciences Departmental Committee on Graduate Students, 1994-1997, 2005-2006 (acting head, spring semester 1996)

Committee on the Undergraduate Program Subcommittee on Freshman Advising, 1998-1999

Media Arts & Sciences Undergraduate Officer, 1996-present

Founder and Director, Media Arts& Sciences Freshman Program, 1999-present

Government and Other Committees, Service, etc.

Committee on Open High-Resolution Systems, 1990-1991

Federal Communications Commission Advisory Committee on Advanced Television Service, Planning Subcommittee Working Party 4, 1992

Local Arrangements Chair, IEEE International Conference on Multimedia Computing and Systems, 1994

Conference Co-Chair, SPIE Conference on Integration Issues in Large Commercial Media Delivery Systems, 1995, 1996

Board of Editors, SMPTE Journal, 1995-present

Conference Co-Chair, SPIE Conference on Reconfigurable Technology for Rapid Product Development and Computing, 1996

General Chair, ACM Multimedia Conference, 1996

Organizer, Objects of Communication Symposium, 1996

Conference Co-Chair, SPIE Conference on Multimedia Networks and Applications, 1997, 1998, 1999, 2000

Conference Co-Chair, SPIE Conference on Media Processors, 1999, 2000, 2001, 2002, 2003, 2004, 2005

Manuscript reviewer for six journals and three book publishers

Associate Editor, *Optical Engineering*, 2004-present

ARDA Exploratory Program Executive Committee member, 2004-2006

Technical Advisory Panel, Council for Research Excellence, 2005-present

General Chair, IEEE Consumer Communications and Networking Conference 2006

Emmy Advanced Media Committee, National Academy of Television Arts and Sciences, 2006-present

Board of Governors, National Academy of Media Arts and Sciences, 2007-present

Conference co-chair, SPIE Practical Holography conference, 2011, 2012, 2013

Conference co-chair, International Symposium on Display Holography, 2012

Co-Chair, Optical Society of America 3D Display Technology, Perception, and Application Incubator Meeting, 2012

Awards Received

I.B.M. Communications Doctoral Fellowship, 1986 and 1987

Sony Corporation Career Development Professorship, 1991-1995

IEEE ASIC '93 (Conference on Application Specific Integrated Circuits) Speaker's Award, 1993

IEEE Computer Society Certificate of Appreciation, 1994

Alex W. Dreyfoos, Jr. Career Development Professorship, 1995-1997

Marquis Who's Who in Science and Engineering, 1996-1997; Who's Who in the East, 1997, 1998; Who's Who in Entertainment, 1997; Who's Who in America, 2001

ACM Recognition of Service Award, 1997

Distinguished Alumnus Award, John Piersol McCaskey High School, Lancaster PA, 1997

Fellow, IC^2 Institute, University of Texas at Austin, 2001

Fellow, SPIE, 2002

INDEX: Design to Improve Life Award (as member of team that designed OLPC XO laptop), 2007

Effie Award (bronze) for work on Sprite Slam Dunk Competition, 2013

Current Organization Membership

American Institute of Physics

Association for Computing Machinery (ACM)

Institute of Electrical and Electronic Engineers (IEEE)

Optical Society of America (OSA)

Society of Photo-Instrumentation Engineers (SPIE) (Fellow, 2002-present; Associate Editor, *Optical Engineering*, 2004-2011)

Society of Motion Picture and Television Engineers (SMPTE) (Manager, New England Section, 1993-1995; Board of Editors, 1995-present)

Patents

1. U.S. Patent 4,673,981, "Unrecordable Video Signals," (co-inventors Andrew Lippman and Jerome Wiesner)

2. U.S. Patent 5,185,852, "Antialiasing Apparatus and Method for Computer Printers," (co-inventor Christopher Mayer)

3. U.S. Patent 5,946,425, "Method and Apparatus for Automatic Alignment of Volumetric Images Containing Common Subject Matter," (co-inventor Tamas Sandor)

4. U.S. Patent 6,022,648, "Bistable, Thermochromic Recording Materials for Rendering Color and Gray Scale," (co-inventor Joseph Jacobson).

5. U.S. Patent 6,642,940, "Management of Properties for Hyperlinked Video," (co-inventors Edmond Chalom, Jonathan Dakss, and Nuno Vasconcelos).

6. U.S. Patent 6,816,628, "Methods for Outlining and Filling Regions in Multi-Dimensional Arrays," (co-inventors Karen Sarachik, Jonathan Dakss, and Joshua Wachman).

7. U.S. Patent 6,879,720, "Methods for Outlining and Filling Regions in Multi-Dimensional Arrays," (co-inventors Karen Sarachik, Jonathan Dakss, and Joshua Wachman).

8. U.S. Patent 6,944,228, "Method and Apparatus for Encoding Video Hyperlinks," (co-inventors Jonathan Dakss and Daniel Katcher).

9. U.S. Patent 6,978,053, "Single-Pass Multilevel Methods for Applying Morphological Operators in Multiple Dimensions," (2 co-inventors).

10. U.S. Patent 7,117,517, "Method and Apparatus for Generating Data Structures for a Hyperlinked Television Broadcast," (4 co-inventors).

11. U.S. Patent 7,120,924, "Method and Apparatus for Receiving a Hyperlinked

Television Broadcast," (5 co-inventors).

12. U.S. Patent 7,249,367, "Method and Apparatus for Switching Between Multiple Programs by Interacting with a Hyperlinked Television Broadcast," (3 co-inventors).

13. U.S. Patent 7,367,042, "Method and Apparatus for Hyperlinking in a Television Broadcast," (6 co-inventors).

14. U.S. Patent 7,636,365, "Smart Digital Modules and Smart Digital Wall Surfaces Combining the Same," (3 co-inventors).

15. U.S. Patent 8,010,986, "Synchronization and Automation in an ITV Environment," (4 co-inventors).

16. U.S. Patent 8,149,265, "Holographic Video Display System," (3 co-inventors).

17. U.S. Patent 8,356,329, "Method and Apparatus for Interaction with Hyperlinks in a Television Broadcast," (8 co-inventors).

18. U.S. Patent applied for 2001, "Program Stream Switching in a Hyperlinked Video Broadcast," (2 co-inventors).

19. U.S. Patent applied for 2007, "Self-Refreshing Display Controller for a Display Device in a Computational Unit," (3 co-inventors).

20. U.S. Patent applied for 2009, "Tangible Social Network," (1 co-inventor).

21. U.S. Patent applied for 2010, "Methods and Apparatus for Holographic Animation," (2 co-inventors).

22. U.S. Patent applied for 2012, "Methods and Apparatus for Accessing Peripheral Content," (2 co-inventors).

23. U.S. Patent applied for 2013, "Force-Sensing Net," (3 co-inventors).

24. U.S. Patent applied for 2013, "Context-Aware Omnidirectional Projector," (4 co-inventors).

FT89, 4.994, Media Arts and Sciences Doctoral Proseminar, taught unit on signals and systems (3 weeks), 10 students

ST90, 4.998, Digital Image Processing for Hard Copy, 12 students

FT90, 4.890, Signals and Systems for Media Technology, one of four instructors, 12 students

FT90, 4A05 (freshman advising seminar), Case Studies in Visual Communications, 9 students

ST91, 4.964, Digital Image Processing for Hard Copy, 6 students

FT91, 4.890, Signals and Systems for Media Technology, one of four instructors, 12 students

FT91, 4A05 (freshman advising seminar), Case Studies in Visual Communications, 9 students

ST92, 4.964, Digital Image Processing for Hard Copy, 9 students
FT92, 4.890, Signals and Systems for Media Technology, one of two instructors, 13 students

FT92, 4A05 (freshman advising seminar), Case Studies in Visual Communications, 8 students

IAP93, "Ernie Kovacs"

ST93, 4.964, Digital Image Processing for Hard Copy, 8 students

FT93, MAS101/MAS510, Signals, Systems, and Information for Media Technology, one of two instructors, 20 students

FT93, MASA05 (freshman advising seminar), Case Studies in Visual Communications, 8 students

IAP94, "A Look Back at Colorization"

ST94, MAS814, Digital Image Processing for Hard Copy, 8 students

FT94, MASA05 (freshman advising seminar), Case Studies in Visual Communications, 8 students

FT94, MAS160/MAS510, Signals, Systems, and Information for Media Technology, one of two instructors, 16 students

IAP95, "Dimensional Transcendence," one of three instructors

ST95, MAS814, Digital Image Processing for Hard Copy, 5 students

FT95, MASA05 (freshman advising seminar), Case Studies in Visual Communications, 7 students

FT95, MAS160/MAS510, Signals, Systems, and Information for Media Technology, one of two instructors, 15 students

ST96, MAS961, On Being Meta, one of three instructors, 14 students

FT96, MASA05 (freshman advising seminar), Case Studies in Visual Commu-

nications, 8 students

FT96, MAS160/MAS510, Signals, Systems, and Information for Media Technology, sole instructor, 19 students

ST97, MAS814, Digital Image Processing for Hard Copy, 7 students

ST97, MAS961, On Being Meta, one of three instructors

FT97, MASA05 (freshman advising seminar), Case Studies in Visual Communications, 8 students

FT97, MAS160/MAS510, Signals, Systems, and Information for Media Technology, one of two instructors, 10 students

ST98, MAS816, On Being Meta, one of three instructors

FT98, MASA05 (freshman advising seminar), Case Studies in Visual Communications, 8 students

ST99, MAS814, Digital Image Processing for Hard Copy, 12 students

ST99, MAS111, Introduction to Doing Research in Media Arts and Sciences, 12 students

FT99, MASA09 (freshman advising seminar), Television, Inside and Out, 8 students

ST00, MAS111, Introduction to Doing Research in Media Arts and Sciences, 15 students

ST00, MAS160/MAS510, Signals, Systems, and Information for Media Technology, one of two instructors, 24 students

FT00, MASA09 (freshman advising seminar), Television, Inside and Out, 8 students

ST01, MAS111, Introduction to Doing Research in Media Arts and Sciences, 25 students

ST01, MAS814, Digital Hard Copy, 6 students

FT01, MASA09 (freshman advising seminar), Television, Inside and Out, 9 students

FT01, MAS160/MAS510, Signals, Systems, and Information for Media Technology, one of two instructors, 14 students

ST02, MAS111, Introduction to Doing Research in Media Arts and Sciences, 25 students

ST02, MAS890, Workshop in Community-Maintainable Online Collaborative Spaces, 20 students

FT02, MASA09 (freshman advising seminar), Television, Inside and Out, 9 students

ST03, MAS111, Introduction to Doing Research in Media Arts and Sciences, 15 students

FT03, MASA18 (freshman advising seminar), Engineering: the Good, the Bad,

and the Ugly, 10 students

FT03, MAS160/MAS510/MAS511, Signals, Systems, and Information for Media Technology, one of two instructors, 24 students

ST04, MAS111, Introduction to Doing Research in Media Arts and Sciences, 15 students

FT04, MASA18 (freshman advising seminar), Engineering: the Good, the Bad, and the Ugly, 7 students

ST05, MAS111, Introduction to Doing Research in Media Arts and Sciences, 15 students

FT05, MAS160/MAS510/MAS511, Signals, Systems, and Information for Media Technology, 14 students

ST06, MAS111, Introduction to Doing Research in Media Arts and Sciences, 10 students

FT06, MASA18 (freshman advising seminar), Engineering: the Good, the Bad, and the Ugly, 11 students

ST07, MAS111, Introduction to Doing Research in Media Arts and Sciences, 10 students

FT07, MASA18 (freshman advising seminar), Engineering: the Good, the Bad, and the Ugly, 10 students

FT07, MAS160/MAS510/MAS511, Signals, Systems, and Information for Media Technology, 12 students

FT07, MAS110, Fundamentals of Computational Media Design, 25 students

ST08, MAS111, Introduction to Doing Research in Media Arts and Sciences, 18 students

FT08, MAS110, Fundamentals of Computational Media Design, 25 students

ST09, MAS111, Introduction to Doing Research in Media Arts and Sciences, 9 students

ST09, MAS963, New Media Storytelling, 10 students

FT09, MAS110, Fundamentals of Computational Media Design, 25 students

FT09, MASA19 (freshman advising seminar), Designing Consumer Electronics, 9 students

ST10, MAS111, Introduction to Doing Research in Media Arts and Sciences, 21 students

ST10, MAS963, New Media Storytelling, 9 students

FT10, MAS110, Fundamentals of Computational Media Design, 28 students

FT10, MASA19 (freshman advising seminar), Designing Consumer Electronics, 10 students

ST11, MAS111, Introduction to Doing Research in Media Arts and Sciences, 12

students

FT11, MAS110, Fundamentals of Computational Media Design, 30 students

FT11, MASA19 (freshman advising seminar), Designing Consumer Electronics, 10 students

ST12, MAS111, Introduction to Doing Research in Media Arts and Sciences, 20 students

ST12, MAS160/MAS510/MAS511, Signals, Systems, and Information for Media Technology, 6 students

FT12, MAS110, Fundamentals of Computational Media Design, 30 students

FT12, MASA19 (freshman advising seminar), Designing Consumer Electronics, 10 students

ST13, MAS111, Introduction to Doing Research in Media Arts and Sciences, 20 students

Publications of V. Michael Bove, Jr.

Books

(for book chapters see Other Major Publications)

1. S. A. Benton and V. M. Bove, Jr., *Holographic Imaging,* Wiley, 2008.

Papers in Refereed Journals

1. V. M. Bove, Jr., "A Probabilistic Method for Integrating Multiple Sources of Range Data," *Journal of the Optical Society of America A, 7,* Dec. 1990, pp. 2193-2198.

2. V. M. Bove, Jr. and A. B. Lippman, "Scalable Open Architecture Television," *SMPTE (Society of Motion Picture and Television Engineers) Journal, 101,* Jan. 1992, pp. 2-5.

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[0] 5. K. Tsunashima, J. B. Stampleman, and V. M. Bove, Jr., "A Scalable Motion-Compensated Subband Image Coder," *IEEE Transactions on Communications, 42,* Apr. 1994, pp. 1894-1901.

6. V. M. Bove, Jr. and J. A. Watlington, "Cheops: A Reconfigurable Data-Flow System for Video Processing," *IEEE Transactions on Circuits and Systems for Video Technology, 5,* Apr. 1995, pp. 140-149.

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8. V. M. Bove, Jr., "Multimedia Based on Object Models: Some Whys and Hows," *IBM Systems Journal, 35*, 1996, pp. 337-348.

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14. V. M. Bove, Jr. and W. Butera, "The Coding Ecology: Image Coding Via

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Competition among Experts," *IEEE Transactions on Circuits and Systems for Video Technology, 10*, October 2000, pp. 1049-1058.

[0] 15. V. M. Bove, Jr., J. Dakss, E. Chalom, and S. Agamanolis, "Hyperlinked Television Research at the MIT Media Laboratory," *IBM Systems Journal, 39*, 2000, pp. 470-478.

[0] 16. S. Agamanolis and V. M. Bove, Jr., "Viper: a Framework for Responsive Television," *IEEE Multimedia, 10:3*, July-Sept. 2003, pp. 88-98.

[0] 17. V. M. Bove, Jr. and Wilfrido Sierra, "Personal Projection," *SMPTE Motion Imaging Journal, 113*, Jan. 2004, pp. 17-21.

[0] 18. V. M. Bove, Jr. and J. Mallett, "Collaborative Knowledge Building by Smart Sensors," *BT Technology Journal, 22:4,* Oct. 2004, pp. 45-51.

[0] 19. D. Butler, V. M. Bove, Jr., and S. Sridharan, "Real-Time Adaptive Foreground/Background Segmentation," *EURASIP Journal on Applied Signal Processing, 14:11,* Aug. 2005, 2292-2304.

[0] 20. W. Plesniak, M. Halle, V. M. Bove, Jr., J. Barabas, and R. Pappu, "Reconfigurable Image Projection (RIP) Holograms," *Optical Engineering, 45:11,* Nov. 2006.

21. V. M. Bove, Jr., "Holographic Television: What and When?" *SMPTE Motion Imaging Journal, 120:4,* May/June 2011, pp. 36-40.

22. V. M. Bove, Jr., "Engineering for Live Holographic TV" *SMPTE Motion Imaging Journal, 120:8,* November/December 2011, pp. 56-60.

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[0] 25. D. E. Smalley, Q. Y. J. Smithwick, V. M. Bove, J. Barabas and S. Jolly, Anisotropic leaky-mode modulator for holographic video displays, *Nature, 498,* 20 June 2013, pp. 313 - 317.

Papers in Refereed Conference Journals

1. V. M. Bove, Jr., "Pictorial Applications for Range Sensing Cameras," in *SPIE Vol. 901: Image Processing, Analysis, Measurement, and Quality*, Society of Photo-Optical Instrumentation Engineers, Bellingham WA, 1988, pp. 10-17.

2. B. Girod, V. M. Bove, Jr., A. B. Lippman, "Automatic 3-D Scene Modeling from Range and Motion," *Proc. Second International Workshop on 64kbit/s Coding of Moving Video*, Hannover Germany, 1989.

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5. V. M. Bove, Jr., "Scalable, Spatiotemporal Resolution-Independent Digital Image Format," *Proc. Picture Coding Symposium*, Cambridge MA, 1990, pp. 4.6.1-4.6.4.

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7. W. R. Neuman, A. N. Crigler, V. M. Bove, Jr., "Television Sound and Viewer Preference," *Proc. AES 9th International Conference*, Detroit MI, 1991.

8. V. M. Bove, Jr. and J. A. Watlington, "Cheops: A Modular Processor for Scalable Video Coding," in *SPIE Vol. 1605*, Society of Photo-Optical Instrumentation Engineers, Bellingham WA, 1991, pp. 886-893.

9. I. J. Shen and V. M. Bove, Jr., "Minimization of Aliasing Artifacts During Partial Subband Reconstruction with Wiener Filters," in *SPIE Vol. 1657*, Society of Photo-Optical Instrumentation Engineers, Bellingham WA, 1992, pp. 14-23.

10. V. M. Bove, Jr. and J. A. Watlington, "Experiments in Hardware and Software for Real-Time Image Sequence Processing," *Proc. IEEE Workshop on Visual Signal Processing and Communications*, Raleigh NC, 1992, pp. 98-103.

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[0] 18. E. Chalom and V. M. Bove, Jr., "Segmentation of Frames in a Video Sequence using Motion and Other Attributes," *Proc. SPIE Digital Video Compression: Algorithms and Technologies, 2419*, 1995, pp. 230-241.

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[0] 20. E. K. Acosta, V. M. Bove, Jr., J. A. Watlington, and R. A. Yu, "Reconfigurable Processor for a Data-Flow Video Processing System," *Proc. SPIE FPGAs for Fast Board Development and Reconfigurable Computing, 2607,* 1995, pp. 83-91.

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29. V. M. Bove, Jr., "Object-Based Media and Stream-Based Computing," (invited paper) *Proc. SPIE Multimedia Hardware Architectures 1998, 3311*, 1998, pp. 24-29.

30. V. M. Bove, Jr., J. Dakss, S. Agamanolis, E. Chalom, "Adding Hyperlinks to Digital Television," *Proc. 140th SMPTE Technical Conference*, 1998, pp 395-

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32. V. M. Bove, Jr., "Media Processing with Field-Programmable Gate Arrays on a Microprocessor's Local Bus," *Proc. SPIE Media Processors, 3655*, 1999.

33. A. Westner and V. M. Bove, Jr., "Blind Separation of Real World Audio Signals Using Overdetermined Mixtures," *Proc. ICA '99*, 1999, pp. 251-256.

34. A. Westner and V. M. Bove, Jr., "Applying Blind Source Separation and Deconvolution to Real-World Acoustic Environments," *Proc. 106th Audio Engineering Society Convention*, 1999.

35. V. M. Bove, Jr. and W. J. Butera, "The Coding Ecology: Image Coding via Competition among Experts," *Proc. 1999 Picture Coding Symposium,* 1999, pp. 403-406.

36. V. M. Bove, Jr., "Will Anyone Really Need a Web Browser in Five Years?" *Proc. Montreux World Television Forum,* 2000.

37. V. M. Bove, Jr. and S. Agamanolis, "Responsive Television," *Proc. International Broadcasting Convention,* 2000, pp. 622-626.

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39. V. M. Bove, Jr. and W. Butera, "Extremely Distributed Multimedia," *Proc. 6th Eurographics Workshop on Multimedia,* 2001.

^{0}40. V. M. Bove, Jr. and J. Mallett, "Eye Society: Collaborative Problem Solving by Intelligent Mobile Cameras," *Proc. First GSFC/JPL Workshop on Radical Agent Concepts,* 2001.

^{0}41. W. Butera, V. M. Bove, Jr. and J. McBride, "Extremely Distributed Media Processing," *Proc. SPIE Media Processors,* v. 4674, 2002, pp. 37-41.

^{0}42. V. M. Bove, Jr. and W. Sierra, "Personal Projection," *Proc. SMPTE 144th Technical Conference,* 2002.

^{0}43. D. Butler, S. Sridharan, and V. M. Bove, Jr., "Real-Time Adaptive Video Segmentation," *Proc. ICASSP 2003,* 2003.

^{0}44. V. M. Bove, Jr. and W. Sierra, "Personal Projectors Based on VCSEL Arrays," *Proc. SPIE Projection Displays IX,* v. 5002, 2003, pp. 1-6.

^{0}45. V. M. Bove, Jr. and W. Sierra, "Personal Projection, or How to Put a Large Screen in a Small Device," *Proc. SID 2003 International Symposium, XXXIV,* 2003.

^{0}46. J. Mallett and V. M. Bove, Jr, "Eye Society," *Proc. IEEE ICME 2003*, 2003.

47. V. M. Bove, Jr., "Media Processing Ecologies," *Proc. IEEE ITRE 2003*, 2003.

48. G. Nanda, V. M. Bove, Jr., and A. Cable, "BYOB (Build Your Own Bag):

A Computationally-Enhanced Modular Textile System," *Proc. UBICOMP '04*, 2004.

049. T. Quentmeyer, W. J. Plesniak, and V. M. Bove, Jr., "Computing Real-Time Holographic Video Content with Off-the- Shelf PC Hardware," *Proc. OSA Frontiers in Optics/Laser Science Meeting*, 2004.

050. V. M. Bove, Jr., W. J. Plesniak, T. Quentmeyer, and J. Barabas, "Real-Time Holographic Video Images with Commodity PC Hardware," *Proc. SPIE Stereoscopic Displays and Applications, 5664A,* 2005.

051. B. C. Dalton and V. M. Bove, Jr., "Audio-Based Self-Localization for Ubiquitous Sensor Networks," *Proc. 118th Audio Engineering Society Convention,* 2005.

052. D. E. Smalley, Q. Y. J. Smithwick, and V. M. Bove, Jr., "Holographic Video Display Based on Guided-Wave Acousto-Optical Devices," *Proc. SPIE Practical Holography XXI, 6488,* 2007.

053. V. M. Bove, Jr., D. E. Smalley, and Q. Y. J. Smithwick, "Making Holographic Television a Consumer Product," (invited paper) *Proc. OSA Topical Meeting on Digital Holography and Three-Dimensional Imaging,* 2007.

054. Q. Y. J. Smithwick, D. E. Smalley, V. M. Bove, Jr., and J. Barabas, "Progress in Holographic Video Displays Based on Guided-Wave Acousto-Optical Devices," *Proc. SPIE Practical Holography XXII, 6912,* 2008.

055. B. T. Taylor and V. M. Bove, Jr., "The Bar of Soap: A Grasp Recognition System Implemented in a Multi-Functional Handheld Device," *Proc. ACM CHI,* 2008.

056. J. J. Kalanithi and V. M. Bove, Jr., "Connectibles: Tangible Social Networks," *Proc. 2nd Intl. Conf. on Tangible and Embedded Interaction (TEI'08),* 2008.

056. Q. Y. J. Smithwick, J. Barabas, D. E. Smalley, and V. M. Bove, Jr., "Real-Time Shader Rendering of Holographic Stereograms," *Proc. SPIE Practical Holography XXIII, 7233,* 2009.

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058. V. M. Bove, Jr., Q. Y. J. Smithwick, J. Barabas, and D. E. Smalley, "Is 3-D TV Preparing the way for Holographic TV?" *Proc. 8th International Symposium on Display Holography,* 2009.

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61. V. M. Bove, Jr., "What is Holographic Television, and Will it Ever be in My Living Room?" *Proc. 2010 SMPTE International Conference on Stereoscopic*

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Other Major Publications

1. W. Bender, V. M. Bove, Jr., A. Lippman, L. Liu, J. Watlington, "High Definition Systems in the 1990s: Open Architecture and Computational Video," *HDTV World Review*, 1:3, Summer 1990, pp. 11-15.

2. V. M. Bove, Jr., "Advanced TV should be Open Architecture" (opinion column), *TV Technology*, August 1992, p. 7.

3. A. Lippman and V. M. Bove, Jr., "ATV Profile: Contribution to the Requirements Discussion," ISO/IEC JTC1/SC29/WG11 MPEG92/759, 1992.

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11. V. M. Bove, Jr., "Communication," *The New Book of Knowledge,* Grolier, Bethel CT, 2000, pp. 462-471.

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13. V. M. Bove, Jr., "Connected by Media" (opinion column), *IEEE Multimedia,* Oct. 2001.

Invited Lectures and Seminars

1. "Model Building Cameras," National Computer Graphics Association, Philadelphia PA, April 18, 1989.

2. "Extensible/Intercompatible Digital Video Representations," EIA Digital Advanced Television Workshop, Washington DC, November 7, 1989.

3. "Television of Tomorrow," ILP Symposium on Telecommunications Technology and Policy for the 21st Century, M.I.T., April 24, 1990.

4. "Open Architecture Television," Symposium on the Media Laboratory 5th Anniversary, M.I.T., October 2, 1990.

5. "Open Architecture Television," EIA/IEEE Second International Workshop on Digital Video Communications, Cambridge MA, November 26, 1990.

6. "Scalable Video Representations for Visual Information Services," National Engineering Consortium Information Networking ComForum, Orlando FL, December 14, 1990.

7. "Scalable (Extensible, Interoperable) Video Coding," National Research Council Visual Factors in Electronic Image Communications Conference, Woods Hole MA, July 22, 1991.

8. "Scalability and Open Architecture," Digital Television Symposium, M.I.T.,

May 21, 1992.

9. "A Future Model for HDTV," Production '93, Montreal, May 26, 1993.

10. "Hardware and Software Implications of Representing Scenes as Data," (banquet address) IEEE Conference on Application Specific Integrated Circuits '93, Rochester NY, September 29, 1993.

11. "Some Thoughts on Image Representations, Scene Representations, and Hardware/Software Architectures," IEEE International Conference on Computer Design '93, Cambridge MA, October 4, 1993.

12. "Image and Scene Representations and System Architectures," EIA Digital Advanced Television Workshop, Cambridge MA, October 14, 1993.

13. "Machines Behind the Scenes: Computation and Structured Video," Perspectives Lecture Series, M.I.T., April 26, 1994.

14. "Object-Oriented Television," Joint New England SIGGRAPH/New England SMPTE Meeting, Cambridge MA, October 27, 1994.

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16. "Multimedia Computing: Parallelism without Pain," IEEE Workshop on Multimedia Processors (part of ICMCS '95), Washington DC, May 19, 1995.

17. "Stream-Based Computing and Future Television," EIA/IEEE-CES Digital Television Workshop, Philadelphia, October 5, 1995.

18. "Eyes, Cameras, Objects," Symposium on the Media Laboratory 10th Anniversary, M.I.T., October 10, 1995.

19. "Future Television: Why We Need All Those MIPS and Where We're Going to Get Them," Princeton University Dept. of Electrical Engineering, October 24, 1995.

20. "The Likely Convergence of Multimedia, Video, Communications, and Computing" (panel discussion), Photonics East '95, Philadelphia, October 24, 1995.

21. "Trends to Watch For in Consumer (and Professional) Multimedia," CommExpo, Houston TX, January 11, 1996.

22. "Multimedia Trends," Texas Instruments National Sales Meeting, Dallas TX, April 23, 1996.

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24. "Object-Based Media and Why It's a Good Problem," Bell Laboratories, Murray Hill NJ, August 28, 1996.

25. "The Future of Electronic Visual Communications," Medientage München, Munich, October 17, 1996.

26. "Hardware and Software Impacts of New Media Representations," ACM Workshop on Media Processors (part of ACM MM'96), Boston, November 19,

1996.

27. "Convergence in the 21st Century" (panel discussion), SPIE International Symposium on Voice, Video and Data Communications, Boston, November 20, 1996.

28. "Object-Based Media," Hewlett-Packard Laboratories, Palo Alto CA, February 11, 1997.

29. "Stream-Based Media Computing: What, How, and Why," University of California at Berkeley Dept. of EECS, January 30, 1998.

30. "Responsive Object-Based Media," Greater Boston ACM, February 19, 1998.

31. "Stream-Based Media Processing," American Physical Society Symposium on the Physics of Imaging, Rochester NY, April 24, 1998.

32. "The Future of Media is Object-Based," Southeastern Mass. MIT Alumni Club, New Bedford MA, May 20, 1998.

33. "Object-Based Media and Stream-Based Computing," First International Workshop on Advanced Graphics and Multimedia Systems, Naples Italy, November 17, 1998.

34. "The Object-Based Media Group," Mitsubishi Electric Research Laboratory, Cambridge MA, December 11, 1998.

35. "The Object-Based Media Group," Stanford University Computer Science Dept., January 29, 1999.

36. "Hyperlinked Television as an E-Commerce Portal," Vanguard Technology Transfer Institute, Cambridge MA, May 17, 1999.

37. "Video and the Internet: TV or not TV?" American Museum of the Moving Image, New York, December 8, 1999.

38. "Will Anyone Really Need a Web Browser in Five Years?" Canadian Institute for Telecommunication Research annual meeting, Ottawa, August 28, 2000.

39. "Imaging at the MIT Media Lab" (plenary speaker), IS&T PICS 2001, Montreal, April 23, 2001.

40. "The Future" (panel discussion), ITV Content E-mergency, Columbia University, New York, July 17, 2001.

41. "Responsive Media: The Intersection between Broadcast and Personalization," The Interactive TV Show USA, New York, August 16, 2001.

42. "Development of Technology from Unlikely Sources," Canadian Undergraduate Technology Conference, Toronto, January 17, 2002.

43. "Sharing and Playing Well with Others: Everything We Need to Know about the Future, We Learned in Kindergarten," (keynote) IDC Imaging Convergence Forum, New York, August 7, 2002.

44. "Really Smart Cameras and Sugar-Cube-Sized Video Projectors," MIT

Family Weekend, Cambridge MA, October 18, 2003.

45. "Computational Ecosystems," Ubi-Comp Symposium on Ubiquitous Computing, Seoul, December 10, 2003.

46. "Really Smart Cameras and Sugar-Cube-Sized Video Projectors," MIT Alumni Club of RI, Warwick RI, April 13, 2004.

47. "The Consumer Electronics Laboratory at the MIT Media Laboratory," GSPx, Santa Clara CA, September 29, 2004.

48. "Really Smart Cameras and Sugar-Cube-Sized Video Projectors," MIT Alumni Club of Cape Cod, Hyannis MA, November 17, 2004.

49. "Consumer Electronics Research at the MIT Media Lab," Harvard Business School Entrepreneurship Conference, March 3, 2005.

50. "Changing Dynamic in Consumer Electronics," 2005 Perspective Forum, Berkeley CA, March 9, 2005.

51. "View from the Consumer Electronics Laboratory," 2005 North American Broadcasters Association General Meeting, Toronto, May 18, 2005.

52. "Musings – and a Few Facts – about 3-D TV," MIT CIPS Workshop on Advanced Televsion, Cambridge, January 21, 2009.

53. "Holographic Video and 3-D Television," "Photons, Neurons and Bits: Holography for the 21st Century," Cambridge MA, March 7, 2009.

54. "From 3-D TV to Holographic TV," Microsoft Hardware Day, Redmond WA, August 5, 2009.

55. "Debunking Hollywood's Holograms," MIT Museum, Cambridge MA, December 11, 2009.

56. "Moving Holographic TV from the Lab to Your Living Room," New England Section, Optical Society of America, Cambridge MA, 20 October 2010.

57. "Hollywood's Holograms (and MIT's)" and "Pattern Recognition is Everywhere." (2 lectures), Connecticut Science Education Conference, Hamden CT, 30 October 2010.

58. "A Look Back – and Forward – at Holographic TV," New England SID and SMPTE joint meeting, Needham MA, 18 January 2012.

59. "Holographic Video and How it Might Become Part of the 3D Ecosystem," Third Workshop on 3D Cinematography (part of CVPR 2012), Providence RI, 16 June 2012.

60. "A Look Back – and Forward – at Holographic TV," IEEE Photonics Laser Workshop, Lexington MA, 7 November 2012.

Research Funding

Television of Tomorrow Consortium, 1989-1996

Digital Life Consortium, 1997-present

Intel Digital Expression Project, 2000-2002

Although one of several researchers on the above two contracts, I accounted for a major portion of the research volume. On Television of Tomorrow, for example, I typically supported six research assistants and five UROP students as well as a $150,000 fabricated equipment budget annually. I was responsible for approximately a third of the $2M annual research volume.

Movies of the Future Consortium, 1989-1994, (supported one research assistant annually)

DARPA Contract DAAD 05-90-C-0333, "Scalable Video," 1990-1993, (supported one research assistant annually)

Bell Northern Research, "Video Coding Testbed," $30,000 annually, 1991-1993

NASA SRC-B093-93-043, "High Speed Research," (subcontractor to Honeywell Technology Center), project approved to begin in 1995 but funds were never released by NASA

Broadercasting Special Interest Group, Principal Investigator, 1999-2002

NASA Hierarchical Learning Networks, Principal Investigator, $250,000 annually, 2002-2005

"Smart Architectural Surfaces," ICU/Korean Ministry of Information and Communications, 2003-2004

CELab (consumer electronics research program), Principal Investigator, 2004-present

Center for Future Storytelling, co-director, 2008-present

Office of the Director of National Intelligence (ODNI), Intelligence Advanced Research Projects Activity (IARPA), through the AFRL contract FA8650-10-C-7034, 2010-2012

Theses Supervised by V. Michael Bove, Jr.

SB Theses

Chun, Jang H., *Decoding Data in the NTSC Chrominance Channel*, EECS SB, June 1990.

Davis, Desmond O., *Encoding Digital Data in the NTSC Chrominance Channel*, EECS SB, June 1990.

Lee, David S., *Compression of Images Using Zero Crossings of Bandpass Signals*, EECS SB, June 1990.

Blount, Alan W., *Display Manager for a Video Processing System*, EECS SB, June 1991.

Mitchell, Michael D., *X Windows for an Intelligent Display*, EECS SB, June 1991.

Tewari, Rajeev, *The Cheops Input Module: A Real Time Digitizing and Filtering Engine*, EECS SB, June 1991.

Chackerian, Mark, *A Motion-Estimating Board for the Cheops Imaging System*, EECS SB, May 1992.

Kwon, Chris C., *A Stream Processor for Vector Quantized Images*, EECS SB, May 1992.

Lawai, Adnan H., *Scalable Subband Coding for Continuously Variable Raster Sizes*, EECS SB, May 1992.

Nanayakkara, Prasath S. W., *Communication Protocol for a Digital Video Processor*, EECS SB, May 1992.

Evanco, Kathleen L., *A Compiler for an Object-Oriented Parallel Stream Processing Language*, EECS SB, May 1993.

O, Cholwon, *Motion Compensation Decoder for Cheops Imaging System*, EECS SB, May 1993.

Yu, Jung, *Real-Time Image Morphing, Motion Compensation, and Hidden Surface Removal*, EECS SB, May 1994.

Hsieh, P. Angela, *Solutions for Bus Bandwidth Limitations in a Network Printing Environment*, EECS SB, May 1994.

Sung, Julie, *Image Segmentation using Multi-Dimensional Attributes,* Physics SB, May 1997.

SM Theses

Liu, Lin L., *Digital Intermediate Format for Video Frame Rate Conversion*, EECS SM, September 1990.

Mayer, Christopher M., *Antialiasing Methods for Laser Printers*, EECS SM, June 1991.

Woo, Peter H., *An Accumulating Frame Buffer Architecture for a High-Performance Graphics Engine*, EECS SM, June 1991.

Firestone, Scott S., *VideoChannel: A Real Time Window Processor*, EECS SM, February 1992.

Eldridge, Creighton L., *A Smart Memory for Processing Images*, EECS SM, May 1992.

Shen, Irene J., *Real-Time Resource Management for Cheops: A Configurable, Multi-Tasking Image Processing System*, EECS SM, September 1992.

Hewlett, Gregory J., *Scalable Video in a Multiprocessing Environment*, MAS SM, February 1993.

Lawai, Adnan H., *Scalable Coding of HDTV Pictures Using the MPEG Coder*, EECS SM, May 1994.

Granger, Brett D., *Real-Time Structured Video Decoding and Display*, MAS SM, February 1995.

Acosta, Edward K., *A Programmable Processor for the Cheops Image Processing System*, EECS SM, June 1995.

Chang, Christopher I., *Handwriting Recognition on a Programmable Digital Signal Processor*, EECS SM, June 1995.

Chang, Tzu-Yun, *Real-Time Decoding and Display of Layered Structured Video*, EECS M. Eng., June 1995.

Mikkelson, Chad, *An Implementation of the MPEG-2 Audio Decoding Specification*, EECS M. Eng., June 1995.

Inguilizian, Araz V., *Building a Better "Picture": Synchronized Structured Sound*, MAS SM, September 1995.

Evanco, Kathleen L., *Personalized Video Synthesis for an Information System*, MAS SM, February 1996.

Agamanolis, Stefan, *High-Level Scripting Environments for Interactive Multimedia Systems*, MAS SM, February 1996.

Davison, Brian C., *Image Enhancements for Low-Bitrate Videocoding*, EECS M. Eng., May 1996.

Lin, Eugene S., *Recovery of 3-D Shape of Curved Objects from Multiple Views*, EECS M. Eng., May 1996.

Newbern, Jeffrey L., *Global Optimization of Dither Arrays*, EECS M. Eng., May 1996.

Suryadevara, Rajesh, *Visual Perception Based Bit Allocation for Low Bitrate Video Coding*, EECS M. Eng, May 1996.

Wong, Jeffrey, *Hoover Bus: An Input Bus Optimized for Multiple Real-Time Data Streams,* EECS M. Eng, September 1996.

Yu, Ross A., *A Field Programmable Gate Array Based Stream Processor for the Cheops Imaging System,* EECS M. Eng, September 1996.

Belostotsky, Eugene B., *Secure SNMP,* EECS M. Eng., February 1997.

Chuang, Erika Shu-Ching, *Design and Implementation of a Real-Time Video and Graphics Scaler,* EECS M. Eng., May 1997.

Swamidoss, Kamal S., *Optimizing a Reed-Solomon Decoder for the Texas Instruments TMS320C62x DSP,* EECS M. Eng., May 1998.

Lau, Simon, *Adaptive Degradation of Images in Network Applications,* EECS M. Eng., May 1998.

Lee, Mark, *A Data Servicing Subsystem for the Chidi Reconfigurable Processor,* EECS M. Eng., August 1998.

Liu, Yuan-Min, *A 1394 Bus Interface for the Chidi Processor,* EECS M. Eng., August 1998.

Slowe, Thomas E., *People Objects: 3-D Modeling of Heads in Real-Time,* MAS SM, August 1998.

Westner, Alexander G., *Object-Based Audio Capture: Separating Acoustically-Mixed Sounds,* MAS SM, October 1998.

Zhang, Xiaozhen, *Implementing IS-95, the CDMA Standard, on TMS320C6201*

DSP, EECS M. Eng., May 1999.

Dakss, Jonathan, *HyperActive: An Automated Tool for Creating Hyperlinked Video,* MAS SM, September 1999.

Mallett, Jacky, *Kami: An Anarchic Approach to Distributed Computing,* MAS SM, September 2000.

Wang, Xin, *X-Conference: Reinventing a Teleconference System,* MAS SM, June 2001.

Murithi, Kirimania, *IP Multicast in Digital Television Transmission Infrastructure,* EECS M. Eng., June 2001.

Li, Yi, *VoiceLink: A Speech Interface for Responsive Media,* MAS SM, Sept. 2002.

Patel, Surjit, *MediaConnector: A Gestalt Media Sharing System,* MAS SM, Sept. 2002.

Sierra Hernandez, Wilfrido, *Micro Laser Personal Projector,* MAS SM, May 2003.

Vora, Parul, *Simulacrum: Situated Memory for Architectural Space,* MAS SM, Sept. 2003.

Quentmeyer, Tyeler, *Delivering Real-Time Holographic Video Content with Off-the-Shelf PC Hardware,* EECS MEng, May 2004.

Hill, Samuel L., *Scalable Multi-view Stereo Camera Array for Real World Real-Time Image Capture and Three-Dimensional Displays,* MAS SM, May 2004.

Pilpre, Arnaud, *Self-* Properties of Multi-Sensing Entities in Smart Environments,* MAS SM, May 2005.

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Nanda, Gauri, *Accessorizing with Networks: the Possibilities of Building with Computational Textiles,* MAS SM, Sept. 2005.

Hirsh, Diane E., *Piecing Together the Magic Mirror: a Software Framework to Support Distributed, Interactive Applications,* MAS SM, Sept. 2006.

Barabas, James, *Sensor Planning for Novel View Generation by Camera Networks,* MAS SM, Sept. 2006.

Smalley, Daniel E., *Integrated Optics for Holographic Video,* EECS MEng, Sept. 2006.

Kalanithi, Jeevan J., *Connectibles: Tangible Social Networking,* MAS SM, Sept. 2007.

Taylor, Brandon T., *Graspables: Grasp Recognition as a User Interface,* MAS SM, Sept. 2008.

Smalley, Daniel E., *High-Resolution Spatial Light Modulation for Holographic Video,* MAS SM, Sept. 2008.

de Araujo Santos, Ana Luisa, *uCom: Spatial Displays for Visual Awareness of*

Remote Locations, MAS SM, Sept. 2009.

Alfaro, Santiago, *SurroundVision: A Handheld Screen for Accessing Peripheral Content Around the TV,* MAS SM, Sept. 2010.

Portocarrero, Edwina, *Inside/Out: Mirrors for Reflective, Creative Thinking,* MAS SM, Sept. 2011.

Cranor, David, *Prototouch: A System for Prototyping Ubiquitous Computing Environments Mediated by Touch,* MAS SM, Sept. 2012.

Jolly, Sundeep, *An Updatable Three-Dimensional Display via Direct Optical Fringe Writing of Computer-Generated Holographic Stereograms in Photorefractive Polymer,* MAS SM, Sept. 2012.

Bardagjy, Andrew, *Low Dimensionality Spectral Sensing for Low Cost Material Discrimination and Identification,* MAS SM, Feb. 2013.

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Becker, Shawn, *Vision-Assisted Modeling for Model-Based Video Representations*, MAS PhD, February 1997.

Chalom, Edmond, *Image Segmentation Using Multi-Dimensional Attributes*, EECS PhD, February 1998.

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Mallett, Jacqueline, *The Role of Groups in Smart Camera Networks*, MAS PhD, Feb. 2006.

Doctoral Theses, Reader

St. Hilaire, Pierre, *A Parallel Approach to Holographic Video Scanning*, MAS PhD, September 1994.

Polley, Michael O., *Efficient Channel Coding for HDTV Terrestrial Broadcasting*, EECS PhD, February 1996.

Halle, Michael, *Image Synthesis for Multi-Perspective Spatial Displays*, MAS PhD, September 1997.

Love, Nicole S., *Recognition of 3D Compressed Images and its Traffic Monitoring Applications*, EECS PhD, June 2004.

Karahalios, Kyratso G., *Social Catalysts: Enhancing Communication in Mediated Spaces*, MAS PhD, August 2004.