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**Education**

Ph.D. Computer Science, Brown University, Providence, RI.

Dissertation: *System Architecture for High-Performance Vector Graphics.*

Thesis Advisor: *Andries van Dam, Thomas J. Watson, Jr. University Professor of*

*Technology and Education.*

M.S. Computer Science, Cornell University, Ithaca, NY.

Fil.Kand. Applied Mathematics, University of Stockholm, Stockholm, Sweden.

**Honors and Awards**

* Doctor of Philosophy Honoris Causa, Uppsala University, Sweden, January, 2000.
* Distinguished Graduate School Alumna Award, Brown University, May 2000.
* Featured by the Brown University Alumni Magazine Anniversary Issue, November/December 2000, as one of the 100 alumni who had the greatest impact on the 20th century.

**Current and Past Funding**

THE KNOWLEDGE FOUNDATION, *Feeling is Believing*, 398K SEK, 2009-2010.

THE KNOWLEDGE FOUNDATION, *Whole Hand Haptics with True 3D Displays*, 5250K SEK, 2009-2012.

THE SWEDISH RESEARCH COUNCIL, *Automatic, Quantitative Malignancy Grading of Prostate Cancer using Image Analysis,* 2400K SEK, 2009-2012.

THE SWEDISH RESEARCH COUNCIL, *Beyond Gleason Grading - Malignancy Grading of Prostate Cancer with Image Analysis,* 1500.45K SEK, 2013-2014.

HILLEVI FRIES RESEARCH FOUNDATION, *Automatic Malignancy Grading of Prostate Cancer with Image Analysis,* 62.5KSEK, 2013.

**Ph.D. Students**

Milan Gavrilovic (assistant supervisor) Thesis: *Spectral Image Processing with Applications in Biotechnology and Pathology*, December 2011.

Pontus Olsson (main supervisor)

Jimmy C. Azar (main supervisor)

**Professional Experience**

2008 – present UPPSALA UNIVERSITY

Uppsala, Sweden

*Professor, Centre for Image Analysis*

2008 – 2013 UPPSALA UNIVERSITY

Uppsala, Sweden

*Project Leader, UU Innovation*

2004 TUFTS UNIVERSITY

Medford, Massachusetts

*Research Professor, Department of Computer Science*

1995 – 2008 BELL LABORATORIES, Alcatel-Lucent (formerly Lucent Technologies, AT&T) Murray Hill, New Jersey

*2006 Visiting Scientist, Mathematical and Algorithmic Sciences Center*

*2003 Visiting Scientist, Mathematical Sciences Research Center*

*2000 Director, Visual Communications Research*

*1997 Department Head, Visual Communications Research*

*1995 Department Head, Image Synthesis and Recognition Research*

The conversion from voice to data communication creates new challenges for the telecommunications industry. Bell Labs recruited me to build and head a department to exploit opportunities for visual communications. I created a truly multidisciplinary department, drawing on a broad range of techniques from computer vision, computer graphics, image and signal processing, and acoustics to create novel communications paradigms. I devoted considerable effort in developing new Lucent business opportunities with large network service providers and obtaining value from our research through Lucent spin-offs and licensing.

Telecommunications service providers want to deploy the triple play: voice, video, and data, requiring broadcast quality video over DSL. Led an effort to create a video codec capable of generating broadcast quality video at less than 2Mbps.

While converged packet networks promise both easy introduction of new integrated applications and cheaper phone service, service providers will resist widespread deployment until the end-to-end quality of service issues are addressed satisfactorily. I developed a program for addressing degradation in converged networks of voice quality caused by distortion, echo, delay, and noise.

Led effort to introduce video services for third generation (3G) wireless networks. Developed a video codec for the wireless network that outperforms other commercial codecs by adapting to the characteristics of the cellular network. Also developed a prototype video messaging system that overcomes the problems of diverse capabilities and lack of interoperability among terminals.

Developed the first interactive acoustic modeling system that accounts for diffraction in complex 3D environments. This work has been well received in both the acoustics community and at SIGGRAPH. In 1998, we presented the *only* paper on audio at SIGGRAPH. In 2001, we presented our third SIGGRAPH paper in this area, and audio had its own session! Invented *Sea of Images*, a novel technique for creating interactive walkthroughs of complex environments by resampling video sequences. Sea of Images was the first image-based rendering system to produce view-dependent lighting effects in large indoor environments.

Created LucentVision, a system for enhanced tennis broadcasts using real-time game statistics and virtual replays. LucentVision has been used in broadcasts from over 250 tennis matches in international tournaments over 25 television networks reaching 100 countries (e.g., by CBS at the USOpen 2000).

Created advanced fingerprint software, resulting in a spin-off company, Veridicom, Inc., with leading technology in personal fingerprint authentication. Developed digital image and video watermarking technology that outperformed all commercially available watermarking systems both in terms of transparency and robustness.

Was instrumental in spinning out face2face, Inc., a venture that provides automatic facial motion capture to drive facial animation in television cartoons.

1988 – 1995 DIGITAL EQUIPMENT CORPORATION, Cambridge Research Lab

Cambridge, Massachusetts

*1990 Manager of Visualization Research*

*1988 Member of Technical Staff*

Joined the Cambridge Research Lab when it was less than one year old. Through extensive recruiting efforts, I created a world class research group and made it a leading center in the integration of what were, in those days, disparate fields of computer graphics, computer vision, and image processing. Created tools that made Digital a leader in *image computing.*

Directed research in data exploration, telecollaboration, novel user-interfaces using faces and gestures, reconstruction of models from video sequences, and systems for biomedical imaging.

Developed a system for reconstructing and visualizing 3D models from serial sections, and used this system to reconstruct a 3D model of a neuronal dendrite from serial transmission electron microscopy, and to reconstruct the first volumetric model of a human embryo heart from serial light microscopy.

Applied similar techniques to a clinical application: to model biopsy protocols for determining the extent and severity of prostate cancer. This work was conducted in collaboration with the Uppsala University, Sweden, and continued for several years after I left Digital. The system has been used to demonstrate that the standard sextant protocol is inferior to protocols using ten needles, to optimize needle positions in prostates of different sizes, and to map cancer growth in the prostate gland.

1980 – 1986 SCHLUMBERGER-DOLL RESEARCH

Ridgefield, Connecticut

*1981 Program Leader, Graphical Modeling Program*

*1980 Member Professional Staff*

Schlumberger recruited me to modernize processing of oil exploration data through the use of computer technology. The mission of the Graphical Modeling Program was to replace conventional interpretation of paper well-log and seismic data with modern computer graphics techniques.

Helped develop the Dipmeter Advisor, the first artificial intelligence system for log interpretation. It allowed field engineers to interpret dipmeter data, something that up to that point could only be done by a few experts in the world. The Dipmeter Advisor also demonstrated that interactive log interpretation was not only feasible but offered vast advantages over conventional methods using long paper logs. The success of the Dipmeter Advisor graphics interface led to a major paradigm shift: most well-log processing was converted to interactive data processing.

Developed scientific visualization software and data structures for real-time display and interactive manipulation of complex 3D models of oilfields.

1979 – 1980 THE PENNSYLVANIA STATE UNIVERSITY, Computation Center State College, Pennsylvania

*Research Associate*

Built a graphics laboratory, comprising a high-performance vector graphics system and a host computer.

1975 – 1979 CAPITAL ADVISORS, INC., an investment advisory company Providence, Rhode Island

*Co-Founder and Vice-President*

Developed and implemented a technical stock market model.

1971-1979 BROWN UNIVERSITY, Department of Computer Science and Division of Applied Mathematics

Providence, Rhode Island

*Research Assistant, Teaching Assistant, and Computer Programmer*

Designed the 3D viewing pipeline of the first standard in computer graphics, the Core Graphics System; that viewing pipeline forms the basis for viewing transformations in all current graphics hardware and software systems. Edited the *Status Report of the Graphics Standards Planning Committee of ACM/SIGGRAPH*, containing the proposed graphics standards specification. This proposed standard led to the first graphics standards in ANSI X3H3. The new interoperability resulted in tremendous proliferation of computer graphics techniques and the formation of numerous new graphics companies.

Designed and implemented a microcode simulator for a mini-computer; co-designed and developed a compiler for the Language for System Development; designed and assisted in graduate courses in computer graphics.

1969 – 1971 CORNELL UNIVERSITY, Department of Computer Science

Ithaca, New York

*Teaching Assistant*

Assisted in graduate courses in numerical analysis and picture processing.

1968 – 1969 UNIVERSITY OF STOCKHOLM, Institute for Inorganic and Physical Chemistry

Stockholm, Sweden

*Research Associate*

Developed programs for crystallographic calculations and for illustration of crystallographic structures.

**Professional Activities**

*Expert Advisor,* Promotion to Full Professor, Mid Sweden University, Nov. 2012.

*Organizer*, Aimday™ Image, workshop in connection with SSBA 2012, KTH, Stockholm, Sweden, March 2012.

*Member,* KK Stiftelsen’s workshops on Future of Perceptualization, 2010-2011.

*Chair of Board,* Forskarskolan i Matematik och Beräkningsvetenskap (Graduate School in Mathematics and Computing), Uppsala University, Sweden, 2004 -2010.

*Member*, Review Committee, KK Stiftelsen’s Light and Heavy Projects in Visualization, 2009.

*Co-Editor-in-Chief*, *Graphical Models*, 1997 - 2009.

*Member,* Technical Program Committee, IASTED International Conference on TeleHealth, 2005, 2006, 2007.

*Member,* Technical Program Committee, IASTED International Conference on Biomedical Engineering (BioMed), 2003, 2004, 2005, 2008.

*Member,* Editorial Board, *Computers and Graphics*, 1999 - 2004.

*Member,* Technology Advisory Board, Center for Graphic Communications Management and Technology, New York University, 2000-2003.

*Member,* Program Committee, ACM International Workshop on Immersive Telepresence, Juan Les Pins, France, December 2002.

*Member,* Ph.D. Dissertation Examination Committee, “Navigating Media using Virtual Environments,” by Steele G, Arbeeny, Graduate Program in Electrical and Computer Engineering, Rutgers University, June 2002.

*Member*, External Advisory Board, NSF/ARPA Science and Technology Center for Computer Graphics and Scientific Visualization, 1994 - 2001.

*Member,* Technical Program Committee, IASTED International Conference on Computer Graphics and Imaging, 1998, 1999, 2000, 2001.

*Member,* Technical Program Committee, Computer Animation 1998, 2000, 2001.

*President,* The Swedish Educational Association of New Jersey, Inc., 1998-2000.

*Member,* Technical Program Committee, IEEE Workshop on Knowledge Media Networking, 1999, 2000.

*Area Editor*, *IEEE Transactions on Visualization and Computer Graphics*, 1994 - 1999.

*Member,* Interactive Graphics Advisory Board, 1999 ACM Symposium on Interactive 3D Graphics.

*Member*, External Advisory Board, DoD MURI Research Consortia on Computational Geometry for Intelligent Systems, 1995 - 1998.

*Member*, Technical Program Committee, Symposium on Interactive 3D Graphics, 1997.

*Member,* Technical Program Committee, 1997 IEEE Workshop on Nonrigid and Articulated Motion.

*Chair*, SIGGRAPH Course on “Computer Vision for Computer Graphics,” 1994 and 1995.

*Member*, NSF Site Visit Team that reviewed *the NSF/ARPA Science and Technology Center for Computer Graphics and Scientific Visualization*, June 1994.

*Opponent*, Thesis: *An Adjustable 3D Brain Atlas for Quantitative Analysis of Neuroimaging Data*, Uppsala University, Uppsala, Sweden, May 1994.

*Area Editor*, *Graphical Models and Image Processing*, 1993 - 1996.

*Member*, SIGGRAPH Technical Program Committee, 1982, 1983, 1989, 1990, 1993, 1994.

*Co-Chair*, SIGGRAPH Workshop on Integrating Computer Graphics, Computer Vision, and Image Processing for Scientific Applications, 1991.

*Member*, SIGGRAPH'89 Technical Coordinating Committee.

*Chair*, SIGGRAPH Advisory Board, 1986-1989.

*Member*, Editorial Board, *IEEE Computer Graphics and Applications*, 1985 - 1989.

*Guest Editor*, *IEEE Computer Graphics and Applications*, issue on ``Modeling and Display of Empirical Data'', July 1988.

*Session Chair*, Eurographics, September 1984.

*Director*, SIGGRAPH Board, 1982 - 1986.

*Chair*, SIGGRAPH Courses, 1980 and 1981.

*Observer*, ANSI X3H3 Technical Committee on Computer Graphics, 1979 - 1982.

*Member*, ACM SIGGRAPH Graphics Standards Planning Committee, 1976 - 1977.

**Professional Affiliations**

* ACM - Association of Computing Machinery
* SIGGRAPH - ACM Special Interest Group on Computer Graphics and Interactive Techniques
* IEEE

**Patents**

*Issued:*

I.B. Carlbom, Y.D. Jean, A. Opalach, and G.S. Pingali**,** *Performance Data Mining Based on Real Time Analysis of Sensor Data*, August 2009, U.S. Patent Number 7,580,912.

D.G. Aliaga and I.B. Carlbom, *Camera Model and Calibration Procedure for Omnidirectional Paraboloidal Catadioptric Cameras,* April 2008, U.S. Patent Number 7,362,969.

D.G. Aliaga, I.B. Carlbom, T.A. Funkhouser, and D.V. Yanovsky, *Method and Apparatus for Finding Feature Correspondences Between Images Captured in Real-World Environments,* April 2008, U.S. Patent Number 7,356,164.

D.G. Aliaga, I.B. Carlbom, T.A. Funkhouser, and D.V. Yanovsky, *Method and Apparatus for Compressing and Decompressing Images Captured from Viewpoints Throughout N-Dimensional Space,* December 2007, U.S. Patent Number 7,313,285.

I.B. Carlbom, Y.D. Jean, A. Opalach, and G.S. Pingali**,** *Instantly Indexed Databases for Multimedia Content Analysis and Retrieval,* April 2007, U.S. Patent Number 7,203,693.

I.B. Carlbom, G. Elko, T.A. Funkhouser*, Acoustic Modeling Apparatus and Method Using Accelerated Beam Tracing Techniques*, December 2006, U.S. Patent Number 7,146,296.

## I.B. Carlbom, A. Opalach, and G.S. Pingali**,** Method and Apparatus for Retrieving Multimedia Data Through Spatio-Temporal Activity Maps, November 2006, U.S. Patent Number 7,143,083.

D.G. Aliaga, I.B. Carlbom, T.A. Funkhouser, and D.V. Yanovsky, *Method and System for Creating Interactive Walkthroughs of Real-World Environment from Set of Densely Captured Images*, October 2006, U.S. Patent Number 7,126,603.

I.B. Carlbom, A. Opalach, and J. West**,** *Real-Time Method and Apparatus for Tracking a Moving Object Experiencing a Change in Direction*, April 2006, U.S. Patent Number 7,030,905.

D.G. Aliaga and I.B. Carlbom, *Method and System for Reconstructing 3D Interactive Walkthroughs of Real-World Environments*, April 2006, U.S. Patent Number 7,027,049.

D.G. Aliaga and I.B. Carlbom, *Method and System for Reconstructing 3D Interactive Walkthroughs of Real-World Environments*, December 2004, U.S. Patent Number 6,831,643.

I.B. Carlbom, G. Elko, T.A. Funkhouser, S.V. Pingali, M. Sondhi, and J.E. West, *Acoustic Modeling System and Method Using Pre-Computed Data Structures for Beam Tracing and Path Generation*, June 2004, U.S. Patent Number 6,751,322.

I.B. Carlbom, Y.D. Jean, A. Opalach, and G.S. Pingali, *Method and Apparatus for Deriving Novel Sports Statistics from Real Time Tracking of Sporting Events*, August 2002, U.S. Patent Number 6,441,846.

I.B. Carlbom, Y.D. Jean, A. Opalach, and G.S. Pingali, *Method and Apparatus for Tracking Position of a Ball in Real Time*, May 2001, U.S. Patent Number 6,233,007.

I.B. Carlbom, Y.D. Jean, A. Opalach, and G.S. Pingali**,** *Method and Apparatus for Determination and Visualization of Player Field Coverage in a Sporting Event*, October 2000, U.S. Patent Number 6,141,041.

*Published:*

I.B. Carlbom and G.S. Pingali, *Method and Apparatus for Intelligent and Automatic Alert Management Using Multimedia Database System,* December 2004, Application Number 20040249848.

D.G. Aliaga and I.B. Carlbom*, Method and Apparatus for Computing Error-Bounded Position and Orientation of Panoramic Cameras in Real-World Environments,* December 2004, Application Number 20040239756.

I.B. Carlbom, Y.D. Jean, A. Opalach, and G.S. Pingali,*Method and Apparatus for Intelligent and Automatic Sensor Control Using Multimedia Database System,* September 2004, Application Number 20040194129.

*Filed:*

I.B. Carlbom, J-M. Hirsch. F. Nysjö, and P. Olsson,*Haptics-Assisted Virtual Assembly of Fragmented Objects,* Provisional Application, April 2013, Serial No. 61/811,370.

J.C. Azar, C. Busch, I.B. Carlbom,M. Gavrilovic,*Color Decomposition in Histology*, November 2011, US Provisional Application, November 2012, PCT/US12/64282.

**Publications**

**SIGGRAPH and Refereed Journals**

M. Gavrilovic, J.C. Azar, J. Lindblad, C. Wählby, E. Bengtsson, C. Busch, I.B. Carlbom, **“**Blind Color Decomposition of Histological Images,” *IEEE Transactions of Medical Imaging*, 32(6), June 2013, pp. 983-94.

P. Olsson, F. Nysjö, J. Hirsch, and I. Carlbom, ”A Haptics-Assisted Cranio-Maxillofacial Surgery Planning System for Restoring Skeletal Anatomy in Complex Trauma Cases”, *Intl. J. Computer Assisted Radiology and Surgery (IJCARS),* April 2013.

J.C. Azar, C. Busch, I.B. Carlbom, “Histological Stain Evaluation for Machine Learning Applications,” *Journal of Pathology Informatics 4 (11)*, March 2013.

J.C. Azar, C. Busch, I.B. Carlbom, “Microarray Core Detection by Geometric Restoration,” *Analytical Cellular Pathology* *35* (5-6), 2012, pp. 381-393.

D.G. Aliaga, P. Rosen, V. Popescu, I. Carlbom, “Image Warping for Compressing and Spatially Organizing a Dense Collection of Images,” *Signal Processing: Image Communication 21* (9), Special issue on Interactive Representation of Still and Dynamic Scenes, October 2006, pp. 755-769.

D.G. Aliaga and I.B. Carlbom, “Fiducial Planning for Error-Bounded Pose Estimation of a Panoramic Camera in Large Environments,” *IEEE Robotics and Automation Magazine*, special issue on Panoramic Robotics,December 2004, pp. 53-61.

T.A. Funkhouser, N. Tsingos, I.B. Carlbom, G. Elko, M. Sondhi, J.E. West, G. Pingali, P. Min, and A. Ngan, “A Beam Tracing Method for Interactive Architectural Acoustics,” *Journal of the Acoustical Society of America (JASA) 115* (2), February 2004, pp. 739-756.

D.G. Aliaga, T.A. Funkhouser, D. Yanovsky, and I.B. Carlbom, “Sea of Images: A Dense Sampling Approach for Rendering Large Indoor Environments,” *IEEE Computer Graphics & Applications* special issue on *3D Reconstruction and Visualization of Large Scale Environments,**23(*6), November/December 2003, pp. 22-30.

N. Tsingos, I.B. Carlbom, G. Elko, T.A. Funkhouser, and R. Kubli, “Validation of Acoustics Simulations in the Bell Labs Box,” *IEEE Computer Graphics & Applications, 22(*4), July 2002, pp. 28-37.

G.S. Pingali, A. Opalach, Y.D. Jean, and I.B. Carlbom, “Instantly Indexed Multimedia Data Bases of Real World Events,” *IEEE Transactions on Multimedia, 4*(2), June 2002, pp. 269-282.

N. Tsingos, T.A. Funkhouser, A. Ngan, and I. Carlbom, “[Modeling Acoustics in Virtual Environments Using the Uniform Theory of Diffraction,](file:///C:\Documents%20and%20Settings\ingrid-carlbom\Mina%20dokument\CVs\ERC\sig01.pdf)” *Computer Graphics* (SIGGRAPH'01), Los Angeles, CA, August 2001, pp. 545-552.

D.G. Aliaga and I. Carlbom, “Plenoptic Stitching: A Scalable System for Reconstructing 3D Interactive Walkthroughs,” *Computer Graphics* (SIGGRAPH'01), Los Angeles, CA, August 2001, pp. 443-450.

T.A. Funkhouser, P. Min, and I. Carlbom, “Real-Time Acoustic Modeling for Distributed Virtual Environments,” *Computer Graphics* (SIGGRAPH'99), Los Angeles, CA, August 1999, pp. 365-374.

L. Egevad, H. Frimmel, M. Norberg, S. Mattson, I. Carlbom, E. Bengtsson, and C. Busch,“Three-Dimensional Computer Reconstruction of Prostate Cancer from Radical Prostatectomy Specimens. Evaluation of the Model by Core Biopsy Simulation,” *Urology 53* (1), 1999, pp. 192-198.

T.A. Funkhouser, I. Carlbom, G. Elko, G. Pingali, M. Sondhi, and J. West, “A Beam-Tracing Approach to Acoustic Modeling for Interactive Virtual Environments,” *Computer Graphics* (SIGGRAPH'98), Orlando, Florida, July 1998, pp. 21-32.

M. Loughlin, I. Carlbom, C. Busch, T. Douglas, L. Egevad, H. Frimmel, M. Norberg, I. Sesterhenn, and J. Frogge, “Three-Dimensional Modeling of Biopsy Protocols for Localized Prostate Cancer,” *Computerized Medical Imaging and Graphics, Vol. 22*(3), 1998, pp. 229-238.

I. Carlbom, D. Terzopoulos, and K.M. Harris, “Computer-Assisted Registration, Segmentation, and 3D Reconstruction from Images of Neuronal Tissue Sections,” *IEEE Transactions on Medical Imaging, 13*(2), June 1994, pp. 351-362.

I. Carlbom, W.M Hsu, G. Klinker, R. Szeliski, K. Waters, M. Doyle, J. Gettys, K.M. Harris, T.M. Levergood, R. Palmer, L. Palmer, M. Picart, D. Terzopoulos, D. Tonnesen, M. Vannier, and G. Wallace, “Modeling and Analysis of Empirical Data in Collaborative Environments,” *CACM, 35*(6), June 1992, pp. 74-84.

P. Sabella and I. Carlbom, “An Object-Oriented Approach to Solid Modeling for Empirical Data,” *IEEE Computer Graphics and Applications*, *9*(5), September 1989, pp. 24-35.

I. Carlbom, “An Algorithm for Geometric Set Operations Using Cellular Subdivision Techniques,” *IEEE Computer Graphics and Applications*, *7*(5), May 1987, pp. 44-55.

I. Carlbom, I. Chakravarty, and D. Vanderschel, “A Hierarchical Data Structure for Representing the Spatial Decomposition of 3D Objects,” *IEEE Computer Graphics and Applications 5*(4), April 1985.

I. Carlbom and J. Michener, “Quantitative Analysis of Vector Graphics System Performance,” *ACM Transactions on Graphics 2*(1), January 1983.

J. Michener and I. Carlbom, “Natural and Efficient Viewing Parameters,” *Computer Graphics 14*, 1 (SIGGRAPH’80), July 1980.

R. Gurwitz, R. Thorne, A. van Dam, and I. Carlbom, “BUMPS: A Program for Animating Projections,” *Computer Graphics 14*, 1 (SIGGRAPH’80), July 1980.

I. Carlbom and J. Paciorek, “Planar Geometric Projections and Viewing Transformations,” *Computing Surveys 10*(4), December 1978.

**Refereed Conferences**

P. Olsson, F. Nysjö, B. Aneer, S. Seipel, and I.B. Carlbom, "SplineGrip - An Eight Degrees-of-Freedom Flexible Haptic Sculpting Tool," ACM SIGGRAPH 2013 (Abstract), Anaheim, CA, July 2013.

P. Olsson, F. Nysjö, J. Hirsch, and I.B. Carlbom, ”A Haptics-Assisted Cranio-Maxillofacial Surgery Planning System for Restoring Skeletal Anatomy in Complex Trauma Cases”, *Proc. Computer Assisted Radiology and Surgery (CARS)*, Heidelberg, Germany, June 2013.

P. Olsson, F. Nysjö, J. Hirsch, and I.B. Carlbom, "Snap-to-Fit, a Haptic 6 DOF Alignment Tool for Virtual Assembly", *Proc. IEEE World Haptics*, Daejeon, Korea, April 2013.

J.C. Azar, C. Busch, I.B. Carlbom, “Histological Stain Evaluation for Machine Learning Applications”, *Workshop on: Histopathology Image Analysis (HIMA), 15th International Conference on Medical Image Computing and Computer Assisted Intervention (MICCAI)*, Nice, France, Oct. 2012.

P. Olsson, S. Johansson, F. Nysjö and I. Carlbom, "Rendering Stiffness with a Prototype Haptic Glove Actuated by an Integrated Piezoelectric Motor", in P. Isokoski and J. Springare, editors, *Proc. Eurographics 2012: Haptics: Perception, Devices, Mobility, and Communication,* Tampere, Finland, June 2012, Vol. I, pp. 361-372. Published as Lecture Notes in Computer Science (LNCS), No. 7282, Springer-Verlag, Berlin-Heidelberg.

P. Olsson, F. Nysjö, S. Seipel and I. Carlbom, "Physically Co-Located Haptic Interaction with 3D Displays", *Proc. 2012 IEEE Haptics Symposium*, Vancouver, Canada, March 2012, pp. 267-27.

D.G. Aliaga and I.B. Carlbom, “A Spatial Image Hierarchy for Compression in Image-Based Rendering,” *Proc. International Conference on Image Processing (ICIP 2005),* September 2005, pp. 1-609-612.

D.G. Aliaga, D. Yanovsky, T.A. Funkhouser, I.B. Carlbom, “Interactive Image-Based Rendering Using Feature Globalization,” *Proc. ACM Symposium on Interactive 3D Graphics*, April 2003, pp. 163-170.

D.G. Aliaga, T.A. Funkhouser, D. Yanovsky, and I.B. Carlbom, “Sea of Images,” *Proc. IEEE Visualization 2002 (Vis’2002)*, Boston, MA, October 2002, pp. 331-338.

L. Zhao, G.S. Pingali, and I.B. Carlbom, “Real-Time Head Orientation Estimation Using Neural Networks,” *Proc. IEEE 2002 International Conference on Image Processing (ICIP 2002)*, Rochester, NY, September 2002, pp. 297-300.

G.S. Pingali, A. Opalach, Y. Jean, and I. Carlbom, “Visualization of Sports using Motion Trajectories: Providing Insights into Performance, Style, and Strategy,” *Proc. 12th* *Annual IEEE Visualization Conference (Vis'2001)*, San Diego, CA, October 2001, pp. 75-82.

G.S. Pingali, A. Opalach and I. Carlbom, “Multimedia Retrieval through Spatio-Temporal Activity Maps,” *Proc. 9th ACM International Multimedia Conference*, Ottawa, Canada, September 2001, pp. 129-136.

G.S. Pingali, Y. Jean, A. Opalach, and I. Carlbom, “LucentVision: Converting Real World Events into Multimedia Experiences,” *Proc. IEEE International Conference on Multimedia and Expo 2000 (ICME’2000)*, New York, NY, August 2000.

G.S. Pingali, G. Tunali, and I. Carlbom “Audio-Visual Tracking for Natural Interactivity,” *Proc. ACM International Conference of Multimedia (MM99)*, October 1999, pp. 373-382.

G.S. Pingali, Y. Jean, and I. Carlbom, “LucentVision: A System for Enhanced Sports Viewing,” *Proc. Third International Conference on Visual Information Systems*, June 1999, pp. 689-696.

G.S. Pingali, Y. Jean, and I. Carlbom, “Real-time Tracking for Enhanced Tennis Broadcasts,” *Proc. IEEE Conference on Computer Vision and Pattern Recognition*, June 1998, pp. 260-265.

I. Carlbom, G. Klinker, D. Terzopoulos, and L. Thurfjell, “General-Purpose Soft Tissue Segmentation from Medical Images,” *Proc. 9th Scandinavian Conference on Image Analysis*, Uppsala, Sweden, June 1995, pp. 905-912. Swedish Society for Automated Image Analysis.

G. Klinker, I. Carlbom, W.M Hsu, and D. Terzopoulos, “Biomedical Data Exploration Meets Telecollaboration,” in N. Ayache, editor, *Proc. First International Conference on Computer Vision, Virtual Reality, and Robotics in Medicine, CVRMed'95*, Nice, France, April 1995, pp. 84-91. Published as Lecture Notes in Computer Science (LNCS), No. 905, Springer-Verlag, Berlin-Heidelberg.

I. Carlbom, “Optimal Filter Design for Volume Reconstruction and Visualization,” *Proc. Visualization'93*, San Jose, CA, October 1993. IEEE Computer Society, Los Alamitos, CA.

W.M Hsu, I. Carlbom, D. Terzopoulos, and M. Doyle, “Reconstruction and Visualization of a Human Embryo Heart,” Poster session, *IEEE Visualization'92*, Boston, MA, Oct 1992.

I. Carlbom, D. Terzopoulos, and K.M. Harris, “Reconstructing and Visualizing Models of Neuronal Dendrites,” *Proc. CG International'91: Visualization of Physical Phenomena*, Cambridge, MA, June 1991. Springer-Verlag, Tokyo.

R. Davis, H. Austin, I. Carlbom, B. Frawley, P. Pruchnik, R. Sneiderman, and J.A. Gilreath, “The Dipmeter Advisor: Interpretation of Geologic Signals,” *Proc. 7th Annual International Joint Conference on Artificial Intelligence*, Vancouver, BC, Canada, August 1981, pp. 846-849.

G. Stabler, I. Carlbom, and K. Magel, “A Microprogrammed Satellite Graphics System,” *Proc. SIGPLAN - SIGMICRO Interface Meeting*, 1973.

**Books and Book Chapters**

M. Gavrilovic, J.C. Azar, J. Lindblad, C. Wählby, E. Bengtsson, C. Busch, I.B. Carlbom, **“**Blind Color Decomposition of Histological Images,” in *Spectral Image Processing with Applications in Biotechnology and Pathology*, PhD thesis by M. Gavrilovic, Uppsala University, December 2011.

I. Carlbom, W. Freeman, G. Klinker, W. Lorensen, R. Szeliski, D. Terzopoulos, K. Waters, *Computer Vision for Computer Graphics*, SIGGRAPH'95 Course Notes, ACM SIGGRAPH, 1995.

I. Carlbom, T. Kapur, G. Klinker, D. Terzopoulos, and L. Thurfjell, “General-purpose Soft Tissue Segmentation from Medical Images,” in G. Borgefors, editor, *Theory & Applications of Image Processing II - Selected Papers from the 9th Scandinavian Conference on Image Analysis*. World Scientific, 1995.

I. Carlbom, W. Freeman, G. Klinker, W. Lorensen, R. Szeliski, D. Terzopoulos, K. Waters, *Computer Vision for Computer Graphics*, SIGGRAPH'94 Course Notes, ACM SIGGRAPH, 1994.

I. Carlbom, “Modeling and Visualization of Empirical Data,” in D.F. Rogers and R.A. Earnshaw, editors, *State of the Art in Computer Graphics - Aspects of Visualization*. Springer-Verlag, New York, NY, 1994.

N. Badler and I. Carlbom, “Overview of Raster Graphics Hardware,” in G. Enderle, M. Grave, and F. Lillehagen, editors, *Advances in Computer Graphics*, Springer-Verlag, 1986.

I. Carlbom, I. Chakravarty, and D. Vanderschel, “ Hierarchical Data Structure for Representing the Spatial Decomposition of 3D Objects,” in T.L. Kunii, editor*, Frontiers in Computer Graphics*, Springer-Verlag, 1985.

I. Carlbom, *High-Performance Graphics System Architecture: A Methodology for Design and Evaluation*, UMI Research Press, Ann Arbor, MI, 1984.

R.D. Bergeron, J.D. Foley, P.R. Bono, I. Carlbom, T. Dreisbach, J.C. Michener, E.T. Sonderegger, and A. van Dam. “Status Report of the Graphics Standards Planning Committee of ACM/ SIGGRAPH, Part II: General Methodology and Proposed Standard,” *Computer Graphics, 11*(3), Fall 1977, pp. II:1-117.

**Other Publications**

J.C. Azar, M. Gavrilovic, C. Busch, and I.B. Carlbom, “Automatic Malignancy Grading of Prostate Cancer with Image Analysis,” ***Diagnostics Forum 2013*, Uppsala, Sweden, Feb, 2013 (Poster).**

J.M. Hirsch, K. Gamstedt, J. Sörensen, L.E. Rännar, I. Carlbom, “Virtual Planning of Reconstructions, Production of Individualized Implants, and Transfer of the Plan to the Operating Room in CMF Surgery,” Materialise World Congress, Leuven Belgium, April 2012. (Abstract)

J.M. Hirsch, K. Gamstedt, J. Sörensen, L.E. Rännar, I. Carlbom, “Virtual planning of reconstructions and transfer to the operating room in CMF surgery,” 26th World Congress of the International College of Maxillofacial Surgery, Gran Canaria, Spain, February 2012. (Abstract)

M. Gavrilovic, J.C. Azar, C. Busch, I. Carlbom, “Tissue Separation for Quantitative Malignancy Grading of Prostate Cancer,” Medicinteknikdagarna 2011, Linköping, Sweden, October 2011, pp. 32. (Abstract)

P. Olsson, S. Johansson, I. Carlbom, “Whole Hand Haptics,” Medicinteknikdagarna 2011, Linköping, Sweden, October 2011, pp. 98. (Abstract)

T.A. Funkhouser, N. Tsingos, I.B. Carlbom, G. Elko, M. Sondhi, and J.E. West, “Modeling Sound Reflection and Diffraction in Architectural Environments with Beam Tracing,” *Proc. Forum Acusticum*, Sevilla, Spain, September 2002. (Invited)

T.A. Funkhouser, N. Tsingos, I. Carlbom, G. Elko, G. Pingali, M. Sondhi, and J.E. West, “Interactive and Aliasing-Free Acoustic Modeling of Reflections and Diffractions in Architectural Environments,” *Proc. 141st Meeting of the Acoustical Society of America, Journal of the Acoustical Society of America (JASA), 109* (5), May 2001, pp. 2389. (Abstract)

T.A. Funkhouser, I. Carlbom, G. Elko, G. Pingali, M. Sondhi, and J.E. West, “[Interactive Acoustic Modeling of Complex Environments](file:///C:\Documents%20and%20Settings\ingrid-carlbom\Mina%20dokument\CVs\ERC\berlin.pdf),” *Proc. Joint Meeting of the 137th Regular Meeting of the Acoustical Society of America* and *2nd Convention of the European Acoustics Association: Forum Acusticum’99*; *Journal of the Acoustical Society of America, Vol. 105*(2), February 1999, pp. 1357-1358 (invited).

F. Eryurtly, R.-H. Yan, I. Kriaras, I. Carlbom, C. Podilchuk, A. Jacquin, and H.-L. Lou, *Video Communication for Third Generation Wireless Networks,* Bell Labs Technical Memorandum, 1999.

I. Carlbom, “Audio-Visual Tracking for 3D User Interfaces,” *SIGGRAPH’98 Conference Abstracts and Applications*, Orlando, Florida, July 1998, pp. 220-221. (Abstract)

L. Egevad, H. Frimmel, M. Norberg, T. Bjerner, I. Carlbom, E. Bengtsson, and C. Busch, “Three[-Dimensional Reconstruction of Prostate-Cancer and Simulation of Systematic Transrectal Core Biopsies](http://serials.cib.unibo.it/cgi-ser/start/it/spogli/df-s.tcl?prog_art=547147&language=ITALIANO&view=articoli),” [*Modern Pathology*](http://acnp.cib.unibo.it/cgi-ser/start/it/cnr/df-p.tcl?issn=08933952&m040=ACNP&m040=TEMP&language=ITALIANO&libr=%7b%7d), 11(1), January 1998, pp. 81.

T. Funkhouser, G. Pingali, G. Elko, M. Sondhi, J. West, I. Carlbom, and M. Gatlin, “Interactive Auralization of Virtual Environments,” *Lucent NetDays’97.* (Abstract)

I. Carlbom, T. Funkhouser, “Three-Dimensional Virtual Environments for Business Applications,” *Lucent NetDays’97.* (Abstract)

L. Egevad, H. Frimmel, M. Loughlin, I. Carlbom, M. Norberg, I. Sesterhenn, T. Douglas, E. Bengtsson, C. Busch, “Three-dimensional Modeling of Biopsy Protocols for Localized Prostate Cancer,” presented at XXI International Congress of the International Academy of Pathology, Budapest, October 1996.

I. Carlbom, “Visualization: Computer Vision Meets Computer Graphics,” *Proc. IEEE Workshop on Visualization and Machine Vision*, Seattle, WA, June 1994, pp. 107-108. Position paper for panel discussion on Future Directions in Visualization and Machine Vision.

G. Klinker, I. Carlbom, W.M Hsu, and D. Terzopoulos, *Tele-Collaboration with Customizable Views for Scientific Data Exploration*, Technical Report CRL-TR 94, Digital Equipment Corporation, Cambridge Research Lab, Cambridge, MA, June 1994.

M. Doyle, A. Noe, I.Carlbom, C. Ang, and D. Martin, “The Virtual Embryo: VR Applications in Human Developmental Anatomy,” *Medicine Meets Virtual Reality II: Interactive Technology and Healthcare*, San Diego, CA, January 1994. (Extended Abstract)

W.M Hsu, I. Carlbom, D. Terzopoulos, and M. Doyle, “Reconstruction and Visualization of a Human Embryo Heart,” *The Second Annual Human Developmental Anatomy Center Conference*, Washington, DC, December 1992; *Telemedicine Seminar and Workshop sponsored Armed Forces Institute of Pathology*, Rockville, MD, May, 1993; *SIGGRAPH/NE Meeting*, January, 1993, and *SIGGRAPH'93 Small Animation Theater*, August 1993; *SIGGRAPH'93 Video Review*, August 1993. (Video Tape)

I. Carlbom, W.M Hsu, G. Klinker, R. Szeliski, and K. Waters, “Scientific Visualization Using the DECmpp 12000/Sx,” *Frontiers of Massively Parallel Computation*, McLean, VA, Oct, 1992. (Video Tape)

I. Carlbom, I. Chakravarty, and W.M Hsu, “SIGGRAPH'91 Workshop Report: Integrating Computer Graphics, Computer Vision, and Image Processing in Scientific Applications,” *Computer Graphics, 26*(1), January 1992, pp. 8-17.

I. Carlbom, D.Terzopoulos, and K.M. Harris, “Reconstructing and Visualizing Neuronal Dendrites,” *CG International'91: Visualization of Physical Phenomena*, Cambridge, MA, June 1991. (Video Tape)

I. Carlbom and I. Chakravarty, “The Role of Computer Graphics, Computer Vision, and Image Processing in Scientific Applications,” *SIGGRAPH'91 Workshop on* *Integrating Computer Graphics, Computer Vision, and Image Processing in Scientific Applications,* Las Vegas, Nevada, August 1991.

I. Carlbom and I. Chakravarty, “Standards for Scientific Visualization Environments are Premature,” *Visualization’91 Workshop on Scientific Visualization Environments,* San Diego, CA, October 1991.

I. Carlbom, “Polytree - A Data Structure for Geometric Modeling,” *SIAM Conference on Geometric Modeling and Robotics*, July 1985. (Abstract)

N. Badler and I. Carlbom, “The Computer Graphics Scene in the United States*,*” *Proc. Eurographics*, September 1984.

I. Carlbom, I. Chakravarty, and D. Vanderschel, “A Hierarchical Data Structure for Representing the Spatial Decomposition of 3D Objects,” *Proc. Computer Graphics Tokyo:84*, April 1984.

**Major Demonstrations**

*IEEE Workshop on Applications of Computer Vision*: “Vision-Based Virtual Tennis,” October 1998.

*SIGGRAPH'93 Digital Booth*: Telemedicine, showing registration, region-based segmentation (snakes), multi-spectral segmentation, and volume rendering in a telecollaborative environment.

*Telemedicine Seminar and Workshop* (sponsored Armed Forces Institute of Pathology): “Telecollaborative Data Exploration,” 1993.

*SIGGRAPH'92 Showcase*: (1) Interactive modeling and visualization of medical and biological data, (2) 3D object input, modeling, and manipulation, (3) DECface, (4) teleconferencing, and (5) EDI: an environment for data interpretation, 1992.

*DECworld'92 Innovation Showcase*: (1) Interactive modeling and visualization of medical and biological data, (2) 3D object input, modeling, and manipulation, and (3) DECmouth, 1993.

**Invited Talks and Courses Taught**

“Whole Hand Haptics and True 3D Displays”, Visual Forum 2010, Norrköping, May 2010.

“Whole Hand Haptics and True 3D Displays”, Vårdgalan 2009, Stockholm, December 2009.

“Challenges in Multi-Disciplinary, Multi-Media Research”, KTH – VIC VIsualiseringsCentrum, February, 2009.

“Telepresence – the Next Communications Paradigm,” Samuel D. Conte Distinguished Lecture Series in Computer Science, Purdue University, November 2004.

“Telepresence – the Next Communications Paradigm,” Plenary Talk, Swedish Symposium on Image Analysis, Uppsala University (SSBA), March 2004.

“Telepresence – the Next Communications Paradigm,” Computer Science Colloquium, Tufts University, October 2003.

“Telepresence – the Next Communications Paradigm,” Distinguished Lecture Series, Department of Electrical and Computer Engineering, School of Engineering, Rutgers University, February 2002.

“Computer Science at Brown: Profiles in Leadership,” Brown University alumni panel, Alumni Leadership Conference 2000, Brown University, Providence, RI, September, 2000.

“Telepresence – The Next Communications Paradigm,” University of Uppsala, Sweden, January, 2000.

“Telepresence – The Next Communications Paradigm,” Fraunhofer Center for Research in Computer Graphics, Inc., Providence, RI, January, 2000.

“Telepresence – The Next Communications Paradigm,” Fraunhofer – Institute for Computer Graphics, Darmstadt, Germany, October 1999.

“Telepresence – The Next Communications Paradigm,” at *The Computer, the Academy and the World*, Symposium on the occasion of Professor Andy van Dam’s 60th birthday, May 1999.

“Interactive Immersive Television,” in the 1999 ACM Symposium on Interactive 3D Graphics panel on *The Future of Interactive 3D Graphics: Industry Perspective*, April, 1999.

“Audio-Visual Tracking for 3D User Interfaces,” in the SIGGRAPH’98 panel on *Computer Vision for 3D Interactivity*, July 1998.

“The Real World of Virtual Worlds,” *World of Science Seminars*, Bell Laboratories, April 1988.

“Virtual Reality for Business and Home,” presented to Chinese President Jiang Zemin, Bell Laboratories, October 1997.

“Virtual Reality for Business and Home,” presented to the Cummins Science and Technology Council, Bell Laboratories, June 1997.

“Computer Vision for Computer Graphics,” *ACM SIGGRAPH Course*, August 1995.

“Computer Vision for Computer Graphics,” *ACM SIGGRAPH Course*, July 1994.

“Segmentation of Biomedical Data,” Center for Imaging and Pharmaceutical Research,

Massachusetts General Hospital, May 1993.

“Reconstruction and Visualization of a Human Embryo Heart,” *Second Annual Human Developmental Anatomy Center Conference*, the National Museum of Health and Medicine, December 1992.

“Modeling and Visualization of Empirical Data,” part of a one week course on *The State of the Art in Computer Graphics - Aspects of Scientific Visualization*, the International Summer

Institute, Reading, England, July 1992.

“Polytree - A Data Structure for Geometric Modeling,” New York Institute of Technology, August 1985.

“Computer Graphics Hardware and Software Architecture,” two-day course at *Eurographics*, with A. van Dam, September 1984.

“Computer Graphics Hardware and Software Architecture,” one-day course sponsored by *ICAN* and *The Scandinavian CAD/CAM Society*, with A. van Dam, September 1984.

“Recent Advances in Computer Graphics Research and Applications,” Josef Stefan Institute, Ljubljana, Yugoslavia, September 1982.

“Three-Dimensional Viewing,” *ACM SIGGRAPH Tutorial on Graphics Standards*, August 1979.