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Education

1967-72 B. Engg. Electronics and Communications, Mysore University, Mysore India.

1972-76 Ph.D. Computer Science, Indian Institute of Science, Bangalore, India.

Faculty Appointments

1976-78 Scientific Officer, Department of Electrical Engineering, Indian Institute of Science, Bangalore, India.

1978-81 Research Assistant Professor, Medical Image Processing Group, Department of Computer Science, State University of New York at Buffalo.

1981-83 Adjunct Assistant Professor, Medical Image Processing Group, Department of Radiology University of Pennsylvania.

1983-91 Adjunct Associate Professor, Medical Image Processing Group, Department of Radiology University of Pennsylvania.

1991-92 Research Associate Professor, Medical Image Processing Group, Department of Radiology University of Pennsylvania.

1992-94 Associate Professor, Department of Radiology, University of Pennsylvania.

1994- Professor of Radiologic Science, University of Pennsylvania.

Administrative Appointments

1982-91 Director, Medical Image Processing Group, Department of Radiology, University of Pennsylvania.

1991- Chief, Medical Imaging Section, Department of Radiology, University of Pennsylvania.

Awards, Honors

1974-76 Research Fellowship, Council of Scientific and Industrial Research, India.

1976-77 Alumni Gold Medal for best Ph.D. research during 1976-77, Indian Institute of Science, Bangalore, India.

1993 3DVIEWNIX (see under Transfer of Technology) considered one of the top 10 visualization software systems of 1993 by the journal IEEE Computer Graphics and Applications.

1997 Honorable Mention, Scientific Exhibit, “Automatic Cluster-free Volume Rendering for MR Angiography Using Fuzzy Connectedness,” J.K. Udupa, D. Odhner, J. Tian, G. Holland and L. Axel, Society of Photo-Optical Instrumentation Engineers Medical Imaging Conference, Newport Beach, California.

1998 Honorable Mention, Scientific Exhibit, “3D Architecture of the Rear Foot from MRI Data: Technical Validation and Clinical Description,” E. Stindel, J.K. Udupa and B.E. Hirsch, Society of Photo-Optical Instrumentation Engineers Medical Imaging Conference, San Diego, California.

1998 Certificate of Merit, Scientific Exhibit, “On Standardizing the MR Image Intensity Scale,” L.G. Nyul, J.K. Udupa, Radiological Society of North America, 84th Scientific Assembly and Annual Meeting, Chicago, Illinois.

1999 Cum Laude, Scientific Exhibit, “3D Analysis of the Peritalar Complex Using MR Imaging in Live Patients,” E. Stindel, J.K. Udupa, B.E. Hirsch and D. Odhner, Society of Photo-Optical Instrumentation Engineers Medical Imaging Conference, San Diego, California.

1999 Certificate of Merit, Scientific Exhibit, “An Order Magnitude Faster Surface Rendering of Medical Object in Software on a PC Than by Using a Dedicated Rendering Hardware,” Excellence in Design, Radiological Society of North America, 85th Scientific Assembly and Annual Meeting, Chicago, Illinois.

2000 Honorable Mention, Scientific Exhibit, “Standardizing MR Intensity Scale: Making MR Intensities Have Tissue Specific Meaning,” L.G. Nyul and J.K. Udupa, SPIE Medical Imaging (Image Display) 2000, San Diego, California.

2000 Honorable Mention, Scientific Exhibit, “Multiprotocol MR Image Segmentation in Multiple Sclerosis: Experience With Over 1000 Studies,” J.K.

Udupa, R.I. Grossman, L.G. Nyul, Y. Ge and L. Wei, SPIE Medical Imaging (Image Processing), San Diego, California.

2000 Certificate of Merit, Educational Exhibit, “Three-Dimensional Rendering in Radiology: Some Common Misconceptions,” J.K. Udupa, 86th Scientific Assembly and Annual Meeting, Radiological Society of North America, Chicago, Illinois.

2001 Fellow, The American Institute of Medical and Biological Engineering.

2001 Honorable Mention, Scientific Exhibit, “Software Package for Separate Visualization of Arteries and Veins in CE-MRA Images,” T. Lei, J. K. Udupa, D. Odhner and P.K. Saha, SPIE Medical Imaging (Image Display), San Diego, California.

2001 Cum Laude, Education Exhibit, “A Framework for the Evaluation of Image Segmentation Algorithms,” J.K. Udupa, 87th Scientific Assembly and annual Meeting, Radiological Society of North America, Chicago, Illinois.

2002 Honorable Mention, Scientific Exhibit, “Protocol-Independent Brain MRI Segmentation Method,” L.G. Nyul and J. K. Udupa, SPIE International Symposium on Medical Imaging (Image Processing), San Diego, California.

2002 Honorable Mention, Scientific Exhibit, “Vectorial Scale-Based Fuzzy Connectedness for Segmenting Anatomical Structures in Visible Human Color Data Sets,” Y. Zhuge, J.K. Udupa and P.K. Saha, SPIE International Symposium on Medical Imaging (Image Processing), San Diego, California.

Memberships in Professional and Scientific Societies

Fellow, The American Institute of Medical and Biological Engineering
Senior Member, Institute of Electrical and Electronic Engineers
Member, Association for Computing Machinery
Member, Radiological Society of North America
Member, IEEE Engineering in Medicine and Biology Society
Member, American Association of Physicists in Medicine
Member, Society of Photo Optical Instrumentation Engineers

Editorial Positions

1988- Associate Editor, Computerized Medical Imaging and Graphics
1995- Associate Editor, IEEE Transactions on Biomedical Engineering
2001- Area Editor, Computer Vision and Image Understanding

History of Award of Grants

7/85 to 6/88 Computer Resource for Medical 3D Display and Analysis - NIH.

7/85 to 6/88 Reconstruction and Display in Tomographic Radiology - NIH.

12/87 to 11/89 Reconstruction and Display in Tomographic Radiology - NIH.

8/89 to 7/90 Computerized 3D Analysis of Midtarsal Joint Kinematics, American Association of Colleges of Podiatric Medicine.

7/91 to 6/92 Kinematics of Joints of the Foot, American Association of Colleges of Podiatric Medicine.

7/92 to 6/93 Kinematics of Joints of the Foot, American Association of Colleges of Podiatric Medicine.

4/1/91 to 10/31/93 Surfaces, Objects and Their Borders in Multidimensional Images: Theory and Algorithms, NSF.

7/1/89 to 6/30/94 UNIX-Based Software for 3D Display and Analysis - NIH.

4/92 to 6/95 Volume Rendering and Manipulation in Tomographic Radiology NIH.

9/97 to 8/00 Mammographic Lesion and Density Detection and Classification, Department of Army.

12/97 to 11/99 Object Definition in Tomographic Radiology - NIH.

4/98 to 6/99 Three-Dimensional MR Angiographic Visualization Using Fuzzy Connectedness Vessel Definition - Sponsored Research - EPIX Medicals Inc..

7/99 to 6/00 Three-Dimensional MR Angiographic Visualization Using Fuzzy Connectedness Vessel Definition - Sponsored Research - EPIX, Medicals Inc..

8/99 to 12/99 Supplement to Object Definition in Tomographic Radiology, NIH.

4/00 to 3/03 Biomechanics of Foot/Ankle Injuries using 3D Imaging - NIH.

7/00 to 6/01 Three-Dimensional MR Angiographic Visualization Using Fuzzy Connectedness Vessel Definition - Sponsored Research, EPIX Medicals, Inc..

1/02 to 12/05 Object Definition in Tomographic Radiology, NIH.

Transfer of Technology and Dissemination

The first to transfer 3D visualization technology to the medical imaging industry. Implemented an early version of the software package DISPLAY82 (developed with a major role played by me at MIPG) on an Independent Physician Display Console (IPDC) of the General Electric (GE) CT Scanners in 1979 and in 1980. This was the earliest attempt to bring to use the 3D visualization technology via medical imaging scanner manufacturers. Subsequently, played a major role in developing software packages called 3D82, 3D83 and 3D98 all designed to run on the GE IPDC. This had a major impact on the industrialization of medical 3D visualization.

In 1984 almost all scanner manufacturers and a few other independent vendors entered this field. Since then the field has seen tremendous growth. Subsequently assisted several vendors in their early development of the 3D visualization technology. Some major examples are: Technicare, Thomson CGR, Multiplanar Diagnostic Imaging, and Virtual Imaging.

Widely disseminated 3D software and techniques worldwide in the academic and research world. A major example is the development of early 3D research activity at the Mayo Clinic. Implemented an early version of DISPLAY82 at the Mayo Clinic (Biodynamics Research Unit) in 1980 and revised again in 1981. This initial effort, which triggered widespread use of 3D in Mayo for research, led to the development of ANALYZE, a package Mayo Clinic has subsequently developed and commercialized.

Designed and directed the development of a major software system, called 3DVIEWNIX, that is data-, machine-, and application-independent, for the visualization and analysis of multidimensional multimodality data. This system with about 40 person-years of work has now been installed at over 174 sites worldwide. I believe that 3DVIEWNIX will have a major impact on multidimensional data visualization and analysis.

Academic Committees at the University of Pennsylvania

1991- Member, Graduate Group, Bioengineering Department

Lectures

February 5, 1986 "Computerized surgical planning: Current capabilities and medical needs," Applications of Optical Instrumentation in Medicine XIV and PACSIV, Newport Beach, California.

April 3, 1986 "3D98: A turnkey system for the 3D display and analysis of medical objects in CT data," International Workshop on Physics and Engineering in Computerized Multidimensional Imaging and Processing, Newport Beach, California.

May 13, 1986 "Simulation of surgical procedures using computer graphics," Seventh Annual Conference and Exposition of the National Computer Graphics Association, Anaheim, California.

November 8, 1986 "Quantified three-dimensional imaging techniques for biomedical analysis of skeletal joints," IEEE Engineering in Medicine and Biology Society 8th Annual Conference, Fort Worth, Texas.

February 19, 1987 "Algorithms and software design in the 3D98 software package," Technicare Corporation, Solon, Ohio.

March 23, 1987 "3D imaging in medicine," Eighth Annual Conference and Exposition of the National Computer Graphics Association, Civic Center, Philadelphia, Pennsylvania.

March 25, 1987 "How to evaluate approaches to 3D display in medicine," Eighth Annual Conference and Exposition of the National Computer Graphics Association, Civic Center, Philadelphia, Pennsylvania.

July 4, 1987 "A unified theory of objects and their boundaries in multidimensional digital images," Computer Assisted Radiology, CAR'87, Berlin, West Germany.

July 23, 1987 "Boundary tracking in multidimensions and some discrete topological problems," SIAM Conference on Applied Geometry, Albany, New York.

September 20, 1987 "3D imaging and its medical applications," Symposium on Ultrasound Imaging, American College, Bryn Mawr, Pennsylvania, sponsored by Drexel University.

October 16, 1987 "Display in three dimensions using shaded graphics," New England Chapter Society of Nuclear Medicine, 20th Annual Meeting, Newport, Rhode Island.

December 12, 1987 "Future trends in 3D imaging: Software aspects," 3D Imaging in Medicine, University of Pennsylvania, Philadelphia, Pennsylvania.

March 21, 1988 "Computer graphics in surgical planning," 9th Annual Conference and Exposition of the National Computer Graphics Association, Anaheim Convention Center, Anaheim, California.

March 24, 1988 "3D imaging in medicine: Pitfalls and possible remedies," 9th Annual Conference and Exposition of the National Computer Graphics Association, Anaheim Convention Center, Anaheim, California.

May 9, 1988 "3D imaging in medicine: Some practical aspects," Symposium on Visualization in Scientific Computing, Princeton University, Princeton, New Jersey.

June 16, 1988 "3D imaging in medicine: Current status and future trends," The First Scientific meeting on Digital Image Management and Communication, Thomas Jefferson Medical College, Philadelphia, Pennsylvania.

October 27, 1988 "Interactive surgical planning using a high-performance workstation," First International Congress on Eidomatic of the Craniomaxillofacial District, Milano, Italy.

October 28, 1988 "Surgical planning using computers," First International Congress on Eidomatic of the Craniomaxillofacial District, Piacenza, Italy.

November 13, 1988 "3D Imaging in biomedicine: The MIPG perspective," Annual Meeting of the Society for Neurosciences, November 13-18, Toronto, Canada.

April 19. 1989 "The MIPG perspective on 3D viewing in biomedicine," 10th Annual Conference and Exposition of the National Computer Graphics Association, Philadelphia, Pennsylvania.

May 17, 1989 "Objects and boundaries in multidimensional discrete spaces," Department of Mathematics, Brigham Young University, Provo, Utah.

May 20, 1989 "Recent developments and on-going projects in 3D imaging at MIPG," Department of Computer Science, Brigham Young University, Provo, Utah.

June 21, 1989 "Display of medical objects and their interactive manipulation," Graphics Interface ’89, London Ontario, Canada.

October 4, 1989 "High-speed display and manipulation of medical objects without specialized hardware," Electronic Imaging, International Electronic Imaging Exposition and Conference, Boston, Massachusetts.

November 16, 1989 "Computer aspects of 3D imaging in medicine: A tutorial," 3D imaging in medicine, Continuing Medical Education Course (sponsored by the Hospital of the University of Pennsylvania, Department of Radiology), Coronado, California.

November 17, 1989 "Surface versus volume rendering: A comparative assessment," 3D imaging in medicine, Continuing Medical Education Course (sponsored by the Hospital of the University of Pennsylvania, Department of Radiology), Coronado, California.

January 17, 1990 "Boundaries in n-dimensional discrete spaces," American Mathematical Society Annual Meeting, Louisville, Kentucky.

January 17, 1990 "Boundaries in n-dimensional spaces: Medical applications and some open problems," American Mathematical Society Annual Meeting, Louisville, Kentucky.

April 5, 1990 "Boundaries in n-dimensional digital images: Some theoretical aspects and algorithms," Department of Mathematics, City University of New York, New York, New York.

May 22, 1990 "Visualization of biomedical data: Principles and algorithms," Visualization in Biomedical Computing, Atlanta, Georgia.

May 23, 1990 "Surface versus volume rendering: A comparative assessment," Visualization in Biomedical Computing, Atlanta, Georgia.

May 23, 1990 "Surface versus volume rendering: position statement," Visualization in Biomedical Computing, Atlanta, Georgia.

May 24, 1990 "Kinematics of the joints of the foot via three-dimensional magnetic resonance imaging," Visualization in Biomedical Computing, Atlanta, Georgia.

May 24, 1990 "A PC-based imaging system for biomedical data," Visualization in Biomedical Computing, Atlanta, Georgia.

May 25, 1990 "High-speed display and manipulation of biomedical objects without specialized hardware," Visualization in Biomedical Computing, Atlanta, Georgia.

June 15, 1990 "A comparison of volume and surface rendering methods," The 10th Conference on Computer Applications in Radiology, SCAR90, Anaheim, California.

July 17, 1990 "Surface rendering in medical 3D imaging," NIH DIRB Consensus Building Workshop on 3D Display and Analysis, Bethesda, Maryland.

July 18, 1990 "Application-, approach-, data-, and machine-independent software development for medical 3D imaging," NIH DIRB Consensus Building Workshop on 3D Display and Analysis, Bethesda, Maryland.

November 4, 1990 "Surface and volume rendering: A comparison," 12th Annual International Conference IEEE Engineering in Medicine and Biology Society, Philadelphia, Pennsylvania.

November 14, 1990 "Three-dimensional imaging and its medical applications," Image Processing Center, Drexel University, Philadelphia, Pennsylvania.

April 10, 1991 "3DVIEWNIX: A machine-, data-, and application-independent software environment for the visualization and analysis of multidimensional biomedical structures," Scanning 91, Atlantic City, New Jersey.

August 28, 1991 "Three-dimensional imaging at MIPG: Some recent developments," Department of Radiology, Emory University, Atlanta, Georgia.

August 29, 1991 "High-speed volume rendering of surfaces," Graphics, Visualization and Usability Center, College of Computing, Georgia Institute of Technology, Atlanta, Georgia.

September 18, 1991 "High-speed volume rendering and analysis of surfaces," Bioengineering Center, University of Washington, Seattle, Washington.

February 23, 1992 "High-speed volume rendering," SPIE Conference Medical Imaging VI, Newport Beach, California.

February 23, 1992 "3DVIEWNIX: A machine-, data-, and application-independent software environment for the visualization and analysis of multidimensional images," SPIE Conference Medical Imaging VI, Newport Beach, California.

February 26, 1992 "Multidimensional data format for biomedical visualization: A generalization of the ACR-NEMA standards," SPIE Conference Medical Imaging VI, Newport Beach, California.

February 27, 1992 "Volume rendering," Department of Computer Science, Brigham Young University, Provo, Utah.

February 28, 1992 "Current research directions of MIPG," Department of Computer Science, Brigham Young University, Provo, Utah.

March 10, 1992 "Multidimensional image visualization, data representation and analysis," Electronic Imaging of the Human Body. A working group sponsored by Armstrong Laboratory Human Engineering Division, CSERIAC, Wright Patterson AFB, Dayton, Ohio.

March 17, 1992 "Biomedical visualization: A tutorial, Part I," Department of Electrical and Computer Engineering, University of Sao Paulo, Brazil.

March 18, 1992 "Biomedical visualization: A tutorial, Part II," Department of Electrical and Computer Engineering, University of Sao Paulo, Brazil.

March 19, 1992 "Recent developments in multidimensional image visualization and analysis," Department of Electrical and Computer Engineering, University of Sao Paulo, Brazil.

April 1, 1992 "3DVIEWNIX: A machine independent software system for the visualization and analysis of multidimensional biomedical image data," SCANNING'92, Atlantic City, New Jersey.

October 14, 1992 "Boundary detection via dynamic programming," Visualization in Biomedical Computing, VBC'92, Chapel Hill, North Carolina.

October 16, 1992 "Joint kinematics via three-dimensional MR imaging," Visualization in Biomedical Computing, VBC'92, Chapel Hill, North Carolina.

October 30, 1992 "Frontiers of computers in biomedical visualization," 14th IEEE Engineering in Medicine and Biology Society Conference, Paris, France.

October 30, 1992 "3DVIEWNIX: A machine-independent software system for the visualization and analysis of multidimensional biomedical images," 14th IEEE Engineering in Medicine and Biology Society Conference, Paris, France.

October 30, 1992 "Kinematics of joints via three-dimensional MR imaging," 14th IEEE Engineering in Medicine and Biology Conference, Paris, France.

December 7, 1992 "Volume visualization: Some recent developments," Seminar sponsored by the Department of Electronical Engineering and Bioengineering, University of Pittsburgh, Pennsylvania.

February 14, 1993 "3DVIEWNIX: An open transportable software system for the visualization and analysis of multidimensional, multimodality, multiparametric images," Medical Imaging 1993 SPIE Conference, Newport Beach, California.

February 14, 1993 "Analysis of kinematics of joints via 3D imaging," Medical Imaging 1993 SPIE Conference, New port Beach, California.

March 2, 1993 "3DVIEWNIX: An open transportable software system for 3D imaging," NSF Planning Workshop on Computer Assisted Surgery, Washington, D.C.

June 23, 1993 "Some recent developments in multidimensional data visualization and analysis at MIPG, " Institute of Mathematics and Computer Science in Medicine, University of Hamburg, Hamburg, Germany.

June 26, 1993 "Imaging transforms for 3D biomedical imaging: An open, transportable system (3DVIEWNIX) approach," Computer Assisted Radiology, CAR'93, Berlin, Germany.

August 2, 1993 "3D imaging systems," American Association of Physicists in Medicine, Summer School, University of Virginia, Charlottesville, Virginia.

August 2, 1993 "3D visualization of images," American Association of Physicists in Medicine, Summer School, University of Virginia, Charlottesville, Virginia.

September 17, 1993 "3DVIEWNIX: A transportable, open system for 3D imaging," Visible Embryo Project Meeting, National Museum of Health and Medicine, Washington, D.C.

November 23, 1993 "Portability issues, sharing code, and images in multidimensional image analysis," A workshop sponsored by the National Library of Medicine Extramural Programs, Bethesda, Maryland.

November 28, 1993 "3DVIEWNIX: A transportable, open software system for multimodality 3D imaging," RSNA 79th Scientific Meeting and Annual Assembly, Chicago, Illinois.

December 7, 1993 "Volume visualization and analysis: Some recent developments," CAIP Center for Computer Aids for Industrial Productivity and Department of Electrical and Computer Engineering Joint Seminar, Rutgers University, Piscataway, New Jersey.

January 29, 1994 "3DVIEWNIX: A machine-independent software system for the visualization and analysis of multidimensional, multimodal images," Medicine Meets Virtual Reality II, San Diego, California.

February 13, 1994 "Shape-based interpolation of multidimensional grey-level images." SPIE Medical Imaging, 1994, Newport Beach, California.

February 13, 1994 "3DVIEWNIX: An open, transportable, multidimensional, multimodality, multiparametric imaging software system," SPIE Medical Imaging 1994, Newport Beach, California.

February 17, 1994 "Volume visualization: Some recent developments," Department of Computer Science Seminar, Brigham Young University, Provo, Utah.

February 17, 1994 "Ongoing research in volume visualization at MIPG," Department of Computer Science, Brigham Young University, Provo, Utah.

March 22, 1994 "MIPG research activities and their relevance to the goals of ICMIT," International Consortium on Medical Imaging Technology, MIT, Cambridge, Massachusetts.

July 4, 1994 "3D Imaging: A Tutorial I," IEEE Summer School on Medical Imaging, Ile Berder, France.

July 5, 1994 "3D Imaging: A Tutorial II," IEEE Summer School on Medical Imaging, Ile Berder, France.

July 21, 1994 "Recent Developments in 3D Imaging," Joszef Attila University, Szeged, Hungary.

August 15, 1994 "3D Imaging I," Pre Congress Course on Medical Image Processing, Sao Joao Del Rei, Brazil.

August 16, 1994 "3D Imaging II," Pre Congress Course on Medical Image Processing, Sao Joao Del Rei, Brazil.

August 17, 1994 "3D Imaging III," Pre Congress Course on Medical Image Processing, Sao Joao Del Rei, Brazil.

August 18, 1994 "3D Imaging IV," Pre Congress Course on Medical Image Processing, Sao Joao Del Rei, Brazil.

August 18, 1994 "3D Imaging V," Pre Congress Course on Medical Image Processing, Sao Joao Del Rei, Brazil.

August 26, 1994 "3DVIEWNIX: An open, transportable multidimensional, multimodality, multiparametric imaging software system," World Congress on Medical Physics and Biomedical Engineering, Rio De Janeiro, Brazil.

October 4, 1994 "3D imaging in biomedical computing: Principles, algorithms and systems," Visualization in Biomedical Computing VBC'94, Rochester, Minnesota.

October 5, 1994 "Fuzzy objects and their boundaries," Visualization in Biomedical Computing VBC'94, Rochester, Minnesota.

December 7, 1994 "Advances in 3D medical image processing," Plenary Lecture, 8th International Conference on Biomedical Engineering, Singapore.

February 16, 1995 "Visualizing multidimensional images," 1995 AAAS Annual Meeting, Symposium on Fundamentals of Imaging Science, Atlanta, Georgia.

February 26, 1995 "Fuzzy connectedness and object definition." SPIE Medical Imaging 1995, San Diego, California.

February 26, 1995 "Shell manipulation: interactive alteration of multiple material fuzzy structures," SPIE Medical Imaging 1995, San Diego, California.

April 6, 1995 "Visualizing 3D images," Seminar, Department of Biomedical Engineering- The Cleveland Clinic Foundation, Cleveland, Ohio.

April 7, 1995 "In vivo 3D kinematic analysis of joints via MRI," Seminar, Department of Biomedical Engineering - The Cleveland Clinic Foundation, Cleveland, Ohio.

April 28, 1995 "Detection and quantitation of MS lesions via fuzzy connectedness in MR images," A consensus building meeting held at University of British Columbia - Vancouver. Sponsored by Berlex Laboratories, Richmond, California.

August 25, 1995 "Visualization and analysis of multidimensional image information: A current perspective," Theory Institute on Large-Scale Medical Imaging, Argonne National Laboratories, Chicago.

November 6, 1995 "Computer-assisted lesion quantification in multiple sclerosis," in workshop entitled "Evaluation of Multiple Sclerosis Lesion Load: Comparison of Multiple Image Processing Techniques, Montreal Neurological Institute, Montreal, Canada.

December 5, 1995 "Fuzzy connectedness: Principles and algorithms for image segmentation," Division of Engineering, Brown University, Providence, Rhode Island.

December 5, 1995 "Detection of MS lesions via MR imagery," Department of Radiology, Brown University, Providence, Rhode Island.

February 12, 1996 "Detection and quantification of MS lesions using fuzzy topological principles." SPIE Medical Imaging 1996, Newport Beach, California.

June 10, 1996 "Clinical applications of 3D imaging," Norwegian Institute of Technology Trondheim, Norway.

June 10, 1996 "Image segmentation: The use of fuzzy topology and user steering," Norwegian Institute of Technology, Trondheim, Norway.

October 30, 1996 "Visualization and segmentation of multidimensional images," in "Intelligent Image Analysis," a workshop at the 1996 IEEE Engineering in Medicine and Biology Society Conference, Amsterdam, The Netherlands.

November 14, 1996 "Digital object definition in 3D imaging," 6th Digital Geometry for Computer Imagery Workshop, Lyon, France.

December 17, 1996 "Some recent medical applications of three-dimensional imaging," Heart Institute (INCOR), University of Sao Paulo, Brazil.

December 19, 1996 "Object definition in images," University of Campinas, Campinas, Brazil.

January 16, 1997 "Quantitation of MS lesions via MR imagery: Pitfalls," Workshop on the Role of Magnetic Resonance Techniques in Understanding and Managing Multiple Sclerosis, Oxford, UK.

February 24, 1997 "3D Imaging and its applications: Where do we stand?" SPIE Medical Imaging - Workshop, Newport Beach, California.

February 25, 1997 "Three-dimensional MR angiography using fuzzy connectedness." SPIE Medical Imaging, Newport Beach, California.

February 26, 1997 "A system for the comprehensive analysis of multiple sclerosis lesion load based on multiprotocol MR imagery," SPIE Medical Imaging, Newport Beach, California.

February 26, 1997 "Segmentation of 3D objects using live wire," SPIE Medical Imaging, Newport Beach, California.

March 26, 1997 "Practical Image Segmentation," Siemens Medical Systems, Princeton, New Jersey.

May 1, 1997 "Vessel Segmentation in MRA Using Fuzzy Connectedness," EPIX Medical, Inc., Cambridge, Massachusetts.

June 20, 1997 "A Pentium PC-Based Craniofacial 3D Imaging System," International Congress on Cranial and Facial Bone Distraction Processes, Paris, France.

October 29, 1997 "In vivo kinematic analysis of the joints of the foot via MRI," Human Motion Analysis Workshop, IEEE EMBS Conference, Chicago, Illinois.

December 1, 1997 "3D imaging in medicine: A current perspective," Category I Credit, Radiological Society of North America, 83rd Annual Meeting, Chicago, Illinois.

February 13, 1998 "Kinematic analysis of joints via MRI," Podiatric Research Society, Annual Meeting, Orlando, Florida.

February 21, 1998 "3D imaging for medical applications," a whole day tutorial, SPIE Medical Imaging, 1998, San Diego, California.

February 22, 1998 "Fuzzy connected object rendering," SPIE Medical Imaging, 1998, San Diego, California.

May 7, 1998 "3D imaging for surgery planning: An overview," First Symposium of the Indian Association of Computer-Assisted Surgery, Chennai.

May 8, 1998 "Analysis of joint kinematics for surgery planning," First Symposium of the Indian Association of Computer-Assisted Surgery, Chennai.

May 8, 1998 "3DVIEWNIX: A portable software system for surgery planning," First Symposium of the Indian Association of Computer-Assisted Surgery, Chennai.

May 8, 1998 "3D imaging systems for surgery planning," First Symposium of the Indian Association of Computer-Assisted Surgery, Chennai.

May 9, 1998 "A system for craniomaxillofacial surgery planning," First Symposium of the Indian Association of Computer-Assisted Surgery, Chennai.

October 12, 1998 "Joint motion parameters from 3D imaging data," Biomedical Engineering Society 1998 Annual Meeting, Cleveland, Ohio.

October 22, 1998 "3D imaging: Where do we stand?" Conference on Multispectral Signal Processing. Huazhang University of Science and Technology, Wuhan, China.

December 2, 1998 "A method for standardizing the MR image intensity scale," 84th Scientific Assembly and Annual Meeting of the Radiological Society of North America, Chicago, Illinois.

January 18, 1999 "3D imaging with 3DVIEWNIX," Multidimensional Imaging, Inc., Newport Beach, California.

February 23, 1999 "Fuzzy connected object definition in images with respect to co-objects," SPIE Medical Imaging, San Diego, California.

February 23, 1999 "User-assisted hard and fuzzy segmentation of imagery," SPIE Medical Imaging, Workshop on Segmentation of Medical Images, San Diego, California.

April 9, 1999 "Kinematic analysis of joints via MR imaging," Drexel University, Philadelphia, Pennsylvania.

April 16, 1999 "User-assisted hard and fuzzy image segmentation: Some recent developments and their medical applications," Distinguished lecture, Department of Bioengineering, University of Toledo, Toledo, Ohio.

May 24, 1999 "Artery vein separation in MRA contrast enhanced with MS-325," Special symposium organized by EPIX Medicals, Inc., at the ISMRM meeting in Philadelphia, Pennsylvania.

August 8, 1999 "3D Kinematic Analysis via MRI," 17th Annual Meeting of the International Society of Biomechanics, Calgary, Canada.

September 15, 1999 "3D MRA Visualization and Artery/Vein Separation Using Bloodpool Contrast Agent MS325," Contrast Media Research CMR'99, Woodstock, Vermont.

November 1, 1999 "User-Assisted Hard and Fuzzy Image Segmentation Paradigms." National Library of Medicine, SRT Consortium Meeting, Bethesda, Maryland.

December 8, 1999 "Some Discrete Problems in Practical Image Segmentation and Visualization," DIMACS Workshop on Discrete Mathematical Problems with Medical Applications, Rutgers University, New Brunswick, New Jersey.

December 9, 1999 "Some Open Discrete Mathematical Problems in Medical Applications, " DIMACS Workshop on Discrete Mathematical Problems with Medical Applications, Rutgers University, New Brunswick, New Jersey.

February 12, 2000 "3D Imaging for Medical Applications," 4-hour tutorial, SPIE Medical Imaging Conference, San Diego, California.

March 6, 2000 "Go Digital, Go Fuzzy," Korean Advanced Institute of Science and Technology, Taejon, Korea.

March 7, 2000 "Fuzzy Connected Object Definition: Theory, Algorithms and Applications," Korean Advanced Institute of Science and Technology, Taejon, Korea.

March 8, 2000 "Kinematic Analysis of Joints Via MRI," Seoul National University Hospital, Seoul, Korea.

March 21, 2000 "A Framework for the Evaluation of Image Segmentation Methods," National Library of Medicine Consortium on Segmentation and Registration Tool Kit, Columbia University, New York, New York.

April 14, 2000 "Fuzzy Connectedness Object Definition: Theory, Algorithms, Applications," Center for Image Analysis, Uppsala University, Sweden.

April 18, 2000 "MR Image Standardization: Issues, Approaches and Neuro Applications," Department of Radiology, University of Leiden, Leiden, The Netherlands.

April 19, 2000 "Fuzzy Connectedness: Principles, Algorithms and Applications in Image Segmentation," Department of Radiology, University of Leiden, Leiden, The Netherlands.

September 26, 2000 "3D Imaging in Medicine: Principles and Approaches I," A tutorial presented at MultiDimensional Imaging, Inc., Newport Beach, California.

September 27, 2000 "3D Imaging in Medicine: Principles and Approaches II," A tutorial presented at MultiDimensional Imaging, Inc., Newport Beach, California.

September 28, 2000 "3D Imaging in Medicine: Principles and Approaches III," A tutorial presented at MultiDimensional Imaging, Inc., Newport Beach, California.

December 14, 2000 “Go Digital, Go Fuzzy,” Discrete Geometry for Computer Imagery, 9th International Conference, Uppsala, Sweden.

February 2, 2001 “Go Digital, Go Fuzzy,” GRASP Laboratory, Computer and Information Science Department, University of Pennsylvania, Philadelphia, Pennsylvania.

February 19, 2001 “Multiobject Relative Fuzzy Connectedness and its Implications in Image Segmentation,” SPIE’s International Symposium Medical Imaging 2001, San Diego, California.

April 26, 2001 "Multi-Dimensional Image Processing, Visualization, and Analysis Efforts at MIPG: Technologies and Applications," Grand Rounds Seminar, Department of Neuro Surgery, University of Pennsylvania, Philadelphia, Pennsylvania.

November 8, 2001 “Fuzzy Connectedness in ITK,” NLM SRT Consortium Meeting, Bethesda, Maryland.

November 15, 2001 “Go Digital, Go Fuzzy,” Columbia University, Bioengineering Department, New York, New York.

February 25, 2002 “Axiomatic Path Strength Definition for Fuzzy Connectedness and the Case of Multiple Seeds,” SPIE International Symposium on Medical Imaging (Image Processing), San Diego, California.

February 26, 2002 “Methodology for Evaluating Image Segmentation Algorithms,” SPIE International Symposium on Medical Imaging (Image Processing), San Diego, California.

March 6, 2002 “Three-Dimensional Imaging: A Current Perspective,” SIAM Life Sciences Conference, Boston, Massachusetts.

Bibliography

Udupa, J.K., Murthy, I.S.N., A model for visual recognition of alphanumerics, International Journal of System Sciences 5(6):575-603, 1974.Journal Papers:

Murthy, I.S.N., Udupa, J.K., A search algorithm for skeletonization of thick patterns, Computer Graphics and Image Processing 3:247-259, 1974.

Udupa, J.K., Murthy, I.S.N., Some new concepts for encoding line patterns, Pattern Recognition 7:225-233, 1975.

Udupa, J.K., Murthy, I.S.N., Machine visualization of three-dimensional objects via skeletal transformations, IEEE Transactions on Systems, Man and Cybernetics SMC-7(6):424-434, 1977.

Udupa, J.K., Murthy, I.S.N., New concepts for three-dimensional shape analysis, IEEE Transactions on Computers, C-26:1043-1049, 1977.

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