

CURRICULUM VITAE

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A. Education

1990 Ph.D. (C.S.) University of Maryland, College Park, USA.

Worked as RA/Programmer with the Biostatistics department at Strong Memorial Hospital, Rochester, NY, 1984-86. Received an M.S. in Statistics from the University of Rochester during this period.

Worked as Programmer with Tata Consultancy Services, 1983-84.

1983 M.Tech. (C.S.) Indian Statistical Institute, India.

1980 B.S. (Math/Stat) Indian Statistical Institute, India.

B. Professional and Administrative Experience

- Alberta Innovates Industrial Research Chair, 2010-present
- Visiting Professor, Telecom Paris-Tech, 2015
- Visiting Professor, LIRIS, INSA-Lyon, France, 2010, 2011, 2013
- TA Director, Department of CS, Univ. of Alberta, 2011-2012
- iCORE – NSERC – Castle Rock Research Chair Professor, 2006-2010
- Professor, University of Alberta, Computing Science Department, 1999-present.
- Member of Canadian Delegation in MPEG-4 international committee for Multimedia standardization, Research advisor for Castle Rock Research and others.
- Associate Professor, University of Alberta, Computing Science Department, 1995-1999.
- Director, Hewlett-Packard Imaging Systems Lab., University of Alberta, 1997-2000.
- Guest Professor, Technical University of Austria, Graz, Institute for Computer Graphics, 1996.
- Adjunct Professor, TR Labs Edmonton, 1994-1995.
- Assistant Professor, University of Alberta, Computing Science Department, 1990-1995.

- Research Assistant, Computer Vision Laboratory, University of Maryland, 1987-1990.
- Research Assistant and Programmer, Strong Memorial Hospital (Rochester, New York), Biostatistics Division, 1985-1986.
- Assistant Systems Analyst, Tata Consultancy Services (India), 1983-1984.

C. Academic Awards

- Fellowship, Indian Statistical Institute (ISI).
- Fellowship, University of Rochester.
- Award for outstanding academic performance, ISI.
- Hewlett-Packard Award for Curriculum Development in Multimedia.
- Fellow, American Neurological Association

D. Research interests and industrial applications of research

Research Areas: Computer Vision, Image Processing, Multimedia Communications, Internet Applications, High Resolution 3D Imaging & Graphics

Pioneering and Significant Research Contributions

(i) Active Camera Calibration

Camera calibration is the first step in any inference about 3D scenes from 2D images. Despite thousands of publications in this area over the last three decades, improvements in this area have been incremental and based on knowledge about the patterns being used for calibration, and accurate detection of the calibration patterns when they are projected on an image. The accuracy of these calibration algorithms is affected significantly in case there is any error in the detection of calibration patterns. Dr. Basu pioneered an entirely different approach to camera calibration, which he called “Active Calibration” that follows the human eyes capability of supporting pan, tilt, and torsional movements. His approach does not need any calibration pattern, nor does it need to match feature points between two different images. The active method proposed by him uses averages of weighted moments over a contour; the resulting estimates are therefore extremely robust to noise. For example, the error in his method is less than 12% for Gaussian noise with standard deviation of 16 pixels. By comparison, the other best known existing methods fail to produce meaningful results even when Gaussian noise with variance exceeding 1 pixel is added to the feature points used in the calibration. Though there are many recent elegant solutions to camera calibration, such as calibrating using a line, they too often require sub-pixel accuracy in feature detection to guarantee meaningful results. Most importantly, Dr. Basu’s approach to camera calibration is the first and still the only method that is fully compatible with how the human visual system works and gives us a deeper understanding of the nuances of human vision; at the same time it is by far the most robust and noise resilient algorithm as well.

(ii) Foveated Compression

Dr. Basu initiated the applications of variable resolution (or foveation) emulating the human visual systems for image and video compression and stereo visualization in early 1990s. His first pioneering work in this area was published in the SMC conference. The Human Visual System is supported by a very high resolution fovea with rapidly declining resolution in the periphery. The fovea captures details in about a 2-degree cone extending from the center of the eyes. Thus, we can only see a few letters of text clearly at a time at reading distances. In our mind, however, we think that everything is clearly visible. This perception is a result of our eyes being dynamic or “active” and always being guided by the brain to look at precisely what is most important at a given instant. Following the foveated and dynamic characteristics of the human vision, Dr. Basu has shown how intelligent pre-processing of images can not only lead to improved videoconferencing systems but can also enhance the quality of standard compression algorithms, such as JPEG, MPEG, and Wavelets. The results are especially useful for communication at low bit-rates. He also demonstrated the advantage of “intelligent” cell loss for image or video data transmitted over congested lossy networks. His publications clearly shows that the traditional approach of treating all types of information as just a stream of bits in network switches is inadequate for congested networks. His work on foveated image compression and stereo visualization has been referenced and extended by several groups of researchers at New York University and University of Texas at Austin. Foveation and Region-Of-Interest (ROI) processing has become commonplace in compression these days; however, it is important to note that Dr. Basu pioneered this area in a publication at the SMC annual conference before many other leading researchers in this field.

In addition to being the first to use foveation for compression, Prof. Basu was the first to show that foveation optimizes 3D perception for stereo with vergence. This work is unique because researchers worked with the assumption that vergence or “directing both eyes on an object of interest” improves 3D reconstruction when working with day-to-day cameras. Dr. Basu also developed the first algorithm for determining the Optimum Aspect Ratio for Stereo Reconstruction. Recent aspect ratio design for Televisions has moved towards 4:3 or 16:9, based on industrial user studies. These ratios are actually close to the theoretical derivations in Dr. Basu’s early research. Thus, Dr. Basu’s pioneering contribution to foveated multimedia transmission and systems is having an impact on the products we all use today.

(iii) Panoramic Stereo

Dr. Basu pioneered a stereo panoramic imaging device using a single camera and a mirror surface. He conceived the idea of adding a small hemispherical mirror on top of a larger hemispherical mirror to achieve this device. Since then, many improvements have been made to this approach. A problem that he studied more recently is maintaining clarity on a region or object of interest while having a panoramic view. This was achieved by a hybrid system consisting of a panoramic camera combined with a tracking camera. Dr. Basu’s contributions to this area include high accuracy calibration of the hybrid imaging system and real-time hardware design. The research has been successfully commercialized by VisionSplend. The work was funded by several industries, including Panoramic Viewing Systems Inc. (PVSI), Telecommunications Research Labs (TRLabs), and NSERC University-Industry programs. Panoramic stereo has since become an area of significant research interest, with many variations of the concept being introduced by researchers around the world.

- Developed the first algorithm for determining the Optimum Aspect Ratio for Stereo Reconstruction (Pattern Recognition Letters, 1992).
- First to show that foveation optimizes 3D perception for stereo with vergence (ECCV workshop 1994, CVGIP 1996).
- Developed a statistical approach for “Optimal Bandwidth Monitoring” for single server connections as well as for distributed multimedia retrieval. The approach provides an estimate based on statistical confidence level and has been shown to produce expected results based on real network tests.
- Developed the first Quantitative Metric for estimating the perceptual quality of 3D objects. The work is important for 3D communication based on perceptual quality.
- First to Automatically detect White Matter Injury in Preterm born Infants, in collaboration with SickKids Hospital, Toronto; the work being applied to the prediction of development of Cerebral Palsy.

Industrially Oriented Research

- Focus of my present research is on developing Multimedia Innovative Item types for computer adaptive testing & robust 3D transmission under packet loss; a project funded by iCORE and Castle Rock Research.
- Working on Medical Imaging for 4D integrated visualization of MRI and 3D structure, and measurement of changes pre- and post-surgery; a project funded by Alberta Innovation and Science.
- Worked on the Synthetic Natural Hybrid Coding (SNHC) component of MPEG-4 coding. SNHC is part of Working Group 11 (WG11) in MPEG-4. More specifically, I worked on detection and tracking of facial features, and displaying such information in a videoconferencing scenario through model-based coding and transmission.
- Research in Multimedia Teleconferencing and Telepresence was funded by several industries, including Panoramic Viewing Systems Inc. (PVSI), Telecommunications Research Labs (TRLabs)), and NSERC University-Industry programs. I introduced several novel designs for real-time panoramic imaging which were all implemented in hardware in collaboration with PVSI. Some of this work has been published, others have been used commercially by PVSI.
- Worked on designing robots capable of working under hazardous conditions and poor visibility. The project was funded by NSERC and Northern Underwater System (NUS).
- Collaborated with Zoomage Inc. starting from the initiation of the company several years ago, to build a Super High Resolution digital imaging device that is ideal for several applications that require high quality. Cameras have been successfully built and are being used for Tunneling projects in Austria, R&D applications in Universities, Multimedia projects in Europe, and Medical Imaging in Alberta.

E. Selected list of grants

As lead applicant:

iCORE - Industry Research Chair in Multimedia: \$1,000,000, 2006-2017.

Alberta Science and Research Authority (ASRA) ERATT grant --- \$500,000, 2002-2009, in partnership with Keewetinok Lakes RHA, TelePhotogenics Inc. and IBM. Total project funds including industry contributions exceed \$2,000,000.

NSERC Research grant: \$39,900/yr., 2006-2010.

NSERC Equipment grant: \$49,000, 2000-2001.

Intellectual Infrastructure Partnerships Program (Govt. of Alberta): \$140,000, 1998.

HP Imaging Systems Curriculum grant, only one to be awarded in Canada : \$365,000, 1996.

PVSI/NSERC Collaborative Research and Development: \$155,000, 1996-1998.

TRlabs/NSERC IOR grant: \$80,000, 1995-1996.

NUS/NSERC Collaborative Research and Development grant: \$252,000, 1993-1996.

Industrial Research and Chinese Scholarships for students: over \$800,000.

Funding acquired for local industries:

I planned and prepared the following proposals, which were funded to support local industries:
National Research Council, IRAP funds for Panoramic Viewing Systems Inc. (PVSI): \$115,000.

Helped PVSI obtain funding from Department of National Defence (Suffield, Alberta) estimated at \$200,000.

CANARIE funding for PVSI: \$300,000 (estimate).

Helped TelePhotogenics Inc. obtain sales and contracts from Tunnelling Institute in Graz, York University, Simon Fraser University, Keetinok Regional Health Authority (High Prairie), NoLimits G.M.B.H., NRC & others totaling close to \$1.5 million.

Selected list of grants (as co-applicant):

NSERC Strategic grant: \$173,000/yr., 1998-2002.

CAVE Stereo Visualization Equipment grant: \$430,000, 1998.

TeleLearning Networks of Centers of Excellence grant: \$59,000/yr. 1995-1999.

TeleLearning Networks of Centers of Excellence grant: \$30,000/yr. 1999-2001.

MACI (Multimedia Advanced Computing Infrastructure): \$2 M for infrastructure and super computer facility development at University of Alberta and University of Calgary.

F. Selected list of publications

Selected refereed journal publications:

1. "Representation, Analysis and Recognition of 3D Humans," (S. Beretti, M. Daoudi, P. Turaga, and A. Basu), ACM Transactions on Multimedia, accepted, Jan 2017.
2. "Enhancement of Low Visibility Aerial Images Using Histogram Truncation and an Explicit Retinex Representation for Balancing Contrast and Color Consistency," (C. Liu, I. Cheng, Y. Zhang and A. Basu), Elsevier ISPRS Journal of Photogrammetry and Remote Sensing, pages 1-26, Accepted subject to Minor Revision, Jan. 2017.
3. "Smart Sensor-Based Motion Detection System for Hand Movement Training in Open Surgery," (X. Sun, I. Cheng, S. Bryns, B. Zheng and A. Basu), Journal of Medical Systems, pages 1-20, In press, Dec 2016.
4. "Subjective and objective visual quality assessment of textured 3D meshes," (J. Guo, V. Vidal, I. Cheng, A. Basu, A. Baskurt and G. Lavoue), ACM Transactions on Applied Perception, pages 1-19, In press, September 2016.
5. "Adaptive Resolution Optimization and Tracklet Reliability Assessment for Efficient Multi-Object Tracking," (R. Yu, I. Cheng, B. Zhu, S. Bedmutha, and A. Basu), IEEE Transactions on Circuits and Systems for Video Technology, pages 1-12, In press, Aug. 2016.
6. "A color intensity invariant low-level feature optimization framework for image quality assessment," (N. Kottayil, I. Cheng, F. Dufaux and A. Basu), Signal, Image and Video Processing, Publisher Springer, pages 1-8, published online Mar 2016.
7. "A Multi-Sensor Technique for Gesture Recognition through Intelligent Skeletal Pose Analysis," (N. Rossol, I. Cheng and A. Basu), IEEE Transactions on Human Machine Systems, July 2015 (in press).
8. "Graph Matching Based on Stochastic Perturbation," (C. Leng, W. Xu, I. Cheng and A. Basu), IEEE Transactions on Image Processing, 14 pages, August 2015 (in press).
9. "Perceptually Motivated LSPiHT for Motion Capture Data Compression," (I. Cheng, A. Firouzmanesh and A. Basu), Computer and Graphics, (also in Shape Modeling International Conference), 8 pages, June 2015.
10. "Stochastic Process for White Matter Injury Detection in Preterm Neonates," (I. Cheng, S.P. Miller, et al., and A. Basu), Neuroimage: Clinical, 622-630, Feb 2015.
11. "A fully Lagrangian Advection Scheme," (J. Bowman, M. Ali Yasseai, and A. Basu), Journal of Scientific Computing, 31 pages, Oct 2014.
12. "Super-resolution fusion of complementary panoramic images based on cross selection kernel regression interpolation," (L. Chen, A. Basu, M. Zhang, W. Wang and Y. Liu), Applied Optics, vol. 53, issue 9, 1918-1928, 2014. (Also in Virtual Journal for Biomedical Optics (VJBO), 2014, IF = 3.16.)

13. "QoE based Multi-exposure fusion in Hierarchical Multivariate Gaussian CRF," (R. Shen, I. Cheng and A. Basu), IEEE Trans. on Image Processing, 2469-2478, June 2013.
14. "A Two-Point Spatial Mapping Method for Hybrid Vision Systems," (S. Tan, A. Basu and M. Zhang), Journal of Modern Optics, in press 2014.
15. "Defocus deblurring for catadioptric omnidirectional imaging based on spatially invariant point spread function," (Y. Li, Y. Liu, W. Wang, J. Lou, A. Basu and M. Zhang), Journal of Modern Optics, 458-466, vol. 60, issue 6, appeared online April 17, 2013.
16. "Cross-Scale Coefficient Selection for Volumetric Medical Image Fusion," (R. Shen, I. Cheng and A. Basu), IEEE Trans. on Biomedical Engineering, 1069-79, vol. 60, no. 4, April 2013.
17. "Improved Robust Kernel Subspace for Object-Based Registration and Change Detection," (Z. Zhang, Z. Tian, M. Ding, and A. Basu), IEEE Geoscience and Remote Sensing Letters, 791-795, vol. 10, issue 4, July 2013.
18. "Perceptually Coded Transmission of Arbitrary 3D Objects over Burst Packet Loss Channels and a Generic JND Formulation," (I. Cheng, L. Ying and A. Basu), IEEE Journal on Selected Areas of Communication (JSAC), 1184-1192, August 2012.
19. "An Edge-Region Force Guided Active Shape Approach for Automatic Lung Field Detection in Chest Radiographs," (T. Xu, R. Long, I. Cheng, M. Mandal and A. Basu), Computerized Medical Imaging and Graphics, 452-463, vol. 36, issue 6, Sep 2012.
20. "Efficient Omni-image Unwarping using Geometric Symmetry," (Z. Xiong, I. Cheng, A. Basu, W. Wang, W. Xu and M. Zhang), Machine Vision and Applications, 725-737, July 2012.
21. "Optimal Pixel Aspect Ratio for Enhanced 3D TV Visualization," (H. Azari, I. Cheng and A. Basu), Computer Vision, Graphics and Image Processing, 38-53, Jan 2012.
22. "Perceptually Guided Fast Compression of 3D Motion Capture Data," (A. Firouzmanesh, I. Cheng and A. Basu), IEEE Transactions on Multimedia, 829-834, Aug. 2011.
23. "Depth Space Partitioning for Omni-Stereo Object Tracking," (Z. Xiong, I. Cheng, W. Wang, A. Basu and M. Zhang), IET Computer Vision, 153-163, March 2012.
24. "Choice of Low Resolution Sample Sets for Efficient Super-resolution Signal Reconstruction," (M. Singh, C. Lu, A. Basu and M.K. Mandal), Journal of Visual Communications and Image Representation, 194-207, Jan 2012.
25. "Generalized Random Walks for Fusion of Multi-Exposure Images," (R. Shen, I. Cheng, J. Shi and A. Basu), IEEE Trans. on Image Processing, 3634-3646, Dec. 2011.
26. "Efficient Video Sequences Alignment Using Unbiased Bidirectional Dynamic Time Warping," (C. Lu, M. Singh, I. Cheng, A. Basu and M.K. Mandal), Journal of Visual Communications and Image Representation, 606-614, Oct. 2011.

27. "A Real-time 3D Visualization Framework for Multimedia Data Management, Simulation, and Prediction in Geospatial-temporal Biomedical Disease Surveillance Networks," (N. Rossol, I. Cheng, J. Berozowski, I. Jamal and A. Basu), *International Journal of Multimedia Data Engineering and Management*, 18 pages, vol. 2, issue 2, 2011.
28. "A 2-point Algorithm for 3D Reconstruction of Horizontal Lines from a Single Omni-directional Image," (W. Chen, I. Cheng, Z. Xiong, A. Basu and M. Zhang), *Pattern Recognition Letters*, 524-531, Feb 2011.
29. "A hybrid knowledge-guided detection technique for screening of infectious pulmonary tuberculosis from chest radiographs," (R. Shen, I. Cheng and A. Basu), *IEEE Trans. on Biomedical Engineering*, 2646-2656, Nov. 2010.
30. "Automatic Segmentation of Spinal Cord MRI using Symmetric Boundary Tracing," (D.P. Mukherjee, I. Cheng, N. Ray, V. Mushawar, M. Lebel and A. Basu), *IEEE Trans. on Information Technology in Biomedicine*, 1275-1278, Sept. 2010.
31. "Interactive Graphics for Computer Adaptive Testing," (I. Cheng and A. Basu), *Computer Graphics Forum*, vol. 28, issue 8, 2033-2045, December 2009.
32. "Stereo 3D Mouse Cursor: A Method for Interaction with 3D Objects in a Stereoscopic Virtual 3D Space," (H. Azari, I. Cheng and A. Basu), *International Journal on Digital Multimedia Broadcasting (Special Issue on 3D TV)*, vol 2010, Article ID 4194939 pages, 11 pages, 2010.
33. "Interactive Multimedia Education: Anywhere at Anytime for Anyone," (I. Cheng, A. Basu and R. Goebel), *IEEE Multimedia Magazine*, 16-25, vol 16, issue 1, Jan-March 2009, 7 pages.
34. "Fluid Vector Flow and Applications in Brain Tumor Segmentation," (T. Wang, I. Cheng and A. Basu), *IEEE Trans. on Biomedical Engineering*, 781-789, vol 56, issue 6, March 2009.
35. "Robust and Scalable Transmission of Arbitrary 3D Models over Wireless Networks," (I. Cheng, L. Ying, K. Daniilidis and A. Basu), *EURASIP Journal on Image and Video Processing IVP/890482*, 14 pages, 2008.
36. "An Effective Multimedia Item Shell Design for Individualized Education: The CROME Project," (I. Cheng and A. Basu), *Advances in Multimedia*, Vol. 2008, Article ID 825671, 10 pages.
37. "Packet Loss Modeling for Perceptually Optimized 3D Transmission," (I. Cheng, L. Ying and A. Basu), *Advances in Multimedia*, Special Issue, Vol. 2007 (2007) Article ID 95218, 10 pages.
38. "Perceptually Optimized 3D Transmission over Wireless Network," (I. Cheng and A. Basu), *IEEE Transactions on Multimedia*, Vol. 9, No. 2, 386-396, February 2007.
39. "Event dynamics based temporal image registration," (M. Singh, A. Basu and M.K. Mandal), *IEEE Transactions on Multimedia*, 1004-1015, August 2007.
40. "Perceptually optimized 3D transmission over wireless networks," (I. Cheng and A. Basu), *IEEE Trans. on Multimedia*, 386-396, vol. 9, no. 2, Feb 2007.

41. "A note on 'A fully parallel 3D thinning algorithm and its applications'," (T. Wang and A. Basu), *Pattern Recognition Letters*, 501-506, vol. 28, 2007.
42. "Fractal-based edge extraction and its application to textured image retrieval," (M Pi, CS Tong and A Basu), *Journal of Electronic Imaging*, 013012-1 to 013012-9, Jan-Mar 2006.
43. "Human activity recognition based on silhouette directionality," (M Singh, A Basu and MK Mandal), *IEEE Transactions on Circuits and Systems for Video Technology*, 1280-1292, vol 18, issue 9, Sept 2008.
44. "Robust transmission of regions of interest in JPEG2000," (V. Sanchez, MK Mandal and A. Basu), *Journal of Electronic Imaging*, 013008-1 to 013008-6, Jan-Mar 2006.
45. "Quality metric for approximating subjective evaluation of 3D objects," (Y. Pan, I. Cheng and A. Basu), *IEEE Transactions on Multimedia*, 269-279, April 2005.
46. "Image retrieval based on histogram of fractal parameters," (M. Pi, M. Mandal and A. Basu), *IEEE Transactions on Multimedia*, 597-605, Aug. 2005.
47. "Gaussian and Laplacian of Gaussian weighting functions for robust feature based tracking," (M. Singh, M.K. Mandal and A. Basu), *Pattern Recognition Letters*, 11 pages, 2005.
48. "Prioritized region of interest coding in JPEG2000," (V. Sanchez, A. Basu and M. Mandal), *IEEE Transactions on Circuits and Systems for Video Technology*, 1149-1155, Sep. 2004.
49. "Scalable edge enhancement for digital x-ray images with automatic optimization," (L. Yin, A. Basu and J.K. Chang), *Pattern Recognition*, 1407-1422, July 2004.
50. "Robot navigation using panoramic imaging," (M. Fiala and A. Basu), *Pattern Recognition*, 2195-2215, Nov. 2004.
51. "Panoramic stereo imaging," (M. Fiala and A. Basu), *Computer Vision and Image Understanding*, 363-397, Feb. 2005.
52. "QoS based video delivery with foveation," 18 manuscript pages, (I. Cheng and A. Basu), *Pattern Recognition Letters*, 2675-2686, vol. 24, 2003.
53. "Optimal adaptive bandwidth monitoring for QoS based retrieval," (Y. Yu, I. Cheng and A. Basu), *IEEE Transactions on Multimedia*, 466-472, September 2003.
54. "Active tracking and cloning of facial expression," (L.Yin, A. Basu and M.Yourst), *Int. Journal of AI Tools*, 279-295, vol. 12, #3, 2003.
55. "Hough transform for feature detection in panoramic images," (M. Fiala and A. Basu), 12 printed pages, *Pattern Recognition Letters*, 2002, in press.
56. "Analysis of depth estimation error for cylindrical stereo imaging", (A. Basu and H. Sahabi), *Pattern Recognition*, 2549-2558, Nov. 2002.

57. "Generating realistic facial expressions with wrinkles for model based coding," (L. Yin and A. Basu), *Computer Vision and Image Understanding*, vol. 84, pages 201-240, 2001.
58. "Line segment extraction in panoramic images," (M. Fiala and A. Basu), *Journal of WSCG*, Vol. 10, Number 1, pages 179-186, 2002.
59. "Improving image and video transmission quality over ATM with foveal prioritization and priority dithering", (K. Wiebe and A. Basu), *Pattern Recognition Letters*, 905-915, 2001.
60. "Synthesizing realistic facial animations using energy minimization for model based coding", (L. Yin, A. Basu, S. Bernoegger and A. Pinz), *Pattern Recognition*, 2000.
61. "Efficient coordinated motion," (A. Basu, A. Elnagar and R. Al-Hajj), *Mathematical and Computer Modeling (Pergamon)*, 39-53, vol. 31, 2000.
62. "Active face tracking for model-based coding," (L. Yin and A. Basu), *Pattern Recognition Letters*, vol. 20, 1999, 651-657.
63. "Videoconferencing using spatially varying sensing," (A. Basu and K. Wiebe), *IEEE Transactions on Systems, Man, and Cybernetics*, March 1998, 137-148.
64. "Modeling ecologically specialized biological visual systems," (K. Wiebe and A. Basu), *Pattern Recognition*, 30 ms. pages, 1998.
65. "Active camera calibration using pan, tilt, and roll," (A. Basu and K. Ravi), *IEEE Transactions on SMC*, 24 ms. pages, 1997.
66. "Analysis of depth perception with vergence and spatially-varying sensing," (H. Sahabi and A. Basu), *Computer Vision, Graphics and Image Processing*, vol. 63, no. 3, May, pp. 447-461, 1996.
67. "Improving boundary detection using variable resolution masks," (A. Basu, M.K. Jain and X. Li), *Pattern Recognition Letters*, 1207-1211, December, 1995.
68. "Motion detection using background constraints," (A. Elnagar and A. Basu), *Pattern Recognition*, Vol. 28, No. 10, 1537-1554, 1995.
69. "Alternative models for fish-eye lenses," (A. Basu and S. Licardie), *Pattern Recognition Letters*, 433-441, April 1995.
70. "Safety optimizing strategies for local path planning in dynamic environments," (A. Basu and A. Elnagar), *International Journal of Robotics and Automation*, Vol. 10, No. 4, 130--142, 1995.
71. "Active calibration: Theory and implementation," (A. Basu), *IEEE Transactions on SMC*, 256-265, February 1995. (Earlier version in IEEE CVPR proceedings, NY, June 1992.)
72. "Motion tracking with an active camera," (D. Murray and A. Basu), *IEEE Transactions on PAMI*, 449-459, May 1994.

73. "Heuristics for local path planning," (A. Elnagar and A. Basu), *IEEE Transactions on SMC*, 624-634, March/April 1993.
74. "Optimal discretization for stereo reconstruction," (A. Basu), *Pattern Recognition Letters*, 813-820, Nov 1992.
75. "Variable resolution character thinning," (X. Li and A. Basu), *Pattern Recognition Letters*, 241-248, April 1992.
76. "A robust correspondenceless translation determining algorithm," (A. Basu and J. Aloimonos), *International Journal of Robotics Research*, October 1990, 35--59.
77. "Algorithms and Hardware for Efficient Image Smoothing," (A. Basu and C. M. Brown), *Computer Vision, Graphics and Image Processing*, vol. 40, 1987, 131-146.

Selected publications in conference proceedings and presentation abstracts:

1. "Spatio-temporal optimized multi-sensor motion fusion," (X. Sun, I. Cheng and A. Basu), IEEE International Symposium on Multimedia, 1-6, San Jose, Dec 2016.
2. "Robust Human Animation Skeleton Extraction using Compatibility and Correctness Constraints," (N. Hajari, I. Cheng and A. Basu), IEEE International Symposium on Multimedia, 1-6, San Jose, Dec 2016.
3. S. Tan et al., and A. Basu, "Crowd Visualization on Mobile Devices based on Video Analysis for Low Bandwidth Mobile Devices," Mobile Graphics at Siggraph Asia, 1-5, Dec. 2016.
4. A. Furtado, I. Cheng, E. Fung, B. Zheng and A. Basu, "Low Resolution Tool Tracking for Microsurgical Training," IEEE Engineering in Medicine and Biology Conference, Orlando, Florida, pages 1-4, August 2016.
5. N. Hajari, I. Cheng, B. Zheng and A. Basu, "Determining Team Cognition from Delay Analysis using Cross Recurrence Plots," IEEE Engineering in Medicine and Biology Conference, Orlando, Florida, pages 1-4, August 2016.
6. N.K. Kottayil, R. Bogdanova, I. Cheng, A. Basu and B. Zheng, "Investigation of Gaze Patterns in Multi View Laparoscopic Surgery," IEEE Engineering in Medicine and Biology Conference, Orlando, Florida, pages 1-4, August 2016.
7. S. Mukherjee, I.Cheng and A. Basu, "Highlighting Objects of Interest in an Image by Integrating Saliency and Depth," IEEE International Conference on Image Processing, pages 1-5, Phoenix, Arizona, Sep 2016.
8. "Robust Transmission of Motion Capture Data using Interleaved LDPC and Inverse Kinematics," (A. Furtado, I. Cheng, F. Dufaux and A. Basu), Eurographics, Short Paper, 4 pages, Lisbon, Portugal, May 2106.

9. "Foveated High Efficiency Video Coding for Low Bit Rate Transmission," (I. Cheng, M. Mohammadkhani, F. Dufaux and A. Basu), IEEE International Symposium on Multimedia, 547-552, Miami, Dec 2015.
10. "Normalized Gaussian Distance Graph Cuts for Image Segmentation," (C. Leng, W. Xu, I. Cheng, Z. Xiong and A. Basu), IEEE International Symposium on Multimedia, 523-528, Miami, Dec 2015.
11. "Ground Truth Delineation for Medical Image Segmentation based on Local Consistency and Distribution Map Analysis," (I. Cheng, X. Sun et al., and A. Basu), IEEE International Conference on Engineering in Medicine and Biology (EMBC), 4 pages, Milan, Italy, August 2015.
12. I. Cheng, A. Firouzmanesh and A. Basu, "Efficient interactive visualization of crowd scenes on mobile devices," Siggraph Asia Symposium on Mobile Graphics, 6 pages, Dec. 2014.
13. N. Rossol, I. Cheng, R. Shen and A. Basu, "Touchfree Medical Interfaces," IEEE International Conference on Engineering in Medicine and Biology (EMBC), 4 pages, Chicago, August 2014.
14. I. Cheng, R. Shen, R. Moreau, V. Brizzi, N. Rossol and A. Basu, "An Augmented Reality Framework for Optimization of Computer Assisted Navigation in Endovascular Surgery," IEEE International Conference on Engineering in Medicine and Biology (EMBC), 4 pages, Chicago, August 2014.
15. "Perceptually Motivated Real-Time Compression of Motion Data Enhanced by Incremental Encoding and Parameter Tuning," (A. Firouzmaneh, I. Cheng and A. Basu), Eurographics, Short Paper, 4 pages, Spain, May 2103.
16. "A Time Series 3D Hierarchy for Real-time Dynamic Point Cloud Interaction," (H. Azari, I. Cheng and A. Basu), SIGGRAPH Asia, Technical Brief, 5 pages, Singapore, December 2102.
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Patents:

1. "Method and apparatus for super high resolution stereo imaging," (A. Basu), Canadian Patent #2,120,240, 2002.
2. "Method and apparatus for 3D scanning of objects with voids," (A. Basu), Canadian Patent #2,369,710, approved Sept. 2006.

G. Contribution to the Training of Highly Qualified Personnel**Currently supervised**

Nasim Hajari, Sara Soltaninejad, Navneeth Kamballu, Subhayan Mukherjee, Mehdi Faraji and Nathaniel Rossol: Ph.D. students. Queenie Luc, Alvin Sun, Sweta Bethmuda: MS students.

In addition, I co-supervise several part-time undergraduate and graduate assistants.

Already completed

Hossein Azari (Ph.D.), Senior Researcher, Century Link, Bellingham, USA.

Amirhossein Firouzmanesh (Ph.D.) Researcher, Century Link, Edmonton

Rui Shen (Ph.D.), Senior Scientist, APTINA, San Jose, USA.

Lihang Ying (Ph.D.), research officer, City of Edmonton.

Tao Wang (Ph.D.), Senior Manager, SAS, North Carolina.

Meghna Singh (Ph.D.), Senior Scientist, ACCENTURE.

Mark Fiala (Ph.D.), research officer, National Research Council, Ottawa.

Jonathan Baldwin (Ph.D.), research staff at Syncrude Research, Edmonton.

Lijun Yin (Ph.D.), assistant professor, SUNY, Binghamton.

Hossein Sahabi (Ph.D.) --- currently with CYRAS Communications Inc., California.

Stefan Bernoegger --- visiting Ph.D. student from Technical University of Graz, Austria.

Kevin Wiebe (Ph.D.) working as Vice-president for a software company in Vancouver.

Ashraf Elnagar (Ph.D.). Received an NSERC post-doctoral fellowship & worked with Simon Fraser University in 1994. He is at present the Chair at University in UAE.

Antonio Furtado (MS), working with Computer Games company in Montreal

Feng Chen (MS), Systems Analyst, Century Link, Edmonton

Liang Shi (MS), Systems Analyst, Booking.com, Amsterdam

Saul Rodriguez (MS), Systems Analyst at a Computer Games company in Edmonton.

Chris Kerr, Research Assistant, Bioware.

Yixin Pan (MS) – working with a software company in Buffalo, NY.

Yinzhe Yu (MS), continuing Ph.D. at University of Minnesota, USA.

Robert Shaffer (M.S.) working in Nortel, Wireless group, Calgary.

Meghna Singh (M.S.) continued on PhD.

David Li (M.S.) working in Hong Kong.

Yongjie Liu (M.S.) working in China.

Yaohua Wu (M.S.) working in Hong Kong.

Zhibin Ann (M.S.) working in Edmonton.

Biswaroop Palit (M.S.) worked with Siemens, currently in India.

Kenneth Der (M.S.) continuing as a PhD student.

Xiaolin Qiu and Warren Wong (MS) working with companies in Toronto and Edmonton.

Kavita Ravi, (M.S.) Working in Lucent Technologies, USA.

Sydney Lee (M.S.) Working with a software company in Calgary.

Raju Patil (M.S.). Working on Ph.D. at the Robotics Institute, Carnegie Mellon University.
Sergio Licardie (M.S.). Working on GPS with a company in Mexico City.
Alan Sullivan (M.S.). Working with Govt. of Canada, Ottawa.
Don Murray (M.S.). Partner in Point Grey Research.
Manoj Jain (M.S. 1992). Working in Toronto.

Postdoctoral Supervision

Dr. Changjiang Liu, Visiting Prof. and Chinese Fellowship Holder, 2015-2016
Dr. Ruixing Yu, Visiting Prof. and Chinese Fellowship Holder, 2012-13
Dr. Shuren Tan, Visiting Prof. and Chinese Fellowship Holder, 2011-2012
Dr. Zhihui Xiong, Visiting Prof. and Chinese Fellowship Holder, 2009-2010.
Dr. Minghong Pi (post-doc.), 2000-2004.
Dr. David Southwell (post-doc. & research associate), 1994-1997. Currently, VP Hardware, YottaYotta, a Network Storage company in Edmonton/Seattle.
Dr. Qing Tan (Post-doc) 1995-1996, currently a faculty member at Athabasca University.

H. Teaching interests:

◆ Undergraduate Courses taught:

Multimedia
Image Processing
Computer Graphics
Introduction to Algorithms
Introduction to Data Structures in JAVA

◆ Graduate Courses taught:

Online 3D Multimedia
Quality-of-Service (QoS) on the Internet
Multimedia Communication
Image Processing
Computer Vision

I. External Administration and Service to Academic Community

General Chair IEEE SMC Conference 2017.
Industrial Program Chair, IEEE SMC Conference 2014.
General Chair, IEEE International Conference in Multimedia 2013.
Conference operations chair for IEEE International Conference on Multimedia, 2011.

IEEE SMC Society Technical Committee Chair on Human Factors in Multimedia. Served on many committees including PC for several IEEE Int. Conf. on Image Processing (ICIP), Computer Vision and Pattern Recognition (CVPR), ICCV, and Int. Conference on Pattern Recognition (ICPR); PC-chair at Vision Interface 1992; MPEG-4 committee member. Organized a Vision Interface conference. Served as the IEEE local computer and communication chapter chair. Associate Editor for IEEE Transactions of Human Machine Systems and Pattern Recognition Journals.