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Education

University of Delaware, Newark, DE, USA

Ph.D., Computer and Information Sciences, December 2008.

- Advisor: Dr. Chandra Kambhamettu
- *GPA - 3.96/4.0* (M.S. + Ph.D. courses)

M.S., Computer and Information Sciences, May 2004.

- Advisor: Dr. Chandra Kambhamettu
- *GPA - 3.92/4.0* (M.S. courses)

Birla Institute of Technology and Science, Pilani, Rajasthan, India

B.E.(Hons.), Computer Science, August 1999.

- *GPA - 8.54/10.0*

Book Chapters

Geiger, C. A., M. V. Thomas, and C. Kambhamettu. "SAR motion products: Tools for monitoring changes in sea ice mass balance and thickness distribution", in "Arctic Sea Ice Thickness: Past, Present and Future", 10 pages, 2007.

Journal Publications

Thomas, M., C. Kambhamettu, C. A. Geiger, "Analysis of Large Scale Discontinuous Motion of Sea Ice", ACM SIGSPATIAL Special, 1, 1, March, 2009.

Hutchings, J., C. Geiger, A. Roberts, J.Richter-Menge, M. Doble, R. Forsberg, K. Giles, C. Haas, S. Hendricks, C. Khambhamettu, S. Laxon, T. Martin, M. Pruis, M. Thomas, P. Wadhams and J. Zwally, "Exploring the role of ice dynamics in the sea ice mass balance", *Eos, Transactions, American Geophysical Union*, 2008.

Misra, S.K., J.T. Kirby, M. Brocchini, F. Veron, M. Thomas, C. Kambhamettu, "The Mean and Turbulent Flow Structure of a Weak Hydraulic Jump", *Physics of Fluids*, 20, 035106, 2008.

Thomas, M., C. A. Geiger and C. Kambhamettu. "High Resolution (400m) Motion Characterization of Sea Ice using ERS-1 SAR Imagery", *Journal of Cold Regions Science and Technology*, 52, 207-223, 2008.

Misra, S.K., M. Thomas, C. Kambhamettu, J.T. Kirby, F. Veron and M. Brocchini, "Estimation of Complex air-water Interfaces from PIV Images", *Experiments in Fluids*, 40, 764-775, May 2006.

Thomas, M., S.K. Misra, C. Kambhamettu, and J.T. Kirby, "A Robust Phase-Correlation Based Motion Estimation Algorithm for PIV", *Measurement Science and Technology*, 16(3), 865-877, 2005.

Conference Presentations

Thomas, M., C. A. Geiger, C. Kambhamettu and P. Kannan, "Streamline Regularization for Large Discontinuous Motion of Sea Ice", Proceedings of the 5^{th} IAPR Workshop on Pattern Recognition in Remote Sensing (in conjunction with ICPR), Tampa, Florida, December, 2008.

Thomas, M., C. Kambhamettu and C. A. Geiger, "Vector Field Resampling using Local Streamline Approximation", Proceedings of the 19^{th} International Conference on Pattern

Recognition (ICPR), Tampa, Florida, December, 2008.

Thomas, M., C. Kambhamettu, C. A. Geiger, "Analysis of Large Scale Discontinuous Motion of Sea Ice", Ph.D. showcase at the ACM SIGSPATIAL International Conference on Advances in Geographic Information Systems (ACM GIS), Irvine, November, 2008.

Thomas, M., C. Kambhamettu and S. Kumar, "Face Recognition using a Color Subspace LDA approach", Proceedings of the 20^{th} Int. Conf. on Tools with Artificial Intelligence (ICTAI), Dayton, Ohio, November, 2008.

Thomas, M., S. Kumar and C. Kambhamettu, "Face Recognition using a color PCA framework", Proceedings of the 6^{th} International Conference on Computer Vision Systems (ICVS), Santorini, Greece, May, 2008.

Thomas, M., C. Kambhamettu, C. A. Geiger, J. Hutchings and M. Engram, "Near-real time motion analysis for APLIS 2007: A systems modeling perspective", Proceedings of the 15^{th} ACM International Symposium on Advances in Geographic Information Systems (in cooperation with SIGMETRICS), Seattle, November, 2007.

Thomas, M., C. A. Geiger, C. Kambhamettu, J. Hutchings and M. Engram, "Near-real time estimation of sea ice deformation and its application at the APLIS Ice Camp 2007", Proceedings of the Annual Conference of the Remote Sensing and Photogrammetry Society, Newcastle-Upon-Tyne, UK, September, 2007.

Thomas, M., C. A. Geiger and C. Kambhamettu, "High Resolution Motion Estimation of sea ice using an Implicit Quad-Tree Approach", Proceedings of the ISPRS Workshop on High-Resolution Earth Imaging for Geospatial Information, Hannover, Germany, May, 2007.

Thomas, M., C. A. Geiger and C. Kambhamettu, "Vector field characterization in ERS-1 imagery of sea-ice", Proceedings of the 8^{th} Workshop on Applications of Computer Vision (WACV), Austin, February, 2007.

Thomas, M. and C. Kambhamettu, "An approximation to mean-shift via swarm intelligence", Proceedings of the 18^{th} Int. Conf. on Tools with Artificial Intelligence (ICTAI), pp583-590, Arlington, VA, November, 2006.

Thomas, M., S. K. Misra, C. Kambhamettu and J.T. Kirby, "Dynamic Open Contours Using Particle Swarm Optimization with Application to Fluid Interface Extraction", Proceedings of the Asian Conference on Computer Vision (ACCV), pp643-652, Hyderabad, January, 2006.

Thomas, M., C. A. Geiger and C. Kambhamettu, "Mesoscale Sea Ice Features Derived From Discontinuous Nonrigid Motion SAR Products", Proceedings of the 18th International Conference on Port and Ocean Engineering Under Arctic Conditions (POAC), Vol. 3, pp1011-1020, Potsdam, NY, 2006.

Thomas, M., C. Geiger and C. Kambhamettu, "Discontinuous Non-Rigid Motion Analysis of Sea Ice using C-Band Synthetic Aperture Radar Satellite Imagery", IEEE Workshop on Articulated and Nonrigid Motion (in conjunction with CVPR), Washington DC, June, 2004.

Misra, S. K., J. T. Kirby, M. Brocchini, F. Veron, M. Thomas and C. Kambhamettu, "Coherent Turbulent Structures In A Quasi-Steady Spilling Breaker", Waves 2005, Madrid, July, 2005.

Misra, S. K., J. T. Kirby, M. Brocchini, M. Thomas, F. Veron, and C. Kambhamettu, "Extra strain rates in spilling breaking waves", 29th International Conference on Coastal Engg. (ICCE), Lisbon, September, 2004.

Mani, V. T., A. Shah, and G. C. Reddy, "A Fast Block Motion Estimation Algorithm Based on Motion Adaptive Partitioning", Indian Conference on Computer Vision, Graphics and Image Processing (ICVGIP), Bangalore, December, 2000.

Demos

S. Kumar, M. Thomas and C. Kambhamettu, "Face Recognition for Patient Monitoring using a color PCA framework", Alcatel-Lucent Innovations Forum, Paris, February 21-22, 2008.

Thesis

M. Thomas, "Analysis of Large Magnitude Discontinuous Non-rigid Motion", Ph.D. Dissertation, University of Delaware, December 2008.

M. Thomas, "Global Motion Estimation Of Sea Ice Using Synthetic Aperture Radar Imagery", Master's Thesis, University of Delaware, May 2004.

Talks

"Validation of a high-resolution (400m) SAR motion tracking system using GPS buoys near the APLIS07 Ice Camp", AGU Fall Meeting, San Francisco, CA, December 2007.

"An Approach for Spot Matching in 2-D Electrophoresis Gels", 13^{th} Int. Conf. on Image Proc. (ICIP), Atlanta, GA, October, 2006

"Estimation and Characterization of sea-ice motion using ERS-1 imagery", Applied Mathematics Workshop, Dover, DE, August, 2006.

"Linear Vector Space Models and Latent Semantic Indexing", invited lecture on Statistical Techniques in Natural Language Processing, University of Delaware, May, 2006.

"Motion Analysis and Factorization", invited lecture for the graduate course on Computer Vision, University of Delaware, April, 2006.

"Fourier Theory", "Non rigid correspondence estimation" and "Factorization" - talks at the SIGVISGRAPH colloquium conducted by the CIS department.

Professional Experience

Quantum Leap Innovations, Newark, DE. **October 2008 - present**

Software scientist

- Involved in the development of planning and optimization algorithm for AI based decision support systems.
- Involved in the development of data mining tools for large scale data sets.

AT&T Bell Labs, Murray Hill, NJ. **Sept. 2007 - Dec. 2007**

Research Internship

- Developed a 3D Color tensor oriented PCA and LDA approach to improve face recognition accuracy (∼94% - PCA and ∼98% - LDA).
- Implemented a real time face recognition package that is going to be demonstrated at the Trade Exhibition in Paris.
- Performed a detailed comparative study on the accuracy and computational efficiency of different subspace techniques for face recognition.

Tata Elxsi Ltd., Bangalore, India. **June 2000 - July 2001**

Senior Software Engineer

- Technical lead for the MPEG-4 Advanced Simple profile codec team.
- Conducted workshops for the employees within the DSP group.
- Represented the company for the SEI CMM Level 5 certification interview conducted by KPMG.
- Involved in the peer review and external consultation for MPEG-4 Simple Profile Codec project.
- Developed the psycho acoustic module and sub-band coding for MPEG-4 Advanced Audio Codec (AAC) - received the "Best Project" award for performance and software quality control.
- Optimized the MPEG-4 AAC encoder to achieve real time efficiency.

Tata Elxsi Ltd., Bangalore, India. **August 1999 - June 2000**

Software Engineer

- Development team member of the MPEG-4 Core Profile video encoder and decoder for Hitachi Ltd., Japan - received the "Best Project" award for zero customer reported defects.
- Achieved performance measures of 15 fps for encoding CIF images (352X288 pels) and 45 fps for decoding CIF images using pure software optimization.
- Implemented to view and play image sequences using MFC/VC++ (*PShop*).

Sasken Comm. Ltd., Bangalore, India. **January 1999 - May 1999**

Research Internship

- Designed and developed a Vector Quantization (VQ) based video codec.
- Developed a heuristic segmentation algorithm to function as the basis of the VQ codec.
- Defined an end-to-end transport specification for the transmission and reception of VQ video.

Research Experience

Research Assistant **January, 2002 - May 2004**

University of Delaware, Newark, DE, USA

Includes current Ph.D. research, Ph.D. and Masters level course work and course projects (in reverse chronological order).

- *System design for deployment in Arctic*
  - Developed the analysis modules (using C, C++ and Python) to understand sea-ice motion in the Arctic for the SEDNA project (http://research.iarc.uaf.edu/SEDNA/).
    - The routines estimates Lagrangian motion at a resolution of 800m (currently available data products have a resolution of 5km).
    - The algorithm is computationally efficient, being able to process 200km^2 grids (4096 $\times$ 4096 pixels) in under 20 minutes on a desktop PC.
  - Developed and configured a server at VIMS Lab to localize ridge activity in the Beaufort Sea at real-time (http://vims.cis.udel.edu/∼mani/SEDNA).
  - Stationed at the ice camp for two days for a feasibility study of topography construction using stereo cameras.

- *High Resolution ERS motion estimation*
  - Developed a hierarchical motion estimation algorithm (in Matlab) for estimating global, piecewise linear and affine motion of sea-ice using for the ERS-1 imagery.
    - The algorithm formed an important remote sensing component for the SEDNA project to study Arctic sea-ice (http://aplis07.iarc.uaf.edu/)
  - VIMS lab received a $1.4 million NSF grant to apply the algorithm for real-time processing of RADARSAT imagery to localize ridge activity.

- *Particle Swarm Optimization (PSO)*
  - Developed an approximation algorithm to improve the efficiency of mean-shift technique using Swarm Intelligence.
  - Applied the PSO driven mean-shift algorithm to perform hierarchical image segmentation.
  - Adapted the PSO to track non-rigid objects with arbitrary inter frame temporal distances.

- *Bio-medical Imaging*
  - Developed algorithms for non rigid point correspondence estimation in 3D (x, y, t) and 4D (x, y, z, t) tongue contours from Ultrasound imagery.
  - Developed interfaces in MATLAB to study the tongue motion as observed in from MRI imagery of the vocal tract.
  - Worked on techniques for volume reconstruction of the tongue using contours extracted from MRI and ultrasound images of the vocal tract.

- *Clustering Algorithms*
  - Worked on clustering algorithms for disambiguating normal and ataxic speech patterns.
  - Implemented k-means and mean-shift based clustering techniques for studying speech variations.

- *Particle Image Velocimetry*
  - Adapted the motion estimation algorithm for PIV (Particle Image Velocimetry) images to study the turbulence of "Breaking Waves".
  - This algorithm is currently being adapted to study rip currents at the Center for Applied Coastal Research, University of Delaware - *Video-based bathymetric determination for rip current studies.*

- *Texture Analysis*
  - Developed algorithms to handle interface estimation in PIV imagery using texture statistics such as GLCM (Gray Level Co-occurrence Matrix) and LBP (Local Binary Pattern).
  - The algorithm was adapted to capture air-water interface in PIV images using active contours.

- *Dynamic contour analysis*
  - Implemented a dynamics open contour model in MATLAB
  - Developed a Particle Swarm Optimization technique to improve the robustness and computational complexity of the interface estimation mechanism.

- *Structure from Motion*
  - Conducted an in-depth analysis of various Factorization algorithms for structure recovery.
  - Implemented the Factorization algorithms developed by
    - Tomasi and Kanade (structure under orthographic view).
    - Poelman and Kanade (structure under para-perspective view).
    - Costeira and Kanade (structure of multiple objects under orthographic view).
    - Bregler et al. (non rigid structure under orthographic view).

- *Surface Reconstruction*
  - Analyzed the properties and characteristics of Radial Basis Functions.
  - Implemented surface reconstruction algorithm of pancake ice formation using Thin Plate Splines (RBF).

- *Particle filters*
  - Implemented a particle filter based automobile tracking system using MATLAB.
  - Developed a modified Roulette wheel updation scheme to compute the posterior probability density from observations.

- *Scene Reconstruction*
  - Implemented the Single View Metrology paper by Criminisi, et al., for scene reconstruction from a single view.
  - Implemented a VRML model to visualize the reconstructed scene (2nd Floor of Pearson Hall, University of Delaware)

Academic Experience

Teaching Assistant **Sept. 2004 - May 2006**

University of Delaware, Newark, DE, USA

Duties at various times have included grading assignments and projects, providing technical help to the students and handling classes in the absence of the professor

- CISC 320 - Introduction to Algorithms, Fall 2004, Fall 2005.
- CISC 640 - Computer Graphics, Fall 2004, Spring 2005, Fall 2005, Spring 2006.

- CISC 689 - Computer Vision, Spring 2006.
- CISC 361 - Operating Systems, Spring 2005.

Sys. Admin. Experience

Web Administrator **August 2004 - May 2007**
Video/Image Modeling and Synthesis lab, Newark, DE, USA
Involved in managing hardware and software resources at the VIMS Lab

- Configuring and maintaining the Apache webserver for VIMS lab (http://vims.cis.udel.edu).
- Configuring and managing user accounts for Windows and Linux machines.
- Trouble shooting hardware and software related problems encountered in the lab.
- Developed a web based assignment submission portal for CISC640 and CISC689 using HTML, Javascript (front end), Perl (file uploading) and mySQL (authentication).

Professional Services

- Reviewer, *IEEE Transactions on Pattern Analysis and Machine Intelligence*
- Reviewer, *Signal Processing: Image Communications*
- Reviewer, Computer Vision and Pattern Recognition (CVPR '04, CVPR '05)
- Reviewer, International Conference on Computer Vision (ICCV '05)
- Reviewer, European Conference on Computer Vision (ECCV '05)
- Reviewer, Medical Image Computing and Computer-Assisted Intervention (MICCAI '08)
- Student Member of the Institute of Electrical and Electronics Engineers (IEEE)
- Student Member of the Association for Computing Machinery (ACM)
- Student Member of the American Geophysical Union (AGU)

Computer Skillset

Languages:	C, C++, Lisp, VRML.
Scripting Languages:	Python, Javascript.
Object Oriented Design:	Rational Rose, StarUML.
Operating Systems:	Unix/Linux, Solaris, Windows.
Mathematical Packages:	Matlab 7, R, Minitab, S-plus, PV-WAVE.
Geographic Info. Systems:	ArcInfo Workstation (ArcView, ArcCatalog, ArcMap).
Computer Vision Libraries:	OpenCV, FFTW, VIGRA, C-Img, CxImage.
Graphics Libraries:	openGL/GLUT, FLTK, GUIDE.
Map Projections Libraries:	GDAL, GMT, mapx.
Version Control Tools:	Visual Source Safe, SubVersion, TortoiseSVN.
Web server/web design:	Apache, HTML.
Software tools:	LaTeX, Windows Office.

Honors and Awards

Recipient of the Frank A. Pehrson Outstanding Graduate Student Award for 2007-2008.

Recipient of the University of Delaware dissertation fellowship for 2007-2008.

Recipient of the Quantum Leap Innovations Graduate Student Excellence Award for 2006-2007.

Recipient of the University of Delaware graduate fellowship for 2006-2007.

Selected to the Dean's list at the University of Delaware for 2003-2004.

Recipient of the University of Delaware graduate travel award in 2004, 2006 and 2007.

Elected as one of the seven coordinators for cultural activities for a national level festival held at Birla Institute of Technology and Science, Pilani, India.

Secured 1^{st} rank in Pre-University Board (equivalent to High School) examination for the state of Karnataka, India, out of approximately 100,000 students.

Secured 16^{th} rank in the Secondary level Board examination for the state of Karnataka, India,

out of approximately 500,000 students.

Secured 105^{th} position in the National level Science Talent Search in 1993, out of approximately 50,000 students

Relevant Coursework

Graphics and Vision	Computer Graphics, Computer Vision, Modeling and Analysis of Deformable Bodies, Reconstruction of Deformable bodies, Application of Computer Vision.
GIS	Advanced Geographic Information Systems
Statistics	Applied Multivariate Statistics, Vector Space and Optimization.
AI and Learning	Artificial Intelligence, Speech and Natural Language Processing.
Others	Algorithm Design and Analysis, Computer Networks, Programming Languages.