Ranjith Unnikrishnan

Robotics Institute
Carnegie Mellon University
Pittsburgh, PA 15213

412-680-0295
ranjith@cmu.edu
www.cs.cmu.edu/∼ranjith

Objective

A challenging full-time position that makes the best use of my combined academic background in computer vision, mobile robotics and electrical engineering.

Research Interests

I am interested in developing computer vision algorithms that are mathematically sound and solve useful real-world problems in 2D image and 3D range processing. My thesis research focuses on challenges posed when sensor measurements are sparse, noisy and irregular, and when sensing conditions such as illumination are unknown and uncontrolled, and develops new statistical tools applicable to tasks such as shape reconstruction, object recognition and scene understanding in general.

Area keywords: Computer Vision, Pattern recognition, Statistical learning, 2D image processing, 3D range data processing, Algorithm evaluation metrics, Mobile robotics

Education

Carnegie Mellon University — Pittsburgh, PA
Ph.D in Robotics, School of Computer Science (GPA 4.0/4.0) — **2002–present**
(expected graduation in **May 2008**)
Advisor: Prof. Martial Hebert

Carnegie Mellon University — Pittsburgh, PA
M.S. in Robotics, School of Computer Science (GPA 4.0/4.0) — **2000–2002**
Thesis: Globally consistent mosaicking for autonomous visual navigation
Advisor: Prof. Alonzo Kelly

Indian Institute of Technology — Kharagpur, India
B.Tech.(Hons.) in Electronics and Elec. Commn. (GPA 9.32/10.0) — **1996–2000**
Thesis: Evaluation of a multi-camera stereo system for generating dense disparity maps

Research Experience

Robotics Institute, Carnegie Mellon University — Pittsburgh, PA
Research Assistant — **Aug ’02–present**

Environment understanding from images and 3D laser data:

- ⋄ Demonstrated automatic generation of simplified semantic maps of large urban environments for object-referenced navigation and display.
- ⋄ Developed new statistical tools for multi-scale geometric reconstruction from sparse and noisy 3D data with the goal of extending the perceptual horizon of laser scanners.
- ⋄ Implemented fast algorithms to perform online terrain classification in unstructured outdoor environments for mobile robot navigation.
- ⋄ Demonstrated new robust statistical methods for detection of multiple coherent planar structures (such as faces of buildings) in data with high clutter.
- ⋄ Also developed solutions to several ancillary problems, including new techniques for fast and accurate laser-camera calibration.

Low-level vision in 2D images:

- ⋄ Developed algorithm to extract scale-invariant keypoints from color images while being invariant to changes in scene illuminant.
- ⋄ Developed new metrics for quantitative evaluation of image segmentation algorithms.
- ⋄ Formulated extensions of traditional scale-invariant keypoint detectors to process vector-valued quantities such as optical flow and histograms.

Research Experience (contd.)

National Robotics Engineering Consortium — Pittsburgh, PA
Research Assistant — **Aug '00–July '02**

Building large image mosaics for robot localization:

- ◇ Developed a general optimization framework for building mosaics of large-scale cyclic environments at low computational cost.
- ◇ Demonstrated use of image mosaics for visual odometry to automate guided vehicles in complex factory environments.

Indian Institute of Technology — Kharagpur, India
Undergraduate Researcher — **1999–2000**

- ◇ Simulated a multi-camera vision system and studied its utility in generating dense disparity maps.

Industrial Experience

Google Inc. — Mountain View, CA
Engg. Intern (Research, OCR) — **May–July 2007, July–October 2005**

- ◇ Developed new algorithms for **text detection** in unconstrained images, and achieved performance competitive with or surpassing that of benchmarked state of the art systems in diverse image categories.
- ◇ Also helped to develop new metrics for evaluating text detection algorithms.

Texas Instruments (R&D) — Bangalore, India
Engg. Intern — **May–July 1999**

- ◇ Conceived and implemented an efficient technique for VOIP packet encryption (patent pending).
- ◇ Designed and implemented a VOIP communication framework with g.723 voice codec running on a TMS320 processor.

Publications

Journals and Magazines (refereed)

[1] "Towards Objective Evaluation of Image Segmentation Algorithms", R. Unnikrishnan, C. Pantofaru, M. Hebert, *IEEE Trans. Pattern Analysis and Machine Intelligence (PAMI)*, 29(6), June 2007

[2] "An Infrastructure-Free Automated Guided Vehicle Based on Computer Vision", A. Kelly, B. Nagy, D. Stager, R. Unnikrishnan, *IEEE Robotics and Automation Magazine*, 14(3), pp. 24–34, Sept. 2007

Conferences (refereed)

[3] "Denoising Manifolds and Non-manifolds from Point Clouds", R. Unnikrishnan, M. Hebert, *Proc. British Machine Vision Conference (BMVC)*, 2007

[4] "Vegetation Detection for Driving in Complex Environments", D. Bradley, R. Unnikrishnan, J. Bagnell, *Proc. IEEE Intl. Conf. on Robotics and Automation (ICRA)*, 2007

[5] "Extracting Scale and Illuminant Invariant Regions Through Color", R. Unnikrishnan, M. Hebert, *Proc. British Machine Vision Conference (BMVC)*, Vol. 2, pp. 499–508, 2006

[6] "Scale Selection for the Analysis of Point-Sampled Curves", R. Unnikrishnan, J.-F. Lalonde, N. Vandapel, M. Hebert, *Proc. Third Intl. Symposium on 3D Processing, Visualization and Transmission (3DPVT)*, June 2006

[7] "A Measure for Objective Evaluation of Image Segmentation Algorithms", R. Unnikrishnan, C. Pantofaru, M. Hebert, *Proc. IEEE Intl. Conf. on Computer Vision and Pattern Recognition (CVPR), Workshop on Empirical Evaluation Methods in Computer Vision*, June 2005

Publications (contd.)

[8] "Scale Selection for Classification of Point-sampled 3D Surfaces", J.-F. Lalonde, R. Unnikrishnan, N. Vandapel, M. Hebert, *Proc. IEEE Intl. Conf. on 3D Digital Imaging and Modeling (3DIM)*, June 2005

[9] "Measures of Similarity", R. Unnikrishnan, M. Hebert, *Seventh IEEE Workshop on Applications of Computer Vision (WACV)*, pp. 394-400, January, 2005

[10] "Robust Extraction of Multiple Structures from Non-Uniformly Sampled Data", R. Unnikrishnan, M. Hebert, *Proc. IEEE/RSJ Intl. Conf. on Intelligent Robots and Systems (IROS)*, Vol. 2, pp. 1322–1329, 2003

[11] "Toward Generating Labeled Maps from Color and Range Data for Robot Navigation", C. Pantofaru, R. Unnikrishnan, M. Hebert, *Proc. IEEE/RSJ Intl. Conf. on Intelligent Robots and Systems (IROS)*, Vol. 2, pp. 1314–1321, 2003

[12] "Efficient Construction of Globally Consistent Ladar Maps using Pose Network Topology and Nonlin A. Kelly, R. Unnikrishnan, *Proc. 11th Intl. Symposium of Robotics Research (ISRR)*, 2003

[13] "A Constrained Optimization Approach to Globally Consistent Mapping", R. Unnikrishnan, A. Kelly, *Proc. IEEE/RSJ Intl. Conf. on Intelligent Robots and Systems (IROS)*, Vol. 1, pp. 564–569, Oct 2002

[14] "Mosaicking Large Cyclic Environments for Visual Navigation in Autonomous Vehicles", R. Unnikrishnan, A. Kelly, *Proc. IEEE Intl. Conf. on Robotics and Automation (ICRA)*, Vol. 4, pp. 4299–4306, May 2002

Theses & Technical reports

[15] "Fast Extrinsic Calibration of a Laser Rangefinder to a Camera", R. Unnikrishnan, M. Hebert, *Tech. report CMU-RI-TR-05-09, Robotics Institute, Carnegie Mellon University*, July 2005. Associated with the public domain *Laser-Camera Calibration Toolbox (LCCT)*

[16] "Globally Consistent Mosaicking for Autonomous Visual Navigation", R. Unnikrishnan, *Master's thesis, Tech. report CMU-RI-TR-02-22, Robotics Institute, Carnegie Mellon University*, Sept. 2002

Open-Source Contributions

The **Laser-Camera Calibration Toolbox (LCCT)**: A tool for robust and portable external calibration of a camera to a laser rangefinder, with an easy-to-use Matlab©-based graphical interface.

Technical Skills

Programming Languages: C/C++, Matlab, Visual Basic
Operating Systems: Linux/Unix, Windows
Applications: OpenGL, GLUT, Mathematica, Visual Studio, Unix networking

Selected Courses

Computer Vision, Advanced Perception, Artificial Intelligence, Non-parametric methods, Machine Learning, Graphical Models, Optimization Methods, Probability and Math. Statistics (I & II), Comp. Perception and Scene Analysis, Sensor-based Robotic Motion Planning, Kinematics and Controls

Professional Services

Reviewer for IEEE Trans. on Pattern Analysis and Machine Intelligence (PAMI), Journal of Computer Vision and Image Understanding (CVIU), IEEE Transactions on Robotics (ITRO), IEEE Intl. Conf. on Computer Vision and Pattern Recognition (CVPR), Intl. Conf. on Machine Learning (ICML), Intl. Symposium on 3D Processing, Visualization and Transmission (3DPVT), IEEE Intl. Conf. on Robotics and Automation (ICRA), IEEE/RSJ Intl. Conf. on Intelligent Robots and Systems (IROS)

Awards & Scholarships

- ◇ Graduate Fellowship from the School of Computer Science, Carnegie Mellon, since August 2000.
- ◇ Placed among top 3% of candidates in the 1996 Senior Mathematics Olympiad organized by the Central Board of Secondary Education (CBSE), India.
- ◇ Air-India Scholastic Award and the Chairman Award in 1994, for placing 1$^{\text{st}}$ among candidates from five Gulf countries in the Secondary School AISSE examination.

References

Available upon request