# Ajit Rajwade

Computer and Information Science and Engineering Department
CSE Building, Room E301,
P.O. Box 116120,
Gainesville, FL 32611-6120, USA.
+1 (352) 328-1995
avr@cise.ufl.edu
ajit_v_r@yahoo.co.uk
http://www.cise.ufl.edu/~avr

## Education

- **University of Florida**, Gainesville, Florida, USA.
  Ph.D. in Computer Science, Jan. 2005 to Oct. 2010, GPA: 3.87
  *Advisors:* Anand Rangarajan, Arunava Banerjee.
  *Thesis title:* Probabilistic Approaches to Image Registration and Denoising.
- **McGill University**, Montreal, Quebec, Canada.
  M.Sc. in Computer Science, Aug. 2002 to Dec. 2004, GPA: 3.72
  *Master's thesis title:* Facial Pose Estimation and Face Recognition from 3D Data.
- **Government College of Engineering, Pune (University of Pune)**, India.
  B.E., Aug. 2001, Computer Engineering (*First class with distinction in every semester*).

## Areas of Research Interest

- **Image/video restoration:** currently working on denoising, interested in removal of compression artifacts, deblurring, dejittering, removal of fog or haze, contrast enhancement, relighting, inpainting, dither.
- **Image and video compression** using machine learning and sparse representations, inpainting-based methods.
- **Probability density estimation.**
- **Biometrics**, especially face recognition.
- **Problems in computational geometry** (area and perimeter based skulls and hulls).
- **CAPTCHAs** and Automated Turing Tests.

## Awards/ Honors

- **Best Scientific Paper Award** at the International Conference on Pattern Recognition (ICPR), 2008, Tampa, Florida.
- **Selection with full funding at Summer School on Image Processing** at the Park City Math Institute/Institute for Advanced Study (IAS), Park City, Utah in June/July 2010, [declined].
- **Travel Grants** from the Department of CISE at the University of Florida to present papers at the *Workshop on Energy Minimization Methods in Computer Vision and Pattern Recognition (EMMCVPR)*, Bonn, Germany (Summer 2009), and from the Department of CISE and the Student Government at the University of Florida to present my paper at the *IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*, New York (Summer 2006).
- **Tuition Fee Waiver** for Summer 2003, McGill University (awarded to two international students out of 100 in the year 2003-2004, in recognition of academic excellence).
- **Rank 8 in Computer Engineering** at the University of Pune (out of 800 students) in the year 1999-2000.

RESEARCH/ PUBLICATIONS

◇ **Image Filtering**

Project description: This project includes

1. two novel techniques to learn spatially adaptive transform bases for image filtering, building upon the singular value decomposition of the image patch (the methods produce close to state of the art results, are simple to implement and have parameters tuned in a principled way).
2. a new hypothesis-testing based criterion for automatically selecting the optimal parameters of a filter to denoise images corrupted by i.i.d. noise,
3. a technique for filtering driven by low-frequency interpolation (and resulting isocontours) between the pixels of a noisy image,

· Journal papers in preparation.

· Ajit Rajwade, Anand Rangarajan and Arunava Banerjee, *Automated Filter Parameter Selection using Measures of Noiseness*, Canadian Robot Vision Conference, June 2010, Ottawa (Canada).

· Ajit Rajwade, Arunava Banerjee and Anand Rangarajan, *Image Filtering Driven by Level Curves*, International Conference on Energy Minimization Methods in Computer Vision and Pattern Recognition (EMMCVPR), Aug 2009, Bonn (Germany). [Oral Presentation]

◇ **Image Compression**

Project description: A technique for compression of images (or image databases) by learning a group of orthonormal matrix pairs to compactly represent small-sized patches. The learning technique exploits patch-level redundancy within and across images.

· Karthik Gurumoorthy, Ajit Rajwade, Arunava Banerjee and Anand Rangarajan, *A Method for Compact Image Representation using Sparse Matrix and Tensor Projections onto Exemplar Orthonormal Bases*, IEEE Transactions on Image Processing (TIP), Volume 10, Issue 2, Feb. 2010, pp. 322-344.

· Karthik Gurumoorthy, Ajit Rajwade, Arunava Banerjee and Anand Rangarajan, *Beyond SVD: Sparse Projections Onto Exemplar Orthonormal Bases for Compact Image Representation*, International Conference on Pattern Recognition (ICPR), Dec 2008, Tampa (USA). **Best Scientific Paper Award**.

◇ **Probability Density Estimation for Image/Signal Processing**

Project description: This is a new technique for estimating the probability density of the values of a signal (image), driven by the choice of an interpolant to approximate a digital signal as a continuous function. This results in beautiful relationships between geometric entities such as the gradients or level curves of an image and the probability density function of the intensity values. Extensions to gradient-biased density estimation and joint density estimation for multiple images are also presented. The method is not based on external kernels as in classical kernel density estimation.

· Ajit Rajwade, Arunava Banerjee and Anand Rangarajan, *Probability Density Estimation using Isocontours and Isosurfaces: Applications to Information Theoretic Image Registration*, IEEE Transactions on Pattern Analysis and Machine Intelligence (PAMI), Volume 31, Issue 3, March 2009, pp. 475-491. (This work has been cited by various research groups in computer vision, visualization and medical imaging, and in two recent books: 'Information Theory in Computer Vision and Pattern Recognition' by F. Escolano, S. Pablo and B. Bonev, (September 2009) and 'Image Fusion Theories, Techniques and Applications' by H. Mitchell (March 2010), both published by *Springer Verlag*)

· Ajit Rajwade, Arunava Banerjee and Anand Rangarajan, *A New Method of Probability Density Estimation with Application to Mutual Information Based Image Registration*,

IEEE Conference on Computer Vision and Pattern Recognition (CVPR), June 2006, New York (USA) [Oral presentation, acceptance rate 6 %].

- Ajit Rajwade, Arunava Banerjee and Anand Rangarajan, *Continuous Image Representations solve the Histogram Binning Problem in Mutual Information Based Image Registration*, International Symposium on Biomedical Imaging (ISBI), April 2006, Arlington, VA (USA).

◇ **Partially Observable Markov Decision Processes**

- Masoumeh Tabaeh Izadi, Ajit Rajwade and Doina Precup, *Using core beliefs for point-based value iteration*, International Joint Conference on Artificial Intelligence (IJCAI), August 2005, Edinburgh (UK).

◇ **Face Recognition**

- Ajit Rajwade and Martin Levine, *Facial Pose from 3D Data*, Image and Vision Computing, Volume 24, Issue 1, August 2006, pp. 849-856.

## Research Work and Employment History

◇ **Research assistant at the University of Florida** Work on probability density estimation of image intensity values (applied to information theoretic image registration), image compression and image denoising (January 2005 to present).

◇ **Intern at GE Research, Bangalore, India** in the Imaging Technologies Group. Worked on level-set based registration of MR volumes (Summer 2007).

◇ **Research assistant at McGill University** Department of Computer Science, working on Partially Observable Markov Decision Processes (POMDPs) (Fall 2005).

◇ **Research assistant at McGill University** Department of Agriculture, applied machine learning techniques to determining nitrogen content from hyperspectral features of soil (Fall 2005).

◇ **Thesis on 3D face recognition at McGill University** (Summer 2003 to Fall 2004).

◇ **Associate Software Engineer** at Veritas Software India Ltd., now part of Symantec Corp. (August 2001 to August 2002).

## Teaching Experience

◇ **Served as course instructor for:**

- a course on **Applications of Discrete Structures** at the University of Florida (Dept. of CISE), for a class of 110 undergraduate students.
- a course on Calculus instructor for a class of 20 students, as part of the University of Florida STEPUP program for smooth transitioning of minority high school students into university life.

◇ **Served as teaching assistant for:**

- **Analysis of Algorithms** (Graduate Course), UF, Spring 2010.
- **Data Mining** (Graduate Course), UF, Spring 2009.
- **Applications of Discrete Structures**, held discussion sessions for undergraduate students for totally 5 semesters.
- Courses at McGill University: Programming Languages, Theory of Computer Science, Introduction to Java Programming, and Data Structures and Algorithms, Fall 2002 to Summer 2004.

◇ **Served as Guest Speaker for:**

- Lectures on information theory and constrained optimization to a class of graduate students for the course **Mathematical Methods for Intelligent Systems**, Fall 2006.

- Lectures for the course **Advanced Machine Learning** on probability density estimation and its application in medical imaging, Fall 2008.
- Lectures for the courses on **Applications of Discrete Structures** and **Numerical Analysis** on the topics of recursion and recursive function definition, and root-finding techniques respectively, Fall 2008.

TALKS

- **At CVPR 2006, New York** 'A New Method of Probability Density Estimation with Application to Mutual Information Based Image Registration'.
- **At UF Landmines Seminar, October 2008** 'Probability Density Estimation using Isocontours and Isosurfaces: Applications to Information Theoretic Image Registration'.
- **At EMMCVPR 2009, Bonn, Germany** 'Image Filtering Driven by Level Curves'.

PROFESSIONAL SERVICE

- **Reviewer for following journals:**
  - IEEE Transactions on Pattern Analysis and Machine Intelligence for the years 2005, 2006, 2007 and 2010.
  - IEEE Transactions on Medical Imaging, 2008 and 2009.
  - Machine Vision and Applications, 2006, 2009.
  - Computer Vision and Image Understanding, 2007, 2008 and 2010.
- **Reviewer for following conferences:**
  - CVPR, 2009.
  - MICCAI, 2008.
  - EMMCVPR 2005.
- **Seminar Coordinator** for CVGMI (Computer Vision, Graphics and Medical Imaging) research group at the CISE department, University of Florida, Fall 2005 to Fall 2006, and Fall 2008.
- **Student Volunteer** for EMMCVPR 2005.
- **Student Member** of IEEE since 2005.

RELEVANT COURSEWORK

- **At University of Florida** Computer Vision, Machine Learning, Medical Image Analysis, Advanced Topics in Computer Vision, Advanced Topics in Machine Learning, Computer Graphics, Linear Algebra, Numerical Optimization, Combinatorics, Computational Geometry, Analysis of Algorithms, Algebraic Geometry, Formal Languages.
- **At McGill University** Computational Perception, Shape Analysis, Image Processing, Statistical Computer Vision, Robotics, Reinforcement Learning, Artificial Intelligence, Computational Geometry.
- **At University of Pune, India** Digital Signal Processing.

SKILLS

- **Languages** C (expert), C++ (advanced), MATLAB (expert), Java (basic).
- **Operating Systems** Linux, Windows.
- **Packages** GNU Scientific Library (GSL), Visualization Toolkit (VTK) and Insight Toolkit (ITK).

HOBBIES

- **President of the UF chapter of SPICMACAY** (Society for Promotion of Indian Classical Music and Culture Amongst Youth), Summer 2009 to Summer 2010.
- **Writing English poetry**
- **Learning languages** (German, French) besides English, Hindi and Marathi.

- **Playing keyboard** (elementary)
- **Yoga**
- **Ardent listener of all forms of Indian music**
- **Member of magazine committee** at the Government College of Engineering in the year 1998-1999.

REFERENCES ◇ **Available upon request**