

# **Ritwik Kailash Kumar**

Alumni Fellow & PhD Student  
Department of Computer and Information Science and Engineering  
University of Florida  
Gainesville, FL – 32611-6120  
rkkumar@cise.ufl.edu  
www.cise.ufl.edu/~rkkumar

## **RESEARCH INTERESTS**

I am interested in mathematical analysis and solution design of problems in the field of Computer Vision and Machine Learning. In particular, I am interested in exploring the aspects of Face recognition - detection, Video Compression and Medical Image Analysis.

## **EDUCATION**

- 2005 – Present Doctor of Philosophy in Computer Engineering  
Department of Computer and Information Science and Engineering  
University of Florida, Gainesville, FL, USA
- 2001 – 2005 Bachelor of Technology in Information and Communication Technology  
Dhirubhai Ambani Institute of Information and Communication Technology, India  
GPA: 3.97 / 4.00

## **HONORS**

- 2005 President's Gold Medal, DA-IICT  
2005-2009 Alumni Fellowship for PhD, UFL  
2005 IEEE Student Travel Grant  
2004 Best Student Paper Award, ADCOM 2004  
2001 CIDCO Merit Award  
1999 Qualified for CBSE National Level Athletics Meet

## **PROFESSIONAL SERVICE - Reviewer**

- IEEE International Conference on Computer Vision (**ICCV**) 2007
- IEEE Conference on Computer Vision and Pattern Recognition (**CVPR**) 2008
- Journal: Computer Vision and Image Understanding (**CVIU**)

## PUBLICATIONS

### *Journal*

- [2007] **Ritwik K. Kumar** & Suman K. Mitra, “Motion Estimation based Color Transfer and its Application to Color Video Compression”, *Pattern Analysis and Applications*, 2007.

*Abstract.* In this paper a novel scheme for color video compression using color transfer technique is proposed. Towards this, a new color transfer mechanism for video using motion estimation is presented. Encoder and decoder architectures for the proposed compression scheme are also presented. In this scheme, compression is achieved by firstly discarding chrominance information for all but selected reference frames and then using motion prediction and DCT based quantization. At decompression stage, the luminance-only frames are colored using chrominance information from the reference frames applying the proposed color transfer technique. To integrate color transfer mechanism with hybrid compression scheme a new color transfer protocol is defined. Both compression scheme and color transfer work in YCbCr color space.

### *Conference*

- [2008] **Ritwik Kumar**, Angelos Barmpoutis, Baba C. Vemuri, Paul R. Carney, Thomas H. Mareci “Multi-Fiber Reconstruction from DW-MRI using a Continuous Mixture of von Mises-Fisher Distributions”, *IEEE Computer Society Workshop on Mathematical Methods in Biomedical Image Analysis (MMBIA) 2008*.

*Abstract.* In this paper we propose a method for reconstructing the Diffusion Weighted Magnetic Resonance (DW-MR) signal at each lattice point using a novel continuous mixture of von Mises-Fisher distribution functions. Unlike most existing methods, neither does this model assume a fixed functional form for the MR signal attenuation (e.g. 2nd or 4th order tensor) nor does it arbitrarily fix important mixture parameters like the number of components. We show that this continuous mixture has a closed form expression and leads to a linear system which can be easily solved. Through extensive experimentation with synthetic data we show that this technique outperforms various other state-of-the-art techniques in resolving fiber crossings. Finally, we demonstrate the effectiveness of this method using real DW-MRI data from rat brain and optic chiasm.

- [2008] Angelos Barmpoutis, **Ritwik Kumar**, Baba C. Vemuri & Arunava Banerjee “Beyond the Lambertian Assumption: A generative model for Apparent BRDF fields of Faces using Anti-Symmetric Tensor Splines”, *IEEE Conference on Computer Vision and Pattern Recognition (CVPR) 2008*.

*Abstract.* Human faces are neither exactly Lambertian nor entirely convex and hence most models in literature which make Lambertian assumption, fall short when dealing with specularities and cast shadows. In this paper, we present a novel anti-symmetric tensor spline (a spline for tensor valued functions) based method for the estimation of the Apparent BRDF (ABRDF) field for human faces that seamlessly accounts for specularities and cast shadows. Furthermore, unlike other methods, it does not require any 3D information to build the model and can work with as few as 9 images. We also present a novel approximation of the true spherical function (representing the ABRDF) using a continuous mixture of exponential distributions – evaluated in closed form – in order to validate the accuracy and efficiency of our anti-symmetric tensor spline model. We demonstrate the effectiveness of our anti-symmetric tensor spline model in comparison to other popular models in literature, by presenting extensive results for face relighting and face recognition using the extended Yale B and CMU PIE databases.

- [2005] **Ritwik K. Kumar** & Suman K. Mitra, “Color Transfer using Motion Estimation and its Application to Video Compression”, Proc. of 11th International Conference on Computer Analysis of Images and Patterns (CAIP) 2005

*Abstract.* In this paper a novel scheme for colored video compression using color transfer techniques is proposed. Color transfer for video sequences is made more accurate by incorporation of motion information in the transfer mechanism. Encoder and decoder architectures for the proposed compression scheme are also presented. Compression is achieved by firstly discarding chrominance information for all but selected reference frames and then using motion prediction and DCT based quantization techniques. While decoding, luminance-only frames are colored using chrominance information from the reference frames using the proposed color transfer technique. Furthermore, this strategy is such that it can be seamlessly integrated with traditional hybrid compression schemes like MPEG1 and H.263.

- [2004] **Ritwik Kumar**, Dinkar Jha & Shivam Priyadarshi, “Coarse Grain Positioning System for Indoors using Sensor Network”, Proc. of 12th International Conference on Advanced Computing & Communication (ADCOM) 2004.

*Abstract.* This paper examines the classical problem of positioning in general and problem of coarse-grain positioning for indoors in particular. Here ‘coarse-grain’ means position of the sought object is to be determined at a coarse tolerance e.g. at room level, ‘positioning system’ refers to any system which can locate an object e.g. GPS provides latitude and longitude of the receiver and by ‘indoors’ it is meant that with this paper we are only concerned with positioning the object in a domain with walls and roof. This paper looks at various possible solutions to this problem and then proposes a novel solution based on ‘sensor network’, which was found to be most acceptable under the identified constraints for such a system.

## TALKS

- Apr 2006 “Matching 3-D Anatomical Surfaces with Non-Rigid Deformations using Octree-Splines”, Vision Learning Seminar, Center for Vision, Graphics and Medical Imaging (CVGMI), Dept. of CISE, University of Florida.
- May 2005 “On Color Transfer using Motion Estimation and its Application to Color Video Compression”, Undergraduate Thesis Defense, Dhirubhai Ambani Institute of Information and Communication Technology.
- Feb 2005 “Video Compression”, B.Tech. Project Mid-Semester Evaluation, Dhirubhai Ambani Institute of Information and Communication Technology.
- Dec 2004 “Coarse Grain Positioning System for Indoors using Sensor Network”, 12th International Conference on Advanced Computing & Communication (ADCOM) 2004
- Sep 2004 “Speech based application using VoiceXML”, *Aryans* – The Hackers’ Club, Dhirubhai Ambani Institute of Information and Communication Technology.

## EXPERIENCE

- May – Aug '08 Intern, IBM Research Center, Almaden, CA, USA.
- Jan – Apr '08 Teaching Assistant, COP 5555, 'Principles of Programming Languages' course, responsible to assist the course instructor in a non-teaching capacity, Dept. of Computer and Information Sciences and Engineering, University of Florida.
- May – Dec '07 Teaching Assistant, CGS 3460, 'Programming using C' course, responsible to assist the course instructor in a non-teaching capacity, Dept. of Computer and Information Sciences and Engineering, University of Florida.
- Jan – Apr '07 Graduate Assistant, Dept. of Computer and Information Sciences and Engineering, University of Florida.
- Aug – Dec '06 Teaching Assistant, CGS 3460, 'Programming using C' course, responsible to assist the course instructor in a non-teaching capacity, Dept. of Computer and Information Sciences and Engineering, University of Florida.
- Jun – Jul '06 Research Assistant, worked on development of a automated system for epilepsy diagnosis using Hippocampus MRI images, Dept. of Computer and Information Sciences and Engineering, University of Florida.
- Jan – Apr '06 Teaching Assistant, COP 3013, 'C for System Programming' course, responsible to assist the course instructor in a non-teaching capacity, Dept. of Computer and Information Sciences and Engineering, University of Florida.
- Aug – Dec '05 Teaching Assistant, CIS 4930, 'C for System Programming' course, responsible to assist the course instructor in a non-teaching capacity, Dept. of Computer and Information Sciences and Engineering, University of Florida.
- Jan – Apr '05 Research Assistant, worked on IBM sponsored project for designing PowerPC based embedded systems for learning purpose, Dhirubhai Ambani Institute of Information and Communication Technology.
- Aug – Nov '04 Teaching Assistant, 'User Centered Design' course, Responsible for carrying out laboratory sessions for the course, Dhirubhai Ambani Institute of Information and Communication Technology.
- May – Jul '04 Research Intern, worked on Simulation and Optimization of Open Networks of Finite Capacity Queues, Dhirubhai Ambani Institute of Information and Communication Technology.
- May – Jul '03 Industrial Intern, worked on Synchronous Digital Hierarchy based Networks' Management, Design and Maintenance, DAKC (headquarters), Reliance Infocomm.

## **COURSES**

### **Vision & Intelligent Systems**

1. Computer Vision
2. Neural Networks for Computing
3. Medical Image Analysis
4. Pattern Recognition
5. Advanced Topics in Computer Vision

### **Mathematics & Statistics**

1. Modern Analysis – I (Mathematical Analysis)
2. Numerical Linear Algebra
3. Numerical Optimization
4. Probability Theory – I (Mathematical Probability Theory)

### **Computer Science**

1. Computer Architecture Principles
2. Operating Systems Principles
3. Programming Language Principles
4. Formal Languages and Computation Theory