



**UNIVERSITY OF CENTRAL FLORIDA**  
**CENTER FOR RESEARCH IN COMPUTER VISION**

**FINAL ORAL EXAMINATION**

*OF*

**BERKAN SOLMAZ**  
B.S., ORTA DOGU TEKNIK UNIVERSITESI, 2005  
M.S., ORTA DOGU TEKNIK UNIVERSITESI, 2008

*FOR THE DEGREE OF*

**DOCTOR OF PHILOSOPHY**  
(ELECTRICAL ENGINEERING)

Tuesday, July 02, 2013, 11:00 A.M.  
101 Harris Corporation Engineering Center

DISSERTATION COMMITTEE

Professor Mubarak Shah, *Chairman*  
Professor Niels da Vitoria Lobo  
Professor Sumit K. Jha  
Professor Brian E. Moore  
Professor Marcel Ilie

# OUTLINE OF GRADUATE STUDIES

*Major:* Electrical Engineering

Computer Vision

Tappen

Advanced Computer Vision

Shah

Pattern Recognition

Georgiopoulos

## SELECTED PUBLICATIONS

“Identifying Behaviors in Crowded Scenes Using Stability Analysis for Dynamical Systems”, Berkan Solmaz, Brian E. Moore, and Mubarak Shah, IEEE Transactions on Pattern Analysis and Machine Intelligence (PAMI), 2012.

“Classifying Web Videos using a Global Video Descriptor (GIST3D)”, Berkan Solmaz, Shayan Modiri Assari, and Mubarak Shah, Machine Vision and Applications Journal (MVA), 2012.

“Shadow Casting Out Of Plane Candidates for Human and Vehicle Detection in Aerial Imagery”, Vladimir Reilly, Berkan Solmaz, and Mubarak Shah, International Journal of Computer Vision (IJCV), 2012.

“Confidence Guided Enhancing Brain Tumor Segmentation in Multiparametric MRI”, Kishore Reddy, Berkan Solmaz, Pingkun Yan, Nicholas Avgeropoulos, David Rippe, and Mubarak Shah, International Symposium on Biomedical Imaging (ISBI), 2012.

“ADHD Classification Using Bag of Words Approach on Network Features”, Berkan Solmaz, Soumyabrata Dey, A. Ravishankar Rao (IBM T.J. Watson Research Center), and Mubarak Shah, SPIE Medical Imaging, 2012.

“Geometric Constraints for Human Detection in Aerial Imagery”, Vladimir Reilly, Berkan Solmaz, and Mubarak Shah, European Conference on Computer Vision (ECCV), 2010.

“Method and Apparatus for Modeling and Processing fMRI Image Data Using a Bag-of-Words Approach”, U. S. Patent #13/757,102 (Pending).

# DISSERTATION

## HOLISTIC REPRESENTATIONS FOR ACTIVITIES AND CROWD BEHAVIORS

Analyzing the activities of people is an important problem commonly encountered in Computer Vision. Different types of activities can be performed by either an individual at the fine level or by several people constituting a crowd at the coarse level. The overarching goal in this dissertation is to devise new representations for the activities, in settings where individuals or a number of people may take part in specific activities. The holistic description of videos is appealing for visual detection and classification tasks for several reasons including capturing the spatial relations between the scene components, simplicity, and performance benefits. We first present a holistic frequency spectrum based descriptor for the videos, which is computed by applying a bank of 3-D spatio-temporal band-pass filters on the frequency spectrum of a video sequence; hence it integrates the information about the motion and scene structure. Such representations blindly incorporate all the video regions in descriptor computation regardless of their contribution in classification. Next, we present an approach to improve the performance of holistic descriptors by discovering an optimal set of blocks. We measure the discriminativity of a block by examining its response to a pre-learned support vector machine and select a sparse set of blocks which maximizes the total classifier discriminativity. In contrast to the scenes where an individual performs a primitive action, in the scenes containing several people crowd behaviors may take place. For these types of scenes the traditional approaches for recognition will not work due to severe occlusion and limited number of pixels per person. For this problem, we present a novel approach to identify common crowd behaviors. Numerical integration of the optical flow in a scene provides particle trajectories that represent the motion as a dynamical system. Linear approximation of the dynamical system provides behavior classification through the Jacobian matrix; the eigenvalues determine the dynamic stability of points in the flow which corresponds to specific behaviors.



## BERKAN SOLMAZ

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| 1982    | Born in Ankara, Turkey  |
| 2005    | B.S., Orta Dogu Teknik Universitesi, Turkey   |
| 2006-07 | R&D Electronics Engineer, Karel Electronics, Turkey   |
| 2008    | M.S., Orta Dogu Teknik Universitesi, Turkey   |
| 2007-08 | Research Assistant, Multimedia Research Group,<br>Orta Dogu Teknik Universitesi, Turkey             |
| 2012    | Research Intern, Texas Instruments Vision R&D, TX   |
| 2008-13 | Ph.D., University of Central Florida, Orlando, FL   |
| 2013--  | Post-Doctoral Researcher, Section of Biomedical Im-<br>age Analysis, University of Pennsylvania, PA |