



UNIVERSITY OF CENTRAL FLORIDA
CENTER FOR RESEARCH IN COMPUTER VISION

FINAL ORAL EXAMINATION

OF

SUBHABRATA BHATTACHARYA
B.E., UNIVERSITY OF BURDWAN, 2003

FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY
(COMPUTER ENGINEERING)

Monday, July 1, 2013, 2:30 P.M.
101 Harris Corporation Engineering Center

DISSERTATION COMMITTEE

Professor Mubarak Shah, *Chairman*
Dr. Rahul Sukthankar, *Co-Chairman*
Professor Ratan Guha
Professor Joseph Laviola Jr.
Professor Brian Moore

OUTLINE OF GRADUATE STUDIES

Major: Computer Engineering

Computer Vision Systems	Shah
Computer Vision	Tappen
Advanced Computer Vision	Shah
3D Computer Vision	Foroosh
Machine Learning in Bioinformatics	Hu
Mathematical Statistics	Pensky

SELECTED PUBLICATIONS

Y. Jiang, S. Bhattacharya, M. Shah, and S-F Chang, “High-Level Event Recognition in Unconstrained Videos”, *International Journal of Multimedia and Image Retrieval*, Nov 2012.

S. Bhattacharya, R. Sukthankar, and M. Shah, “A holistic approach to aesthetic enhancement of photographs”, *ACM Transactions on Multimedia Computing, Communications and Applications* 2011.

S. Bhattacharya, R. Sukthankar, R. Jin, and M. Shah, “A Probabilistic Representation for Efficient Large Scale Visual Recognition Tasks”, *IEEE Computer Vision and Pattern Recognition*, 2011.

S. Bhattacharya, R. Sukthankar, and M. Shah, “A Framework for Photo-Quality Assessment and Enhancement based on Visual Aesthetics”, *ACM Multimedia* 2010. (Best paper nominee)

S. Bhattacharya, H.Idrees, I.Saleemi, S. Ali, and M. Shah, “Moving Object Detection and Tracking in Infra-red Aerial imagery”, Book chapter in *Machine Vision Beyond Visible Spectrum*, Springer, 2010.

M. Quaritsch, K. Kruggl, D. Wischounig-Strucl, S. Bhattacharya, M. Shah, B. Rinner, “Networked UAVs as Aerial Sensor Network for Disaster Management Applications”, *Springer E&I (Elektrotechnik und Informationstechnik) Journal*, 2009.

DISSERTATION

RECOGNITION OF COMPLEX EVENTS IN OPEN-SOURCE WEB-SCALE VIDEOS: FEATURES, INTERMEDIATE REPRESENTATIONS AND THEIR TEMPORAL INTERACTIONS

Recognition of complex events in consumer uploaded Internet videos, captured under real-world settings, has emerged as a challenging area of research across both computer vision and multimedia community. In this dissertation, we present a systematic decomposition of complex events into hierarchical components and make an in-depth analysis of how existing research are being used to cater to various levels of this hierarchy and identify three key stages where we make novel contributions, keeping complex events in focus. These are listed as follows: (a) Extraction of novel semi-global features — firstly, we introduce a Lie-algebra based representation of dominant camera motion present while capturing videos and show how this can be used as a complementary feature for video analysis. Secondly, we propose compact clip level descriptors of a video based on covariance of appearance and motion features which we further use in a sparse coding framework to recognize realistic actions and gestures. (b) Construction of intermediate representations — We propose an efficient probabilistic representation from low-level features computed from videos, based on Maximum Likelihood Estimates which demonstrates state of the art performance in large scale visual concept detection, and finally, (c) Modeling temporal interactions between intermediate concepts — Using block Hankel matrices and harmonic analysis of slowly evolving Linear Dynamical Systems, we propose two new discriminative feature spaces for complex event recognition and demonstrate significantly improved recognition rates over previously proposed approaches.



SUBHABRATA BHATTACHARYA

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| 1981 | Born in Kolkata, India |
| 1999-03 | B.E., University of Burdwan, West Bengal, India |
| 2004-06 | Research Staff, Infosys Technologies Ltd., Bangalore, India |
| 2006-08 | Staff Software Developer, Systems and Technology Group, IBM, Bangalore, India |
| 2008-13 | Ph.D., University of Central Florida, Orlando, FL |
| 2010 | Research Intern, Intel Labs, Pittsburgh, PA |
| 2012 | Research Intern, Microsoft Research, Redmond, WA |
| 2013 | Post-Doctoral Researcher, Department of EECS, Columbia University, New York City, NY |