

Department of Mathematics
Interdisciplinary Seminar

“Object and Scene Classification Using Co-clustering and Fiedler Embedding”

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Recently in Computer Vision local interest-points and their descriptors for object and scene classification have attracted a lot of attention. Bag of Visterms (BOV) approaches, which have achieved inspiring performance, model images as sets of orderless local features. In this talk, first we will present an approach for scene classification utilizing *Maximization of Mutual Information (MMI)* to discover clusters of semantic concepts, which we call intermediate concepts. Each intermediate concept corresponds to a cluster of visterms. *MMI* co-clustering results in fewer but meaningful clusters. Unlike k-means which is used to cluster image patches based on their appearances in BOV, *MMI* co-clustering can group the visterms which are highly correlated to some concept.

The above approach uses only one kind of image features, local patches. However, in general, the given visual information can be considered as an amalgam of multiple classes of features such as interest points, contours, region segments, etc. As a result, for example, the appearance of any target object in an image stems from the interaction of these classes of features in the form of homogenous (i.e. among features of the same type as in region segment-region segment, contour-contour etc.), and heterogeneous relationships (i.e. among features of different types as in interest point-contour, contour-region segment, etc.). In the second part of this talk, I will present a framework for embedding different entities into a common Euclidian space. For this purpose, the algorithm treats different entities (features and images) as nodes in a graph, where weighted edges between the nodes represent the strength of the relationship between entities. The graph is then embedded into a k-dimensional space, subject to the criteria that similar nodes have Euclidian coordinates which are closer to each other. This is achieved by converting this constraint into a minimization problem whose solution is the eigenvectors of the graph Laplacian matrix. This procedure is known as *Fiedler Embedding*. The applicability of this framework will be demonstrated on the problem of image classification by using images, interest points, contours, and region segments as the input entities.

BIO

Dr. Mubarak Shah, Agere Chair Professor of Computer Science, and the founding director of the Computer Visions Lab at the University of Central Florida, is a researcher in a number of computer vision areas including: activity and gesture recognition, violence detection, event ontology, object tracking, video segmentation, story and scene segmentation, view morphing, ATR, wide-baseline matching, and video registration. He is a co-author of two books (*Motion-Based Recognition* (1997) and *Video Registration* (2003)) both by Kluwer Academic Publisher. Dr. Shah is a fellow of IEEE and IAPR. In 2006, he was awarded a Pegasus Professor award, the highest award at UCF, given to a faculty member who has made a significant impact on the university, has made an extraordinary contribution to the university community, and has demonstrated excellence in teaching, research and service. He was an IEEE Distinguished Visitor speaker for 1997-2000 and received IEEE Outstanding Engineering Educator Award in 1997. He received the Harris Corporation's Engineering Achievement Award in 1999, the TOKTEN awards from UNDP in 1995, 1997, and 2000; Teaching Incentive Program award in 1995 and 2003, Research Incentive Award in 2003, Millionaires' Club awards in 2005 and 2006, University Distinguished Researcher award in 2007, honorable mention for the ICCV 2005 Where Am I? Challenge Problem, and was nominated for the best paper award in ACM Multimedia Conference in 2005. He is an editor of international book series on Video Computing; editor in chief of Machine Vision and Applications journal, and an associate editor of ACM Computing Surveys journal. He was an associate editor of the IEEE Transactions on PAMI, Pattern Recognition journal, and a guest editor of the special issue of International Journal of Computer Vision on Video Computing.

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