USC Viterbi
School of Engineering
Ming Hsieh Department of Electrical Engineering

Seminar Announcement

Human Activity Analysis with Graph Signal Processing Techniques

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USC – PhD Defense

Date: September 5th (Wednesday), 2018
Time: 1:00pm to 3:00pm
Location: EEB 248

Abstract:

Analyzing and understanding human actions has long been a popular yet challenging research area with a broad range of applications. In this thesis, we explore model-based approaches to construct representations for captured skeleton-based motion data with prior knowledge about human skeletons being considered. The main challenge in achieving so is the irregularity in the skeletal structure and its corresponding actions, which we propose to leverage graph structures to tackle with, since graph has shown its superiority in modeling complex relationships among entities in irregular domains. In this work, we propose graph-based motion representations which start with constructing a skeletal or skeletal-temporal graph, followed by applying a graph transform such as Graph Fourier Transform (GFT) or Spectral Graph Wavelet Transform (SGWT) to the graph signals, i.e., motion data, defined on the graph. We discuss the construction of a skeletal graph and further derive the spatial and spectral properties associated with this type of graphs, as well as the interpretations brought by GFT basis. Additionally, we discuss several desirable properties of the proposed representations, including computational efficiency and easier generalization. As an extension, we explore the possibility of learning a set of action-dependent graphs for classification purpose, where we propose a general discriminative graph learning problem together with an iterative algorithm to solve it. Furthermore, a closed-form solution can be derived when graph topology satisfies certain properties.

As for applications, we consider two real-world scenarios where skeleton-based motion data is captured for automated action analysis. The first one is a mobility assessment system where activities performed by patients with musculo-skeletal disorders are captured and utilized to predict their current medication states. The other one is skeleton-based action recognition, which has been a popular research problem in computer vision. Employing our proposed representations can achieve recognition performance comparable to the state of the art, while at the same time provides benefits in significantly lower time complexity, robustness to noisy and missing data, and easiness to re-apply to new datasets. Theoretical interpretations and comprehensive experimental results are presented for the proposed methods.

Bio:

Jiun-Yu (Joanne) Kao is a Ph.D. candidate in Department of Electrical Engineering at University of Southern California (USC), Los Angeles, CA. She received her B.S. degree in Electrical Engineering from National Taiwan University, Taipei, Taiwan in 2012. Her research focuses on human activity analysis and video understanding, with particular interests in graph based approaches.