Kinematic Features based Action Recognition Framework

Saad Ali and Mubarak Shah

Abstract

We propose a framework that explores the use of global motion dynamics for the task of human action recognition in videos. We use optical flow as the basic representation of the video and compute a set of flow kinematic features. The set of kinematic features include: divergence; vorticity; symmetric and anti-symmetric flow fields; second and third principal invariants of flow gradient and rate of strain tensor; and third principal invariant of rate of rotation tensor. It is then hypothesized that the dynamical information of the flow field is represented in these spatio-temporal kinematic patterns in the form of dominant kinematic trends called 'Non-linear Coherent Structures' (NLCS). For each video, these NLCS are discovered by employing the proposed set of kinematic features as kinematic kernels within a snapshot PCA framework by computing a temporal autocorrelation kernel matrix that satisfies the total positivity constraint. This way we also overcome the drawback of the standard PCA which gives only a limited description of the flow dynamics, since it is designed for energy minimization and will not be suitable for the scenarios where the dynamics is the main quantity of interest. For classification, we propose to use a multiple instance learning based framework where each action video is represented by a bag of NLCS, such that each NLCS is an instance representing the bag. Each bag is then embedded into an instance based feature space, and coordinates of bags in that space are used for classification using the nearest neighbor algorithm. The Qualitative and quantitative results are reported on benchmark data sets, and it is demonstrated that our framework is able to achieve much better performance.

Saad Ali is a Ph.D. student in the School of Computer Science at University of Central Florida, Orlando, Fl 32816, USA. Email: sali@cs.ucf.edu. Mubarak Shah is a Professor of Computer Science and director of Computer Vision Lab at University of Central Florida, Orlando, Fl 32816, USA. Email: shah@cs.ucf.edu