Title: 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.

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The public is welcome to attend.