

Motion pattern analysis in video streams based on spectral clustering

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Motion pattern analysis in video streams is currently being used in numerous applications including traffic surveillance, crowd movement monitoring, abnormal event detection, vision based counting systems and many other visual monitoring applications. In all these applications, two fundamental steps are performed; extracting motion trajectories of objects of interest in the given video stream and classifying them based on their similarities using a suitable clustering algorithm. This study proposes a methodology to accomplish the latter stage of the motion pattern analysis process.

Two fundamental issues addressed in motion pattern analysis are identifying the number of clusters in a given scenario and grouping each event into the appropriate cluster. According to literature, it is evident that the most refined clustering method available to achieve both the above tasks, is Spectral Clustering. The standard Spectral Clustering algorithm has two free parameters, K and σ ; that has been set in an Ad-hoc manner. This study proposes a method of selecting the value of K , which is the number of clusters through an eigen value gap based analysis.

According to the proposed methodology, the eigen values of the Laplacian matrix obtained using the definitions in the standard Spectral Clustering algorithm are first sorted in descending order. Then, the Eigen value gap plot is derived by obtaining the differences between consecutive eigen values. Through this work, it is found that the largest Eigen value gap index provides an accurate value for K , closely reflecting human intuition. Further, the impact on K for variations of σ is analyzed by observing the event detection results for different selected σ values.

The accuracy and the validity of the proposed method are justified by applying the results of the proposed algorithm to a given scenario. This algorithm provides accurate results for different scenarios and has the flexibility of adjusting accurately to detect events in any given scenario by setting the parameter σ appropriately. Further, it is evident that the proposed methodology provides more insight to a given motion pattern analysis problem than when using other existing algorithms.