Background subtraction or scene modeling techniques model the background of the scene using the stationarity property and classify the scene into two classes of foreground and background. In doing so, most moving objects become foreground indiscriminately, except for perhaps some waving tree leaves, water ripples, or a water fountain, which are typically "learned" as part of the background using a large training set of video data. Traditional techniques exhibit a number of limitations including inability to model partial background or subtract partial foreground, inflexibility of the model being used, need for large training data and computational inefficiency. In this thesis, we present our work to address each of these limitations and propose algorithms in two major areas of research within background subtraction namely single-view and multi-view based techniques.

We first propose the use of both spatial and temporal properties to model a dynamic scene and show how Mapping Convergence framework within Support Vector Mapping Convergence (SVMC) can be used to minimize training data.

We also introduce a novel concept of background as the objects other than the foreground, which may include moving objects in the scene that cannot be learned from a training set because they occur only irregularly and sporadically, e.g. a walking person. We propose a "selective subtraction" method as an alternative to standard background subtraction, and show that a reference plane in a scene viewed by two cameras can be used as the decision boundary between foreground and background. In our definition, the foreground may actually occur behind a moving object. Our novel use of projective depth as a decision boundary allows us to extend the traditional definition of background subtraction to a much more powerful framework. Furthermore, the reference plane can be selected in a very flexible manner, using for example the actual moving objects in the scene, if needed. We present diverse set of examples to show that: (i) the technique performs better than standard background subtraction techniques without the need for training, camera calibration, disparity map estimation, or special camera configurations; (ii) it is potentially more powerful than standard methods because of its flexibility of making it possible to select in real-time what to filter out as background, regardless of whether the object is moving or not, or whether it is a rare event or a frequent one; (iii) the technique can be used for a variety of situations including when images are captured using stationary cameras or hand-held cameras and for both indoor and outdoor scenes. We provide extensive results to show the effectiveness of the proposed technique in a variety of very challenging environments.

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The public is welcome to attend.