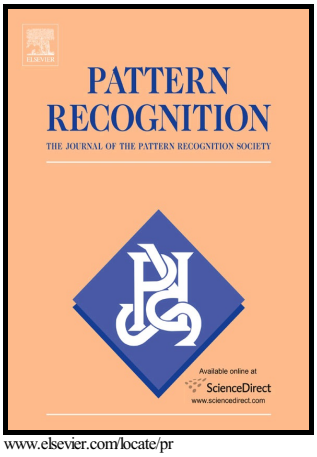

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Dynamic Background Estimation and Complementary Learning for Pixel-wise Foreground/Background Segmentation

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Abstract — Change and motion detection plays a basic and guiding role in surveillance video analysis. Since most outdoor surveillance videos are taken in native and complex environments, these "static" backgrounds change in some unknown patterns, which make perfect foreground extraction very difficult. This paper presents two universal modifications for pixel-wise foreground/background segmentation: dynamic background estimation and complementary learning. These two modifications are embedded in three classic background subtraction algorithms: probability based background subtraction (Gaussian Mixture Model, *GMM*), sample based background subtraction (Visual Background Extractor, *ViBe*) and code words based background subtraction (code book, *CB*). Experiments on several popular public datasets prove the effectiveness and real-time performance of the proposed method. Both *GMM* and *CB* with the proposed modifications have better performance than the original versions. Especially, *ViBe* with the modifications outperforms some state-of-art algorithms presented on the *CHANGEDETECTION* website.

Keywords — ***background subtraction (BS), GMM, ViBe, CB, dynamic background estimation, complementary learning***

I. INTRODUCTION

Thousands of cameras are used to capture visual information in video monitoring systems, telecom conferences and other video based applications. Accurate extraction of change and motion in videos is an important precursor to subsequent detection, tracking, recognition and behavior analysis. Therefore these kinds of video processing modules have been the topic of much research in the community for some time. Since most surveillance videos are taken in natural scenes, they capture complex mixture of background motion and clutter. There are many algorithms designed to extract accurate foreground masks of moving objects. The goal of these systems is to assign a label $F_i(x)$ to each site x in frame i, in which $F_i(x)$=1 indicates that the pixel at that site is *foreground* and $F_i(x)$=0 *background*. Several

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