学 位 論 文 内 容 の 要 旨

博士の専攻分野の名称　　博士（情報科学）　　氏名　周　文俊

学 位 論 文 題 名

Co-occurrence Pixel-Block Background Model and its Application to Robust Event Detection
（共起ピクセルブロック背景モデルとそのロバストイベント検出への応用）

As a basic approach utilized in many computer vision applications, foreground detection plays an important role in various tasks like video surveillance, traffic monitoring, scene background initialization and object tracking. one simple way to do background modelis to acquire a background image without any moving objects. However, foreground detection is faced with many practical challenges, especially the background changes, not least of which is those related to illumination changes, e.g. variable sunlight or lights being switched on and off indoors, and background motion, e.g. the swaying motion of trees, fleeting cloud and moving waves on the water. To handle such challenges, previous statical methods have been proposed, in which the intensity of each pixel is independently analyzed in the temporal domain and then the current frame is subtracted, such as the Gaussian Mixture Model (GMM) to build a pixel-wise model for each pixel, however such kind of methods is difficult to solve illumination changes with the intensity varies rapidly and significantly. Recent many local feature based methods have been put forward for background modeling such as Barnich et al. proposed ViBe, a method that involves comparing each pixel with a set of previous values located the same or neighborhood positions to evaluate whether a pixel belongs to the background. However, such local feature based background models is susceptible to be affected by the dynamic motion of background, thus losing the robustness.

To overcome above problems, this thesis presents a novel background subtraction method called co-occurrence pixel-block pairs (CPB) for detecting objects in dynamic scenes. CPB is a “pixel to block” structure model, which is evolved from the Co-occurrence Probability based Pixel Pairs (CP3) and it uses the correlation of multiple co-occurrence pixel block pairs to detect objects in dynamic scenes. It offers robust background subtraction against a dynamically changing background. We firstly propose a correlation measure for co-occurrence pixel-block pairs to realize a robust background model. We then introduce a novel evaluation strategy named correlation depended decision function for accurate object detection with the correlation of co-occurrence pixel-block pairs. Finally, CPB can estimate the foreground from a dynamic background with a sensitive criterion. Furthermore, a Hypothesis on Degradation Modification (HoD) based on CPB is proposed to further resist background changes for foreground detection, such as illumination changes and background motion. HoD provides CPB with a model update strategy that can be used for a long time. While further improving the robustness of CPB, it also stabilizes the efficiency of CPB over time.

Through the experimental comparisons with other existing foreground detection techniques based on challenging datasets, we demonstrated good performance of our algorithms. In summary, CPB is sufficiently sensitive to detect foreground objects in dynamic scenes and to perform robust detection in outdoor or indoor environments with relatively low complexity. Furthermore, HoD provides a new and natural thought: the structure of background model can be updated by the designed correlation weigh, which is a new strategy can be utilized in the pixel-correlation based algorithms for the background model update.

This thesis is organized into the following chapters:

Chapter 1 introduces related works in foreground detection. Some general problems are involved and discussed. Furthermore, the motivations and contributions of this study are described.

Chapter 2 introduces the Co-occurrence Pixel-Block Background Model (CPB) in detail including the basic concept and essential mechanism of CPB. As an extension from the
“pixel to pixel” structure that our previous work CP3, CPB propose a “ pixel-block ” structure for background model. In this chapter, we describe how to construct the “ pixel-block ” structure for background model and explain the processing of model building in theory.

Chapter 3 discusses the application of CPB in the field of foreground (event) detection. We also introduce introduce a novel evaluation strategy named correlation depended decision function for accurate foreground detection and explain the theoretical meaning of the evaluation strategy. Moreover, we do a comparison to present the performance of CPB for foreground detection.

Chapter 4 focuses on the Hypothesis on Degradation Modification (HoD), which is proposed based on CPB to further improve the robustness of CPB and stabilize the efficiency of CPB over time. In this chapter, the basic knowledge and mechanism of HoD are discussed in detail. Finally, we verify the ability of HoD with adequate experiments.

Chapter 5 introduces the experimental setup in detail. In this chapter, the comparative experiments for CPB and CPB+HoD using several challenging datasets are designed and through these experiments we measure the robustness and efficiency of our methods, CPB and CPB+HoD in various indoor and outdoor challenges.

The final Chapter summarizes the main points of the study and dicuss our algorithms. Finally, the plan and concept for future work are presented.