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A Regularized Tensor Decomposition Method with Adaptive Rank Adjustment for Compressed-Sensed-Domain Background Subtraction.

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Abstract

In intelligent video surveillance, Background Subtraction is the foundation and key to the task of Moving Object Detection (MOD). Recently, the development of Compressive Sensing (CS) theory has made the Compressed-Sensed-Domain Background Subtraction (CSDBS) an interesting task and several related models have been proposed. The latest tensor-based method provides the best performance on both reconstructing video and detecting moving objects at present. Unfortunately, it just simply sets the ranks of the tensor video background fixed along all modes, which makes it impossible to obtain accurate background component when the scene is at different time or places. In this paper, we propose a Regularized Tensor Decomposition Method with Adaptive Rank Adjustment(RTDARA) for CSDBS, which can accommodate backgrounds with differently low-rank property in more scenes to a certain extent. In addition, for the model, we use a non-convex surrogate of the rank instead of the convex nuclear norm. Finally, we develop a fast implementation using the alternative direction multiplier method (ADMM) to solve the proposed model. A large number of experimental results have shown that, on the Compressed-Sensed-Domain video in different scenes, our proposed method is superior over the existing state of the art techniques.

Keywords: Background subtraction, compressive sensing, adaptive rank adjustment, non-convex surrogate, alternative direction multiplier method
2010 MSC: 00-01, 99-00

1. Introduction

Background subtraction is the most commonly used technique to solve the Moving Object Detection(MOD) [1], which plays an important role in many upper-level computer vision tasks, such as intelligent video surveillance [2], object-based video coding [3], and behavior recognition [4].

Most background subtraction techniques consist of four steps, video signal acquisition, encoding, decoding, and separating moving objects from background. Generally, the video data is captured by cameras, and then transmitted through the network to the information processing center, where the background subtraction and MOD are completed. With the rapid development of network technology, the demand for real-time and efficient information transmission is increasing, almost all video data is compressed for storage and transmission. Fortunately, the theory of compression sensing (CS) [5, 6] has shown the potential of significantly improving the energy efficiency of sensors in real-world application. Several CS-based imaging systems have been built in recent years, e.g., the single-pixel camera [7] and high-speed video camera[8].

From the representation of video data acquisition, most existing works on background subtraction can be categorized into two classes, pixel-domain models and compressed-domain models. In the first category, the early non-statistical methods estimate and update the background by running various filtering, such as

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