A Flow-Based Approach to Vehicle Detection and Background Mosaicking in Airborne Video

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DESCRIPTION

In this work, we address the detection of vehicles in a video stream obtained from a moving airborne platform. We propose a Bayesian framework for estimating dense optical flow over time that explicitly estimates a persistent model of background appearance. The approach assumes that the scene can be described by background and occlusion layers, estimated within an Expectation-Maximization framework. The mathematical formulation of the paper is an extension of the work in [9] where motion and appearance models for foreground and background layers are estimated simultaneously in a Bayesian framework.

Layered models of optical flow have been one of the key paradigms for simultaneously segmenting the scene and estimating its motion [3], [5], [8]. Tao et.al. [7] develop a practical, layer-based algorithm within a rigorous Bayesian framework that specifies data terms and priors for object appearance, motion and shape cues. In particular, mixture model frameworks make a soft assignment of pixels to layers. Unfortunately, these methods are typically limited to parametric motion models.

Here, we extend [9] to detect moving vehicles by segmenting dense optic flow fields into background and occlusion layers. Unlike the related work in [2], [4], [6], where thresholding and connected component analysis follow up the background stabilization, our approach is based on a robust optical flow algorithm applied on stabilized frames. Stabilization of the frames compensates for gross affine background motion prior to running robust optical flow to compute dense residual flow. Based on the flow and the previous background appearance model, the new frame is separated into background and foreground occlusion layers using an EM-based motion segmentation. The preliminary results presented here show that ground vehicles can be detected and segmented from airborne video sequences while building a mosaic of the background layer. Further details of the approach and videos can be found in [1] and [10] respectively.

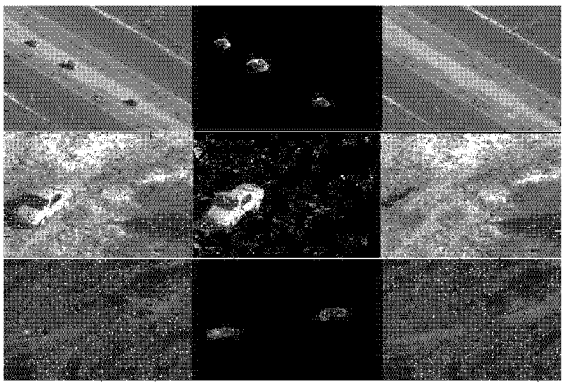

Fig. 1
DETECTING VEHICLES: INPUT FRAMES (COLUMN 1), DETECTED VEHICLES (COLUMN2), BACKGROUND APPEARANCE (COLUMN3).

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