Generalizing Foreground Estimation Algorithms in Dynamic Background Conditions

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Abstract

Foreground estimation through background subtraction is used to identify the region of interest in a video sequence, and is incorporated in many algorithmic pipelines as a preprocessing step. Foreground estimation plays an important role in a wide range of computer vision and image processing applications such as video surveillance, object detection, gesture recognition, etc. Foreground estimation is trivial in the case of static background and dynamic foreground while frame-wise segmentation is used when both background and foreground are static. The problem becomes challenging when both foreground and background are dynamic (e.g.: aquatic). This work aims to (i) set up an experimental case covering different dynamic background conditions (e.g. land, aquatic, human movements, vehicular movements, wind etc), (ii) evaluate a range of existing work (Gaussian and cylindrical mixture models based on expectation maximization, adaptive mixture models, principal component analysis and its variants, graph segmentation based algorithms, etc.) that was proposed for both generic and specific use cases, (iii) identify the relative performance of these algorithms under different conditions (iv) propose necessary hyperparameter tuning for these algorithms to perform well over the general cases (v) explore the performance increments gained by aggregating algorithms (vi) explore the contribution of morphological filters as a post-processing step and (vii) build up an program capable of aggregating customized algorithms to generate better performing pipelines. We conclude our work by proposing a pipeline of algorithms and post-processing and compare and analyze the performance of the proposed model against other works. We show that the proposed model performs well under varying environment conditions in comparison.

Keywords— Computer vision, foreground estimation, background subtraction, video processing

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