Generic Approaches to Enhanced Correlation Filter Tracking

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by

Priya Mariam Raju

Department of Avionics

INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY

THIRUVANANTHAPURAM - 695 547

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Abstract

Automated video analysis and object tracking algorithms have attracted much attention in the recent years. Among the numerous tracking algorithms available, correlation-filter (CF) based discriminative trackers have become quite popular due to their simplicity and efficiency. Even though several tracking algorithms based on correlation filters are available today, most of them need techniques to successfully track an object whose appearance is constantly changing. Despite outstanding real-time tracking performance, correlation filter-based object tracking systems have several drawbacks. Some major challenges of correlation filter-based single object trackers are the object deformations brought on by rotation and scale changes, model drift problems, long-term tracking capabilities, and tracking resumption. The proposed research attempts to provide "generic approaches towards enhancing correlation filter trackers" considering these difficulties.

The initial stage of the thesis identifies the necessity of oriented bounding boxes to represent the target object. Changes in object orientation can result in significant changes in the object appearance relative to its initial appearance. These changes limit the solid training features collected from each video frame. Knowledge of object orientation can adapt the tracker to rotations and deformations. To effectively learn the target appearance model, the proposed research focuses on determining the orientation of the target object and generating oriented bounding boxes. The cost function of the correlation filter tracker is optimized across oriented samples to prevent false positives. Additionally, a localization method that considers the target displacement is used. The effectiveness of the proposed rotation adaptive correlation filter is analysed and has obtained promising results on popular tracking benchmarks.

The proposed research further examines the requirement for a re-initialization technique to handle tracking resumption and long-term tracking capabilities in CF trackers. To address this issue, an adaptive threshold and an online learning detector are developed which detects and overcomes tracking failures. The correlation tracker framework is incorporated with a detector-based re-initialization, significantly reducing model drift, and enhancing CF tracker's ability for long-term tracking. Through extensive evaluations, both qualitative

and quantitative, the proposed re-initialization scheme was observed to outperform the state-of-the-art trackers in accuracy and robustness under most of the challenging conditions.

Subsequently, the conventional recursive search technique in the correlation trackers was identified in the proposed research as a significant contributor to model drift. To minimize this problem, a segmentation-guided attention that creates highly reliable search regions, is integrated into the object tracking framework. These search regions are segmentation masks and are employed as a guiding step in tracking due to their superior localization capabilities. Target-level information is added to the tracking pipeline through a domain adaptation technique corresponding to each video sequence.

Finally, considering the superiority of the human visual attention in continually tracking an object and discriminating it from similar nearby objects, the proposed research establishes the significance of visual attention in object tracking. The subsequent proposal integrates correlation and visual attention on neighbouring frames to localize the target object across a video sequence and provide object representations in the form of bounding boxes and object segmentations.

The proposed tracking algorithms are evaluated on the popular benchmark datasets and have obtained competing performance with the state-of-the-art tracking algorithms.