CONSENSUS-BASED TRACKING AND LOCAL MATCHING OF KEYPOINTS

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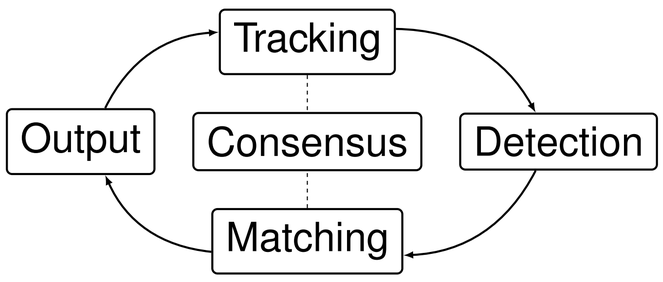
Abstract

We propose a novel keypoint-based method for long-term model-free object tracking. The main contributions of our work are the formulation of a novel consensus-based scheme for outlier detection and a method for addressing problems stemming from ambiguous descriptors and clutter. In contrast to competing approaches, we refrain from updating the appearance information during processing. We are able to achieve state-of-the-art results on a dataset as large as 60 sequences.

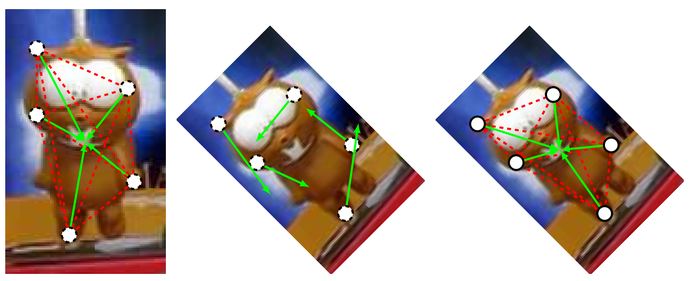
Outline

In each frame, keypoints are both tracked by estimating optic flow [2] and matched by comparing descriptors [1] of candidates and model keypoints.



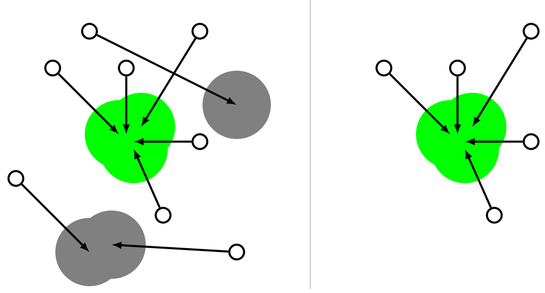
Voting

Each keypoint casts a vote for the object center. Votes are scaled and rotated depending on the pairwise keypoint constellation.



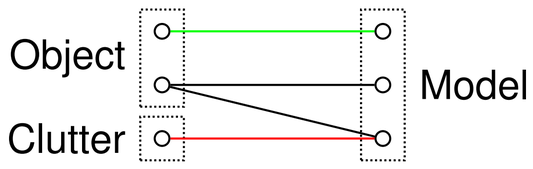
Consensus

Consensus in the voting behaviour is established by clustering the votes. Keypoints that do not vote into the consensus cluster are removed.

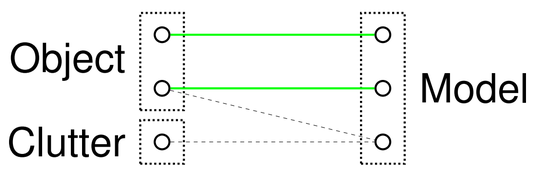


Local Matching

In standard keypoint matching, non-discriminative keypoints are difficult to match, as they might also appear in clutter or on other parts of the object.

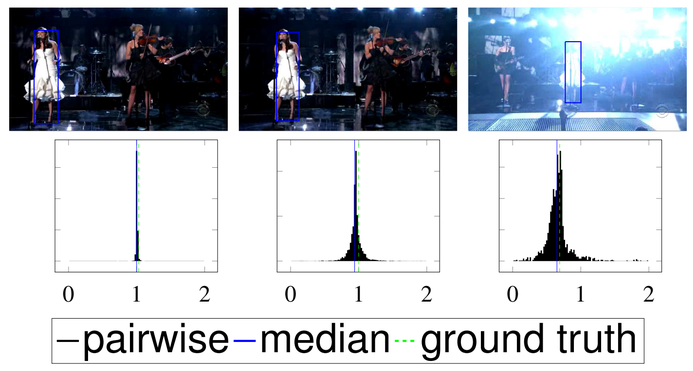


In our local matching technique, an initial estimate of the object is obtained by keypoint tracking. In a second step, implausible candidates for matching are removed and ambiguities are resolved.



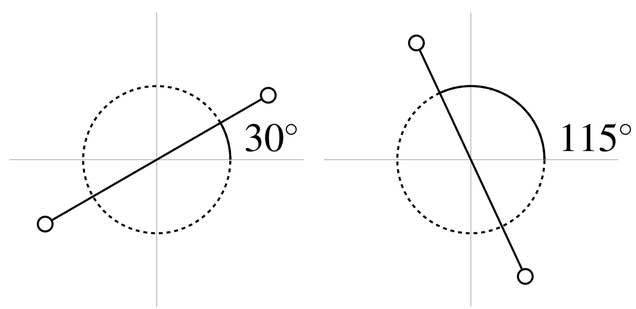
Scale Estimation

We are able to estimate the current scale of the object accurately by computing robust statistics over the pairwise distance changes between individual keypoints



Rotation

In a similar fashion, the in-plane rotation of the object is approximated by evaluating the pairwise angular deviations between keypoints with respect to their constellation in the initial frame.

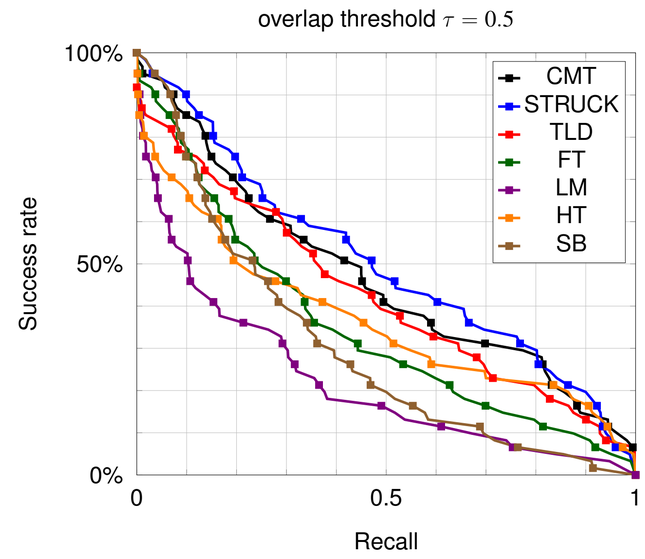


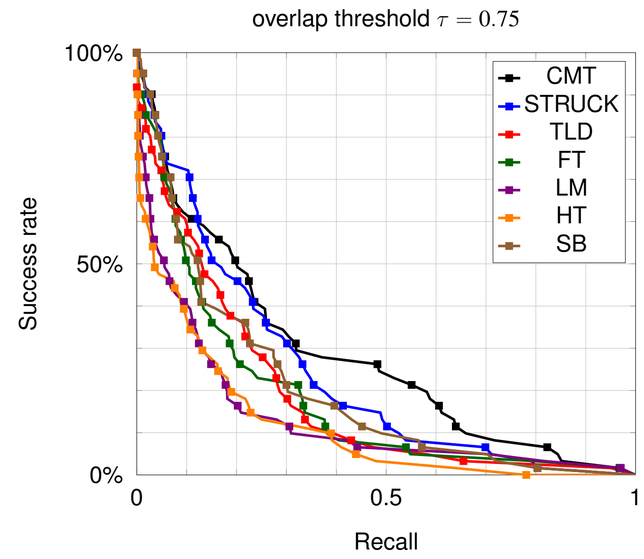
Source Code

The source code is available under the BSD licence at:
http://www.gnebehay.com/cmt

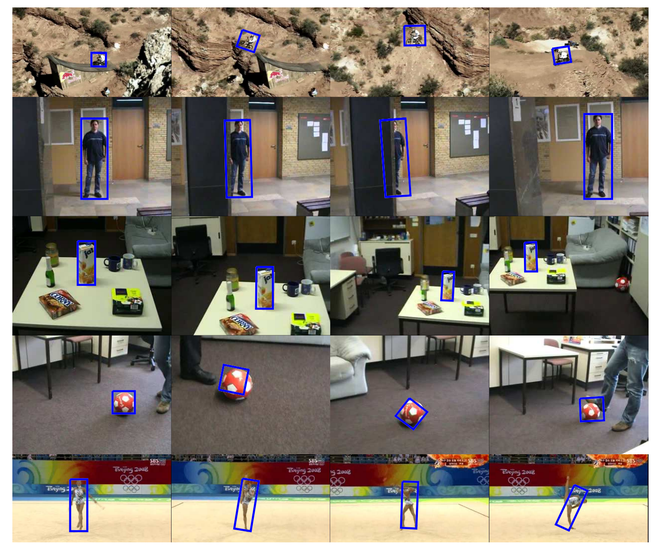
Results

We evaluated our approach (CMT) on a dataset of 60 sequences, achieving state-of-the-art performance. We visualize the performance by employing success plots. Our approach performs especially well when high accuracy is desired.





Qualitative Results



References

[1] S. Leutenegger, M. Chli, and R. Y. Siegwart. “BRISK: Binary Robust invariant scalable keypoints”. In: *ICCV*. 2011.

[2] B. D. Lucas and T. Kanade. “An Iterative Image Registration Technique with an Application to Stereo Vision”. In: *IJCAI*. 1981.

[3] G. Nebehay and R. Pflugfelder. “Consensus-based Matching and Tracking of Keypoints for Object Tracking”. In: *WACV*. Best Paper Award. 2014.

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