

PR03 ORB Feature Points

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CSCI 731 Advance Computer Vision

July 15, 2017

Summary

Rublee et al. have suggested improvements in existing feature detector FAST[3] and feature descriptor BRIEF[1] for achieving higher performance than SURF and SHIFT detector in terms of noise robustness, computational cost and rotational invariance [4]. Their contributions[4] are listed below.

1. **Added a computationally fast and accurate orientation component to FAST.**

Unlike other feature detectors(SHIFT and SURF), FAST doesn't include orientation operator Rublee et al. used intensity centroid method[2] for assigning orientation components to FAST feature points. Intensity centroid was not only computational fast but outperformed other methods like MAX and BIN used for SURF and SIFT respectively in terms of rotational invariance and Gaussian noise robustness. They named the new FAST keypoints as **oFAST (FAST Keypoint Orientation)**.

Rublee et al. also found that FAST keypoints were also containing points corresponding to edges in a image due to missing mechanism for measuring cornerness. So they used Harris corner along with Fast detector for selecting key-points.

2. **Computationally efficient method for calculating Steered BRIEF.** BRIEF descriptor is nothing but a string of bits. Each bit of the descriptor is constructed by performing binary tests between intensity value of key-point(detected by FAST detector) and it's circular neighbor situated at some constant distance(radius) from the key-point. Rotational invariance of BRIEF features are not robust as their performance decrease while matching key points after applying higher(≥ 10) degree in-plan rotation on the test image. Rublee et al. suggested, by performing rotational transformation(with some angle values, multiple of 30 degree) of BRIEF feature we can with a 2D BRIEF descriptor. They called the new augmented BRIEF descriptor as **steered BRIEF**.

3. **Conducted variance and Correlation analysis of BRIEF and steered BRIEF features.** Descriptive ability of the feature descriptors can be measured in terms of variance and mean values of descriptors. BRIEF descriptors show high variance with mean value around .5 which gives them good descriptive power, but Rublee et al. found that the steered BRIEF descriptors have less variance in comparison to BRIEF, hence

they have less descriptive power than BRIEF. They also found that both BRIEF and steered BRIEF have correlation between bit values of their descriptor, which means there was redundant information in the descriptor bit strings.

4. **Suggested a Greedy approach for de-correlating steered BRIEF features.** Rublee et al. suggested a PCA based greedy search algorithm which was selecting 256 binary tests (neighbors for calculating descriptor for BRIEF features) in such way that resultant descriptor doesn't show correlation between bits of the descriptor. They also found that their algorithm significantly increased variance for new steered BRIEF descriptor. They named this new descriptor as **rBRIEF**.

Finally, Rublee et al. show by experiments that **ORB**(combination of **rBRIEF** and **oFAST**) features outperformed SIFT and SURF features in terms of rotational invariance.

References

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