GMS: Grid-based Motion Statistics for Fast, Ultra-robust Feature Correspondence

JW Bian[1]*, W-Y Lin[2]*, Y Matsushita[3], S-K Yeung[1], TD Nguyen[4], M-M Cheng[5]
[1]SUTD, [2]ADSC, [3]Osaka University, [4]I2R, [5]Nankai University

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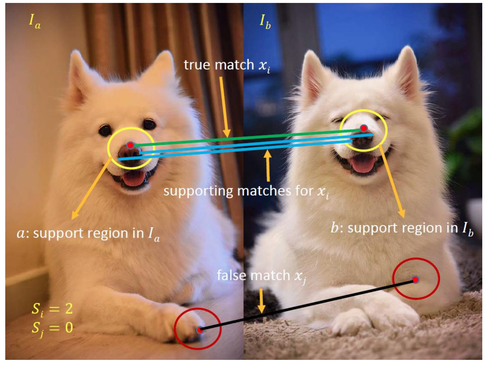
Introduction:

- High computational cost is the major bottleneck in feature matching problem, that limits advanced techniques to be used in real-time applications.
- This paper provides a fast (1ms on CPU) method to identify true matches that enables highly robust image matching while achieving real-time performance.
- The resultant matcher consistently outperforms other real-time methods by a large margin and can be comparable to more sophisticated, several orders of magnitude slower matchers.

Core Idea (Motion Statistics):

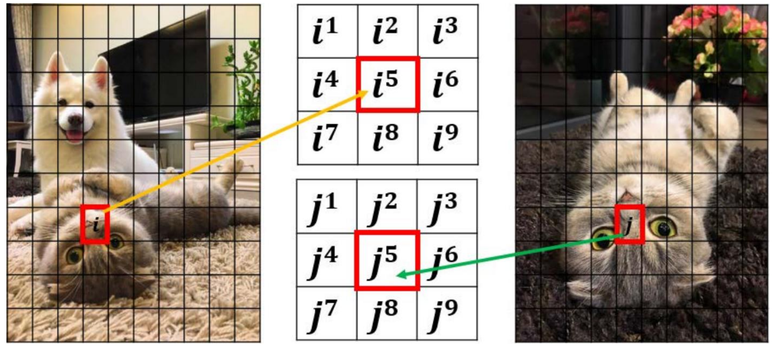


- The idea is from an observation that true matches often have more neighbors than false matches, as shown in the figure above.

- Inliers and outliers show very different neighboring supports, and thus can be separated by a hard threshold.

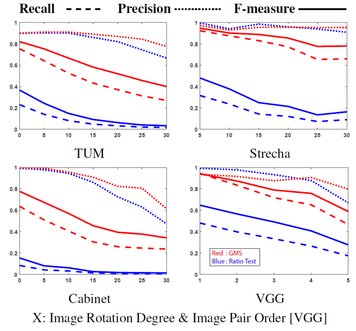
Fast Implementation:

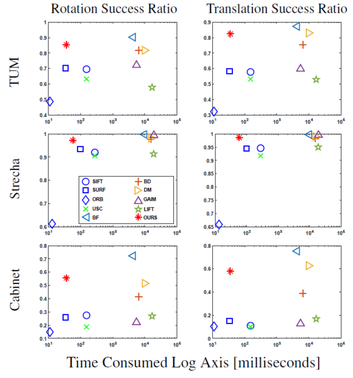
- Grid Framework: The grid structure reduces complexity of measuring a match from O(N) to O(1), and avoids repeatedly calculating scores for features than land in the same cell.
- Motion Kernel: The kernel groups multiple neighboring cells, that allows calculating supports over a large region while not including inaccurate neighbors.



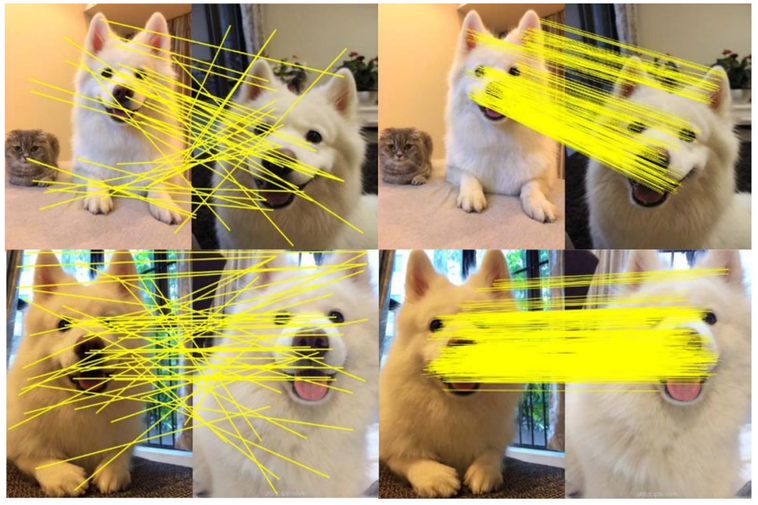
Quantitative Comparison:

- General Matching Performance (left)
- Pose Estimation (right)





Qualitative Evaluation:



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Conclusion:

- We propose GMS, a statistical formulation for partitioning of true and false matches based on the number of neighboring matches. While this constraint has been implicitly employed by other techniques, our more principled approach enables development of simpler, faster algorithms with nearly equivalent performance. In addition, GMS suggests a link between feature numbers and match quality. This may prove an interesting research direction for handling previously intractable matching problems.

Code & YouTube Video is available at the Project Page: https://jwbian.net/gms/