INTRODUCTION

Recently, there is significant interest in developing globally optimal rotation search algorithms. A notable weakness of global algorithms, however, is their relatively high computational cost, especially on large problem sizes and data with a high proportion of outliers.

We present a Guaranteed Outlier Removal (GORE) algorithm suitable when rotations are computed on point matches. Capable of removing the majority of wrong point matches, GORE does not compromise optimality.

GORE

- Only removes wrong matches
- Is deterministic
- Accelerates optimal methods, and
- Is fast!

Source code available at www.cs.adelaide.edu.au/~sparra

ROTATION SEARCH

Given two point clouds related by a rotation, find the best rotation to align them.

Given a set of point matches \( T \), \( (x_i, y_i) \), we aim to solve for rotations inclusively when more than 90% of matches are incorrect. A robust methodology is Consensus Set Maximisation.

For each \( (x_i, y_i) \) that survives the pruning by Result 1, \( \mathbb{N}\) is its true outlier, i.e., \( A \) does not exist in the solution \( \mathbb{Z}^* \).

OUTLIER REMOVAL

The rotation search problem (1) can be rewritten as

\[
\max_{\hat{\theta}} \quad \text{maximize} \quad \hat{\theta}
\]

where \( \hat{\theta} \) is defined as the maximum objective value of the subproblem \( \mathbb{P} \), with \( k = 1, \ldots, N \).

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ALGORITHM

Require: Point matches \( (x_i, y_i) \), inlier threshold \( \epsilon \).

1. \( N = \{1, 2, \ldots, N\} \)
2. \( \epsilon' = \epsilon - \epsilon/2 \)
3. for all \( i \) do
   4. \( \epsilon' = \epsilon' + \epsilon/2 \)
5. Compute upper bound \( \hat{\beta} \) and suboptimal rotation \( \hat{\alpha} \) for problem \( \mathbb{P} \), on data indexed by \( \mathbb{N}\).
6. \( \epsilon' = \epsilon' + \epsilon/2 \)
7. \( i = k \)
8. if \( i > \hat{\beta} \) then
   9. \( \hat{\beta} = \hat{\beta} + \epsilon' \)
10. end if
11. \( \epsilon' = \epsilon' + \epsilon/2 \)
12. end for
13. \( \epsilon' = \epsilon' + \epsilon/2 \)
14. end for

RESULTS ON SYNTHETIC DATA

RESULTS ON REAL DATA

REFERENCES

CONCLUSION

We have presented a guaranteed outlier removal technique for rotation search, in the sense that any datum it removes cannot be in the globally optimal solution. Based on simple geometric operations, our algorithm is deterministic and efficient. Experiments show that, by significantly reducing a significant amount of the outliers, our method greatly speeds up globally optimal rotation search.