Semester Report SS03 of Oliver Klein

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Field of Research:	Computational Geometry and Combinatorics
Topic:	Matching Shapes with a Reference Point
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Field of Research

Given two sets $A, B \subset \mathbb{R}^2$, one can be interested how these sets resemble each other. One good measure of resemblance is the Hausdorff-Distance. This distance is defined as the smallest ε such that the euclidian distance from every point of A to its nearest point of B is at most ε and vice versa. For the reason of measuring the resemblance, one has to determine the minimal Hausdorff-Distance under a given set of transformations. For example, these transformations can be translations, rigid motions (translations and rotations) or even similarity transformations (rigid motions and scalings). Algorithms for determining the optimal transformation to minimize the Hausdorff-Distance are known in all three cases, but the runtime of these algorithms seems not to be sufficient for several applications.

To decrease the runtime, the authors of [1] use reference points to get an approximation for the problem. A reference point is a special point given by each of the two sets. In [2] the Steiner point is shown to be a reference point which induces an approximation algorithm with approximation ratio $\frac{4}{\pi}$ with respect to translations. For other transformations, this algorithm can be used in a natural way to reduce several degrees of freedom. Additionally, it is shown that any approximation algorithm using reference points can not achieve a ratio better than $\frac{4}{\pi}$; this fact is shown even if only convex subsets of $\mathbb{R}^2$ are considered. However, the proof of the lower bound is not constructive. So far, examples showing good lower bounds are only known in the non-convex case and the bound given by these is not as strong as the true lower bound.

We are now interested in either finding better examples which use convex sets only or examples using non-convex sets, which proof a stronger lower bound. Another problem we would like to solve is the extension to higher dimensions.

Activities

- Attended the block course “Applied Network Optimization”, March 31 - April 11, 2003 at TU Berlin
- Attended the lecture “Algorithmische Geometrie” by Dr. Christian Knauer at FU Berlin
- Attended the “Monday Lectures and Colloquia” of the Graduate Program
- Attended the “Mittagsseminar Theoretische Informatik” at FU Berlin. Presentation of the talk
  - “A new (slow) algorithm for Perfect Matching” based on [3]
- Attended the workshop “General ECG Workshop and Workshop on Software”, June 25 to 26, 2003 at FU Berlin
- Attended the “31. Berliner Algorithmen Tag”, Juli 11, 2003 at HU Berlin

Preview

- Attend the “Comprehensive Annual Workshop 2003”, September 29 to October 1, 2003 in Neustrelitz
- Attend the “Fall School on Computational Geometry”, October 2 to 4, 2003 in Neustrelitz
- Attend the “Blockcourse Berlin-Prague 2004”, January 2004 at Charles University, Prague

References

[1] H. Alt, B. Behrends, J. Blömer: ’Approximate matching of polygonal shapes’, Proceedings 7th Annual Symposium on Computational Geometry, 1991, 186-193

[2] O. Aichholzer, H. Alt, G. Rote: 'Matching Shapes with a Reference Point', in International Journal of Computational Geometry and Applications, Volume 7, pages 349-363, August 1997

[3] N. Linial, A. Samorodnitsky, A. Wigderson: 'A Deterministic Strongly Polynomial Algorithm for Matrix Scaling and Approximate Permanents', STOC 1998, pages 644-652