CSc645 — Geometric Matching and Applications to Biology

August 23, 2004

In the seminar we discuss different methods for comparing and matching objects in different geometric settings, with an emphasis on applications to Biology. In particular, we discuss the following subjects (with a temporary list of relevant publications to each subject).

1. Matching sets of points (analytical methods) [CDEK99, CGH+93]
2. Geometric hashing [WR97]
3. Hausdorff distance between surfaces [AHPSW03, KW04]
4. Matching sets of points (approximated methods) [CS98].
5. Curve matching. Frechet distance ([AG95]), Dynamic Time Wrapping and Signature Verification ([MP98]). Applications of Frechet distance to GIS [AERW03].
6. Geometric methods of protein docking [SS02, HMWN02, Len95, GW00, FLWN95]
7. Methods for surface matching — Iterative closets pair and variants [TL94, ZHHK04]. The Michelangelo project [LPC+00].
8. Algorithms for Electrophoresis Gel Analysis [EHK+01] .
9. Algorithms for Drug Design [FKL+97].

References

[AERW03] Helmut Alt, Alon Efrat, Gunter Rote, and Carola Wenk. Matching planar maps. In *Proceedings of the fourteenth annual ACM-SIAM symposium on Discrete algorithms*, pages 589–598, 2003.

[AG95] H. Alt and M. Godau. Computing the Fréchet distance between two polygonal curves. *Internat. J. Comput. Geom. Appl.*, 5:75–91, 1995.

[AHPSW03] Pankaj K. Agarwal, Sariel Har-Peled, Micha Sharir, and Yusu Wang. Hausdorff distance under translation for points and balls. In *Proceedings of the nineteenth annual symposium on Computational geometry*, pages 282–291. ACM Press, 2003.

[CDEK99] L. P. Chew, D. Dor, A. Efrat, and K. Kedem. Geometric pattern matching in d-dimensional space. *Discrete Comput. Geom.*, 21:257–274, 1999.

[CGH+93] P. P. Chew, M. T. Goodrich, D. P. Huttenlocher, K. Kedem, J. M. Kleinberg, and D. Kravets. Geometric pattern matching under euclidean motion. In *Proc. Fifth Canadian Conference on Computational Geometry*, pages 151–156, 1993.

[CS98] David E. Cardoze and Leonard J. Schulman. Pattern matching for spatial point. In *Proceedings of the 39th Annual Symposium on Foundations of Computer Science*, pages 156–165, 1998.

[EHK+01] Alon Efrat, Frank Hoffman, Klaus Kriegel, Christof Schultz, and Carola Wenk. Geometric algorithms for the analysis of 2d-electrophoresis gels. In *Proceedings of the fifth annual international conference on Computational biology*, pages 114–123. ACM Press, 2001.

[FKL+97] P. W. Finn, L. E. Kavraki, J.-C. Latombe, R. Motwani, C. Shelton, S. Venkatasubramanian, and A. Yao. Rapid: randomized pharmacophore identification for drug design. In *Proceedings of the thirteenth annual symposium on Computational geometry*, pages 324–333. ACM Press, 1997.

[FLWN95] D. Fischer, S. L. Lin, H. Wolfson, and R. Nussinov. A geometry-based suite of molecular docking processes. *J. Mol. Biol.*, 248:459–477, 1995.

[GW00] B. B. Goldman and W. T. Wipke. QSD: quadratic shape descriptors. 2. Molecular docking using quadratic shape descriptors (QSDock). *Proteins*, 38:79–94, 2000.

[HMWN02] I. Halperin, B. Ma, H. Wolfson, and R. Nussinov. Principles of docking: An overview of search algorithms and a guide to scoring functions. *Proteins: Structure, Function, and Genetics*, 47:409 – 443, 2002.

[KW04] V. Koltun and C. Wenk. On the overlay of envelopes of piecewise linear functions and the matching of polyhedral terrains. In *Proc. 9th Scand. Workshop Algorithm Theory*, 2004.

[Len95] H. Lenhof. An algorithm for the protein docking problem. *Bioinformatics: From Nucleic Acids and Proteins to Cell Metabolism*, pages 125–139, 1995.

[LPC+00] Marc Levoy, Kari Pulli, Brian Curless, Szymon Rusinkiewicz, David Koller, Lucas Pereira, Matt Ginzton, Sean Anderson, James Davis, Jeremy Ginsberg, Jonathan Shade, and Duane Fulk. The digital michelangelo project: 3d scanning of large statues. In *Proceedings of the 27th annual conference on Computer graphics and interactive techniques*, pages 131–144. ACM Press/Addison-Wesley Publishing Co., 2000.

[MP98] Mario E. Munich and Pietro Perona. Camera-based id verification by signature tracking. In *Computer Vision - ECCV'98, 5th European Conference on Computer Vision*, volume 1406 of *Lecture Notes in Computer Science*. Springer, 1998.

[SS02] G. R. Smith and M. J. E. Sternberg. Prediction of protein-protein interactions by docking methods. *Current Opinion in Structural Biology*, 12:29–35, 2002.

[TL94] Greg Turk and Marc Levoy. Zippered polygon meshes from range images. In *Proceedings of the 21st annual conference on Computer graphics and interactive techniques*, pages 311–318. ACM Press, 1994.

[WR97] Haim J. Wolfson and Isidore Rigoutsos. Geometric hashing: An overview. *IEEE Comput. Sci. Eng.*, 4(4):10–21, 1997.

[ZHHK04] Haitao Zhang, Olaf Hall-Holt, and Arie Kaufman. Range image registration via probability field. In *Computer Graphics International (CGI'04)*, pages 546–552, 2004.