

# Semester Report WS05 of Maike Buchin

Name: Maike Buchin  
Supervisor: Helmut Alt  
Field of Research: Computational Geometry  
Topic: Fréchet Distance of Triangulated Surfaces  
PhD Student in the program since May 2003

## Field of Research and Results

My field of research is computational geometry. I am interested in measuring the similarity of triangulated surfaces. For measuring the similarity I use a metric that is based on parametrizations of the surfaces, the *Fréchet Metric*. Measuring the similarity of surfaces has applications in Computer Vision, Computer Graphics, and Geo-Visualization. It is an important aspect of *Shape Matching*, i.e. given two geometric shapes, transform one shape s.t. the two are most similar.

Computing the Fréchet distance between triangulated surfaces is known to be NP-hard [2] and the aim of my thesis is to learn more about its computability. Previously I have shown that it is semi-computable. This semester, during a research visit with Carola Wenk and Kevin Buchin, we started working on the Fréchet distance for a very restricted but important class of triangulated surfaces: simple polygons. For these we have given an algorithm for computing the Fréchet distance in polynomial time [1].

Also I have worked on the computability of weaker variants of the Fréchet distance. In the definition of the Fréchet distance one takes the infimum over all orientation-preserving homeomorphisms on the unit square. This makes the Fréchet distance hard to compute. If we instead take the infimum over all surjective continuous functions it may become easier. For an (possibly) even weaker variant, where one takes the infimum over all connected components in the *free space diagram*, which project totally onto both parameter spaces, I have given a polynomial time algorithm. Two main open questions remain which I hope to solve soon: Do the two weaker variants coincide and are they metrics?

## Activities

### Talks

- *Minimizing the Total Absolute Gaussian Curvature in a Terrain is Hard*  
17th Canadian Conference on Computational Geometry in Windsor, Canada, August 11, 2005
- *Comparing Geometric Shapes using the Fréchet Distance*  
Colloquium of the Computer Science Department at the University of Texas at San Antonio, August 26, 2005
- *Computing the Fréchet Distance between Simple Polygons*  
Noon Seminar of the Theoretical Computer Science Group at Free University Berlin, September 15, 2005
- *Fréchet Distance of Curves and Surfaces*  
5th Workshop on Combinatorics, Geometry, and Computation on Hiddensee, September 27, 2005
- *Cone Based Topology Control for Ad Hoc Networks*  
Noon Seminar of the Theoretical Computer Science Group at Free University Berlin, November 15, 2005
- *Topology Control for Ad Hoc Networks*  
GI-Dagstuhl Research Seminar, November 23, 2005
- *Weaker variants of the Fréchet distance*  
Noon Seminar of the Theoretical Computer Science Group at Free University Berlin, January 31, 2006

### Attended conferences and workshops

- *17th Canadian Conference on Computational Geometry*  
in Windsor, Canada, August 10 – 12, 2005
- *European Conference on Combinatorics, Graph Theory, and Applications*  
at Technical University Berlin, September 5 – 9, 2005
- *5th Workshop on Combinatorics, Geometry, and Computation*  
on Hiddensee, September 25 – 28, 2005

- *2nd International Symposium on Voronoi Diagrams in Science and Engineering* in Seoul, Korea, October 10 – 13, 2005
- *Algorithms for Sensor and Ad Hoc Networks*  
GI-Dagstuhl Research Seminar, November 23 – 25, 2005

### Attended lectures and seminars

- *Monday Lectures and Colloquia*  
of CGC in Berlin
- *Noon Seminar* of the Theoretical Computer Science Group  
at Free University Berlin

### Research Visit

- Research visit at the University of Texas at San Antonio  
with Dr. Carola Wenk, August 15 – 26, 2005

### Preview

In the next semester I plan to finish my PhD.

### References

- [1] Kevin Buchin, Maike Buchin, and Carola Wenk. Computing the Fréchet distance between simple polygons in polynomial time. In *Proceedings of the 22nd ACM Symposium on Computational Geometry (SOCG)*, 2006. To appear.
- [2] Michael Godau. *On the complexity of measuring the similarity between geometric objects in higher dimensions*. PhD thesis, Freie Universität Berlin, Germany, 1998.