

Computational Topology (Seminar)

In very general terms topology is concerned with the connectivity of spaces. Analyzing their connectivity allows to classify shapes and often also (by including some geometry) to identify interesting features. Classifiers are topological invariants like Betti numbers, homology and cohomology groups. We will discuss how to compute such invariants and look at examples and applications from solid- and bio-geometric modeling and also from machine learning.

When and where

Wednesdays from 9.15am to 11am, MPI building room 023

Lecturers

[Joachim Giesen](#) and [Michael Sagraloff](#).

Literature

You get a good about the content of the seminar from the book: Afra Zomorodian, *Topology for Computing*, Cambridge Monographs on Applied and Computational Mathematics (2005). See also [Afra's thesis](#).

We will provide and discuss other papers in our first meeting.

News

16.10.2006: The first seminar will take place on Wednesday Oct. 25. At our first meeting we will give a short introduction in topology and why and how it can be helpful in solid and bio-geometric modeling and learning. We also will present papers suited for presentation.

23.10.2006: Here are the topics we propose for the seminar. We roughly divided the seminar in three parts.

Filtration of Complexes.

- Simplicial complexes, Cech and Rips complexes ([Afra's notes](#)).
- [Delaunay triangulation and alpha shapes](#).
- [Flow complex and flow shapes](#).
- [Witness complex](#).

Homology and persistence.

- Simplicial homology (Afra's book, Chapter 4).
- [Computing homology for sub-complexes of the 3D Delaunay triangulation](#).
- Computing homology. ([Afra's notes](#)).

- Computing persistent homology (Afra's book, Chapter 7).
- [Computing Betti numbers via combinatorial Laplacians.](#)

Applications.

- [Pockets in proteins.](#)
- [Surface reconstruction and medial axis.](#)
- [Persistence barcodes.](#)

28.10.2006: Note the change of time. The seminar now takes place in the morning.

5.11.2006: Here is the schedule. We tried to respect your preferences whenever possible.

- 8.11.2006: Joachim Giesen and Michael Sagraloff: *Introduction*
- 15.11.2006: Gaurav Pandey: *Simplicial Complexes, Cech and Rips Complex*
- 22.11.2006: Marjan Celikik: [Alpha Shapes](#)
- 29.11.2006: Momchil Rusinov: *Witness Complex*
- 6.12.2006: Madhusudan: *Flow Complex*
- 13.12.2006: Oana Ciobotaru: *Simplicial Homology*
- 20.12.2006: Ivan Popov & Levan Kasradze: *Computing Homology*
- 10.1.2007: Miguel Granados & Biliiana Taneva: *Computing Persistent Homology*
- 17.1.2007: Victor Amaya: *Computing Betti Numbers (via Laplacians)*
- 24.1.2007: Marin Katov: *Pockets in Proteins*
- 31.1.2007: Emanuele Dettori & Andreas Gross: *Surface Reconstruction & Medial Axis*

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