

DSC 214

Topological Data Analysis

Final Remarks

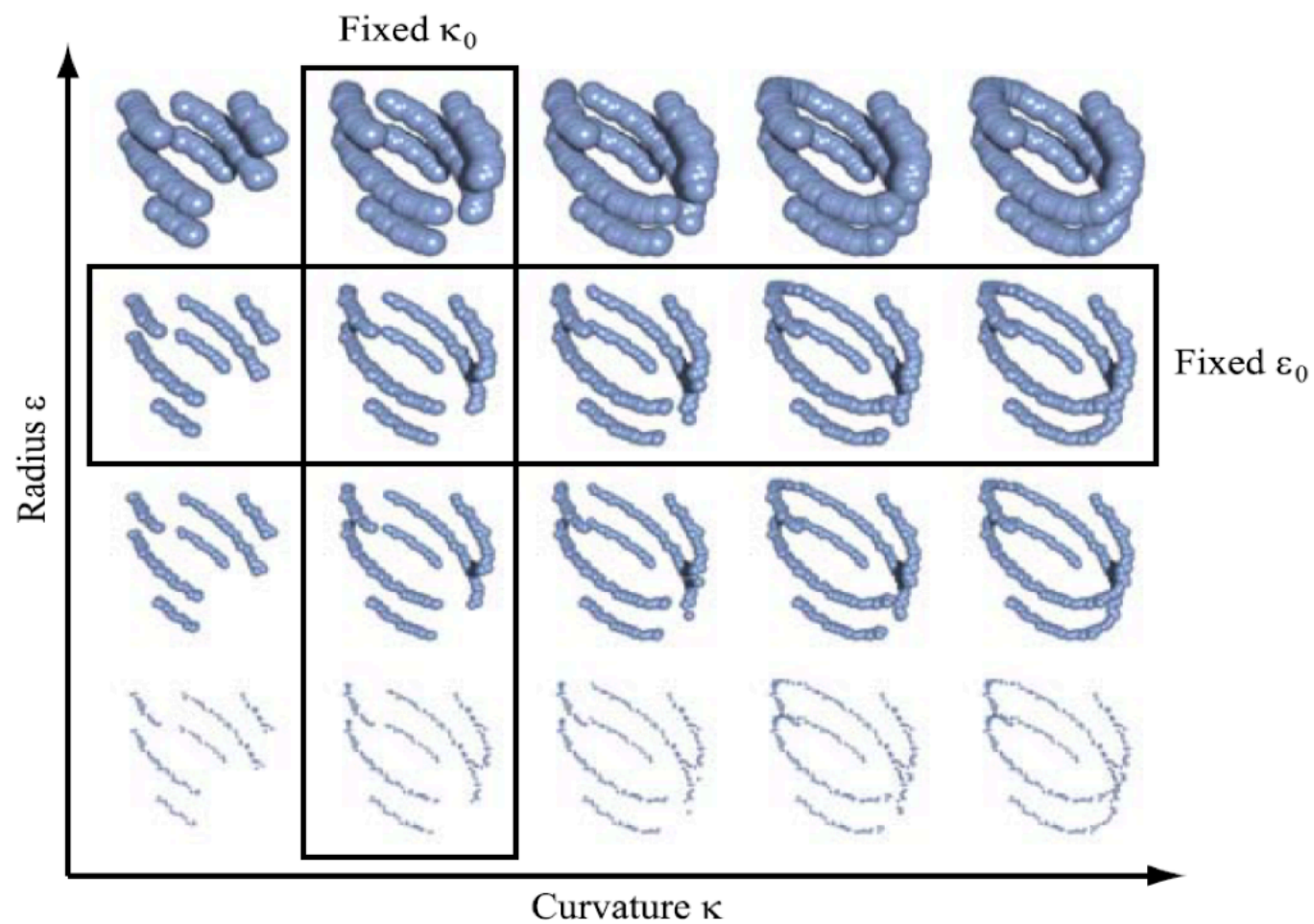
Instructor: Zhengchao Wan

What we've learned

- ▶ Persistent homology - fundamental concept in TDA
 - ▶ Persistent homology for PCD homology inference
 - ▶ Noise handling and data sparsification
 - ▶ Machine learning with PH - vectorization, kernel, NN, topological prior
- ▶ Other topics
 - ▶ Mapper and Reeb graph - topological summary of large data
 - ▶ DMT - a combinatorial Morse theory complementing TDA

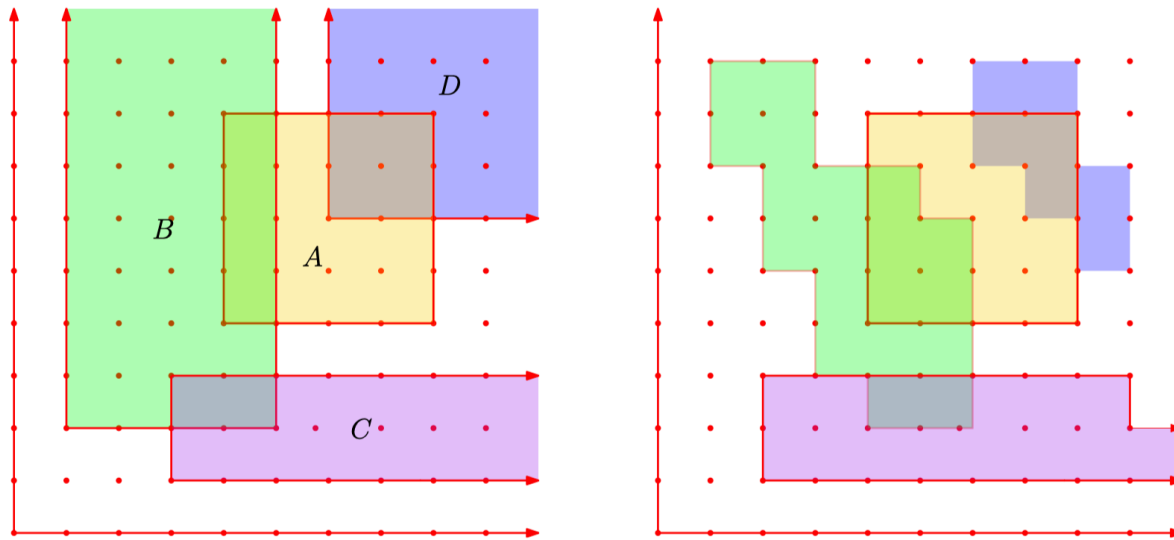
Other research topics in TDA

Multiparameter persistence

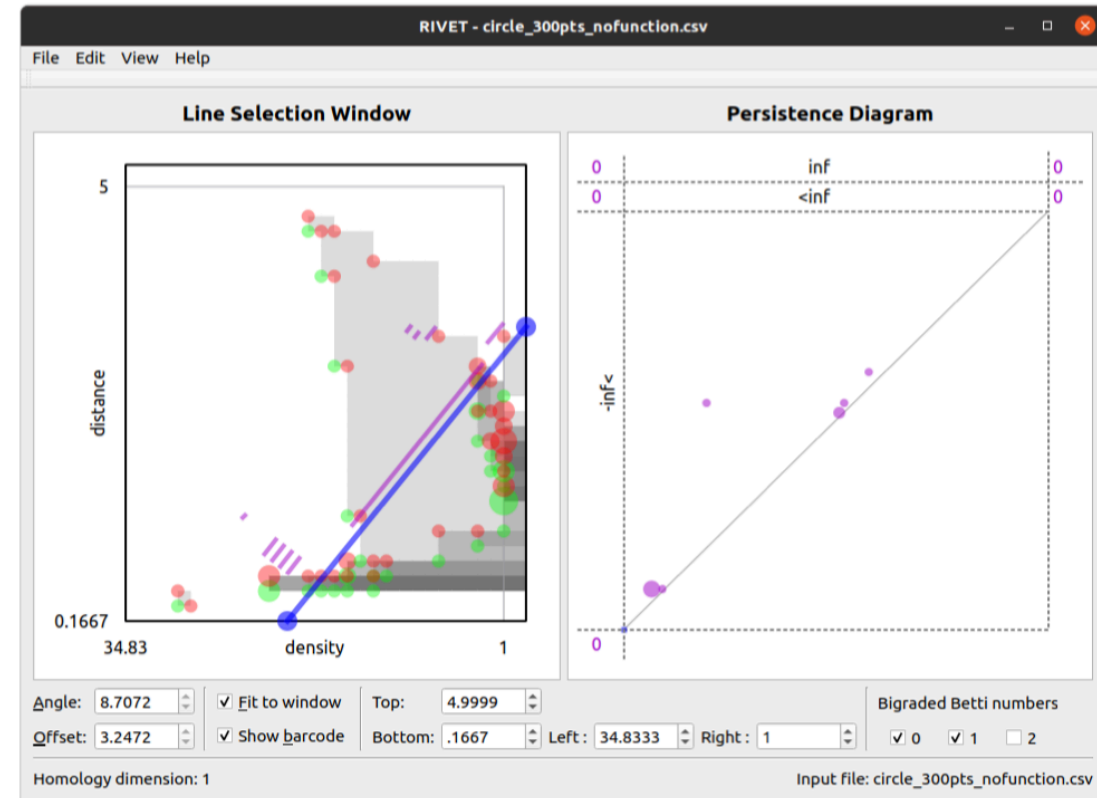


Multiparameter persistence

- Decomposition can be very complicated



- Read more in Dey and Wang's book

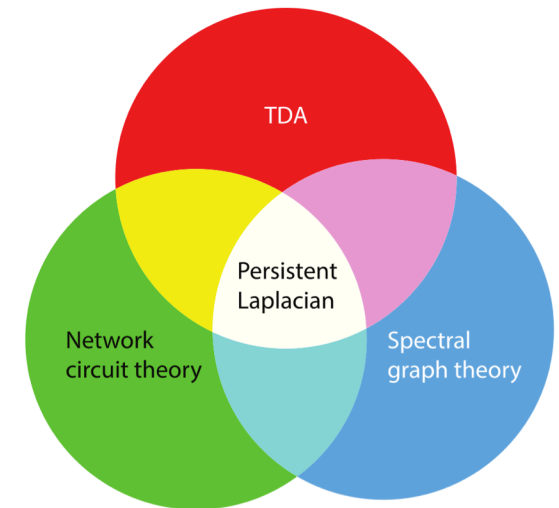


Beyond homology

- ▶ Homology is not strong enough to tell apart different homotopy types
- ▶ Some stronger topological invariants
 - ▶ Homotopy group [[Mémoli, Zhou 2022](#)]
 - ▶ Cohomology rings [[Mémoli, Stefanou and Zhou 2022](#)]

Persistent Laplacian - a spectral approach to TDA

- ▶ Graph Laplacian can recover the number of connected components in a graph
- ▶ Higher dimensional Laplacian can recover higher dimensional Betti number
- ▶ Persistent Laplacian can recover persistence Betti number
- ▶ Check out [[Mémoli, W., Wang 2022](#)]



Final project

- ▶ Due June 15, 2023 (Thursday)
- ▶ Final report (4+ pages): describe the motivation of your project, what you have done, and your findings.
- ▶ Survey (10+ pages): identify the problem, describe the motivation, and methods used in the literature, compare these methods, identify drawbacks in these methods/possible future directions
- ▶ A 10-min video recorded via zoom (send me the link)

FIN