Signal Filtering and Persistent Homology: An Illustrative Example

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Supported by the Priority Program SPP 1324
of the Deutsche Forschungsgemeinschaft (DFG)

Abstract

During the last few years, recent applications of differential geometry and algebraic topology have provided powerful tools for the analysis of point cloud datasets $X = \{x_i\}_{i=1}^m \subset \mathbb{R}^n$. In particular, recent methods for nonlinear dimensionality reduction were inspired by fundamental concepts in differential geometry. In parallel developments, applied topology has delivered new methods for computing homological information of a point cloud data X. In this context, an important task is to understand the interaction of these novel tools with well-established signal analysis methods such as wavelets, Fourier transforms, etc. In this talk, we present illustrative examples describing topological effects when applying convolution filters to signals x_i in a dataset X. We use persistent homology as main tool for measuring topological properties.