Dimensionality Reduction and Topological Tools in Signal Analysis

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During the last few years recent developments in differential geometry and algebraic topology have provided powerful tools for the analysis of datasets embedded in high-dimensional spaces. 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. In this context, an important task is to understand the interaction of these novel tools with well-established signal analysis methods such as wavelets or Fourier transforms. In this talk, we first review relevant concepts before presenting a general framework for signal analysis based on geometrical tools. We also address some applications in signal separation and classification. The talk is based on ongoing joint work with Armin Iske.