Inverse Computational Spectral Geometry

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Abstract

In the last decades, geometry processing has attracted a growing interest thanks to the wide availability of new devices and software that make 3D digital data available and manipulable to everyone. Typical issues faced by geometry processing algorithms include the variety of discrete representations for 3D data (point clouds, polygonal or tet-meshes and voxels), or the type of deformation this data may undergo. Powerful approaches to address these issues come from looking at the spectral decomposition of canonical differential operators, such as the Laplacian, which provides a rich, informative, robust, and invariant representation of the 3D objects.

The focus of this tutorial is on computational spectral geometry. We will offer a different perspective on spectral geometric techniques, supported by recent successful methods in the graphics and 3D vision communities and older but notoriously overlooked results. We will discuss both the "forward" path typical of spectral geometry pipelines (e.g. computing Laplacian eigenvalues and eigenvectors of a given shape) with its widespread applicative relevance, and the inverse path (e.g. recovering a shape from given Laplacian eigenvalues, like in the classical "hearing the shape of the drum" problem) with its ill-posed nature and the benefits showcased on several challenging tasks in graphics and geometry processing.

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