Diffusion Geometry in Shape Analysis

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Abstract
Over the last decade, the intersections between 3D shape analysis and image processing have become a topic of increasing interest in the computer graphics community. Nevertheless, when attempting to apply current image analysis methods to 3D shapes (feature-based description, registration, recognition, indexing, etc.) one has to face fundamental differences between images and geometric objects. Shape analysis poses new challenges that are non-existent in image analysis. The purpose of this tutorial is to overview the foundations of shape analysis and to formulate state-of-the-art theoretical and computational methods for shape description based on their intrinsic geometric properties. The emerging field of diffusion geometry provides a generic framework for many methods in the analysis of geometric shapes and objects. The tutorial will present in a new light the problems of shape analysis based on diffusion geometric constructions such as manifold embeddings using the Laplace-Beltrami and heat operator, heat kernel local descriptors, diffusion and commute-time metrics.