Technion-Israel Institute of Technology

Computer Science Department

Center for Graphics and Geometric Computing

CGGC Seminar

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GWCNN: A Metric Alignment Layer for Deep Shape Analysis

Deep neural networks provide a promising tool for incorporating semantic information in geometry processing applications. Unlike image and video processing, however, geometry processing requires handling unstructured geometric data, and thus data representation becomes an important challenge in this framework. Existing approaches tackle this challenge by converting point clouds, meshes, or polygon soups into regular representations using, e.g., multi-view images, volumetric grids or planar parameterizations. In each of these cases, geometric data representation is treated as a fixed pre-process that is largely disconnected from the machine learning tool. In contrast, we propose to optimize for the geometric representation during the network learning process using a novel metric alignment layer.

Our approach maps unstructured geometric data to a regular domain by minimizing the metric distortion of the map using the regularized Gromov–Wasserstein objective. This objective is parameterized by the metric of the target domain and is differentiable; thus, it can be easily incorporated into a deep network framework. Furthermore, the objective aims to align the metrics of the input and output domains, promoting consistent output for similar shapes. We show the effectiveness of our layer within a deep network trained for shape classification, demonstrating state-of-the-art performance for non rigid shapes.

Deblurring and Denoising of Maps between Shapes

Shape correspondence is an important and challenging problem in geometry processing. Generalized map representations, such as functional maps, have been recently suggested as an approach for handling difficult mapping problems, such as partial matching and matching shapes with high genus, within a generic framework.

While this idea was shown to be useful in various scenarios, such maps only provide low frequency information on the correspondence. In many applications, such as texture transfer and shape interpolation, a high quality pointwise map that can transport high frequency data between the shapes is required. We name this problem map deblurring and propose a robust method, based on a smoothness assumption, for its solution. Our approach is suitable for non-isometric shapes, is robust to mesh tessellation and accurately recovers vertex-to-point, or precise, maps. Using the same framework we can also handle map denoising, namely improvement of given pointwise maps from various sources. We demonstrate that our approach outperforms the state-of-the-art for both deblurring and denoising of maps on benchmarks of non-isometric shapes, and show an application to high quality intrinsic symmetry computation.

The lecture will be held on Sunday, 18.6.2017, at 13:30, Taub 601

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