

Learning 3D Keypoint Descriptors for Non-Rigid Shape Matching

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Abstract. In this paper, we present a novel deep learning framework that derives discriminative local descriptors for 3D surface shapes. In contrast to previous convolutional neural networks (CNNs) that rely on rendering multi-view images or extracting intrinsic shape properties, we parameterize the multi-scale localized neighborhoods of a keypoint into regular 2D grids, which are termed as ‘geometry images’. The benefits of such geometry images include retaining sufficient geometric information, as well as allowing the usage of standard CNNs. Specifically, we leverage a triplet network to perform deep metric learning, which takes a set of triplets as input, and a newly designed triplet loss function is minimized to distinguish between similar and dissimilar pairs of keypoints. At the testing stage, given a geometry image of a point of interest, our network outputs a discriminative local descriptor for it. Experimental results for non-rigid shape matching on several benchmarks demonstrate the superior performance of our learned descriptors over traditional descriptors and the state-of-the-art learning-based alternatives.

Keywords: Local feature descriptor · Triplet CNNs · Non-rigid Shapes

1 Introduction

Designing local descriptors for 3D surface points is within common interests in both computer vision and computer graphics communities. Typically, a local descriptor refers to an informative representation stored in a multi-dimensional vector that describes the local geometry of the shape around a keypoint. It plays a crucial role in a variety of vision tasks, such as shape correspondence [1, 2], object recognition [3], shape matching [4, 5], shape retrieval [6, 7], and surface registration [8], to name a few.

Over the last decades, a large number of local descriptors have been actively investigated by the research community. Despite the recent interests, however, designing discriminative and robust descriptors is still a non-trivial and challenging task. Early works focus on deriving shape descriptors based on hand-crafted

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