SELF-SUPERVISED LEARNING OF DENSE SHAPE CORRESPONDENCE
Halimi Oshri, Litany Or, Rodolà Emanuele, Bronstein Alex, Kimmel Ron

Abstract
We introduce the first completely unsupervised correspondence learning approach for deformable 3D shapes. Key to our model is the understanding that natural deformations (such as changes in pose) approximately preserve the metric structure of the surface, yielding a natural criterion to drive the learning process toward distortion-minimizing predictions. On this basis, we overcome the need for annotated data and replace it by a purely geometric criterion. The resulting learning model is class-agnostic, and is able to leverage any type of deformable geometric data for the training phase. In contrast to existing supervised approaches which specialize on the class seen at training time, we demonstrate stronger generalization as well as applicability to a variety of challenging settings. We showcase our method on a wide selection of correspondence benchmarks, where we outperform other methods in terms of accuracy, generalization, and efficiency.

Unsupervised Learning Process Analysis

Unsupervised Training Process
Unsupervised loss (left axis) and supervised loss (right axis) measured during the unsupervised training process, in logarithmic scale. While training target is the unsupervised loss, the supervised loss is decreased as a by-product.

Supervised Loss
Unsupervised Loss

Unsupervised and supervised network results, evaluated on synthetic Faust intra-subject pairs. Performance is practically the same, and we zoom in to show the separate curves.

Unsupervised Loss

The unsupervised network was trained on just 3 poses of Deadpool and inference results are shown for unseen poses; Supervised FMNet [1] was trained on FAUST synthetic human dataset (80 shapes); The axiomatic method runs one hour for every pair of shapes, while inference of the unsupervised network takes less than a second.

Synthetic Shapes

Real Scans

Average/Worst Error (cm)
Supervised 2.44 26.16
Unsupervised 2.51 24.35

Unsupervised Results

References