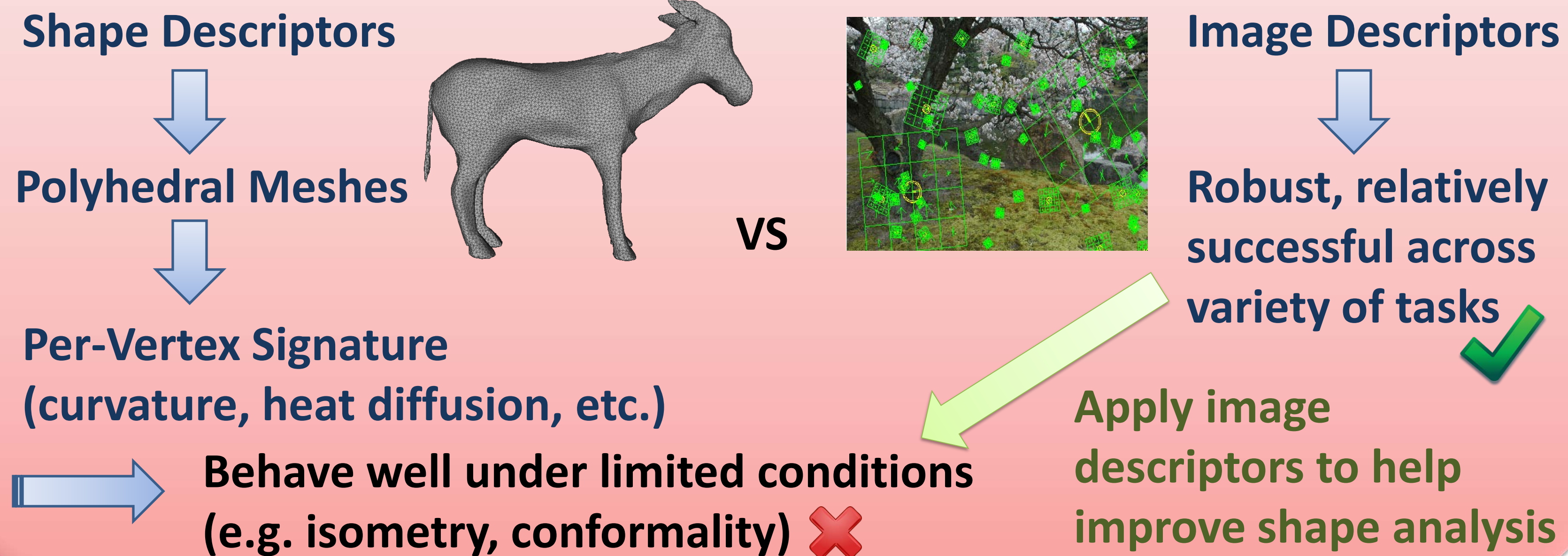


Using Image Descriptors to Guide Shape Analysis

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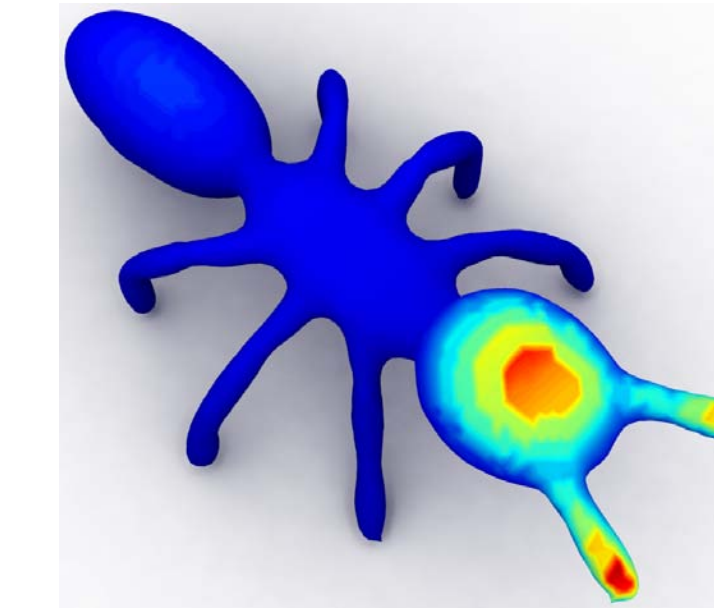
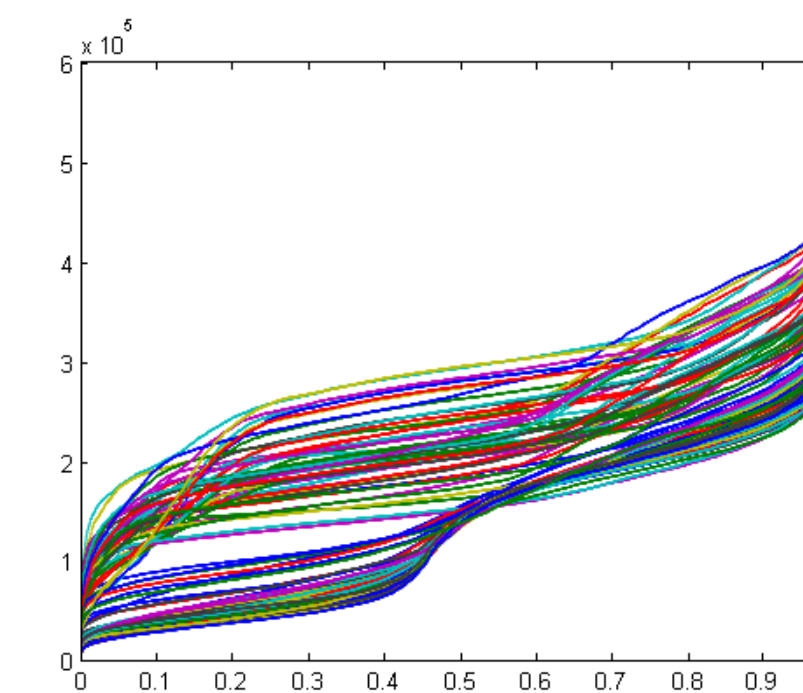
Motivation



Experiments and Results

Dataset: The Surface Correspondence Benchmark database¹ where we focus on triangle meshes from “watertight shape retrieval” subset.

Uniqueness: For a given vertex, we can analyze how discriminative a descriptor is by examining the distribution of distances between different vertices’ descriptors.



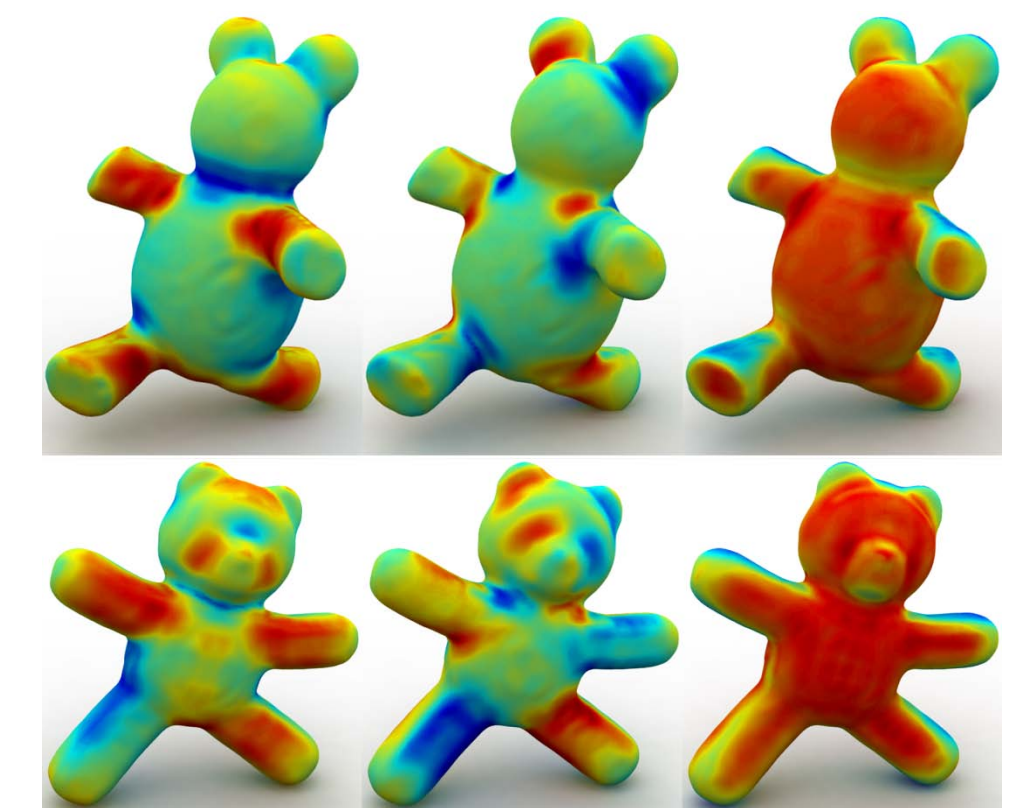
(left) Distance between vertex descriptor. Each curve represents a single vertex from the ant mesh.
(right) A Gaussian distance to the descriptor of the tip of the front right antenna is shown as a function across the surface. The best matches are on the antennae and the head.

Surface Mapping: Using the descriptor to understand a collection of shapes requires that it is preserved from shape to shape.

Models	Accuracy ratio
Teddies	4.1069
Ants	5.2197
Humans	3.9672

PCA technique applied to two models for mapping.

Ratio of the distance to the ground truth target descriptor to the closest



Methodology

Input mesh $\Sigma = (\text{vertices } V, \text{triangles } T)$

Render $|V|$ 50x50-patches, one per vertex. Camera is set at distance δ from the vertex with the vertex at the center of the image.

Generate image descriptors For each patch, compute one SIFT per pixel. Average all the descriptors to represent the descriptor for the corresponding vertex.

Dimension Reduction Perform PCA on the collection of descriptors to project the \mathbb{R}^{128} space of SIFT to lower dimension. This helps reduce noise and highlight the most prominent parts of the descriptor.

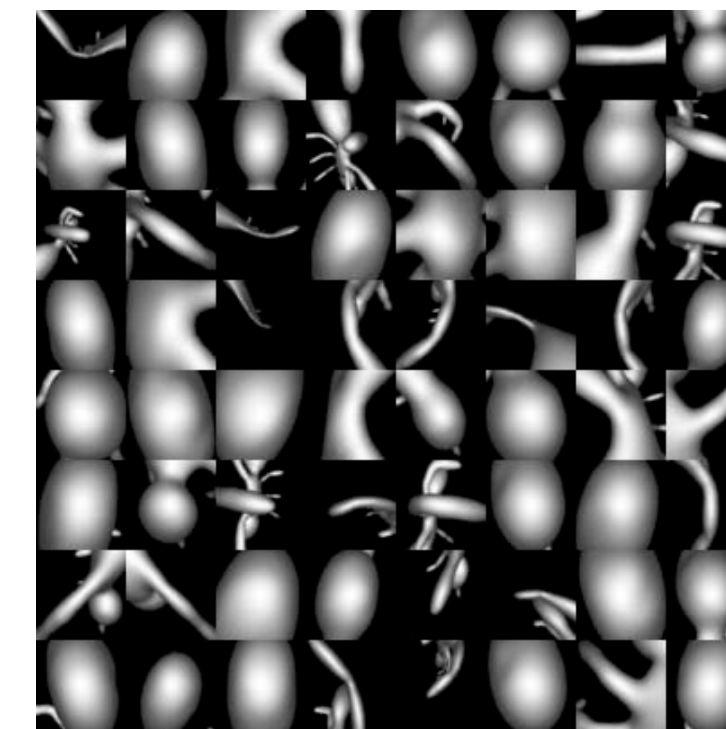
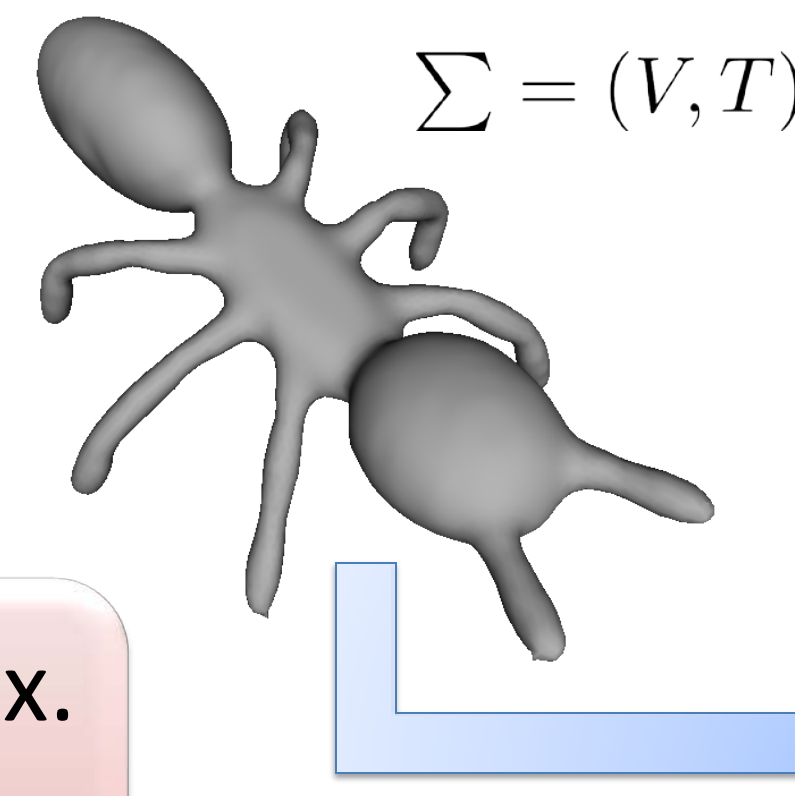
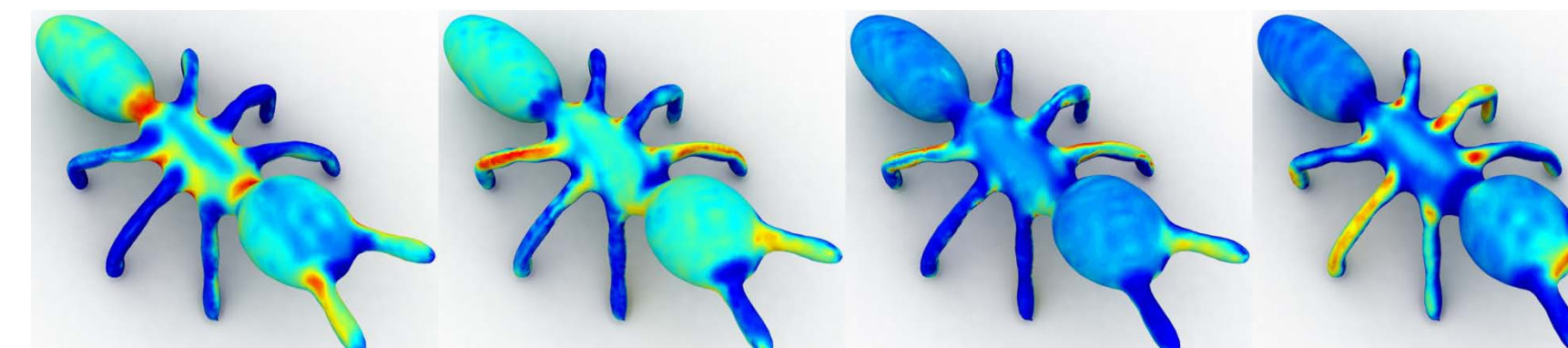
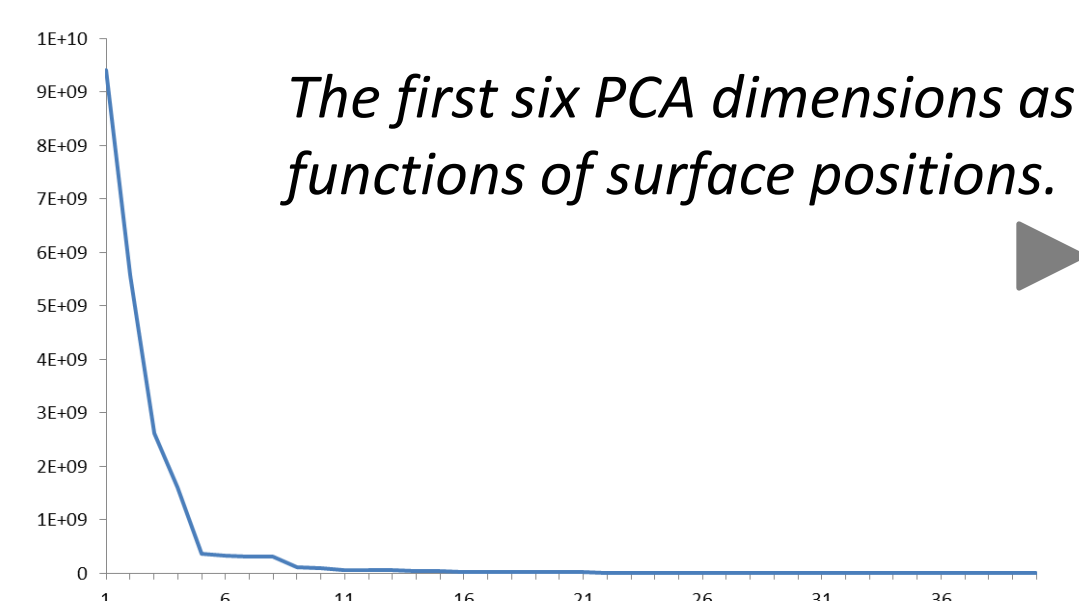


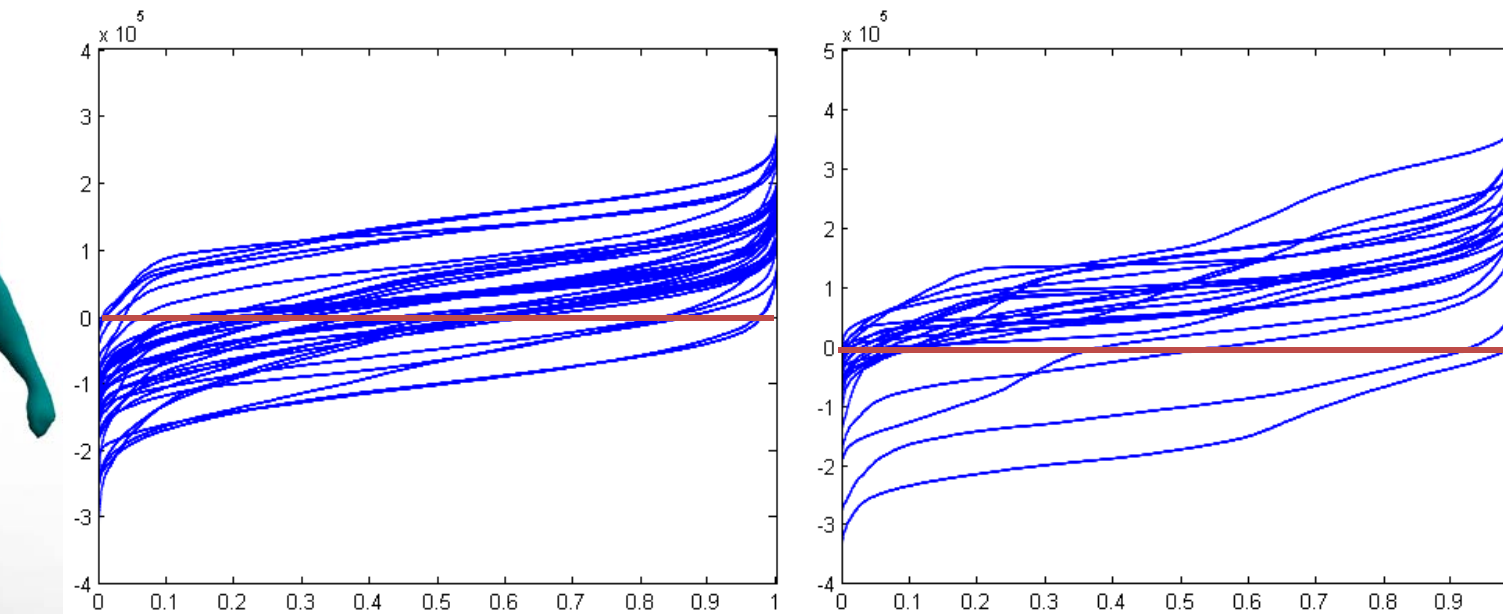
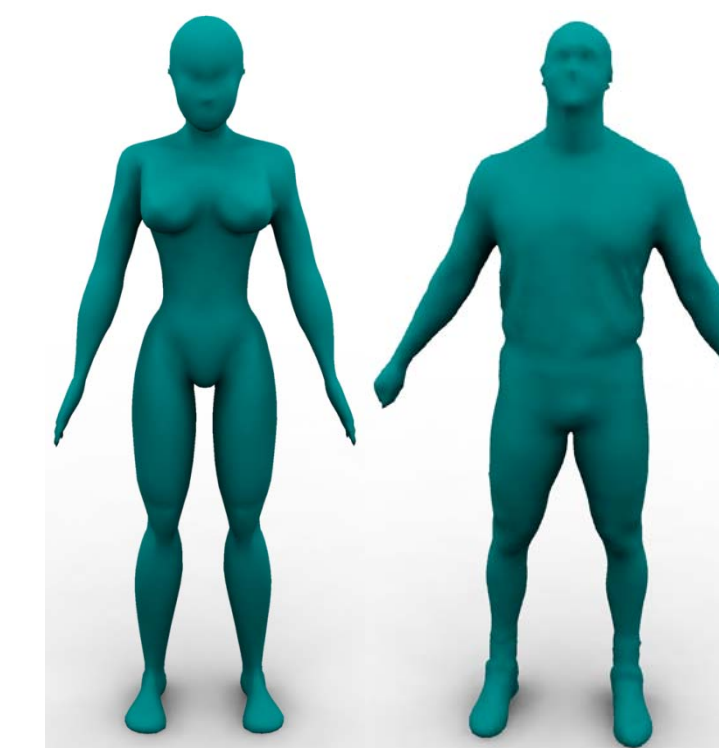
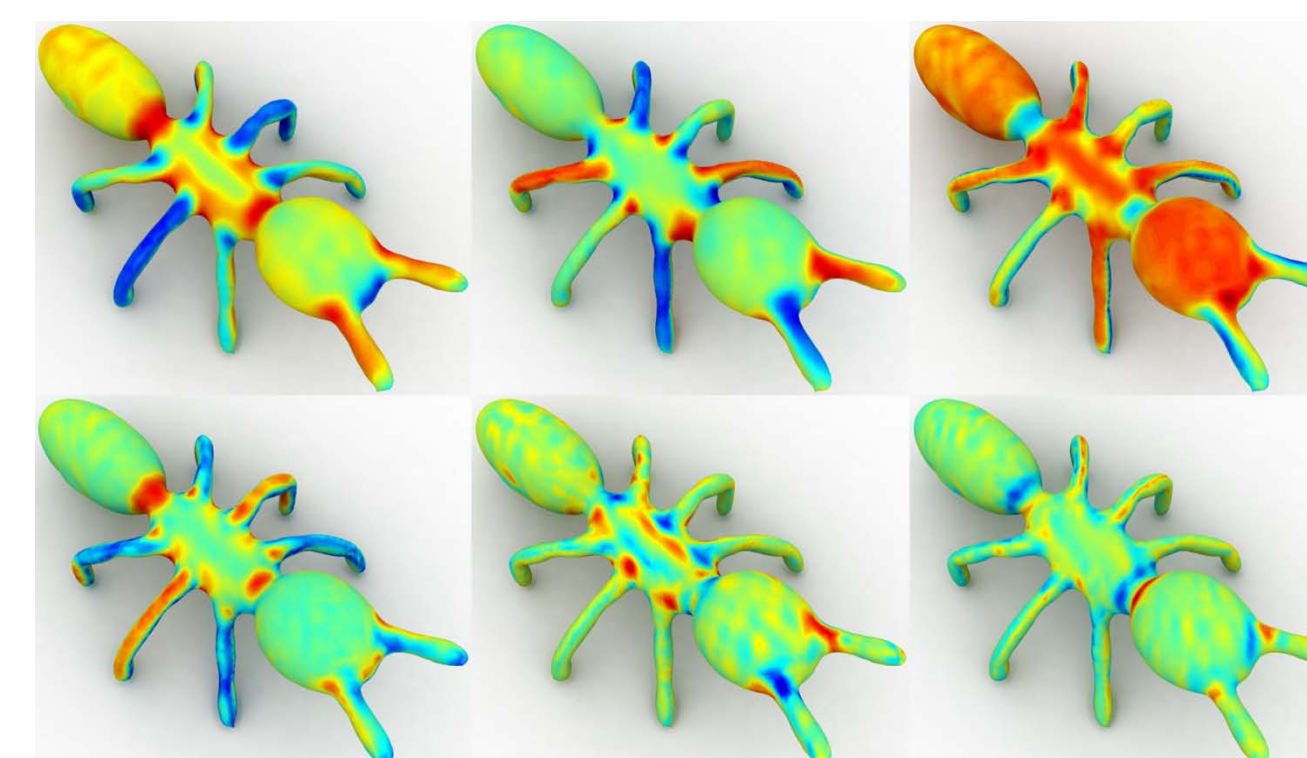
Image patches used to generate per-vertex SIFT descriptors. Note that camera orientation issue can be ignored with SIFT being rotational-invariant.



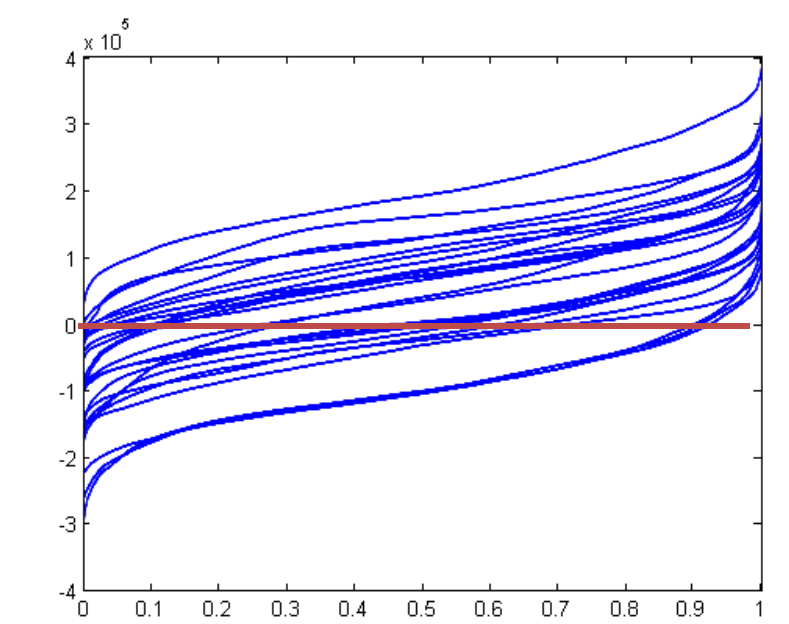
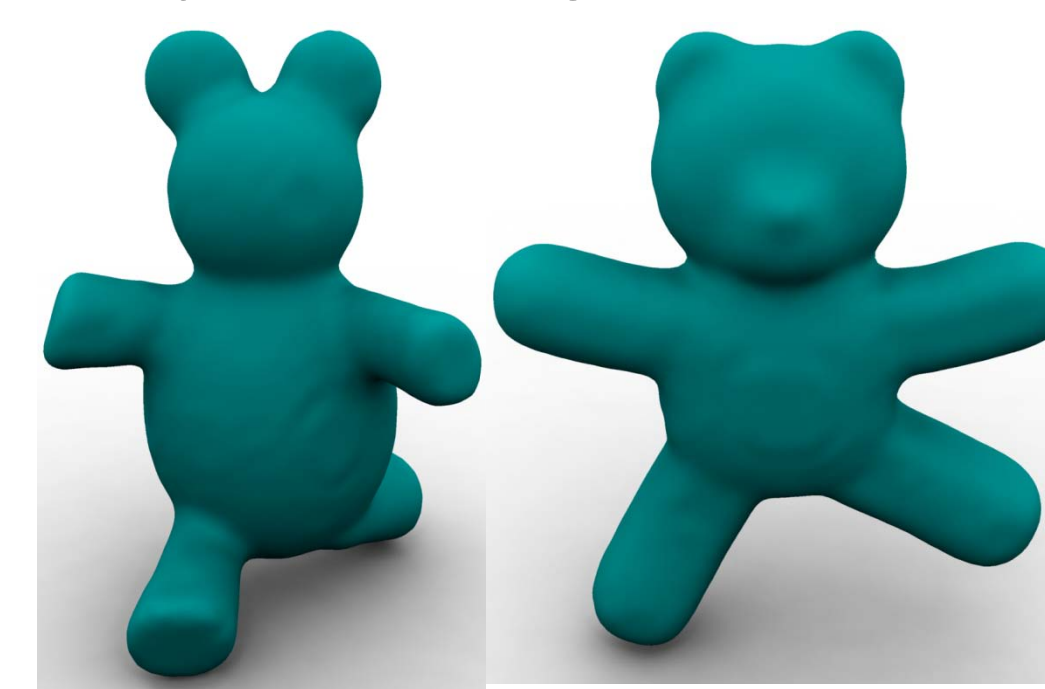
SIFT in different bins of a certain vertex shown as a scalar functions over the surface (blue = lowest and red = highest).



The first 40 singular values corresponding to the PCA on SIFT descriptors.



False matches more prominent than the ground truth correspondence are given by negative y values. (left) Humans; (right) Ants; (below) Teddies



¹<http://www.cs.princeton.edu/~vk/CorrsCode/Benchmark/>