Fundamentals of Computer Graphics

Exercises

Emanuele Rodolà
rodola@di.uniroma1.it

SAPIENZA
UNIVERSITÀ DI ROMA

1st semester a.y. 2018/2019 · December 10, 2018

Overview

There are 3 exercises of increasing difficulty (and decreasing detail in the description)

- You can use all the code from the course webpage
- You can co-operate in groups
- Doing all 3 correctly grants 1 extra point in the final grade for each group member

Exercise 1: Shape approximation

Given a shape $\mathcal{X}$, approximate its vertex coordinates in the Laplacian eigenbasis at increasing number of basis functions.

- Represent the x,y,z coordinates as three functions in the Laplacian eigenbasis of dimension k, obtaining k coefficients for each of the three functions
- Resynthesize the coordinate functions from the k coefficients
- Illustrate the behavior at $k = 10, 20, 50, 100, 300$
- Compute the approximation error for each k as the L_2 distance between each reconstructed vertex and its original position in $\mathbb{R}^3$
- Visualize the approximation error as a scalar function on each reconstructed shape using the inverse hot colormap. The colormap should have fixed extrema across all reconstructions

Exercise 2: Schrödinger eigenbasis

Consider the functional

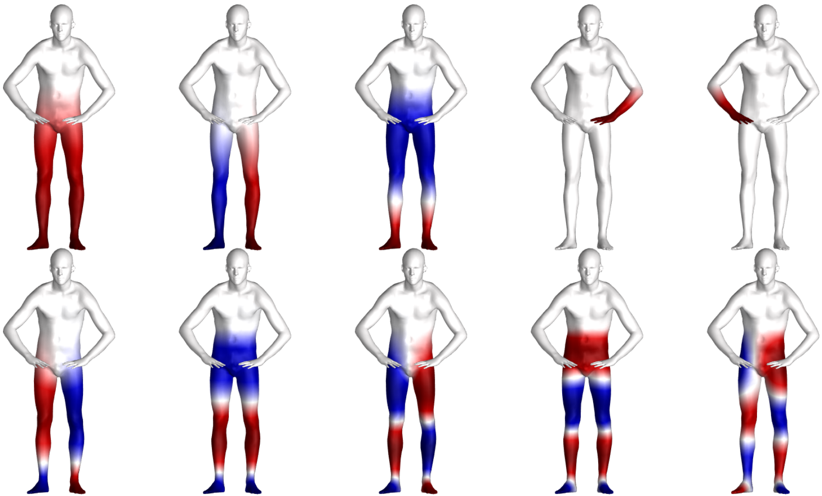
$$\mathcal{R}(f) = \int_{\mathcal{X}} (f(x)(1 - u(x)))^2 dx$$

where $u : \mathcal{X} \to [0, 1]$ is an indicator function such that $u(x) = 1$ for $x \in R \subseteq \mathcal{X}$ and $u(x) = 0$ otherwise

- Write the integral above in matrix notation
- Construct the Schrödinger operator $\mathbf{S} + \mu\mathbf{R}$, where $\mathbf{S}$ is the usual stiffness matrix, $\mu > 0$ is a scalar weight, and $\mathbf{R}$ is the matrix from the previous bullet point
- Compute the eigen-functions of $\mathbf{S} + \mu\mathbf{R}$ and plot them with a zero-centered blue/white/red colormap

The final result should be similar to the next slide.

Exercise 2: Schrödinger eigenbasis



Exercise 3: Localized correspondence

Express the ground-truth functional map in the Schrödinger eigenbasis and use it to transfer delta functions