

Project 1: Statistics in Shape Spaces

Implement the following methods. You may not finish all of the steps, but get as far as you can.

1. Project an object onto the preshape sphere by removing its centroid and scaling it to unit norm. This is a preprocessing step that all objects will go through before applying any of the following routines.
2. Perform Ordinary (a.k.a. Orthogonal) Procrustes Analysis (OPA). This should input a target preshape and moving preshape and output the aligned version of the moving preshape.
3. Compute the log map on Kendall shape space, i.e., given two preshapes, compute the tangent vector at the first preshape that is the initial condition of the geodesic segment between the two. Note: this function will call OPA to first align the two objects, then compute the log map on the sphere.
4. Compute the exponential map on Kendall shape space, i.e., given a preshape and tangent vector, compute the preshape at the end of the corresponding geodesic.
5. Estimate the Fréchet mean shape using gradient descent.

Data: You can use corpus callosum shapes here: <http://www.sci.utah.edu/~fletcher/CS7640/cc-shapes.zip>

Each corpus callosum object consists of 64 points listed in an ASCII text file. Each line of the file contains a single point (x and y coordinates).