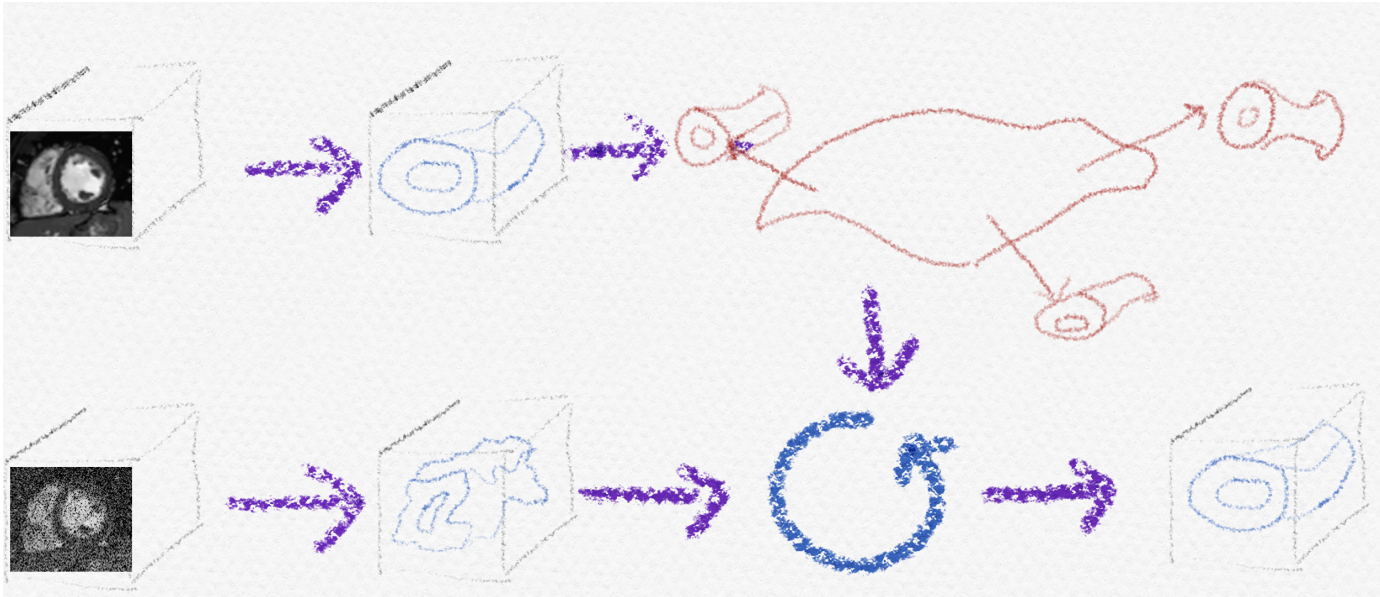
P1 Cardiac motion estimation

January 24, 2024



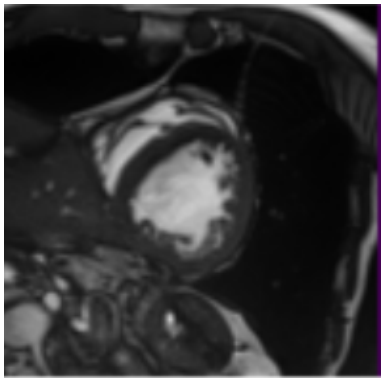
Setup

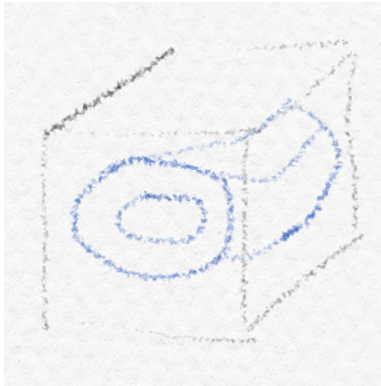
- Needed data: batch of images of the cardiac cycle sliced in z- and t-dimension. Typical batch will have a shape like

$$(30, 8, 256, 256),$$

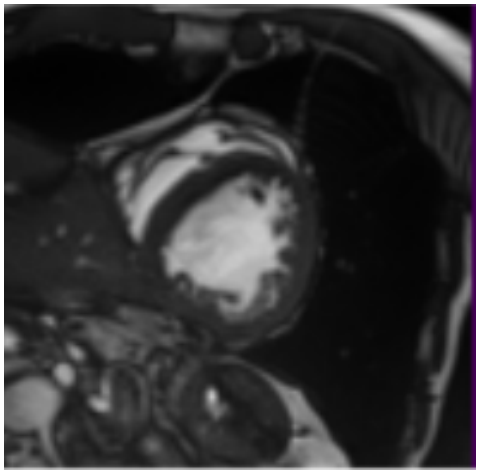
with

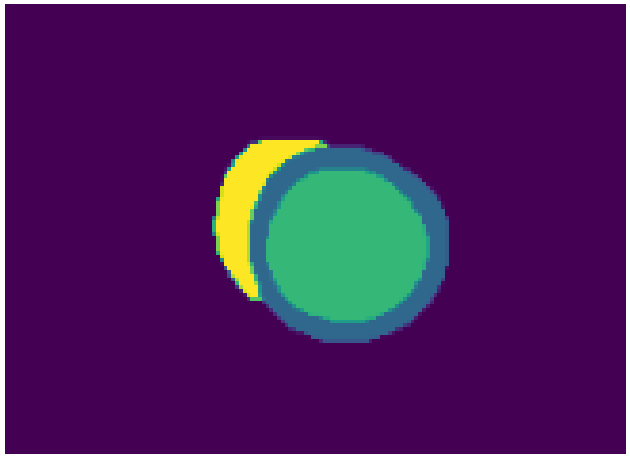
  - 30 t slices.
  - 8 z slices $\longrightarrow$ take middle one $\longrightarrow$ can be omitted.
  - 256×256 pixel images.

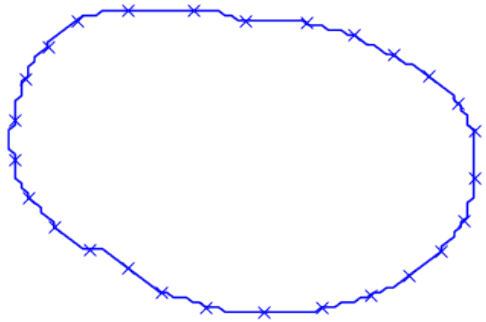




Register data

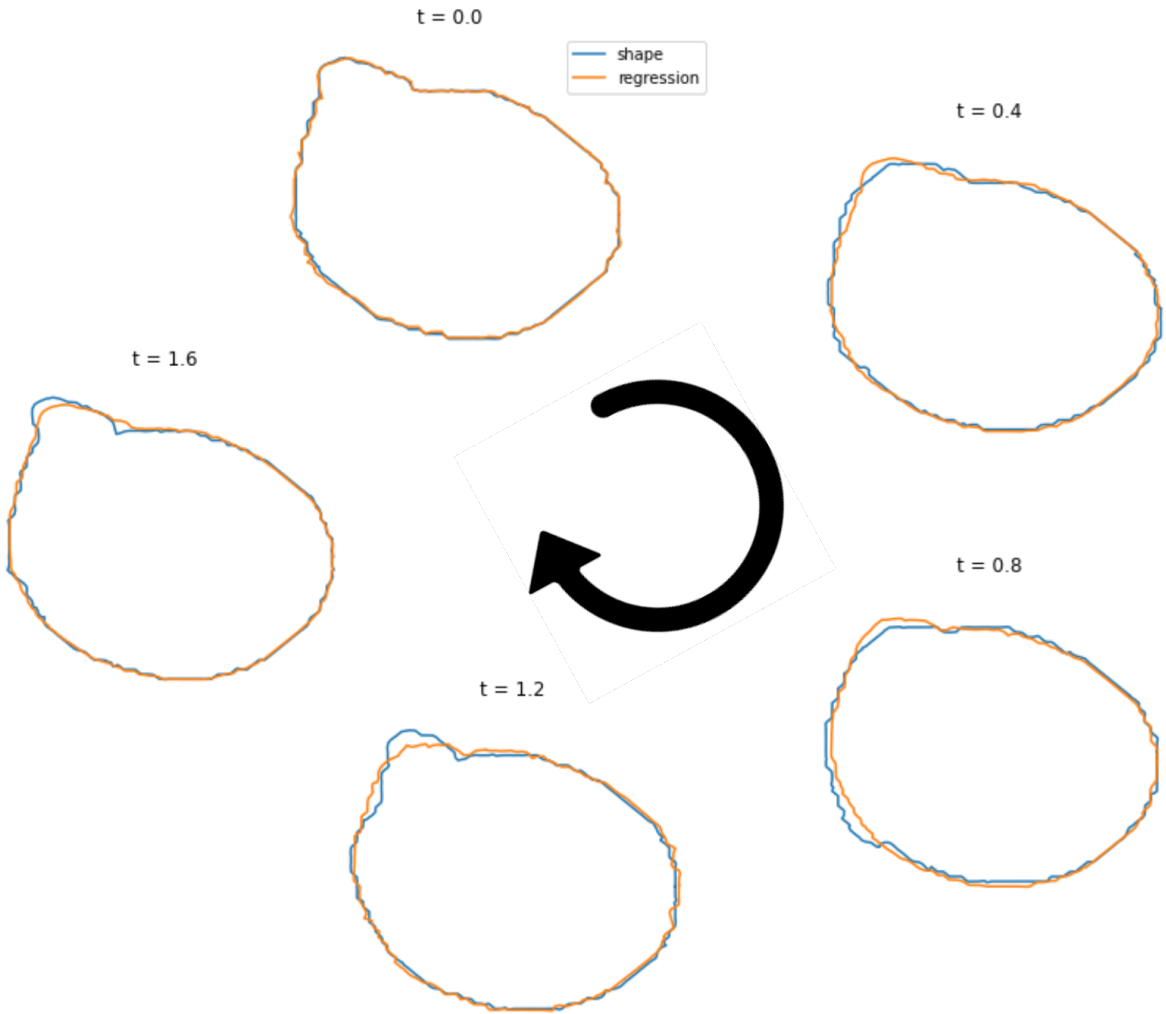




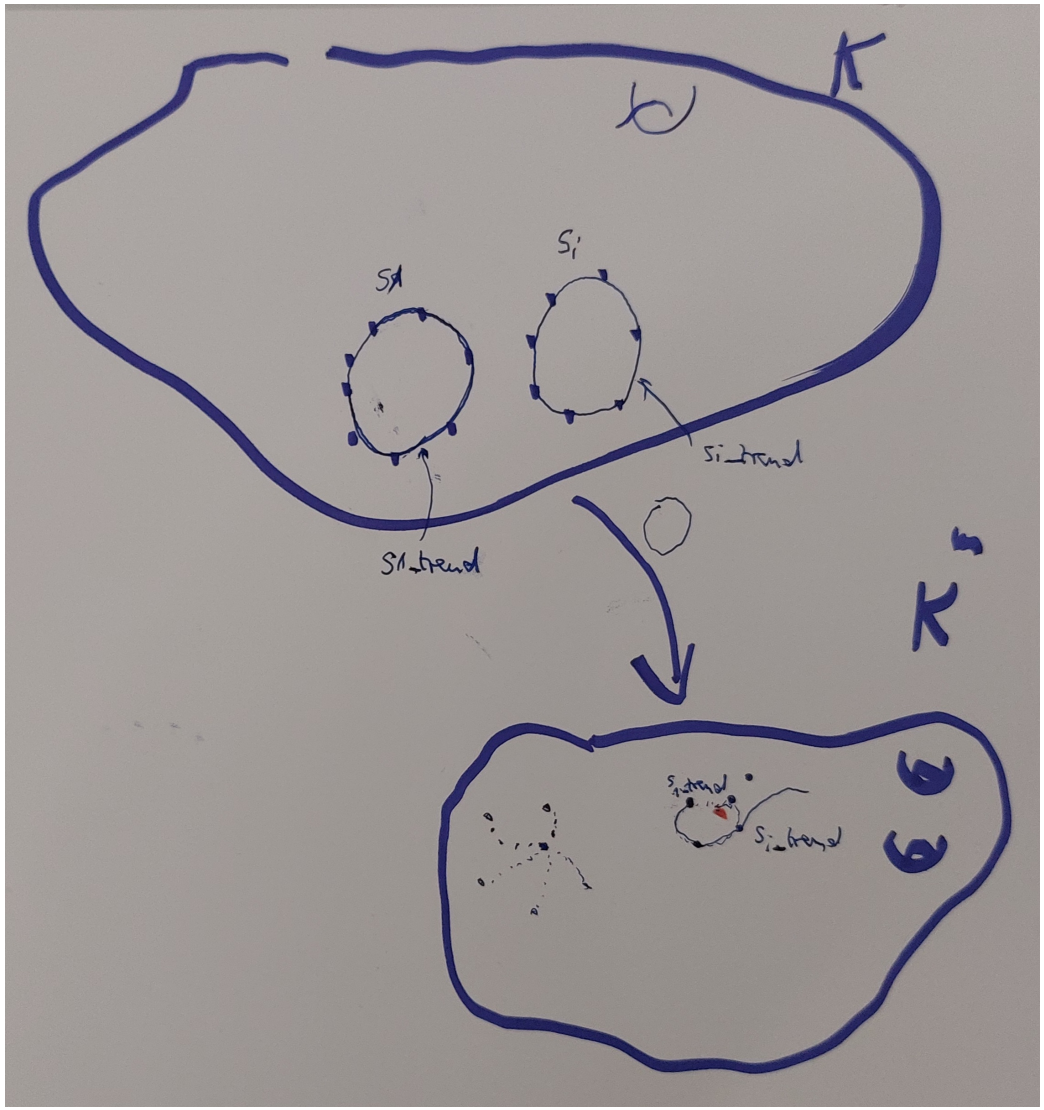


(with `skimage.measure.find_contours`)

Blue: Cardiac contour evolution over time
Orange: Regressed shape interpolation

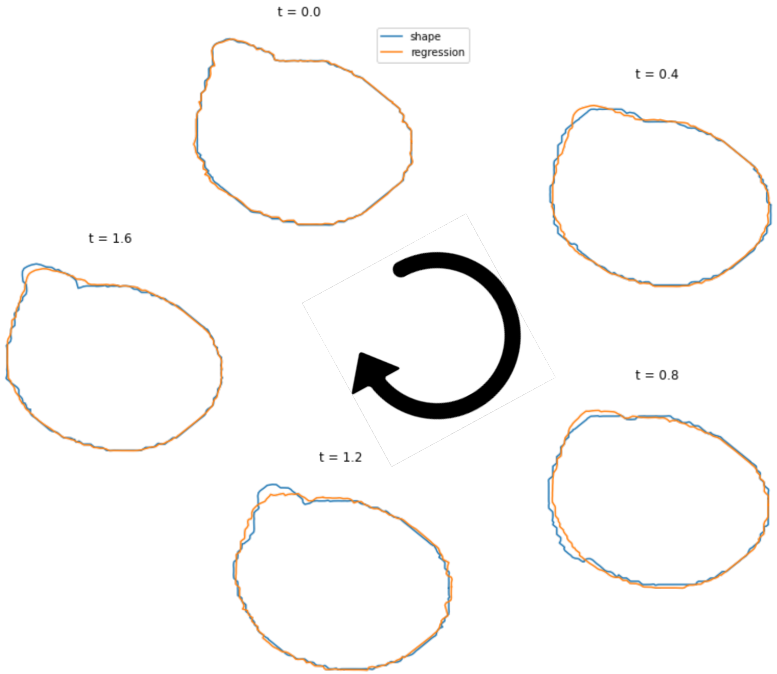


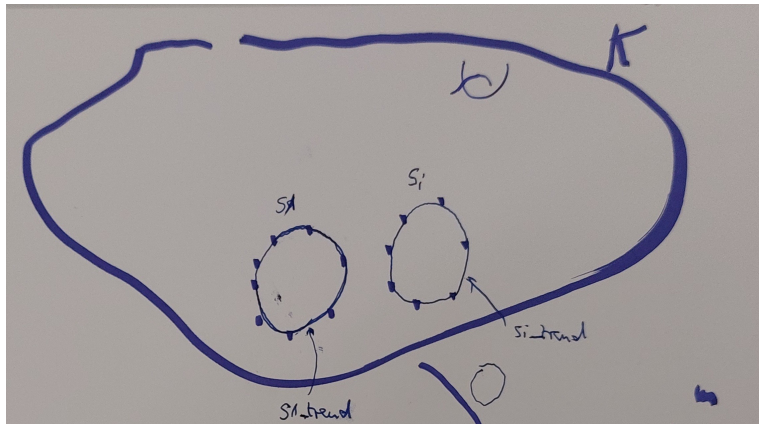
The idea



The idea

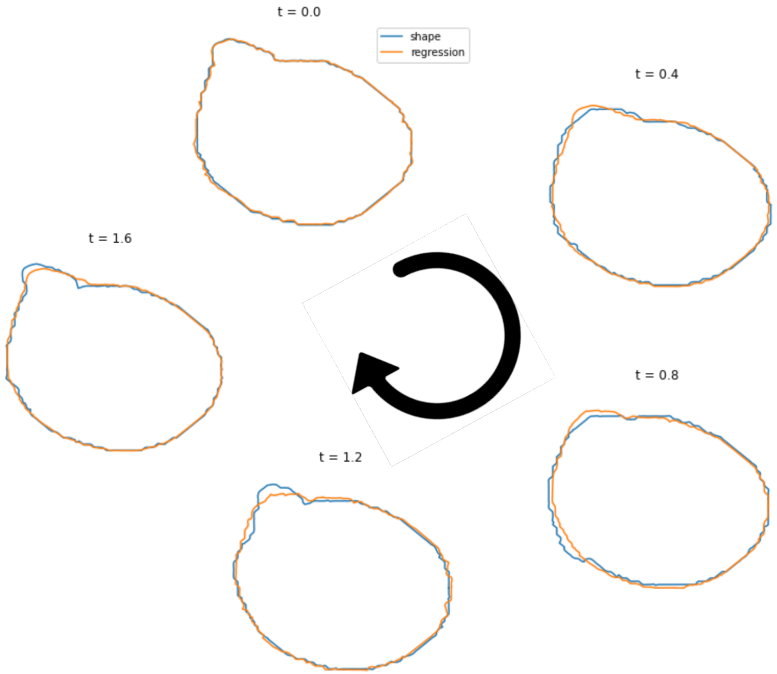
regressed shape interpolations are elements on the manifold



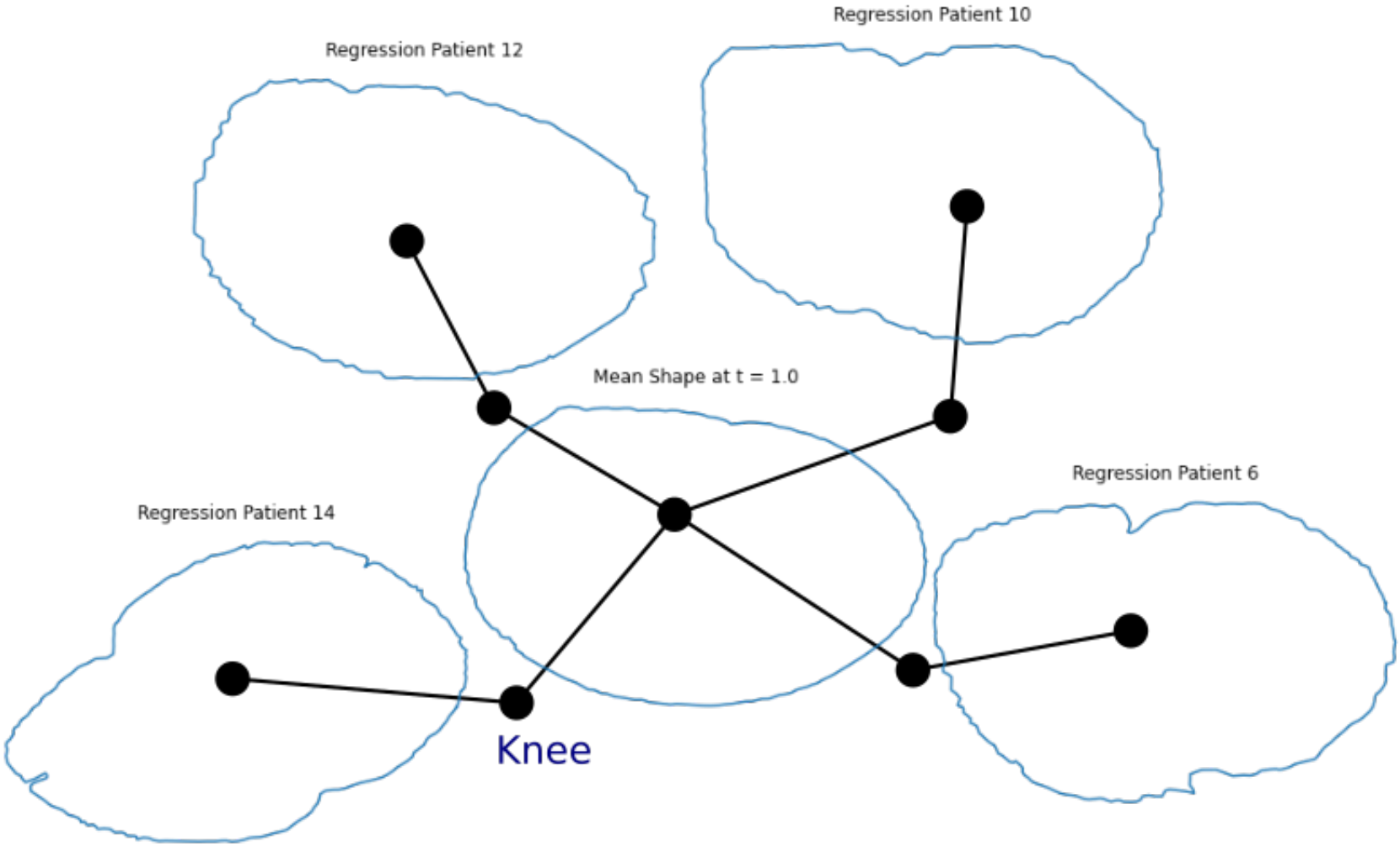


The idea

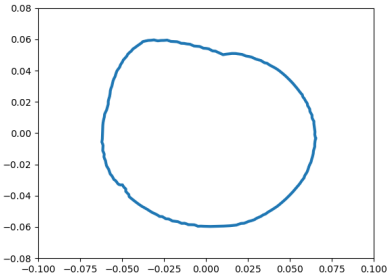
the Bezier splines are again points on a manifold



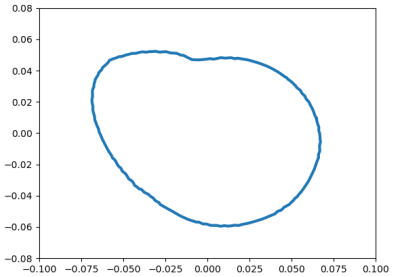
Approximating Mean Shape on a Manifold



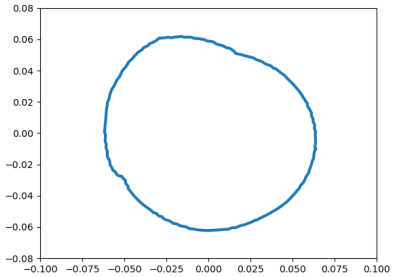
Classify diseases using mean shape trajectories



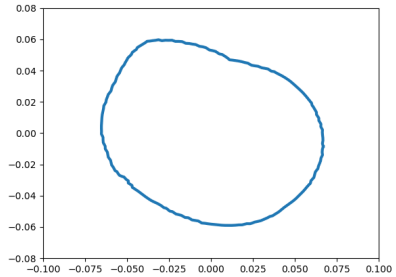
Class DCM



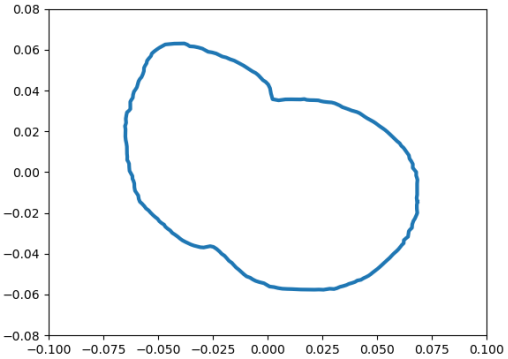
Class HCM



Class MINF



Class NOR



Test data: which class?

Results

- compute distance (on manifold) between Bezier spline of test data and of corresponding means

$$\mathrm{dist}^2(x, y) = \int d^2(x(t), y(t)dt$$

$$d(a, b) = \min_{R \in SO_3} \cos^{-1}\langle a, Rb\rangle$$

- classify test data to class with smallest distance to corresponding mean
- accuracy of 45%
- potential problems:
  - used only 2D data at specific slide $\rightarrow$ maybe slide differs not too much between the classes
  - small data set