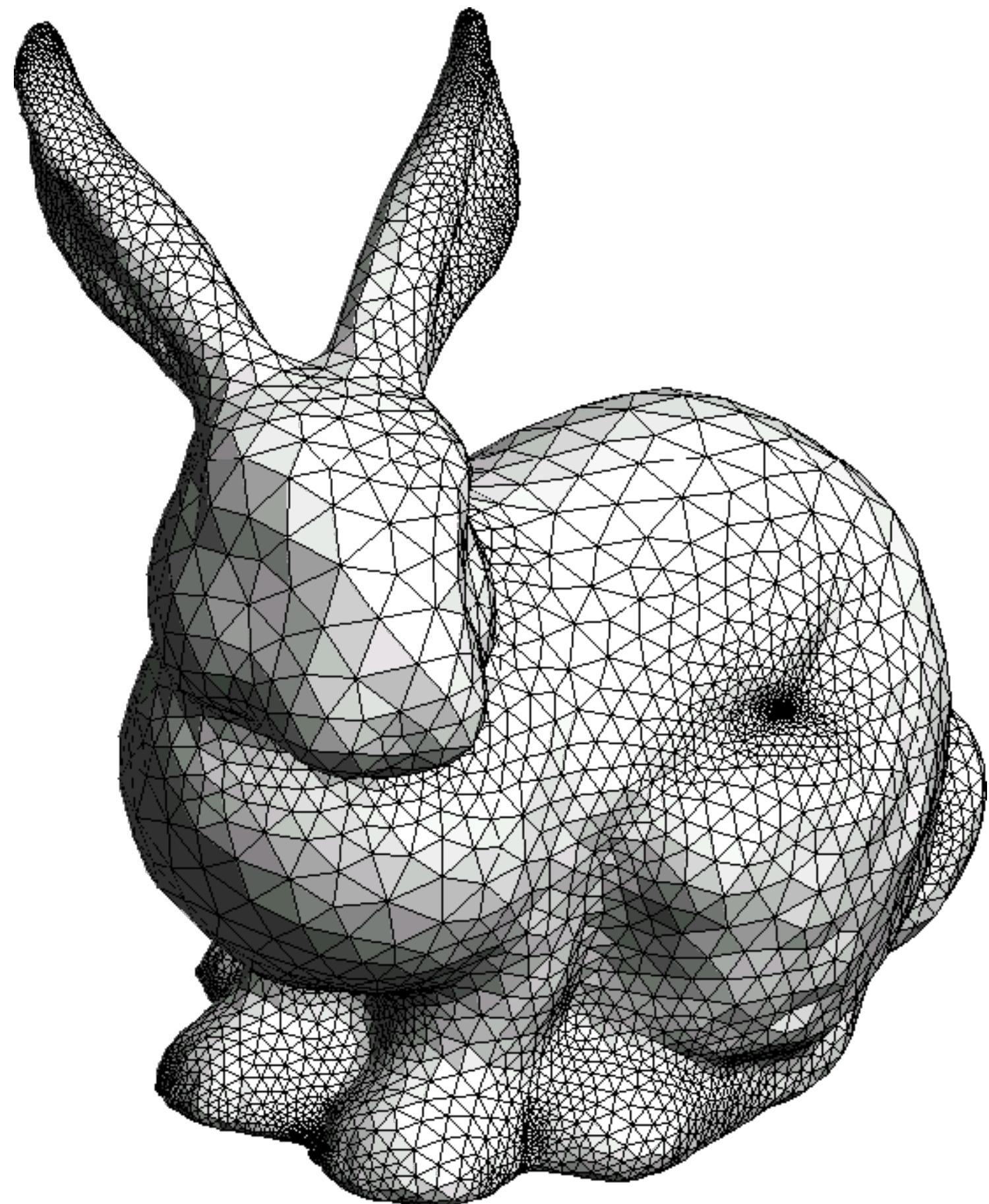


# DDGSpring2016\_Final Project Implementation

Derek Liu

# Review

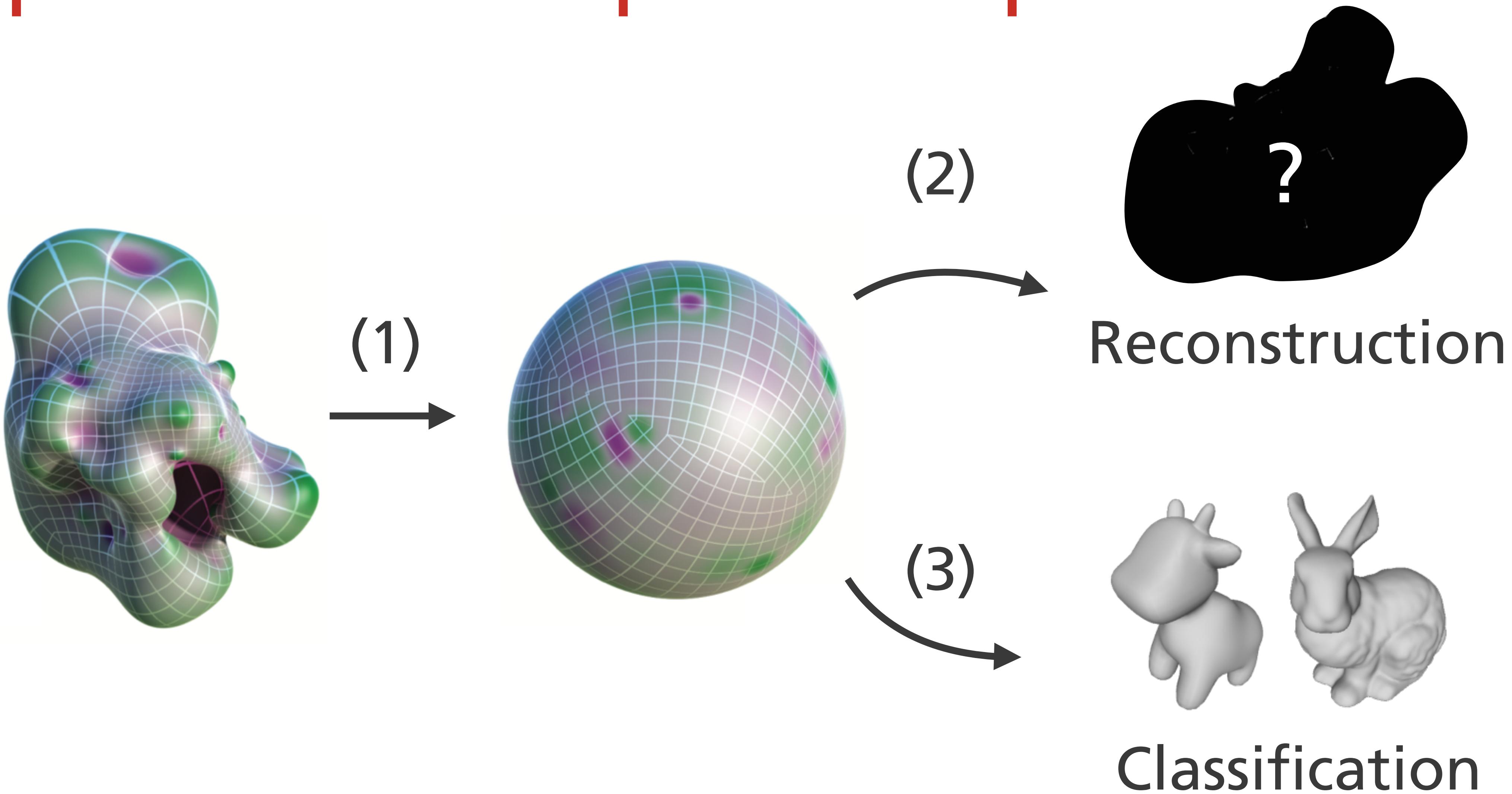
# Shape Descriptors



v 0.309 -0.921 0.450  
v -0.246 0.582 0.060  
v 0.324 -0.919 0.426  
v 0.326 -0.962 0.486  
v -0.281 -0.982 0.058  
v 0.313 -0.969 0.511  
v 0.282 -0.963 0.507  
v -0.485 -0.661 0.305  
v 0.230 -0.949 0.509  
v -0.215 -0.920 -0.089  
v -0.165 -0.917 -0.173  
v 0.545 -0.831 -0.141  
...

$$\begin{pmatrix} a_{1,1} & a_{1,2} & \cdots & a_{1,n} \\ a_{2,1} & a_{2,2} & \cdots & a_{2,n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{m,1} & a_{m,2} & \cdots & a_{m,n} \end{pmatrix}$$

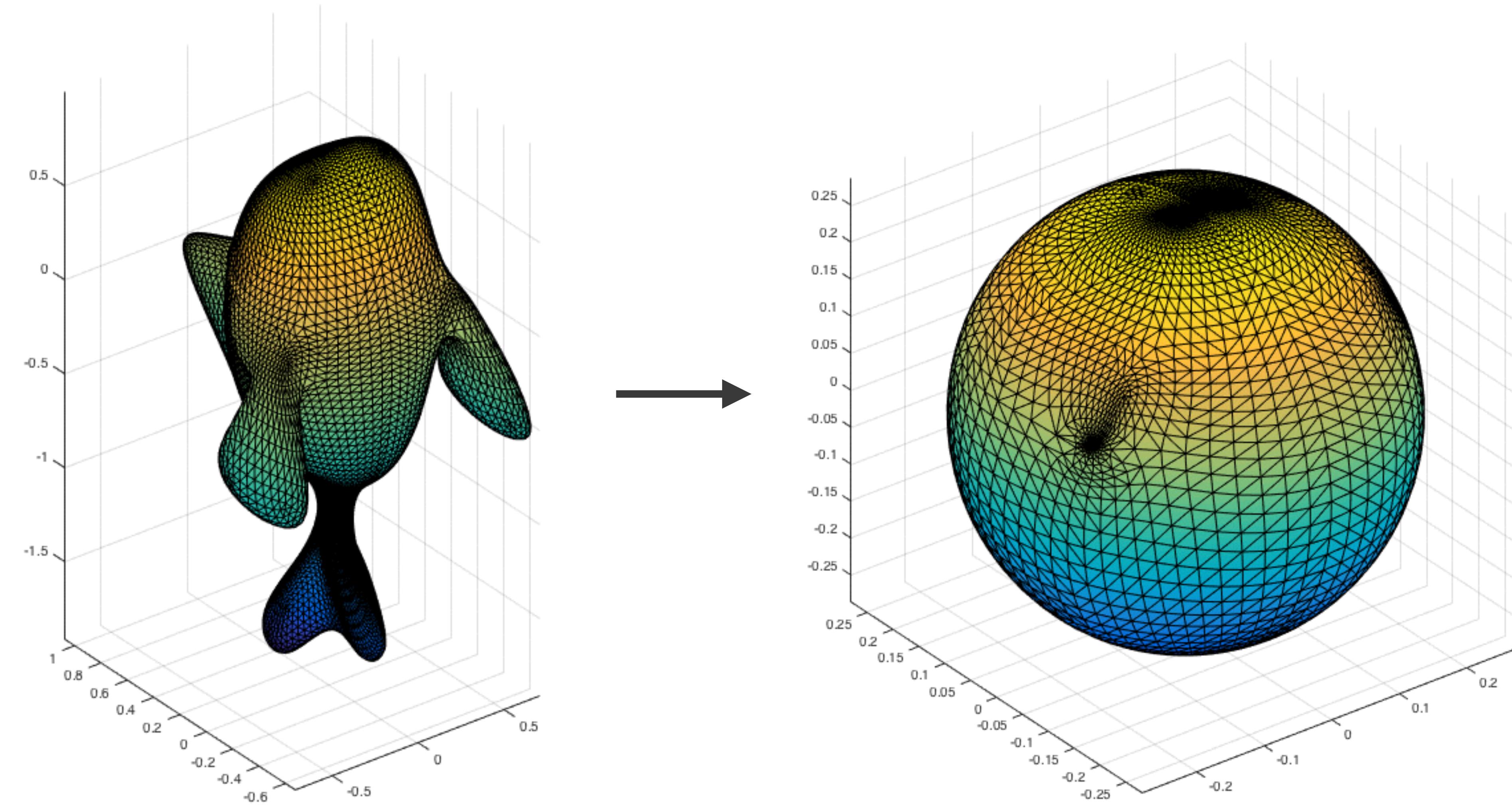
# Spin-based Shape Descriptor



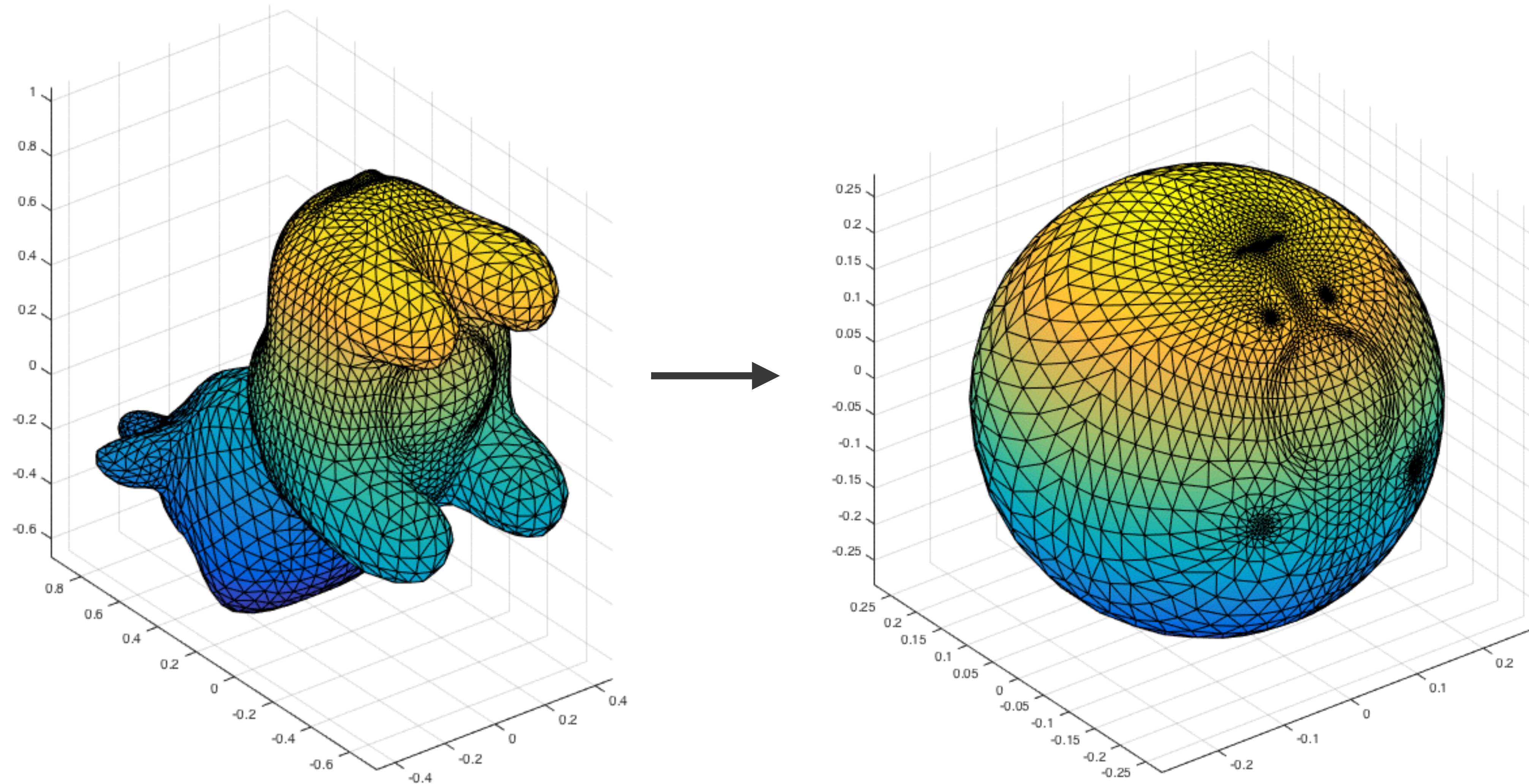
# Modified Mean Curvature Flow

Kazhdan, M., Solomon, J., & Ben-Chen, M. (2012). Can Mean-Curvature Flow Be Made Non-Singular?

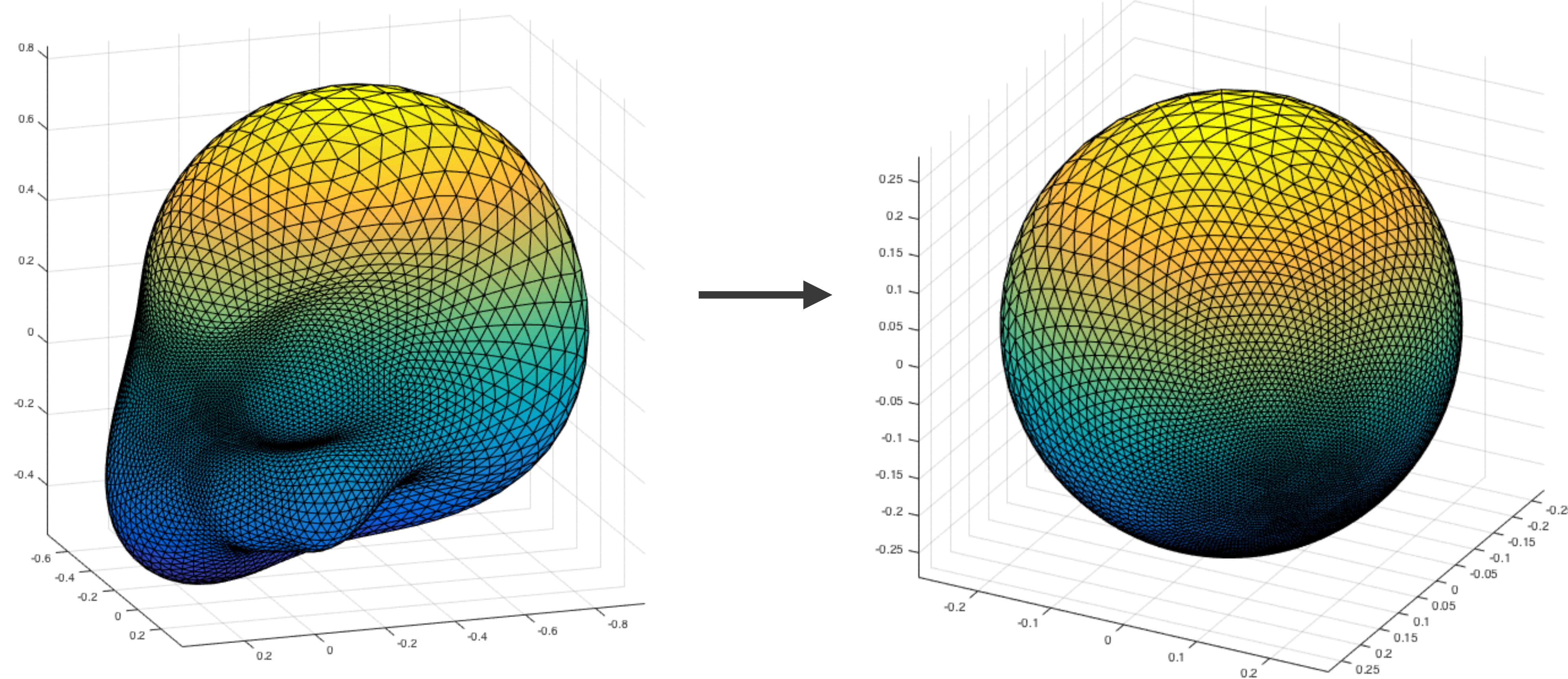
# Modified Mean Curvature Flow



# Modified Mean Curvature Flow



# Modified Mean Curvature Flow



Crane, K., Pinkall, U., & Schröder, P. (2011). Spin transformations of discrete surfaces.

# Encode Curvature Potential

# Methods

$$(1) \quad DN = -2HN$$

$$\rho = \frac{\sqrt{\tilde{A}} \langle \frac{-D\tilde{N}}{2}, \tilde{N} \rangle - \sqrt{A} \langle \frac{-DN}{2}, N \rangle}{\sqrt{A}}$$

$$(2) \quad \Delta f = 2HN$$

$$\rho = \frac{\sqrt{\tilde{A}} \langle \frac{\Delta \tilde{f}}{2}, \tilde{N} \rangle - \sqrt{A} \langle \frac{\Delta f}{2}, N \rangle}{\sqrt{A}}$$

(3) Second-order fitting  $H$   
(eigenvalues of hessian)

$$\rho = \frac{\sqrt{\tilde{A}} \tilde{H} - \sqrt{A} H}{\sqrt{A}}$$

# Methods

$$(1) \quad DN = -2HN$$

$$\rho = \frac{\sqrt{\tilde{A}} \langle \frac{-D\tilde{N}}{2}, \tilde{N} \rangle - \sqrt{A} \langle \frac{-DN}{2}, N \rangle}{\sqrt{A}}$$

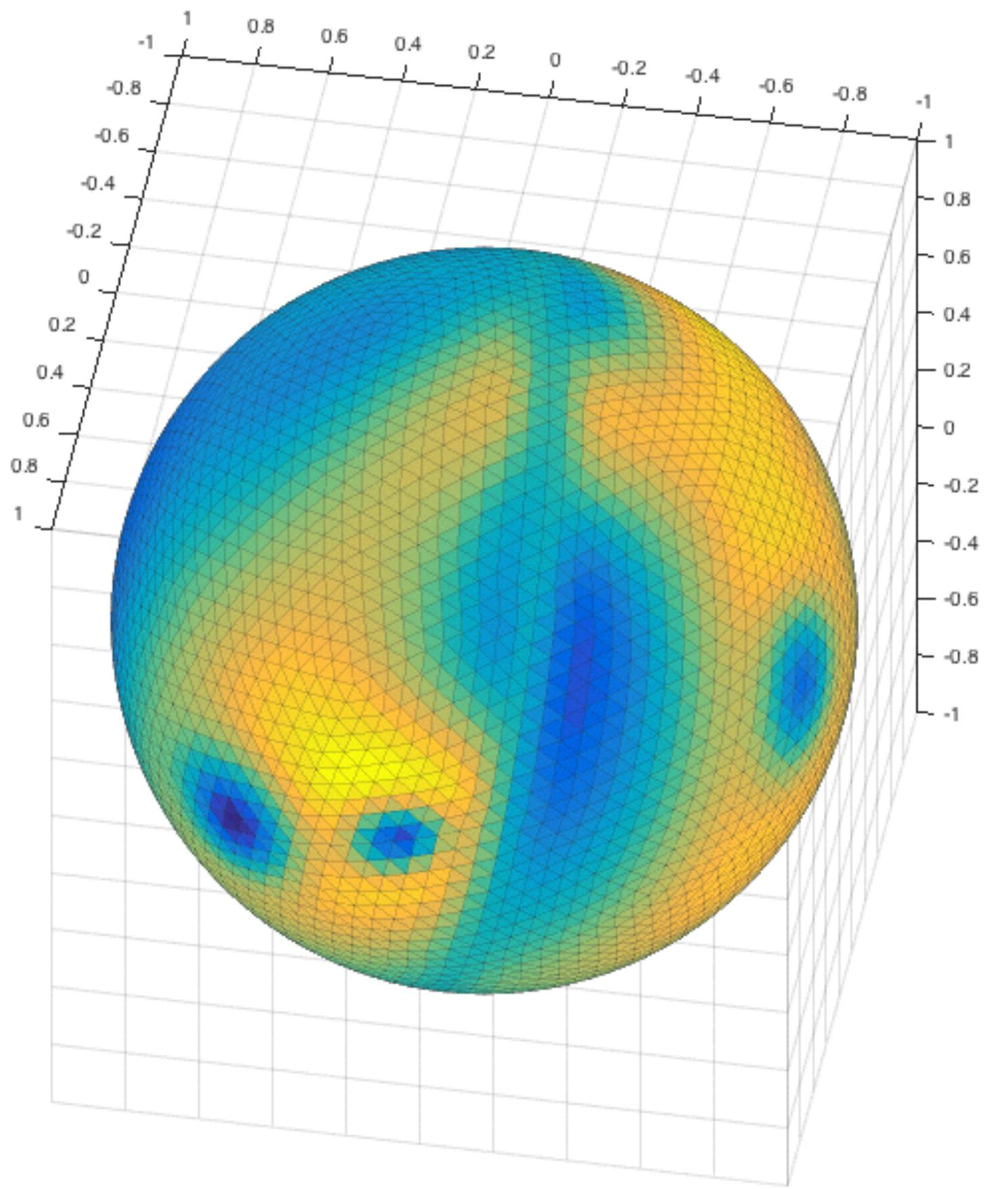
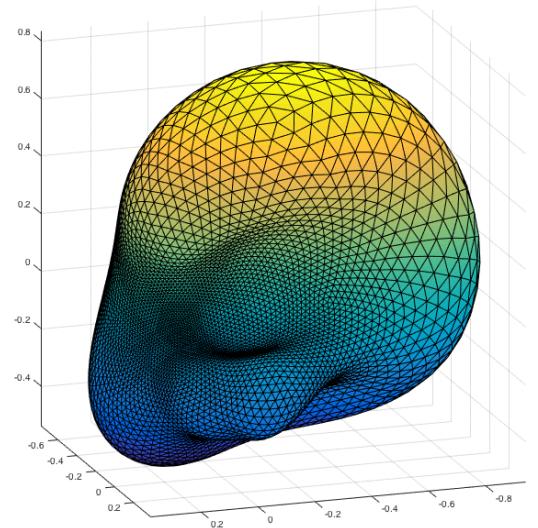
$$(2) \quad \Delta f = 2HN$$

$$\rho = \frac{\sqrt{\tilde{A}} \langle \frac{\Delta \tilde{f}}{2}, \tilde{N} \rangle - \sqrt{A} \langle \frac{\Delta f}{2}, N \rangle}{\sqrt{A}}$$

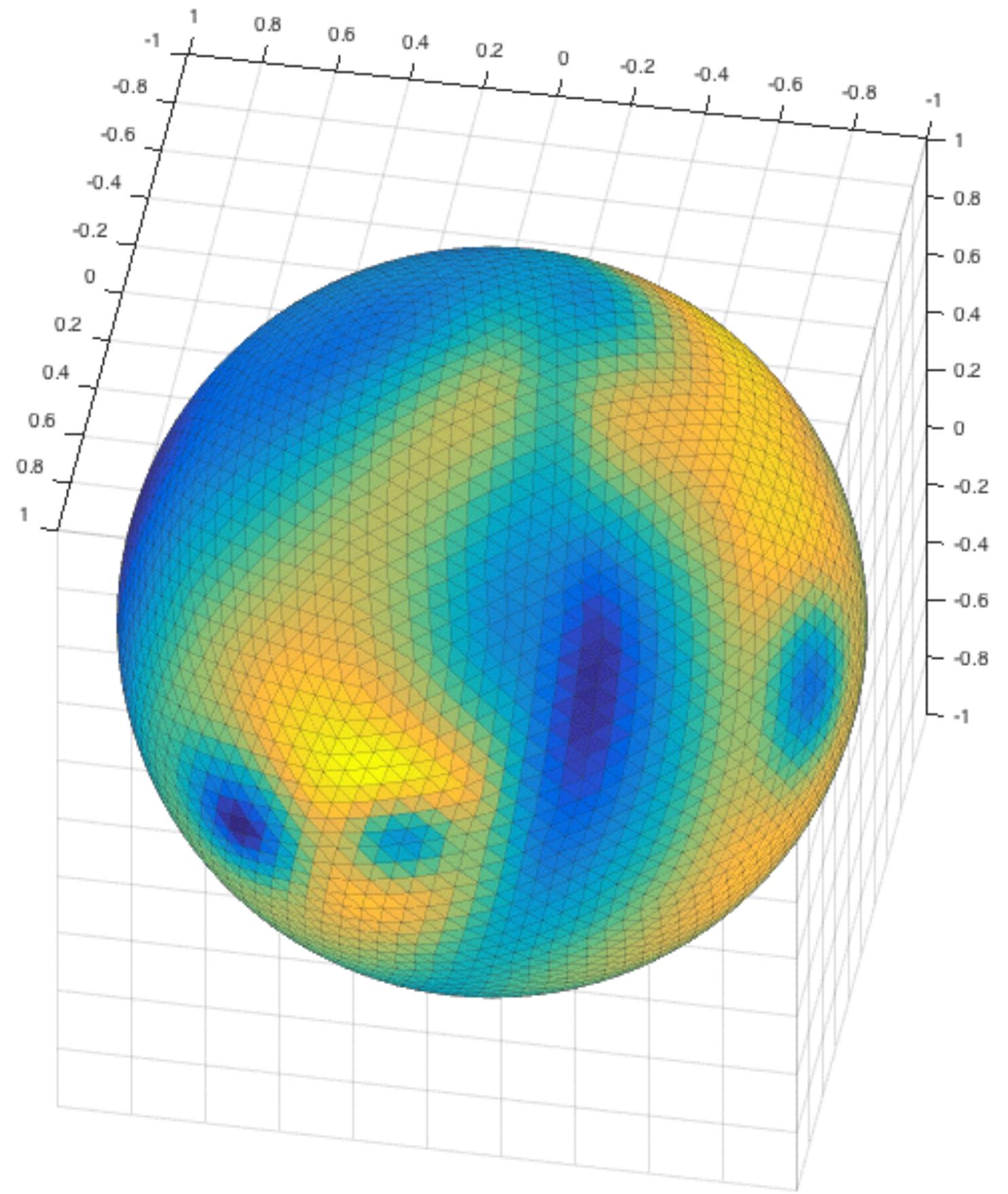
(3)    **Second-order fitting**     $H$   
(eigenvalues of hessian)

$$\rho = \frac{\sqrt{\tilde{A}} \tilde{H} - \sqrt{A} H}{\sqrt{A}}$$

# Encoded Curvature Potential

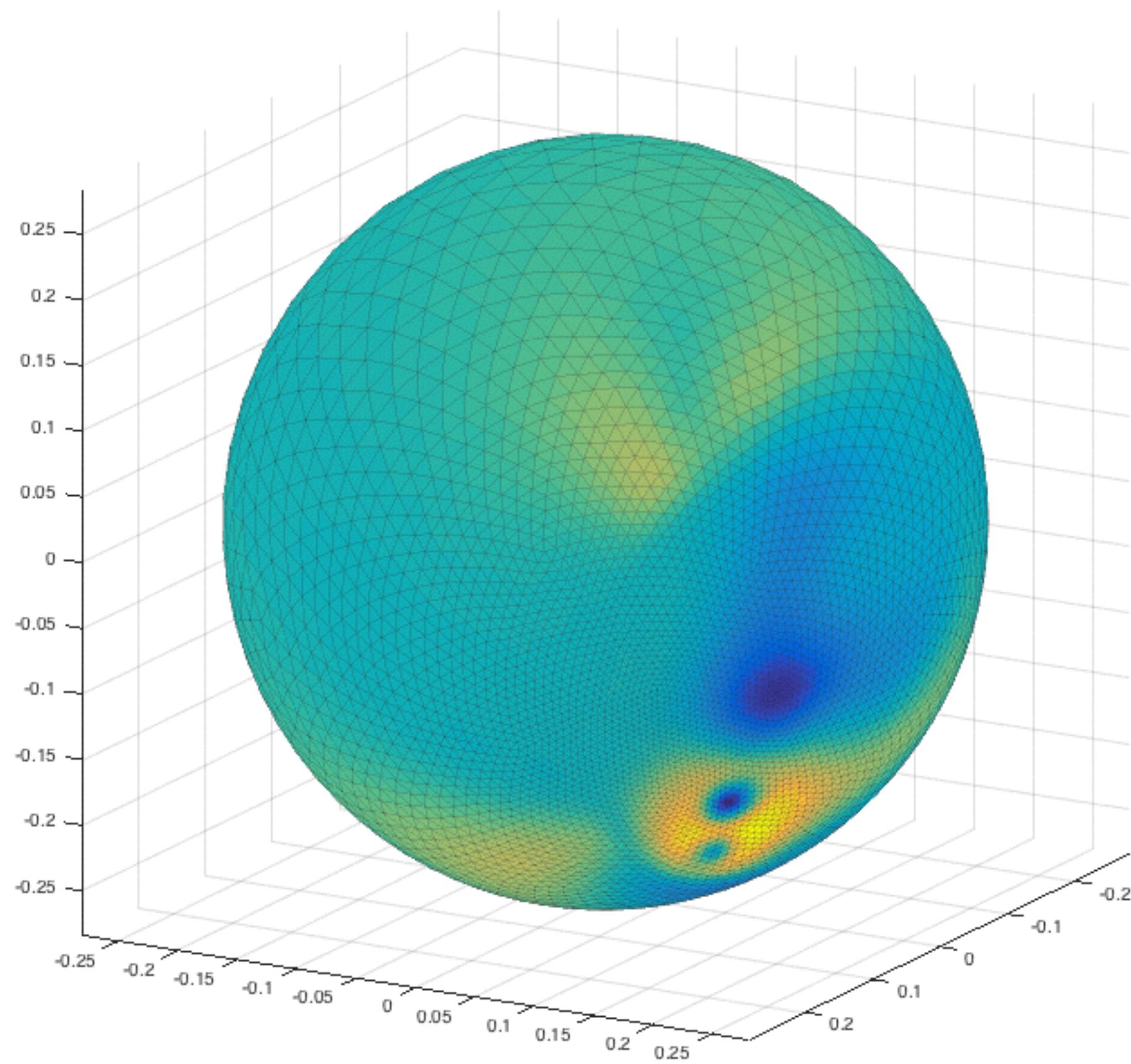
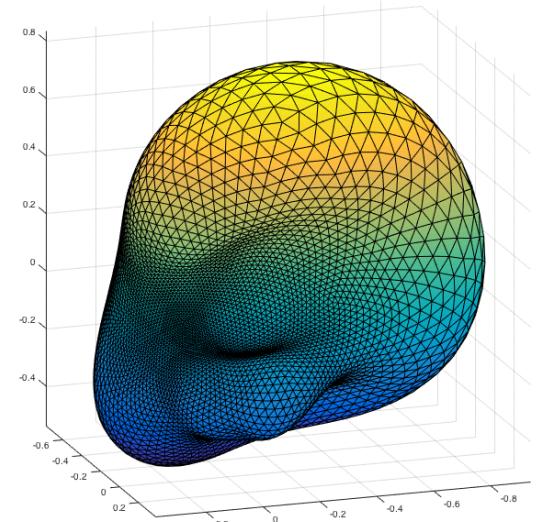


Encoded

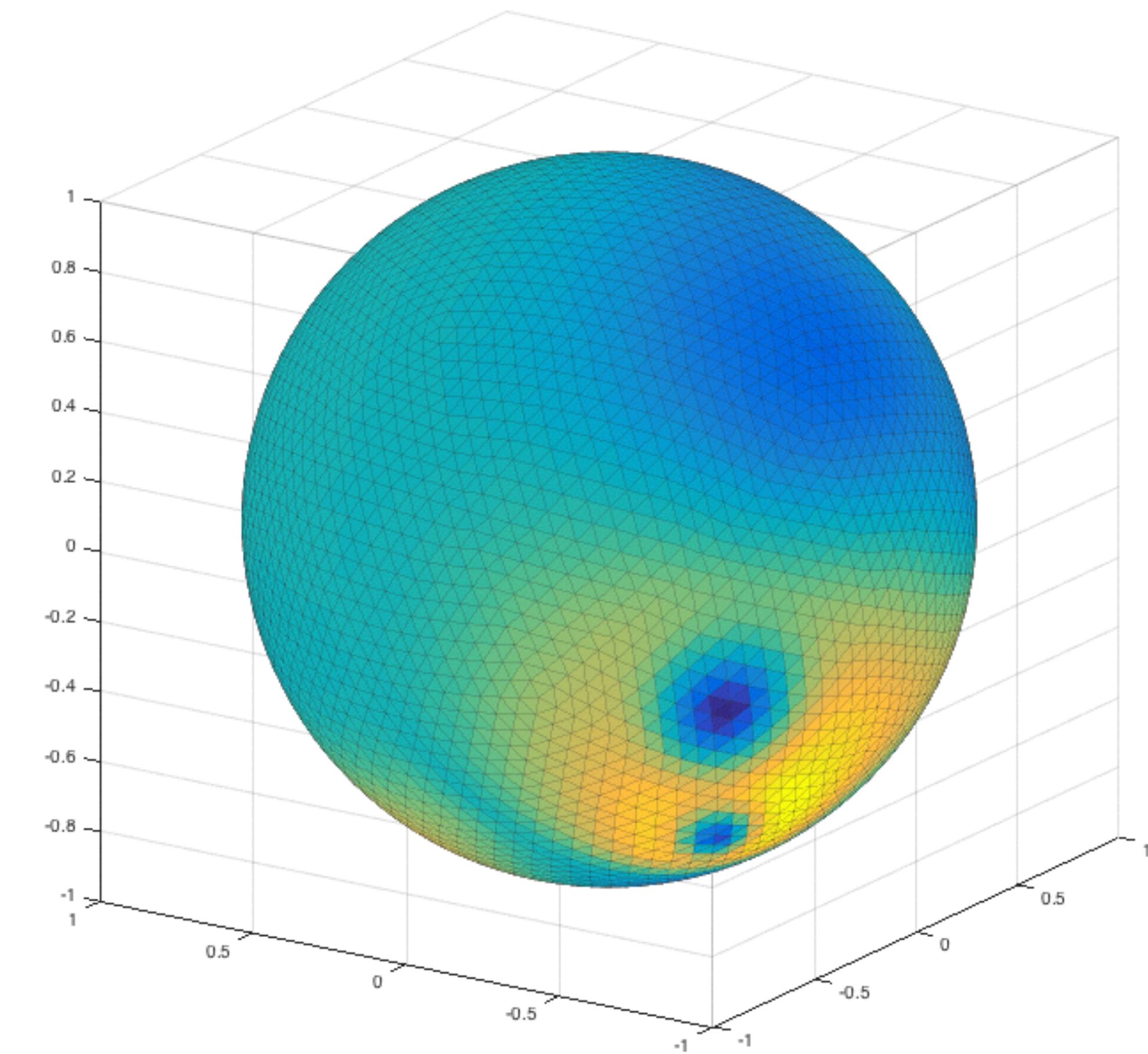


Ground Truth

# Encoded Curvature Potential

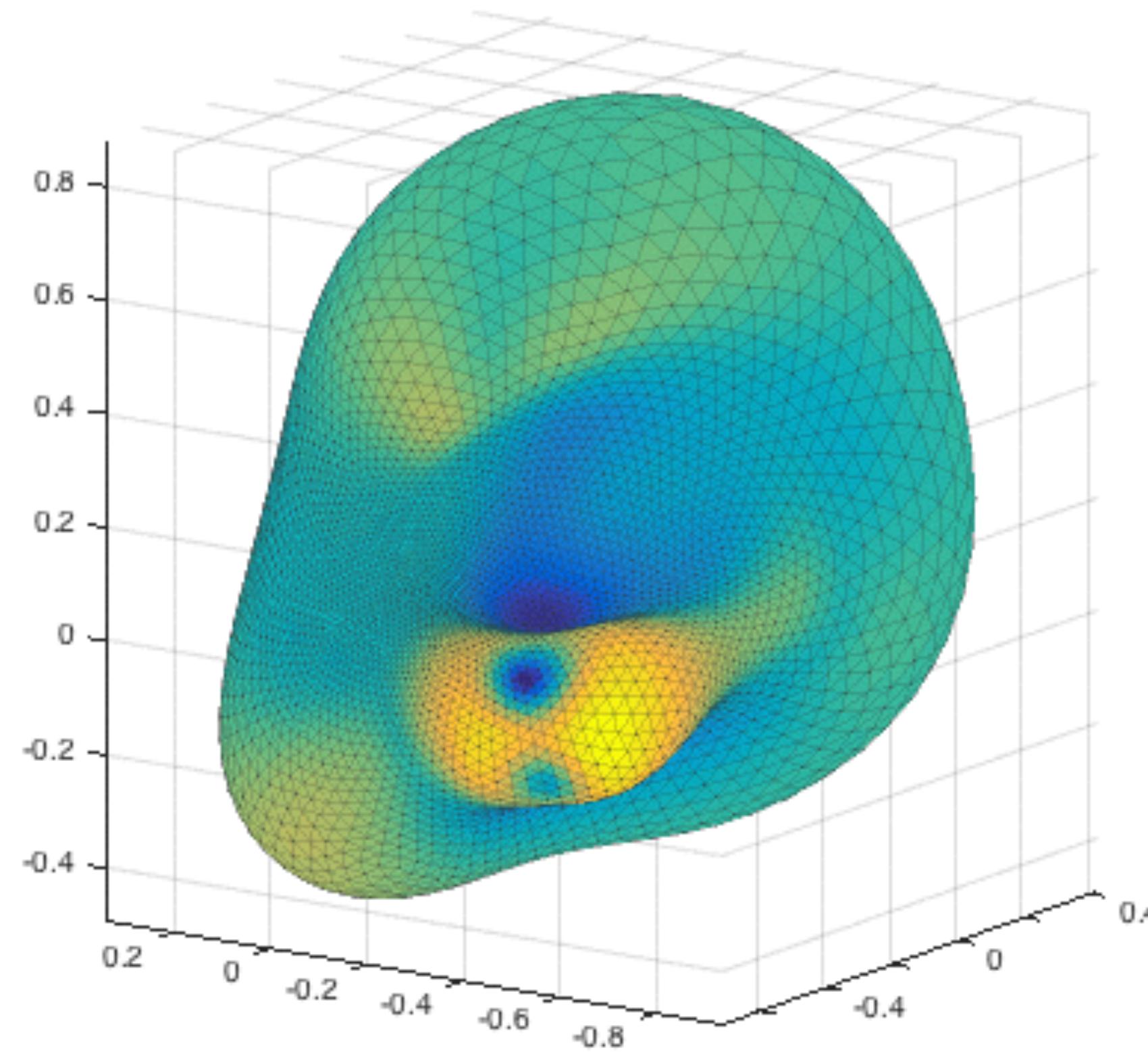
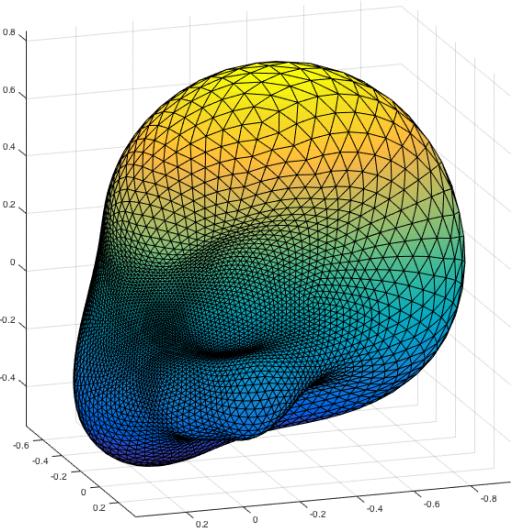


Encoded

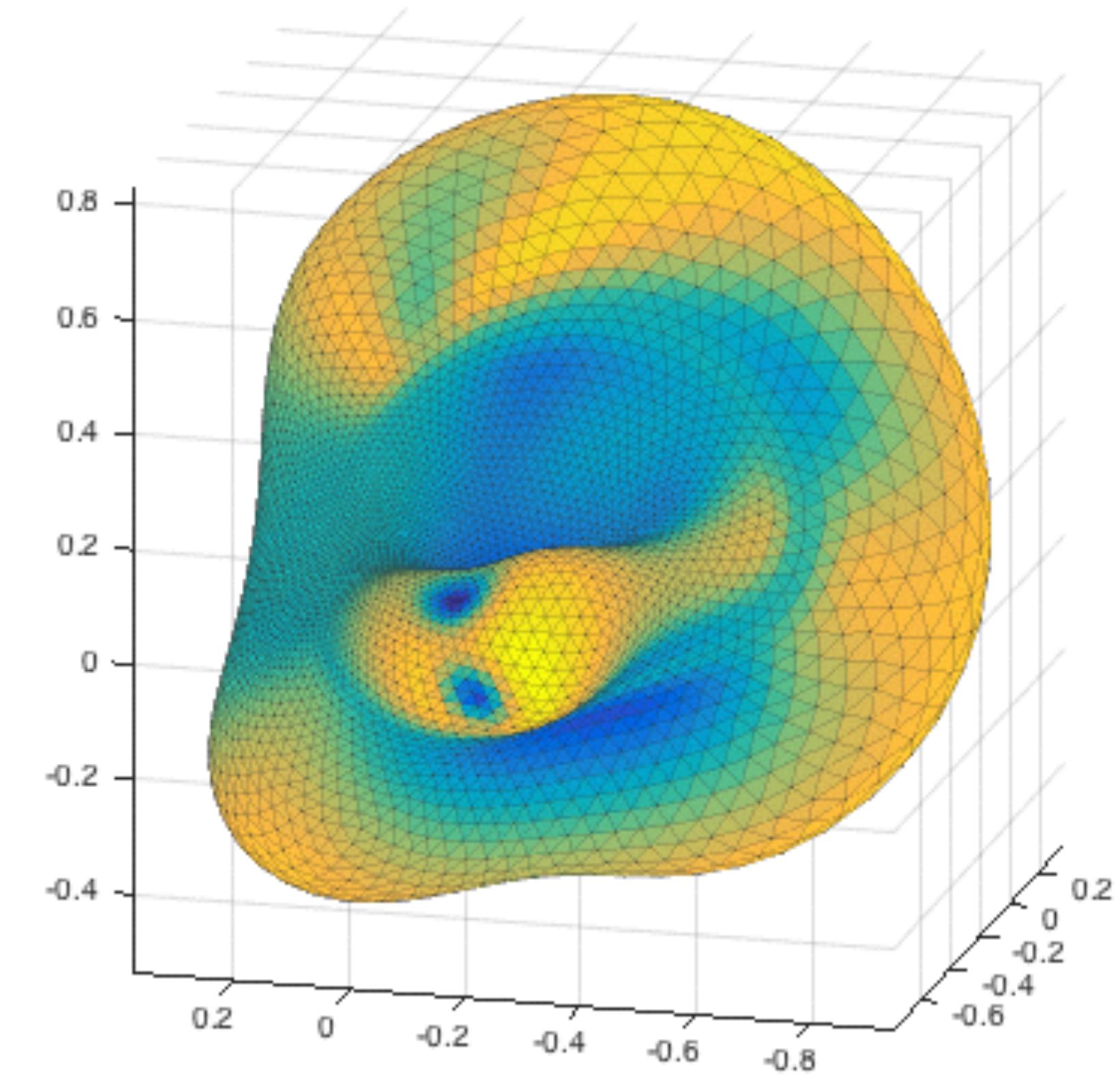


Ground Truth

# Reconstruction Results



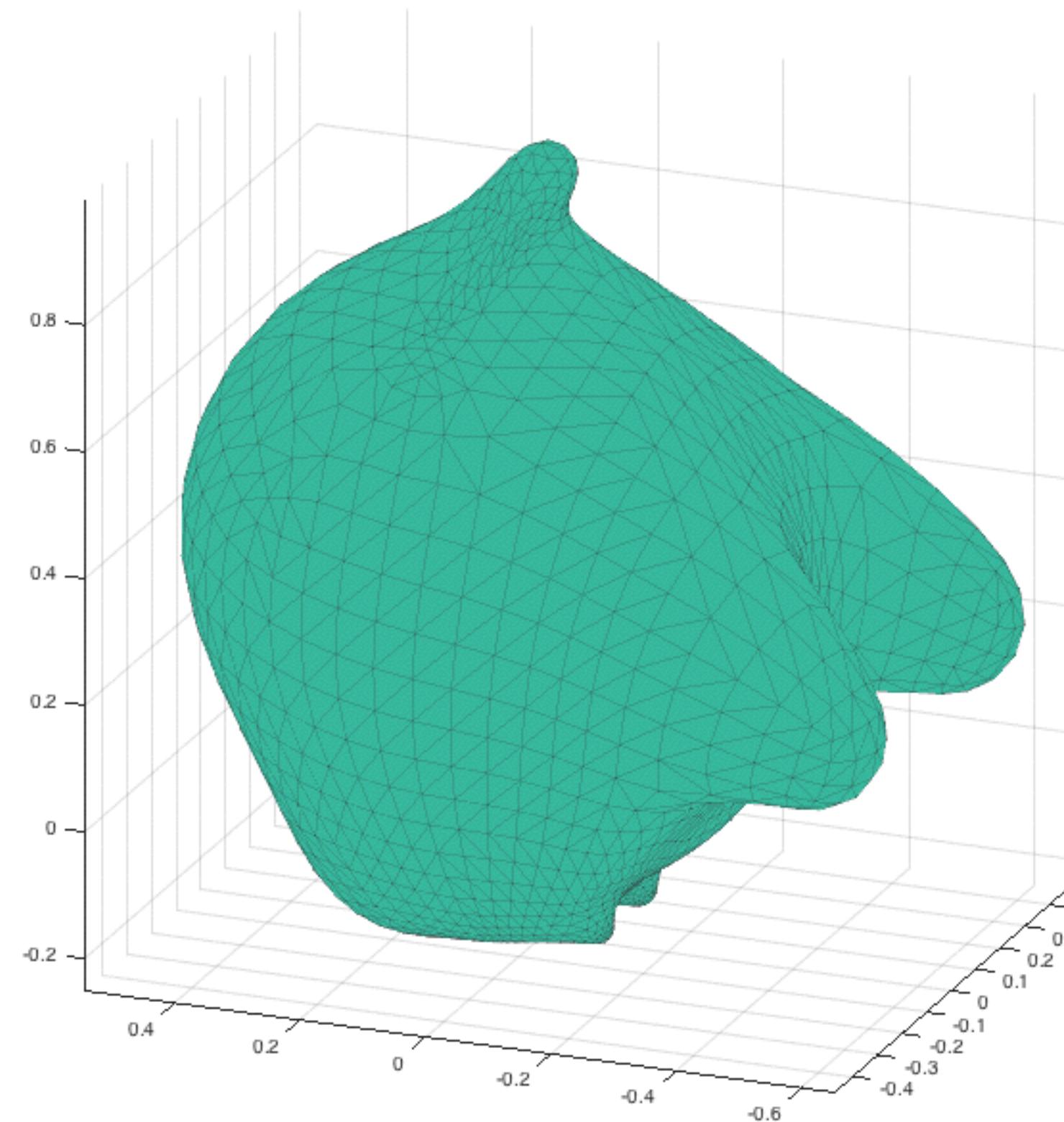
Encoded



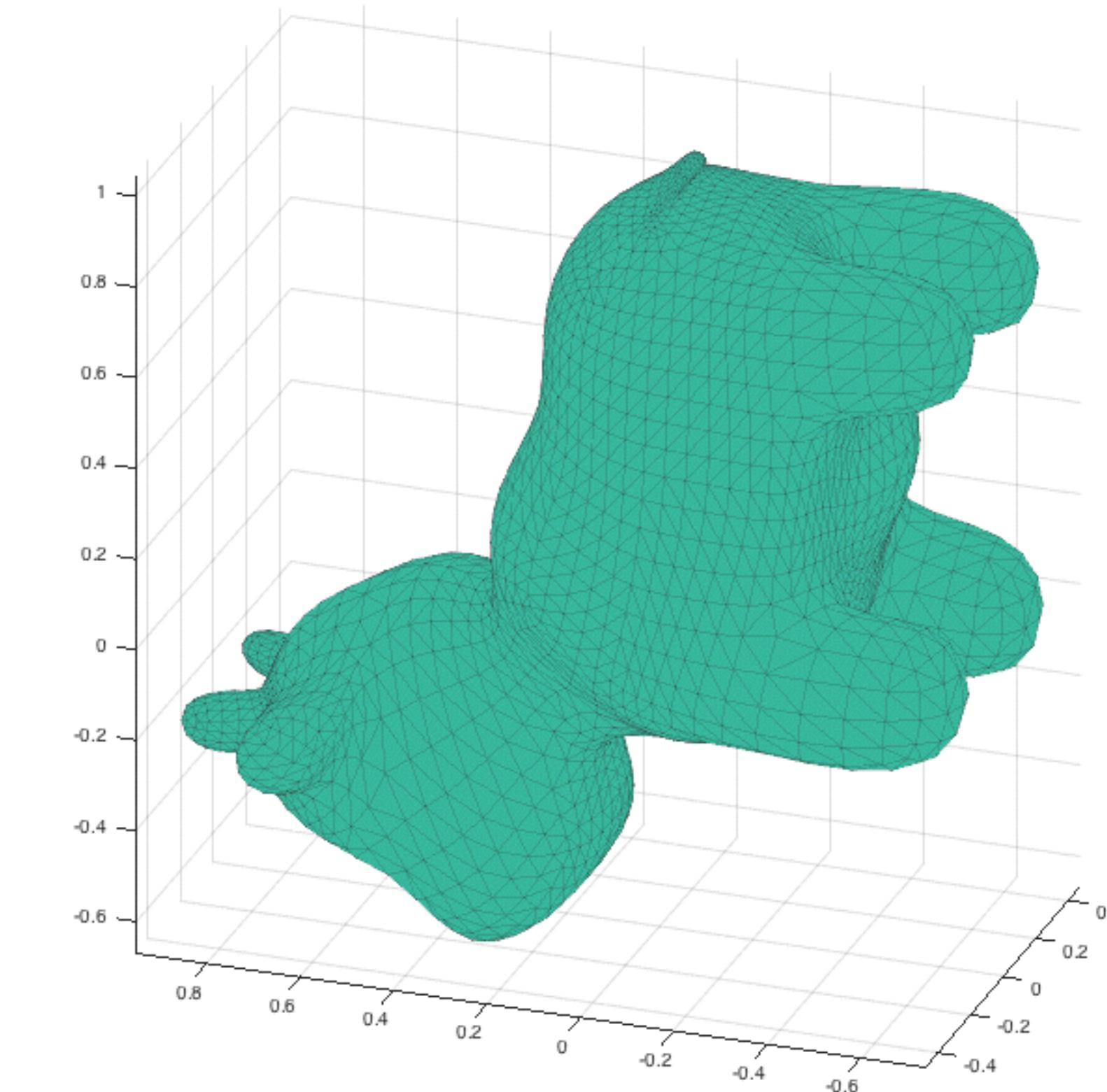
Ground Truth

Crane, K., Pinkall, U., & Schröder, P. (2011). Spin transformations of discrete surfaces.

# However...

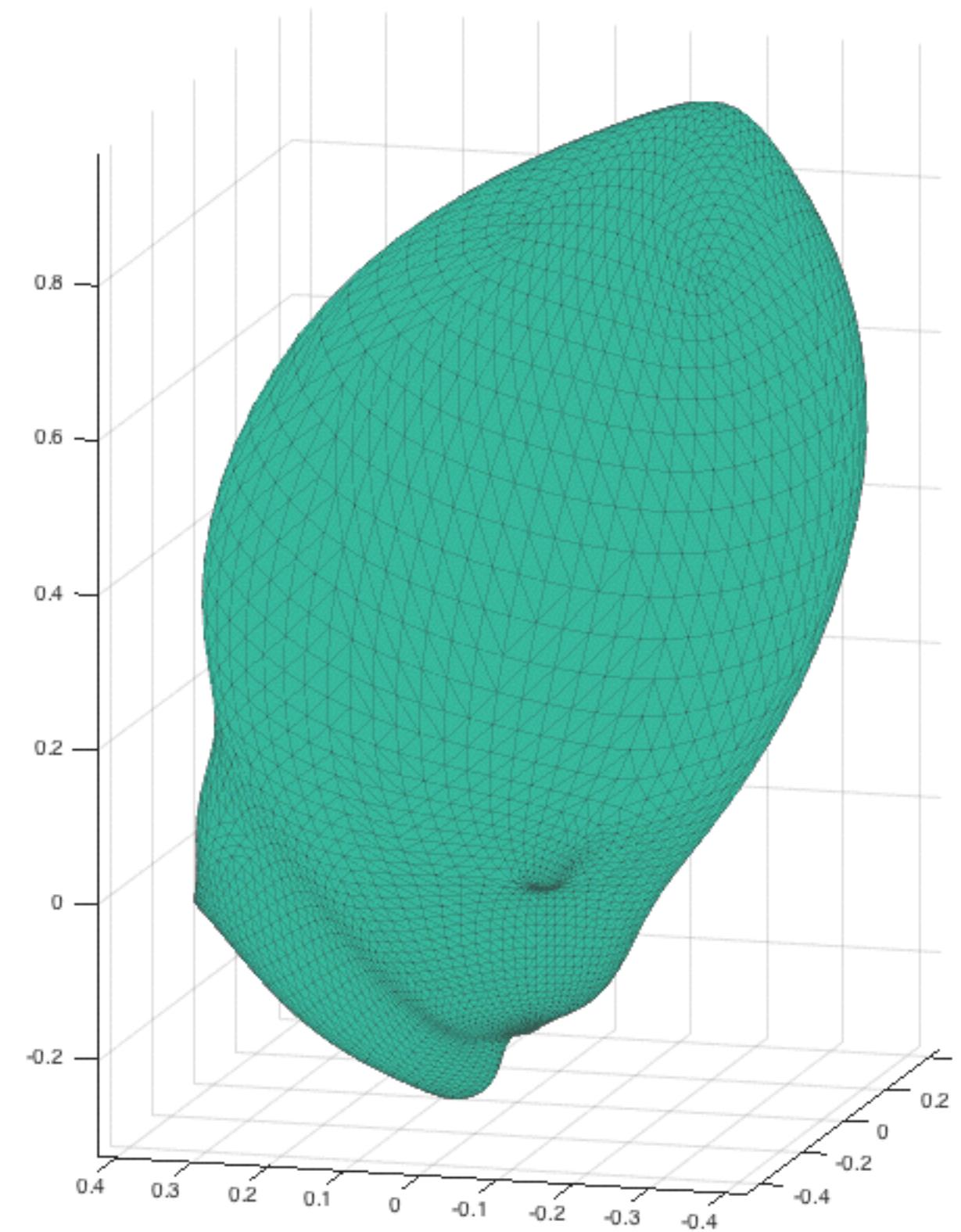


Encoded

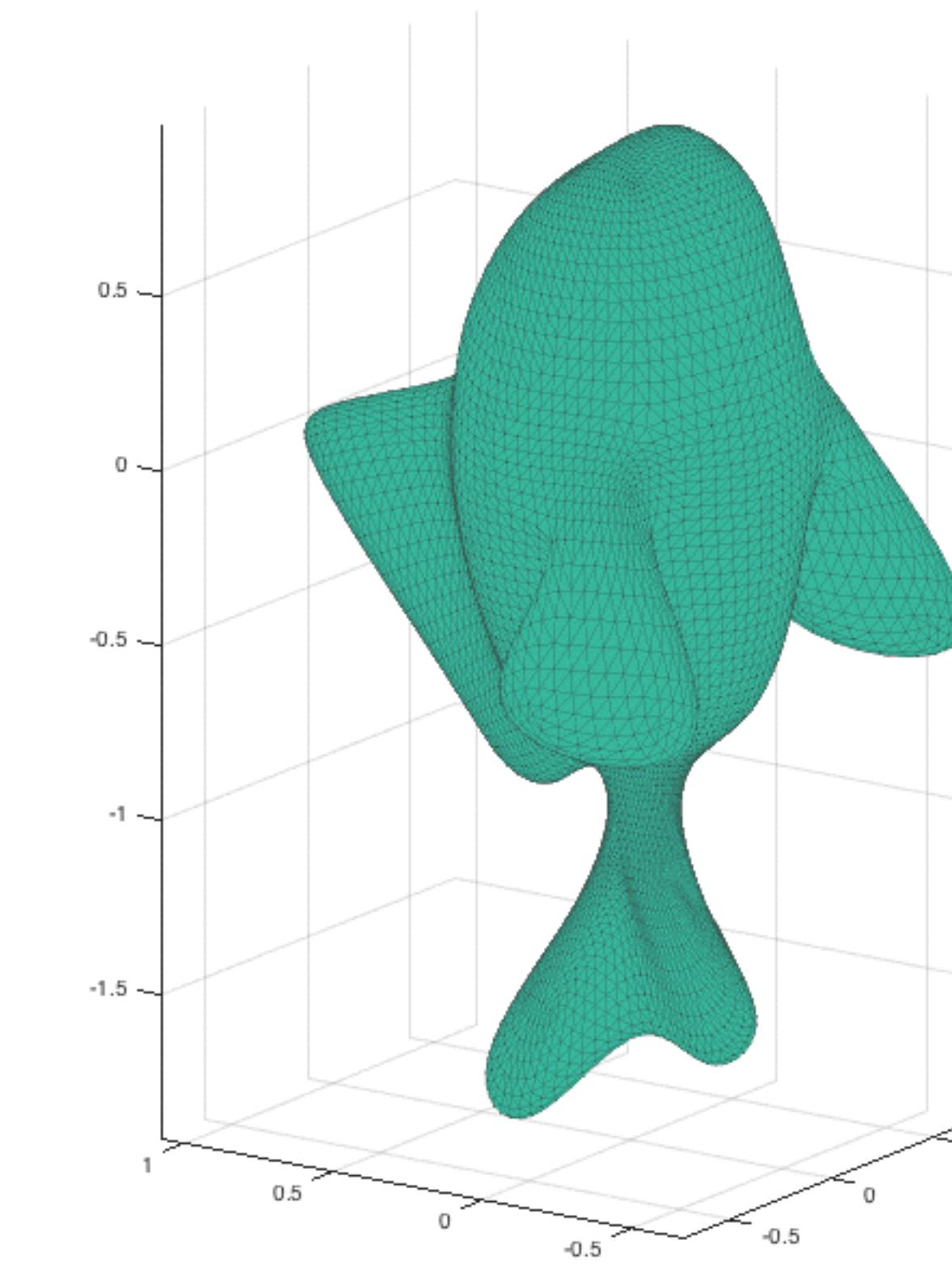


Ground Truth

# However...

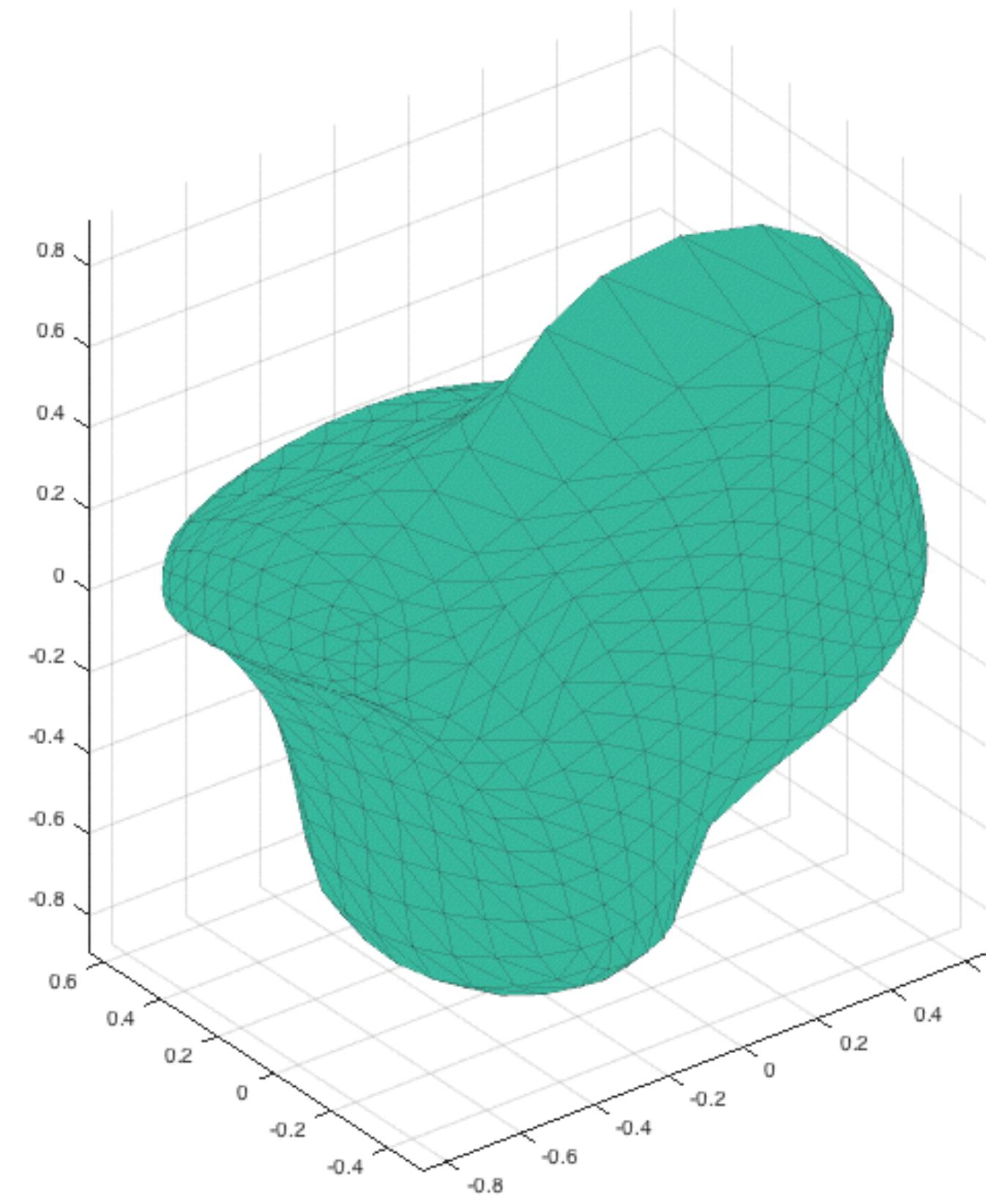


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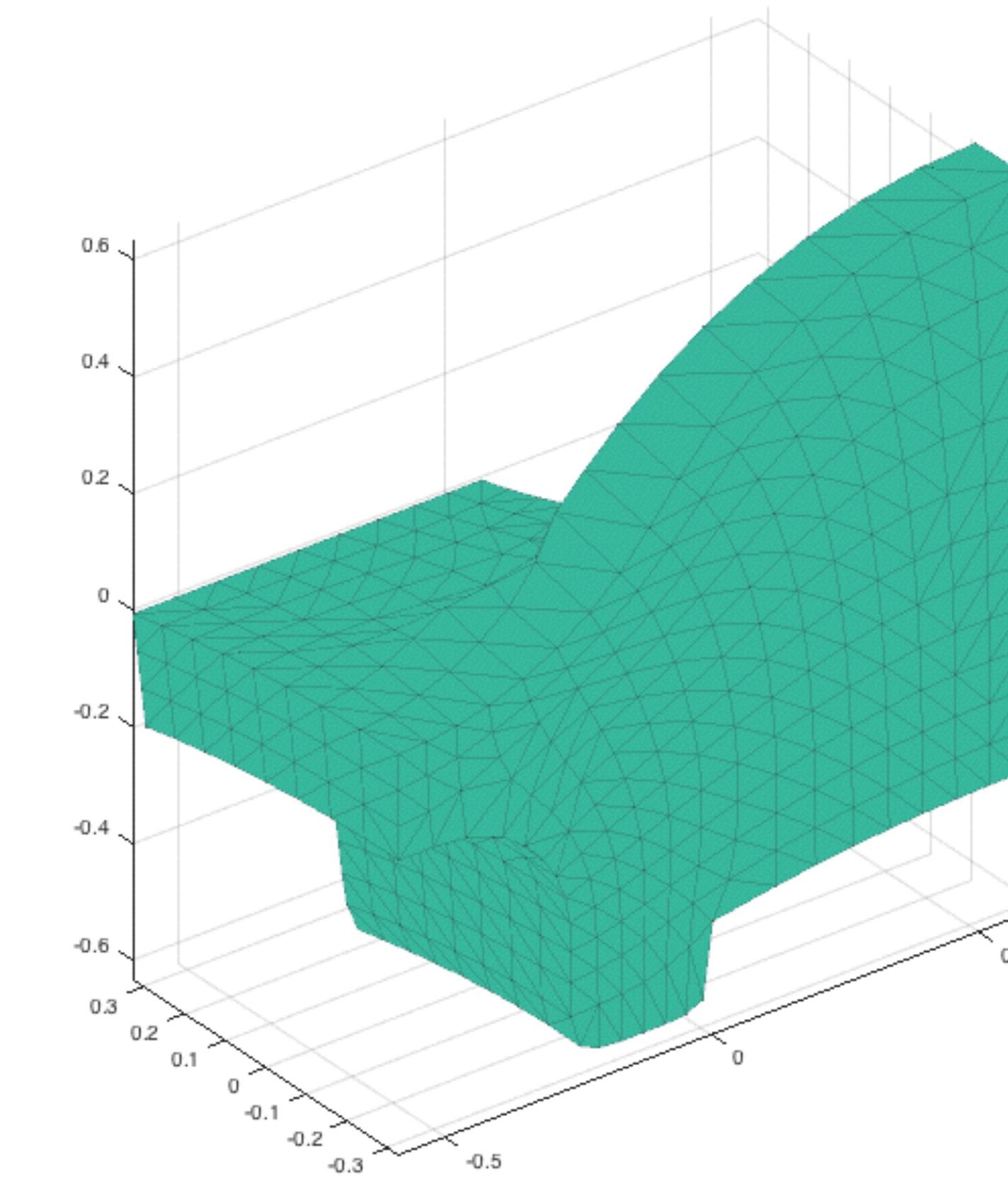


Ground Truth

# However...



Encoded



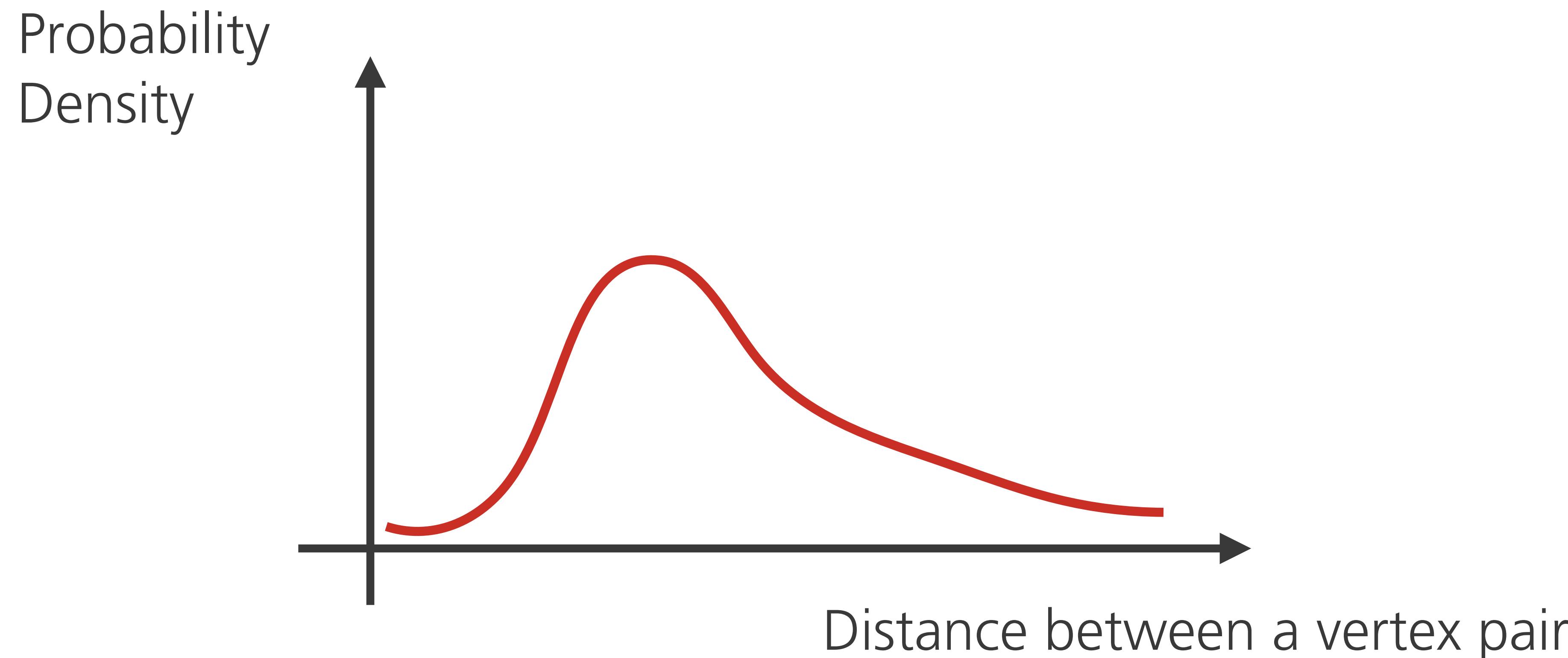
Ground Truth

# Reconstruction Issues

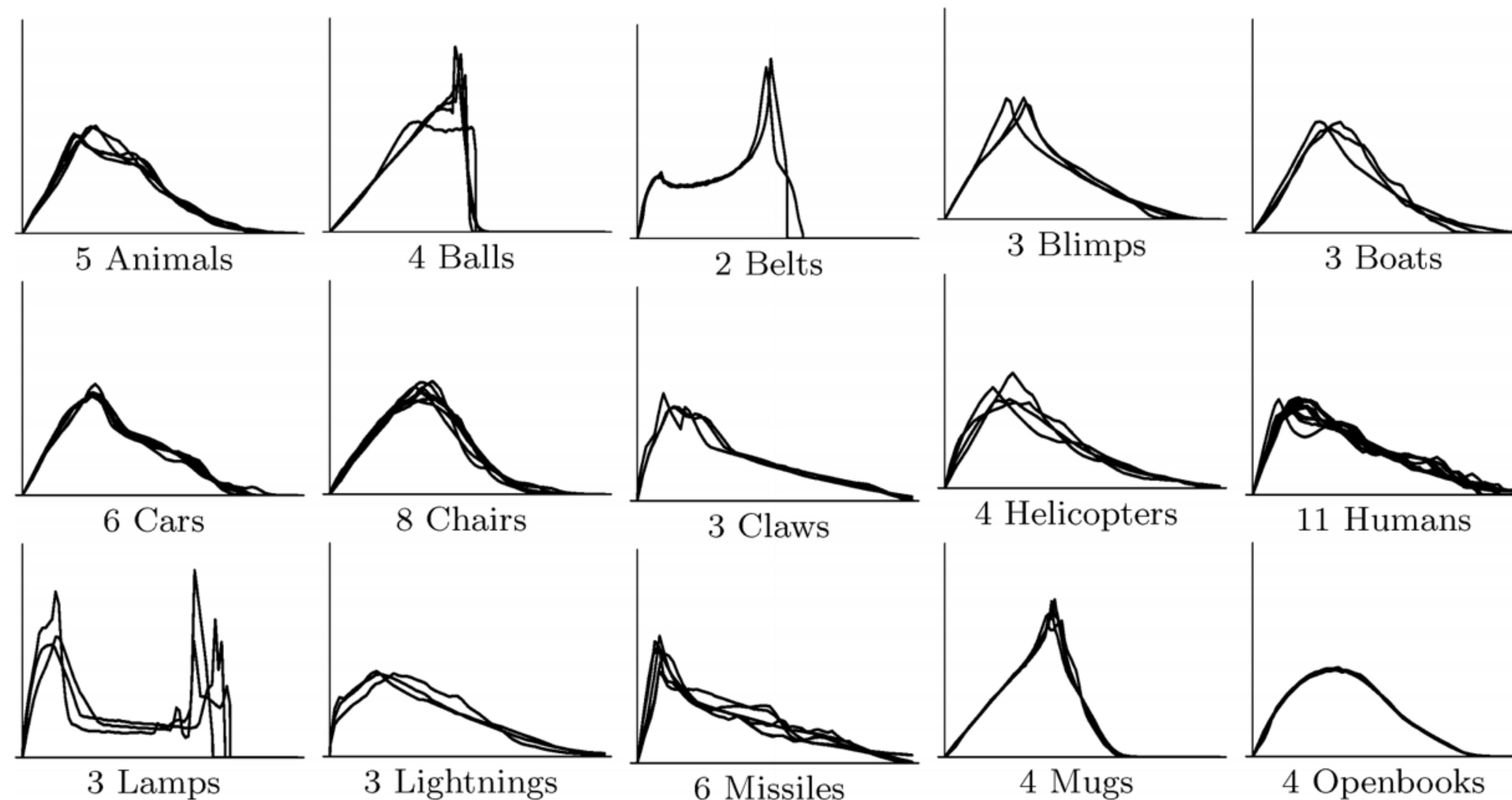
- Not bijective
- Unable to reconstruct salient structures
  - Multiple primitives?
  - Modified spin transformation?
- Unable to reconstruct sharp corners

# Classification

# 1. Shape Distribution

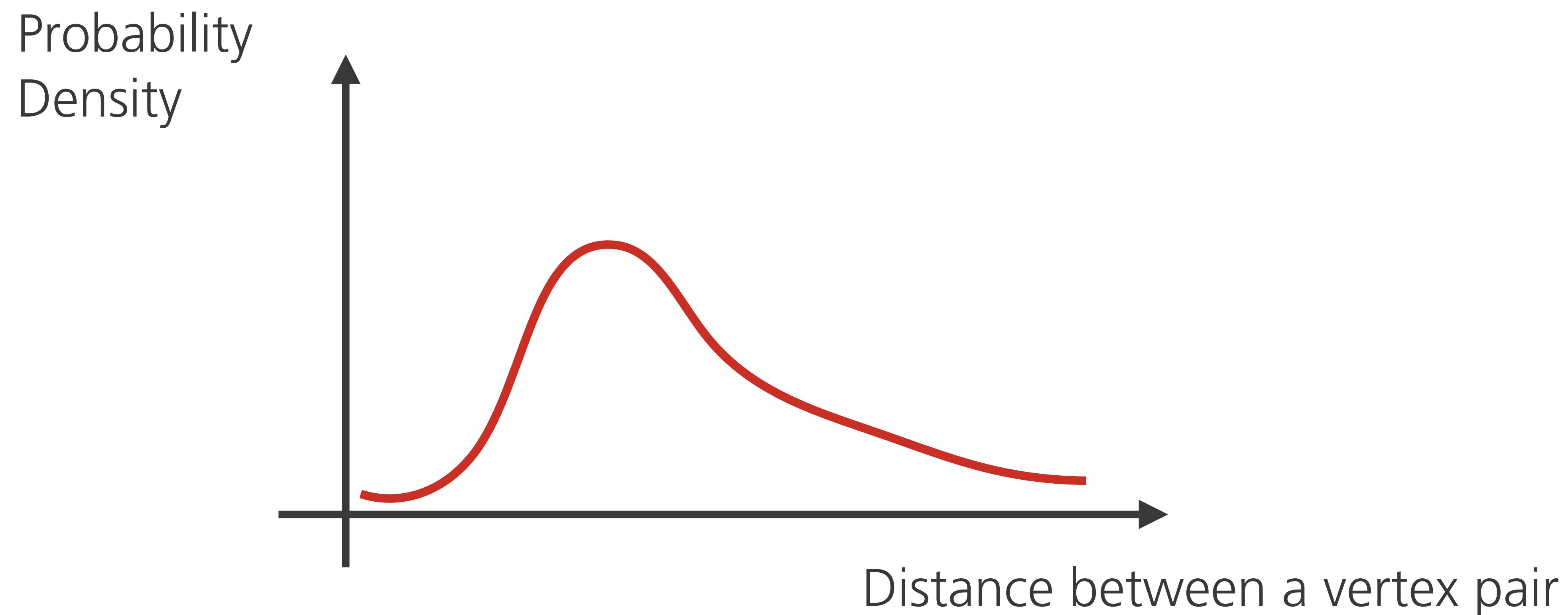


# 1. Shape Distribution

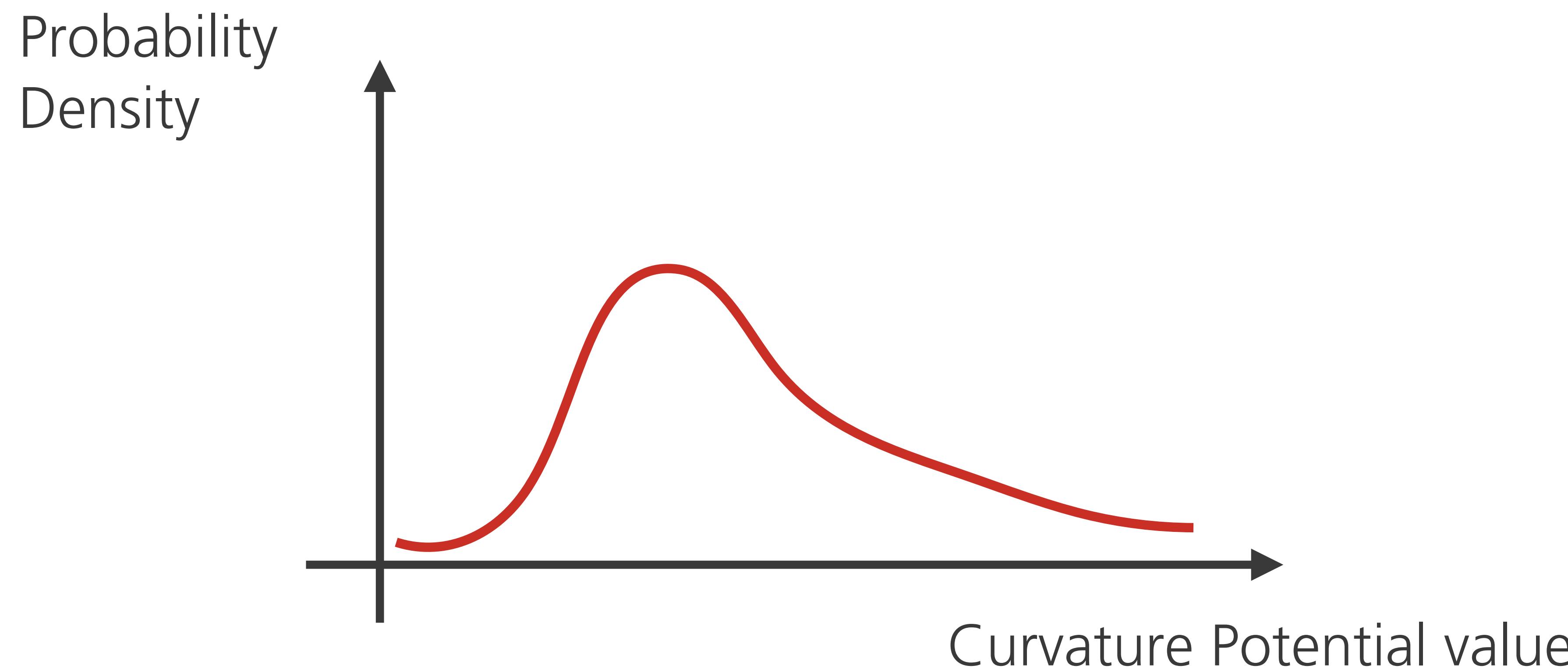


Osada, R., Funkhouser, T., Chazelle, B., & Dobkin, D. (2002). Shape distributions.

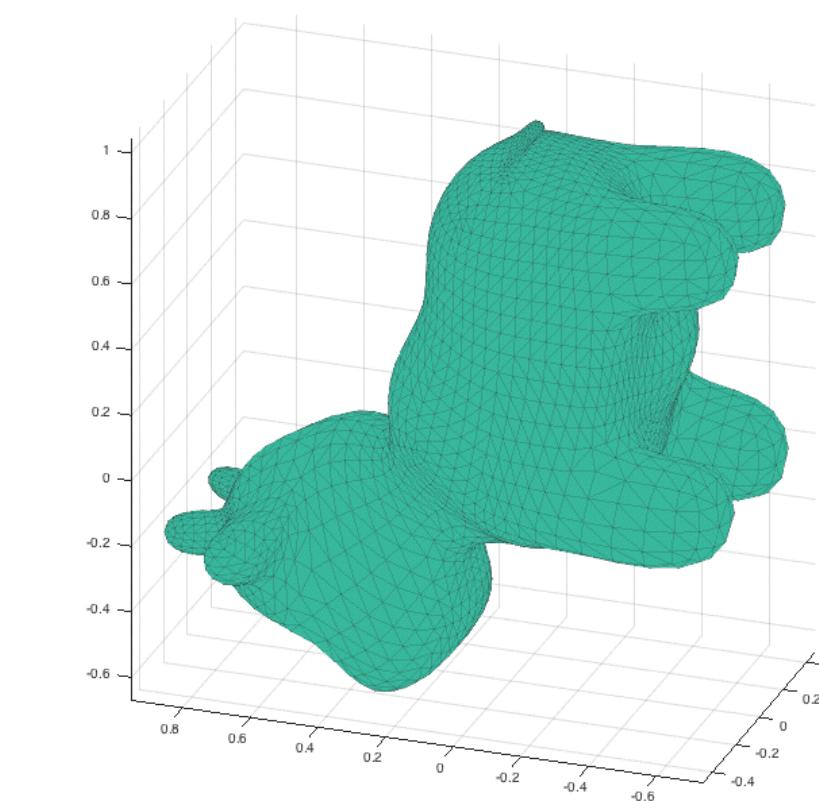
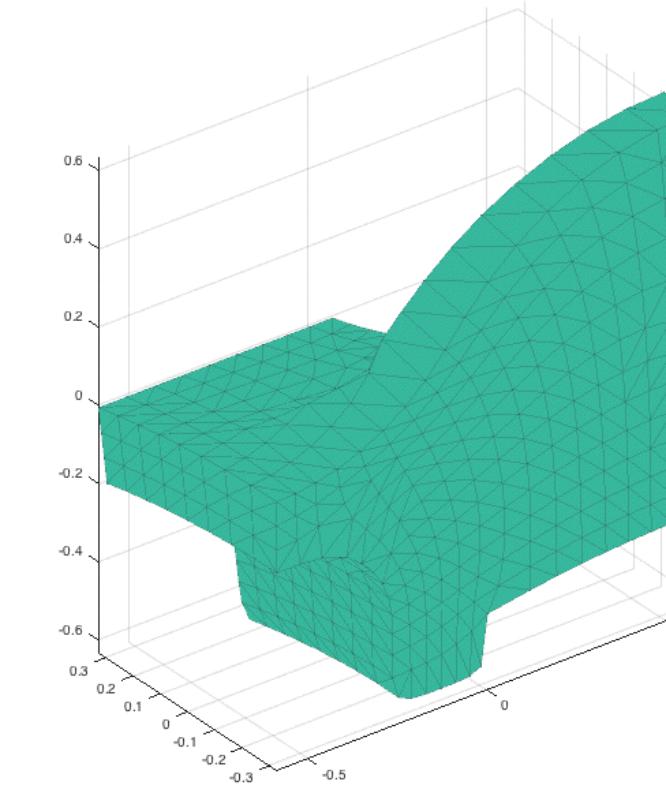
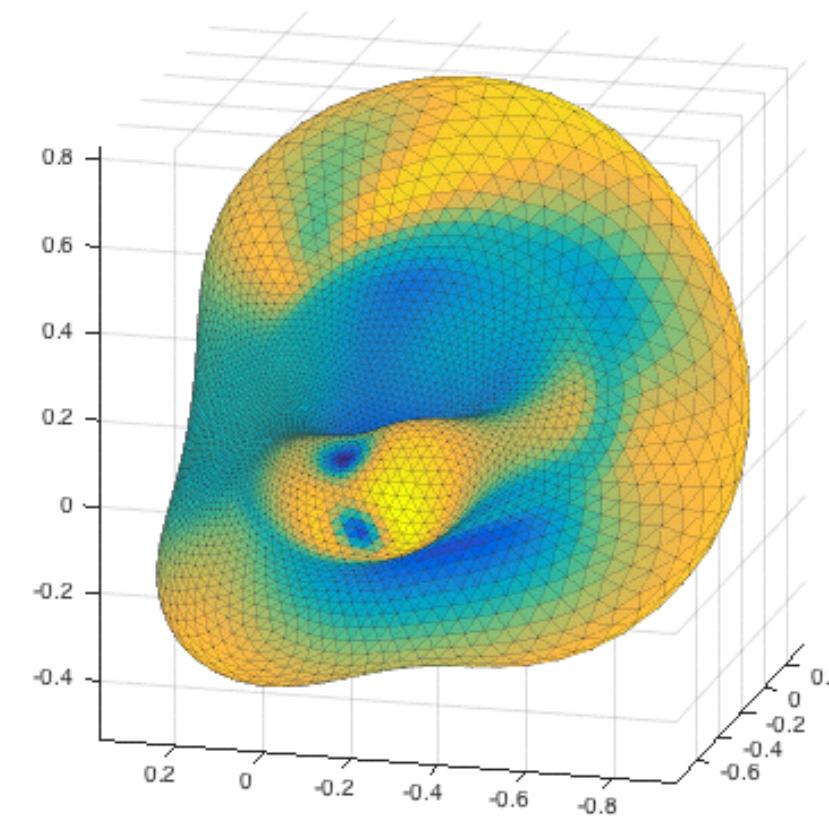
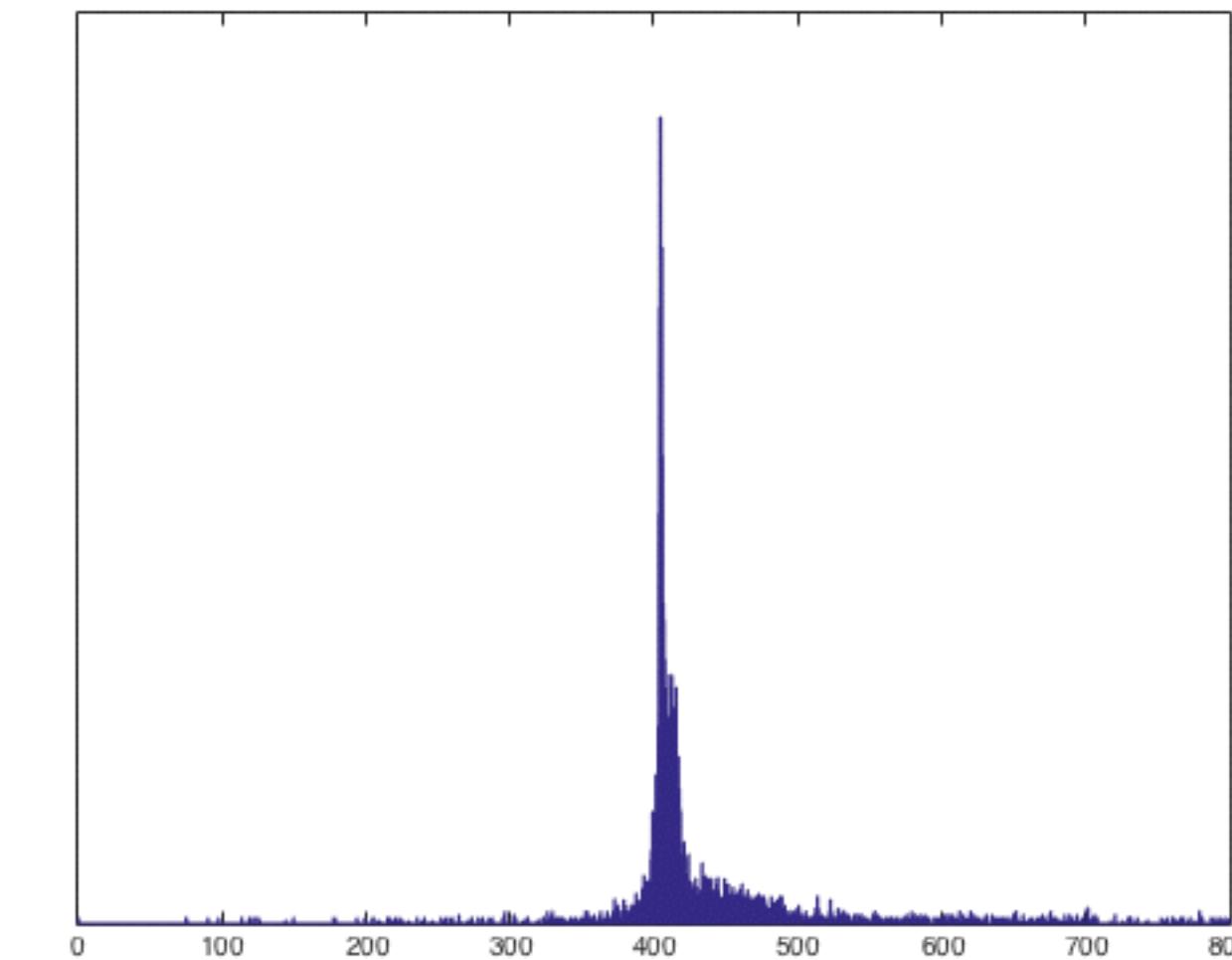
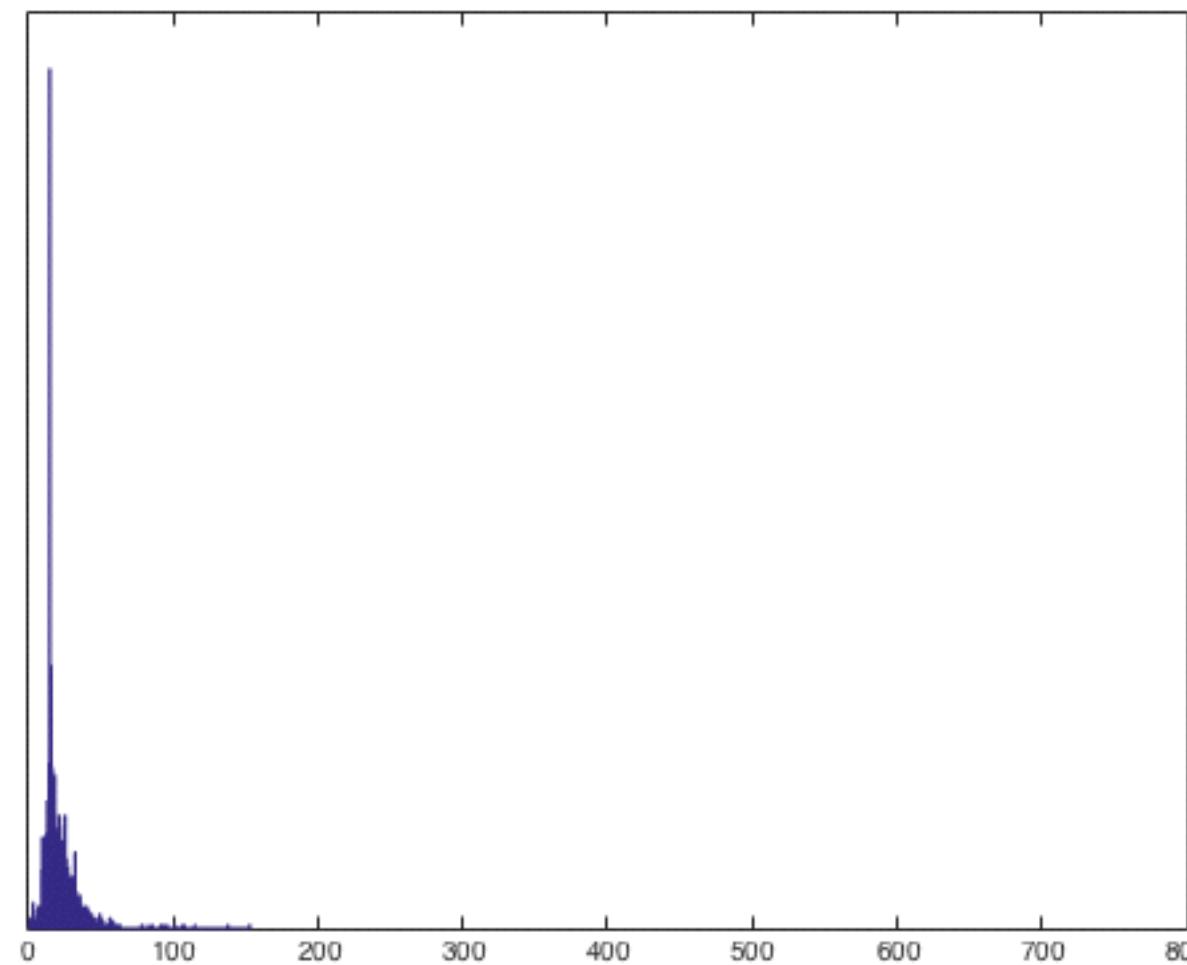
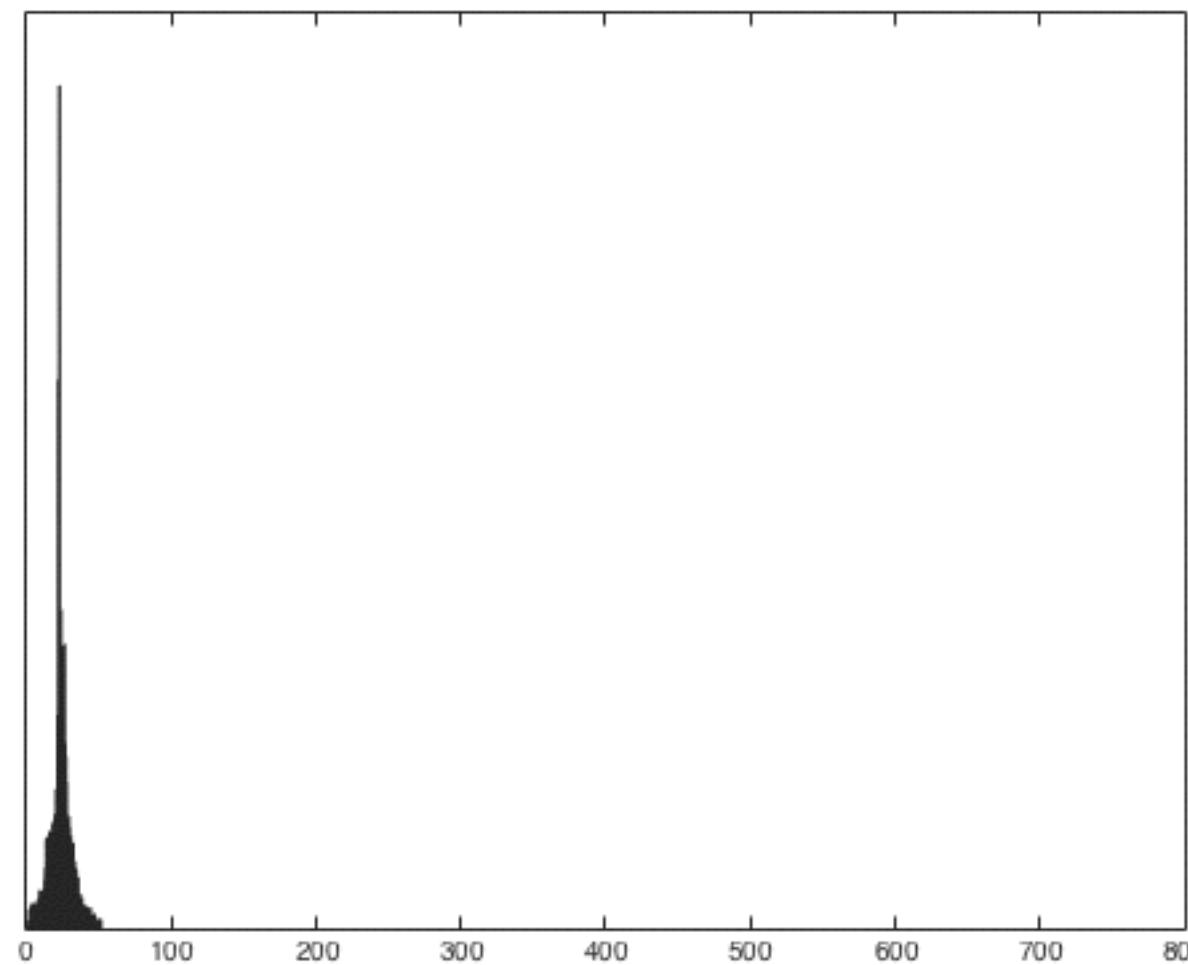
# 1. Modified Shape Distribution



# 1. Modified Shape Distribution



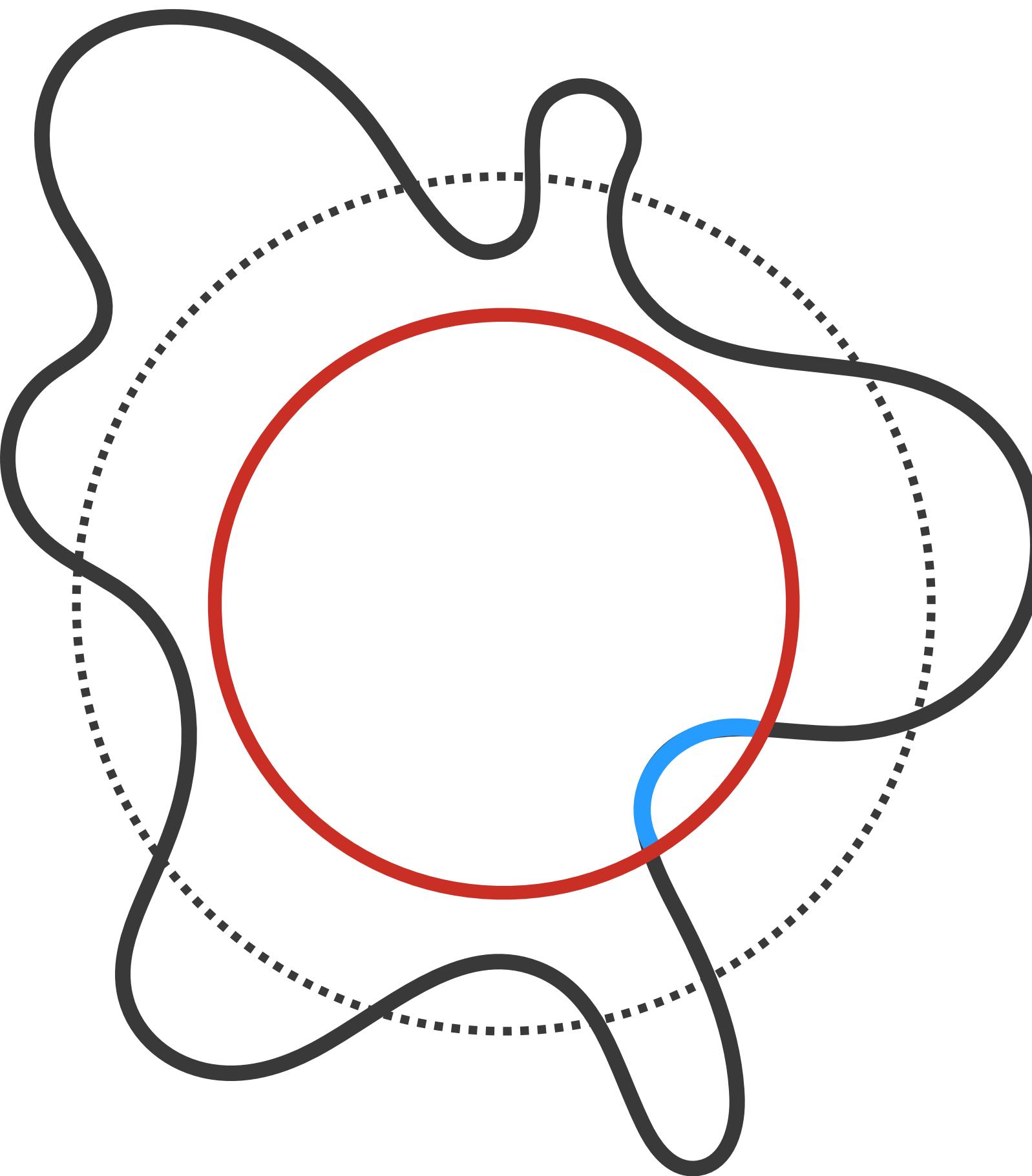
# 1. Modified Shape Distribution



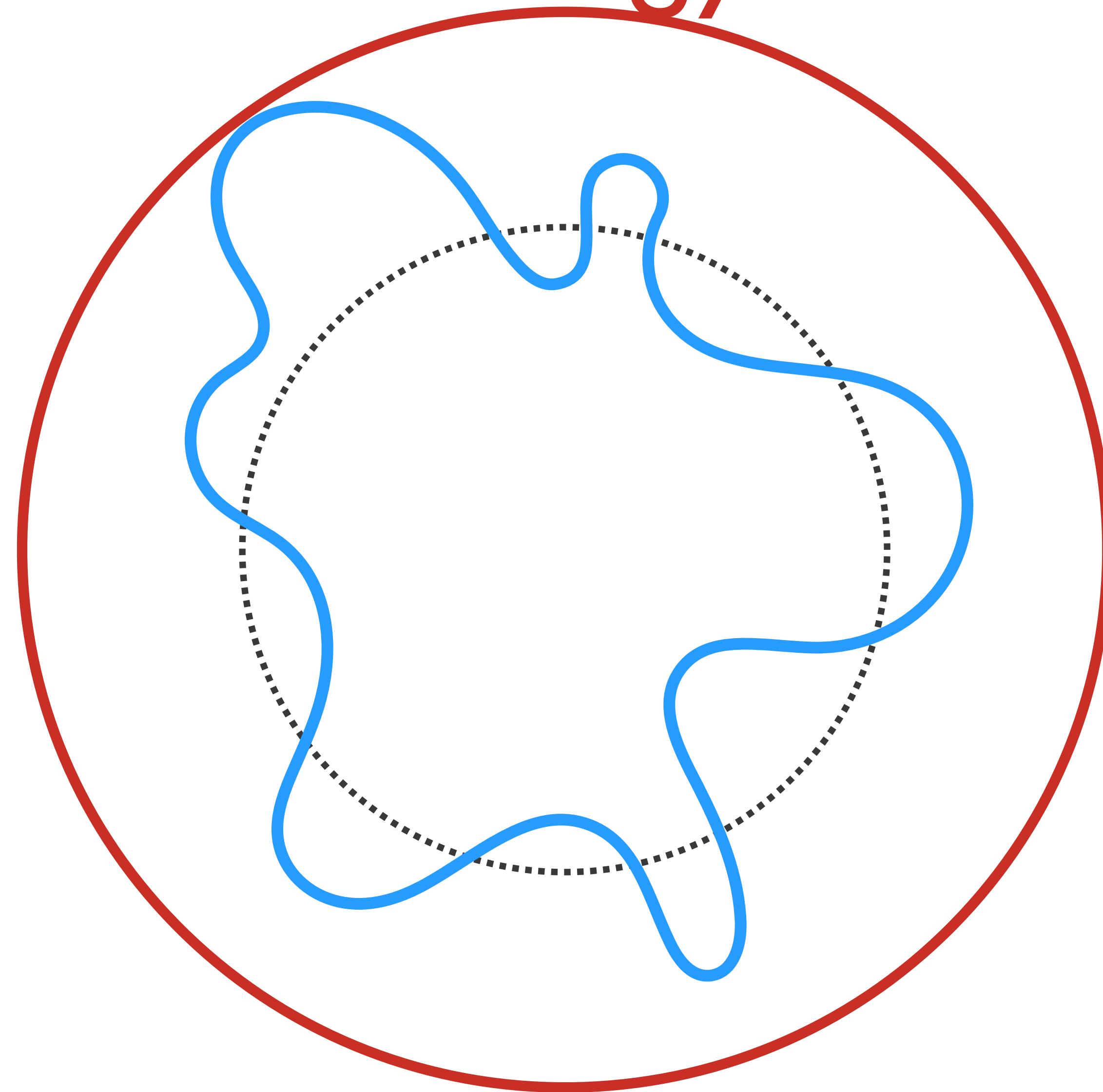
# 1. Modified Shape Distribution

- Largely depends on mesh connectivity
- Looks like not differentiable

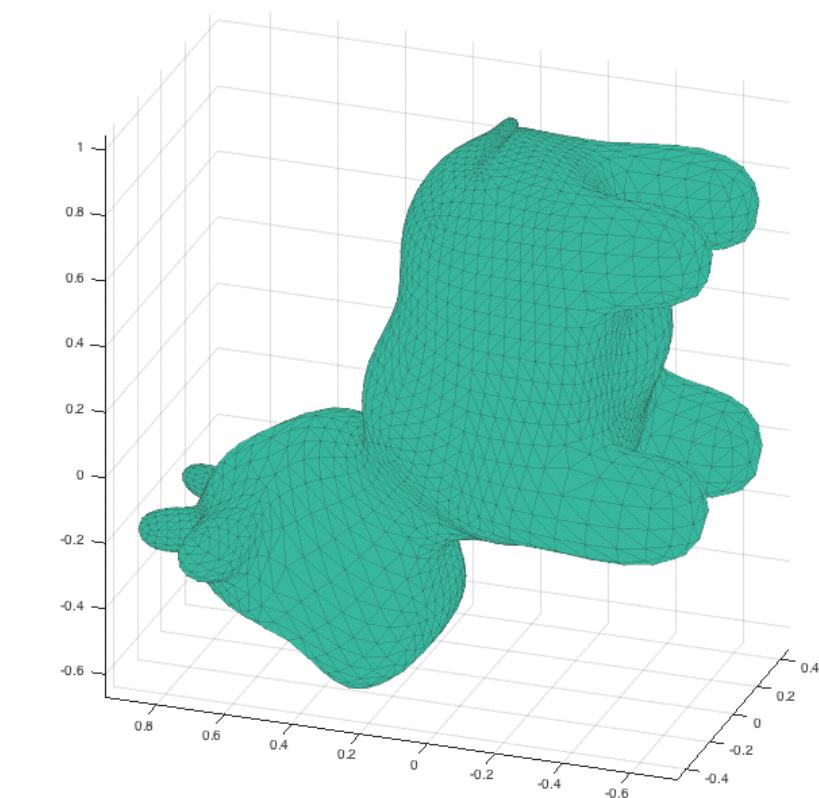
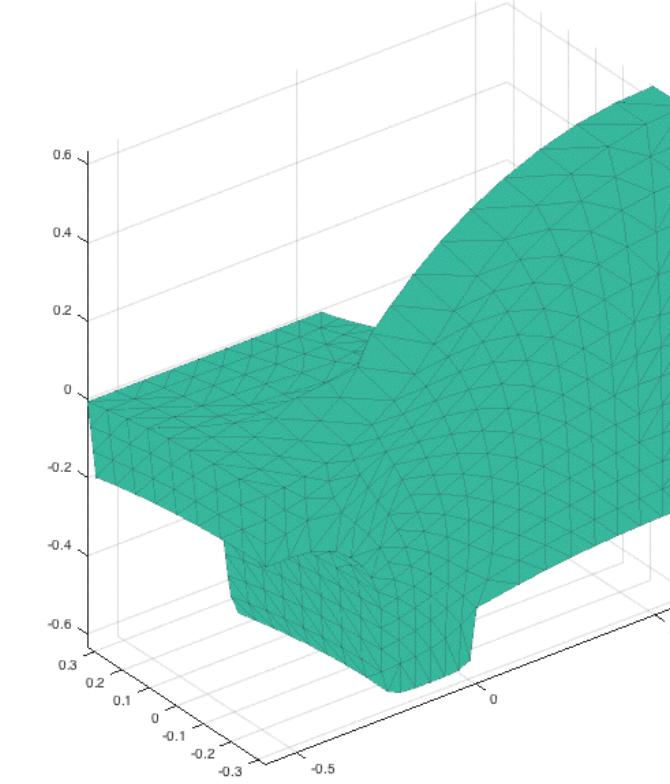
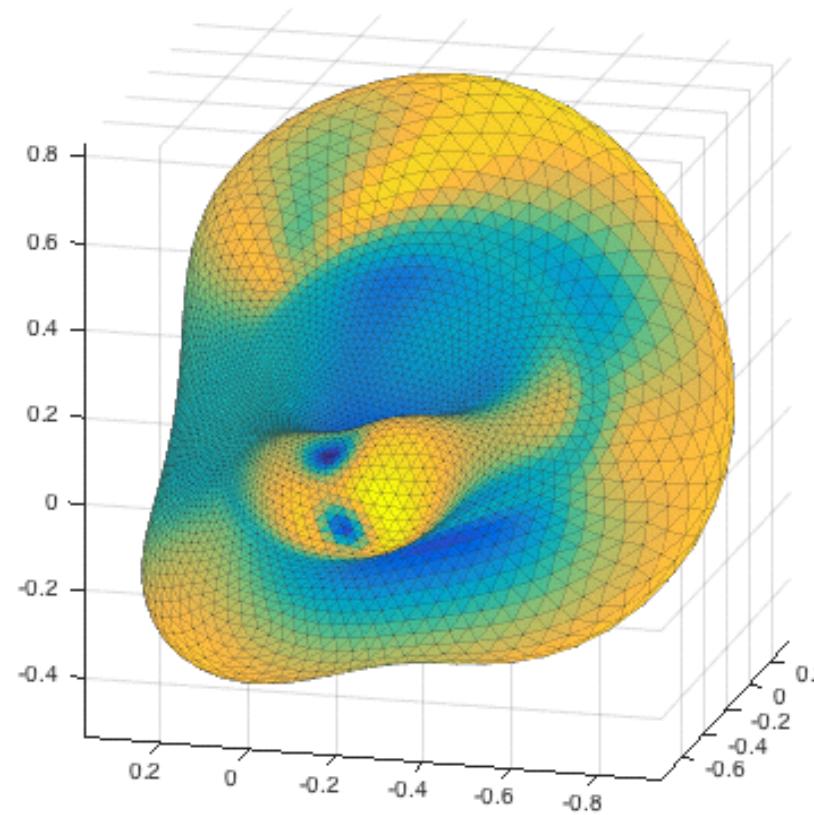
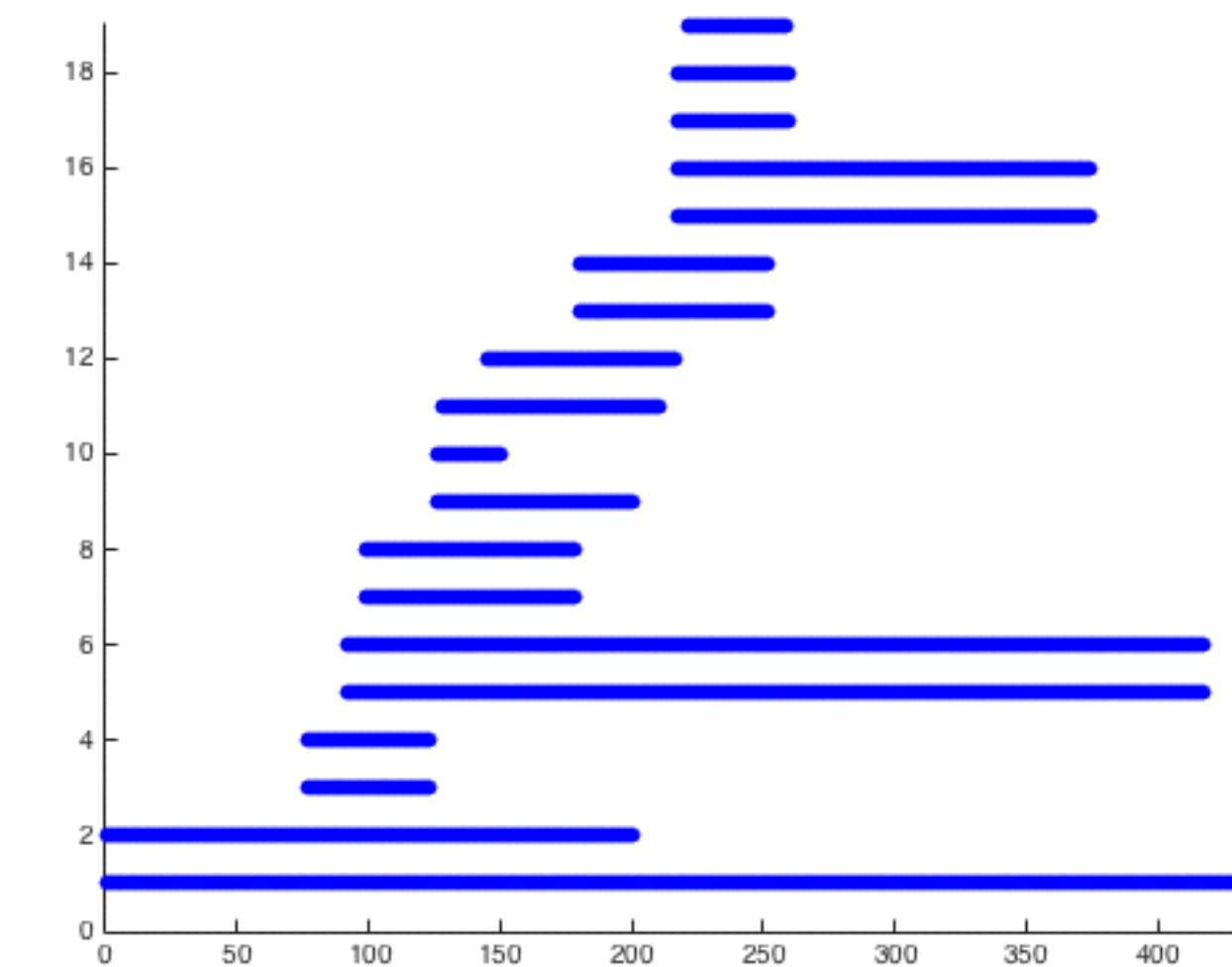
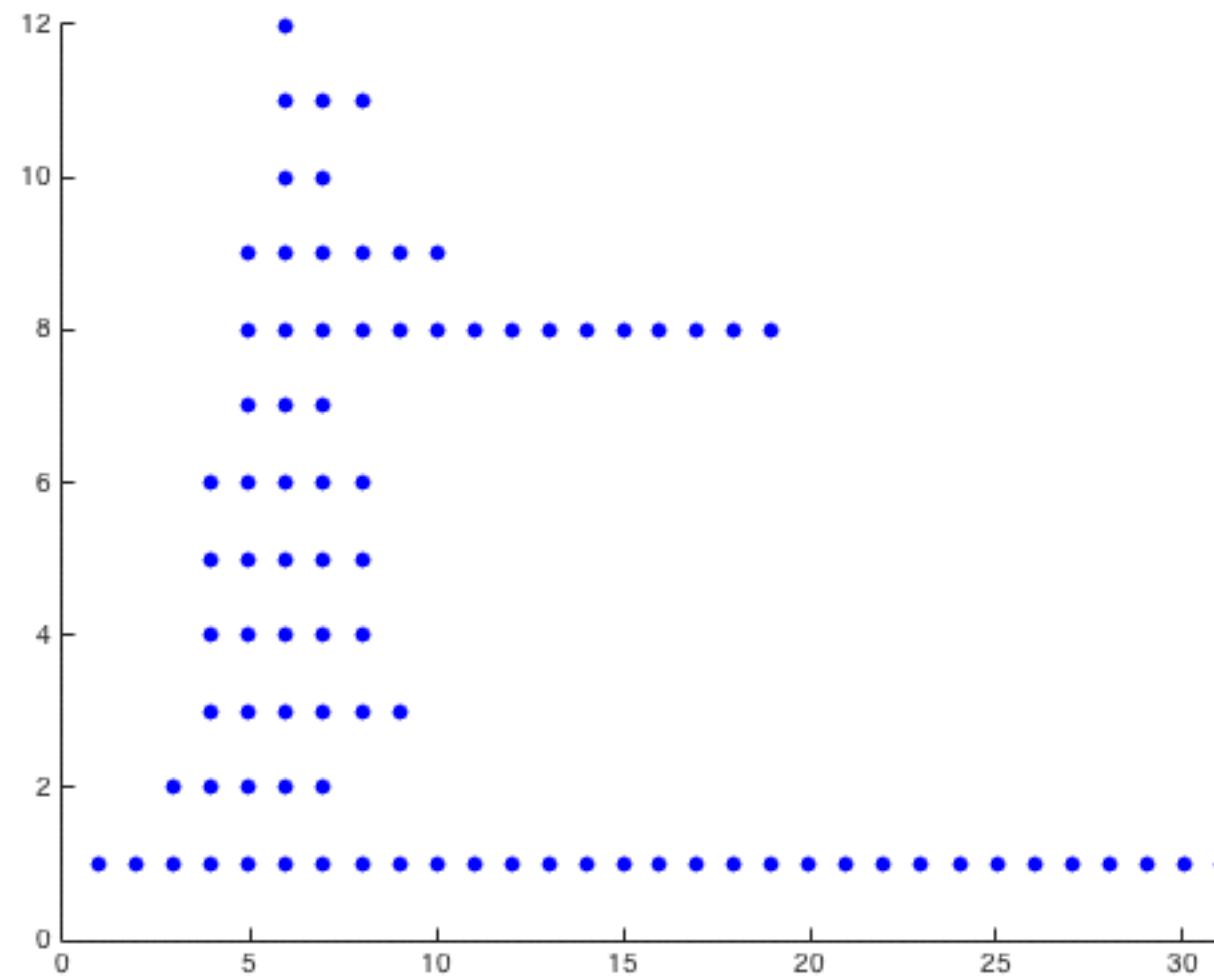
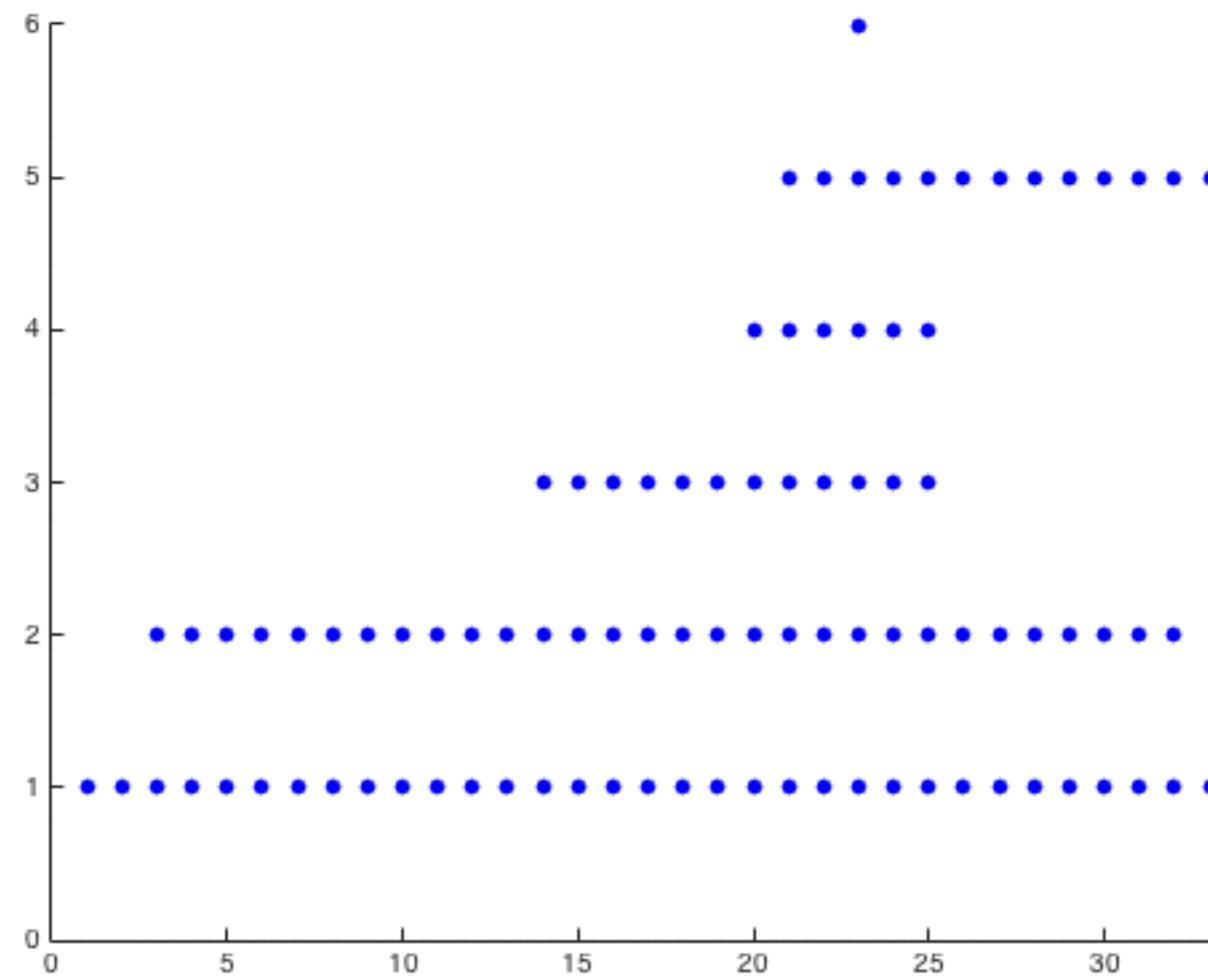
## 2. Persistent Homology



## 2. Persistent Homology



# 2. Persistent Homology



# Discussion

- Multiple primitives fitting and segmentation
  - Persistent barcodes comparison
  - Coping with different connectivities
- 
- Fitting using spherical harmonics ?
  - Using conformal willmore flow ?
  - Is curvature potential bijective ?

The End