Master Thesis

Shape Space learning

Initial Settings:

Network:

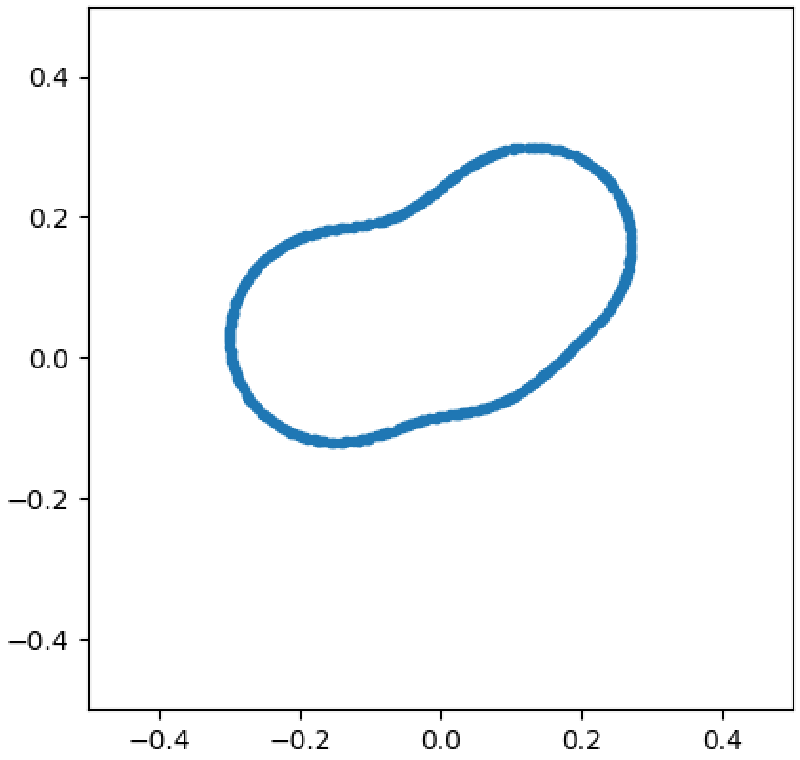
- Training interations: 35000
- Learning rate: 0.01 (automatically reduced if loss doesn't improve after 1500 steps)
- Network: 5 layers of each 512 neurons, with skipping layer into the third layer

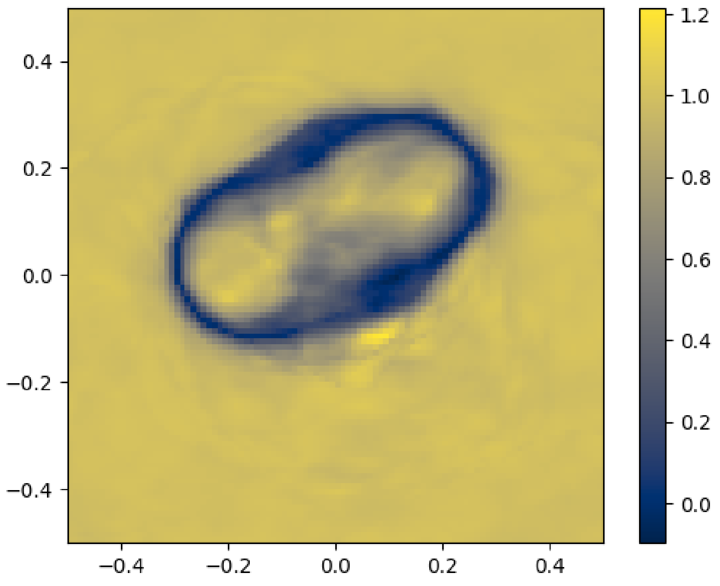
Loss:

- Monte Carlo Samples: 1000
- Shape batch: 50
- Total shapes: 500

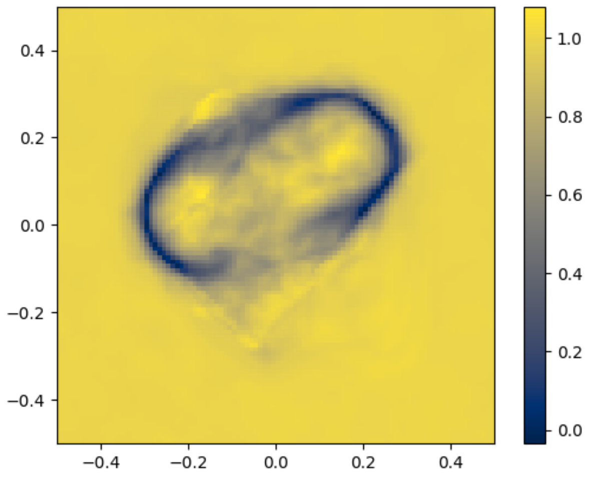
$$\min_{\theta,\psi} \sum_{i=0}^{N} \left(\int_{\Omega} \frac{1}{4\varepsilon} \left(v_\theta(\xi, E_\psi(\mathcal{P}_i)) - 1\right)^2 + \varepsilon \left\|\nabla v_\theta(\xi, E_\psi(\mathcal{P}_i))\right\|^2 \,\mathrm{d}\xi + \frac{\lambda \varepsilon^{-\frac{1}{3}}}{|\mathcal{P}_i|} \sum_{p \in \mathcal{P}_i} \left|v_\theta(p, E_\psi(\mathcal{P}_i))\right| \right)$$

Reference Point Cloud (9D-latent space)

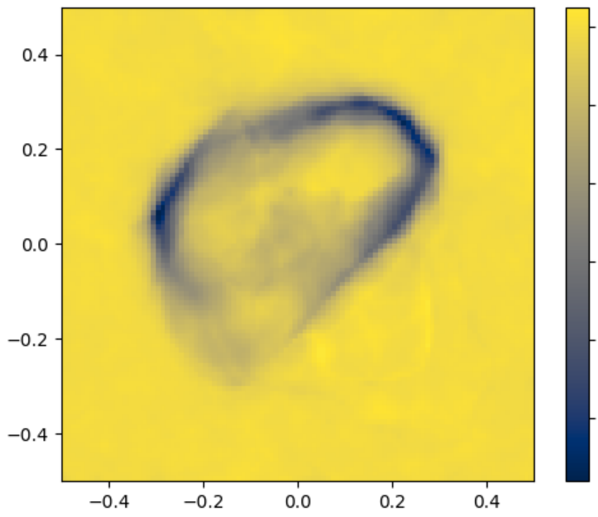




Lambda = 2



Lambda =1



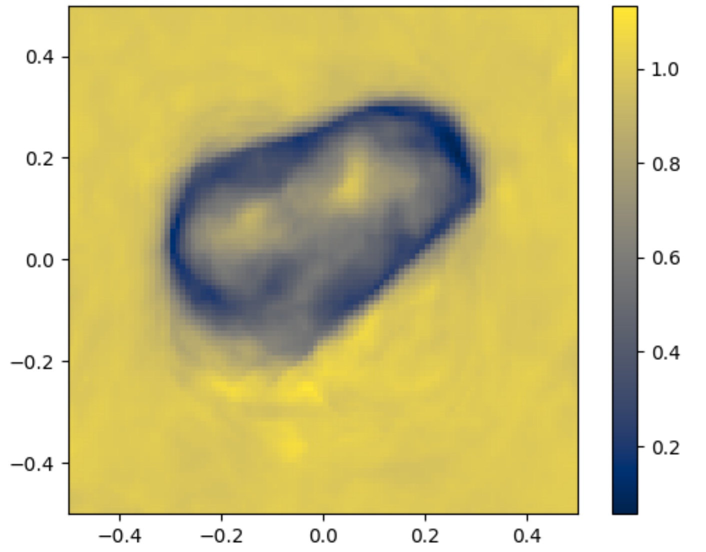
Lambda =0,5

Epsilon = 0,01

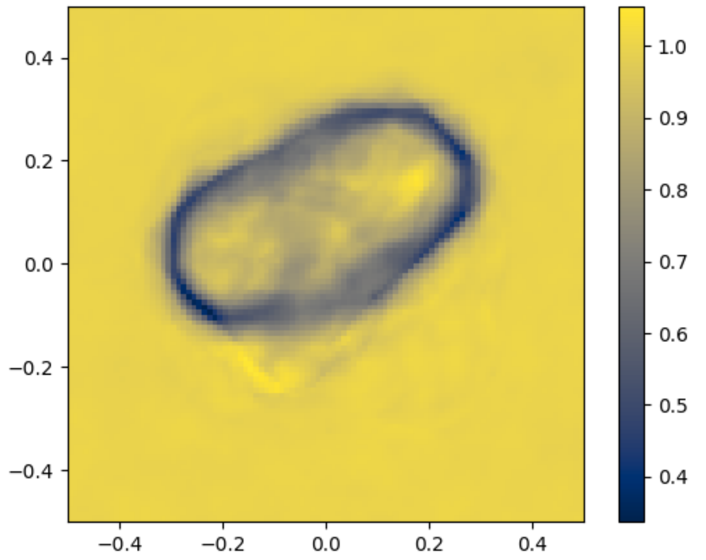
Quadrathic data term:

$$\min_{\theta,\psi} \sum_{i=0}^{N} \left(\int_\Omega \frac{1}{4\varepsilon} \left(v_\theta(\xi, E_\psi(\mathcal{P}_i)) - 1\right)^2 + \varepsilon \left\|\nabla v_\theta(\xi, E_\psi(\mathcal{P}_i))\right\|^2 \mathrm{d}\xi + \frac{\lambda \varepsilon^{-\frac{1}{3}}}{|\mathcal{P}_i|} \sum_{p\in\mathcal{P}_i} \left|v_\theta(p, E_\psi(\mathcal{P}_i))\right|^2 \right)$$

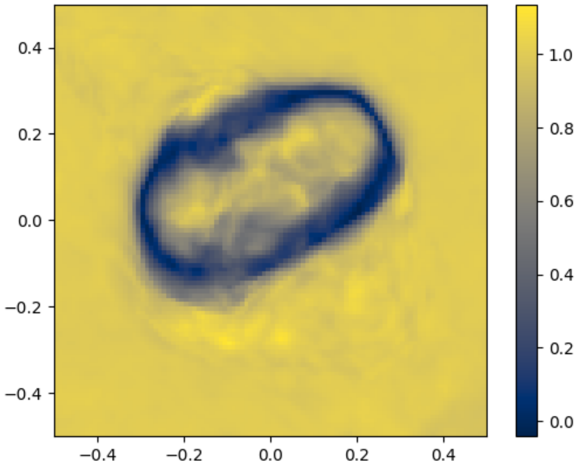
- Epsilon = 0,01



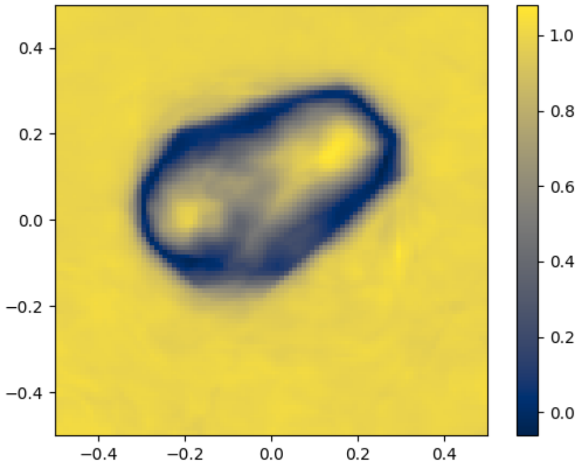
Lambda = 2



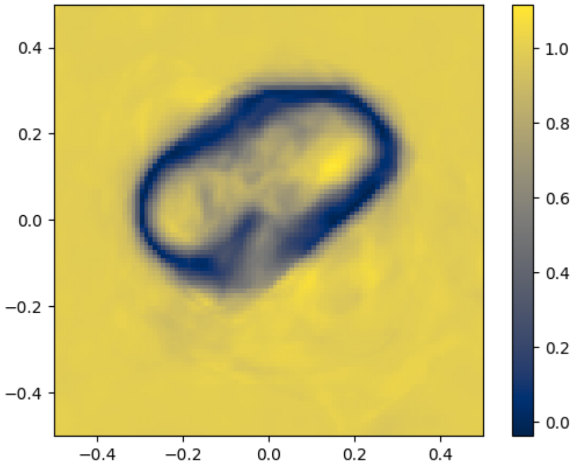
Lambda = 0,5



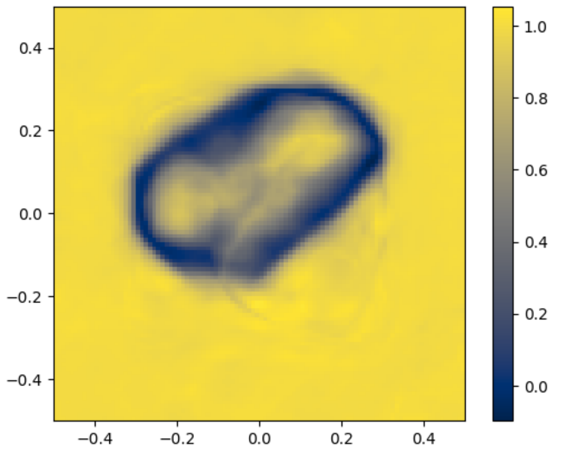
alpha = 0,05



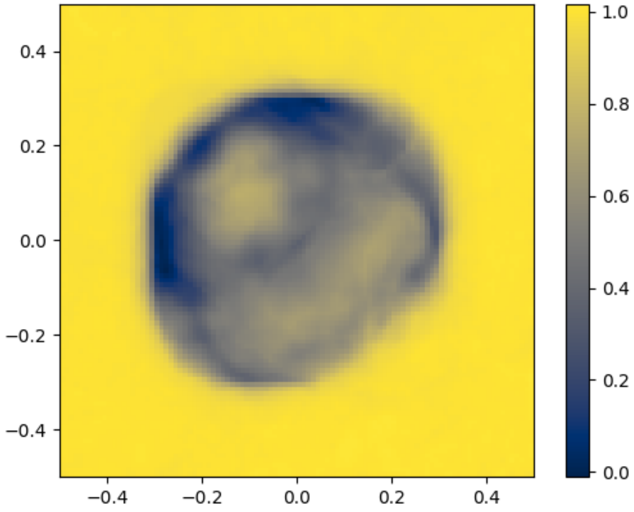
alpha = 0,5



alpha = 1



alpha = 5

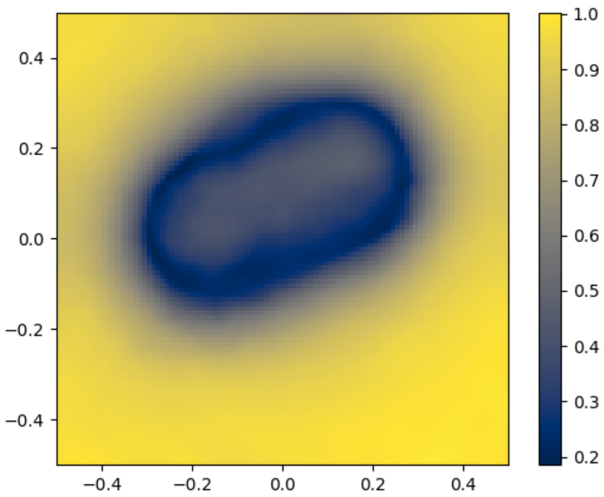


alpha = 10

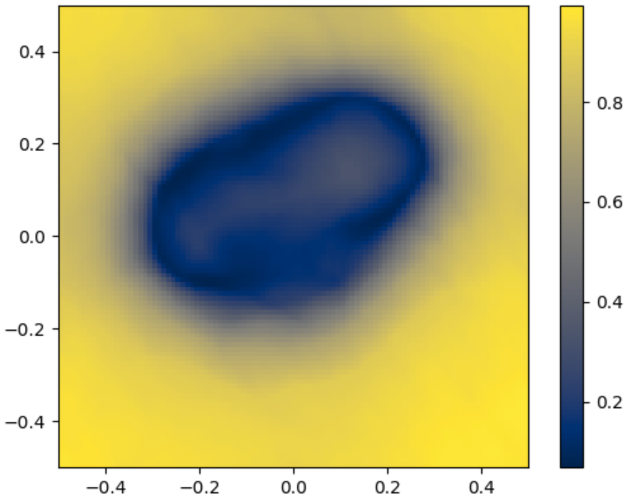
Regularized latent space

$$\sum_{i=0}^{N}\left(\int_\Omega \frac{1}{4\varepsilon}(v_\theta(x,E_\psi(\mathcal{P}_i))-1)^2+\varepsilon\|\nabla v_\theta(x,E_\psi(\mathcal{P}_i))\|^2\mathrm{d}x+\frac{C\varepsilon^{-\frac{1}{3}}}{|\mathcal{P}_i|}\sum_{p\in\mathcal{P}_i}|v_\theta(p,E_\psi(\mathcal{P}_i))|^2\right)+\alpha\|E_\psi(\mathcal{P}_i)\|$$

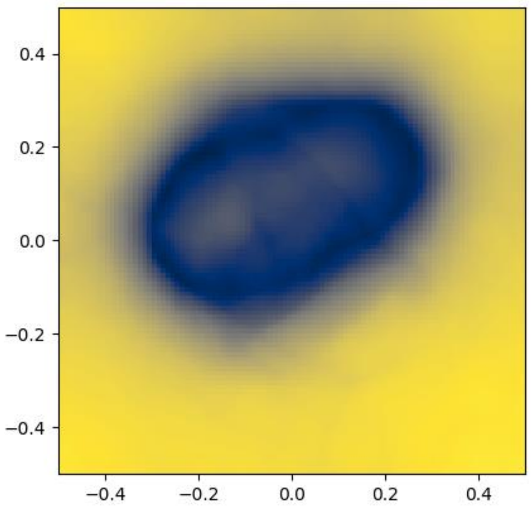
Epsilon = 0,01
Lambda = 0,5



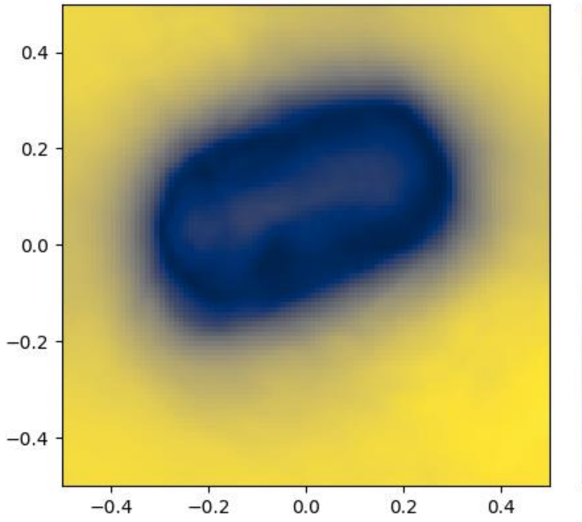
Lambda = 2



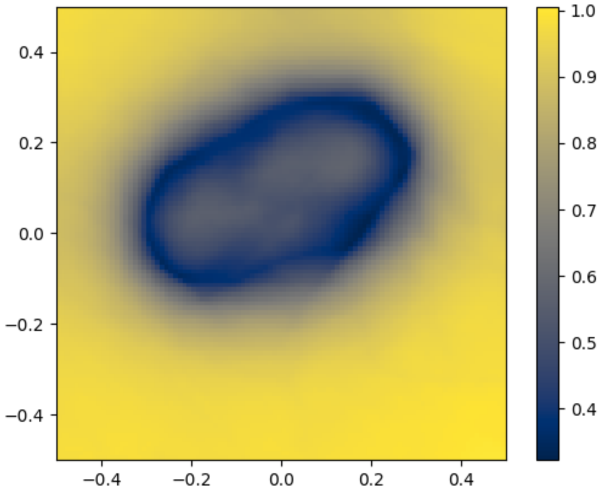
Lambda = 5



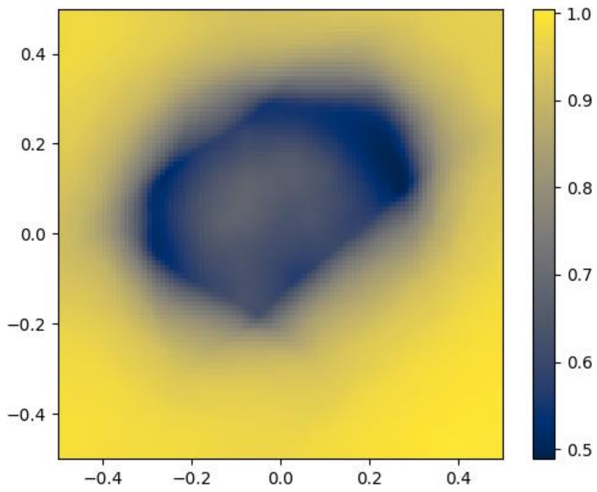
Lambda = 7



Lambda = 10



Lambda = 1



Lambda = 0,5

Larger epsilon

$$\min_{\psi,\theta}\sum_{i=0}^{N}\left(\int_\Omega \frac{1}{4\varepsilon}(v_\theta(x,E_\psi(\mathcal{P}_i))-1)^2+\varepsilon\|\nabla v_\theta(x,E_\psi(\mathcal{P}_i))\|^2\mathrm{d}x+\frac{C\varepsilon^{-\frac{1}{3}}}{|\mathcal{P}_i|}\sum_{p\in\mathcal{P}_i}|v_\theta(p,E_\psi(\mathcal{P}_i))|^2\right)$$

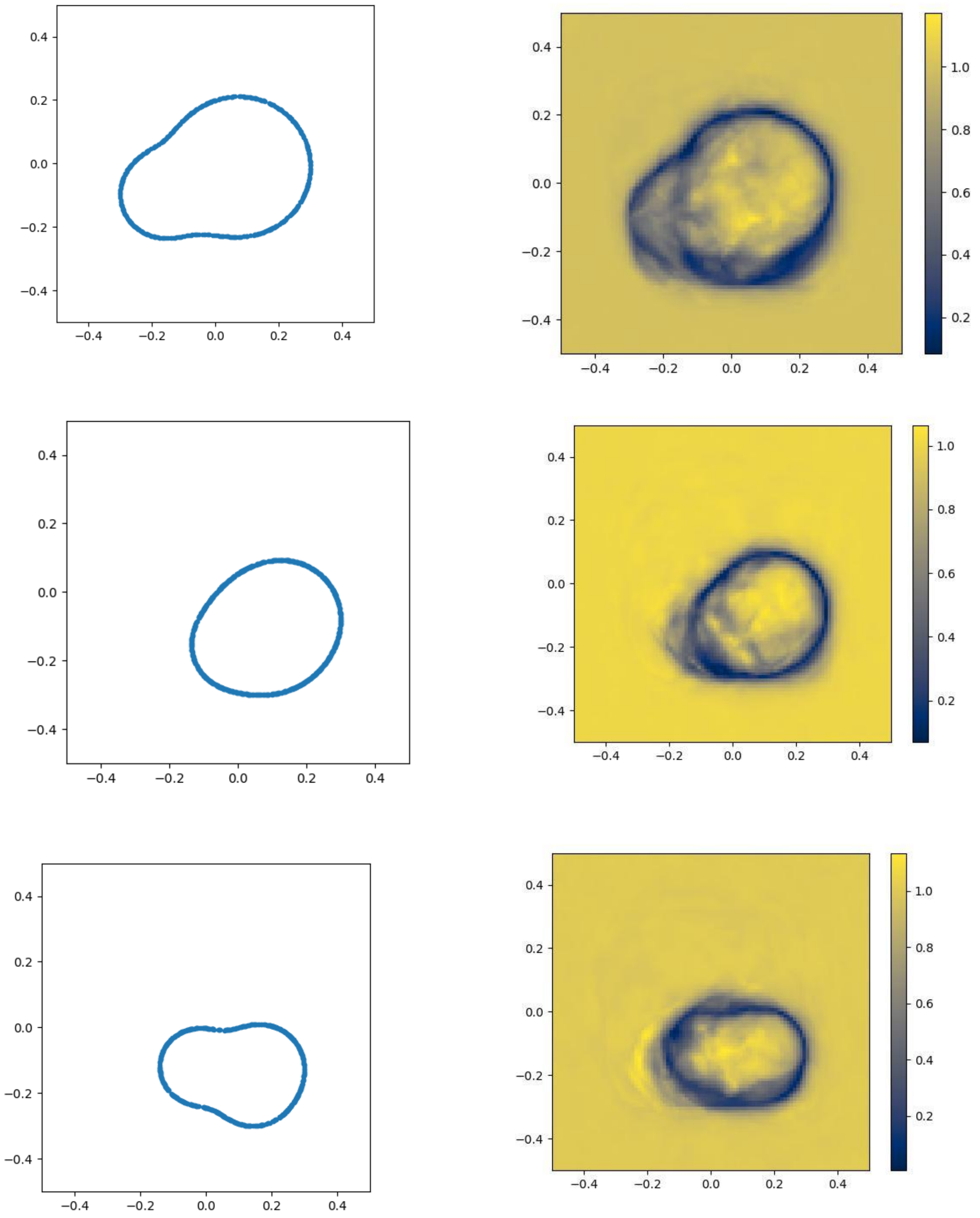
epsilon = 0,05

Larger Network:

7 Layer of 512 Neurons and skipping layer in 4th layer:

```
# Training Parameters
NUM_TRAINING_SESSIONS = 35000
START_LEARNING_RATE = 0.01
PATIENCE = 1500
NUM_NODES = 512
FOURIER_FEATUERS = True
SIGMA = 1.7
MONTE_CARLO_SAMPLES = 1000
SHAPES_EACH_STEP = 80
EPSILON = .01
CONSTANT = 2. if FOURIER_FEATUERS else 10.0

# Network Design
FEATURE_DIMENSION = 9
SIZE_POINTCLOUD = 500
TOTAL_SHAPES = 499
```



Larger Network: (continued!) 7 Layer of 512 Neurons and skipping layer in 4th layer:

```
# Training Parameters
NUM_TRAINING_SESSIONS = 35000
START_LEARNING_RATE = 0.01
PATIENCE = 1500
NUM_NODES = 512
FOURIER_FEATUERS = True
SIGMA = 1.7
MONTE_CARLO_SAMPLES = 1000
SHAPES_EACH_STEP = 80
EPSILON = .01
CONSTANT = 2. if FOURIER_FEATUERS else 10.0

# Network Design
FEATURE_DIMENSION = 9
SIZE_POINTCLOUD = 500
TOTAL_SHAPES = 499
```