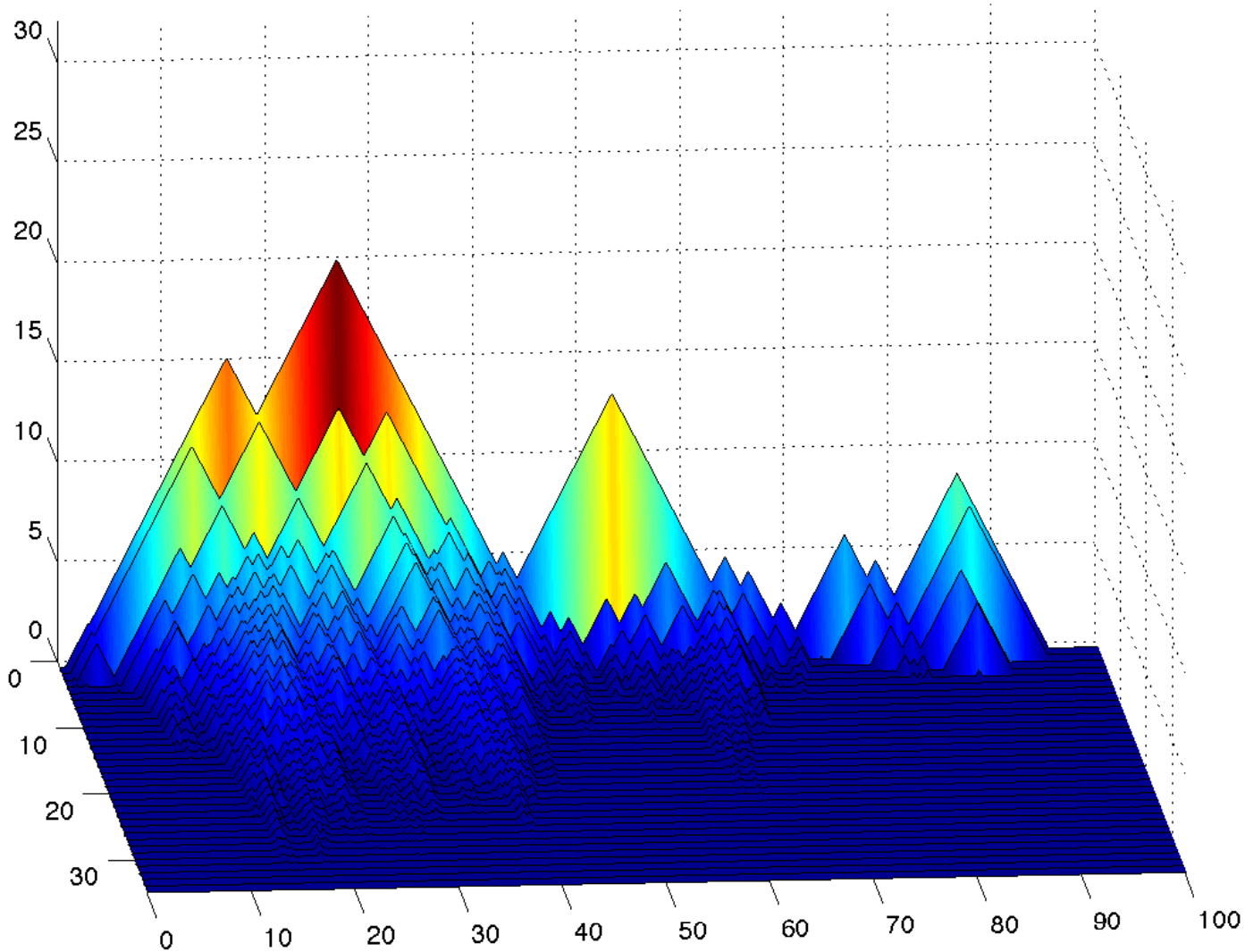
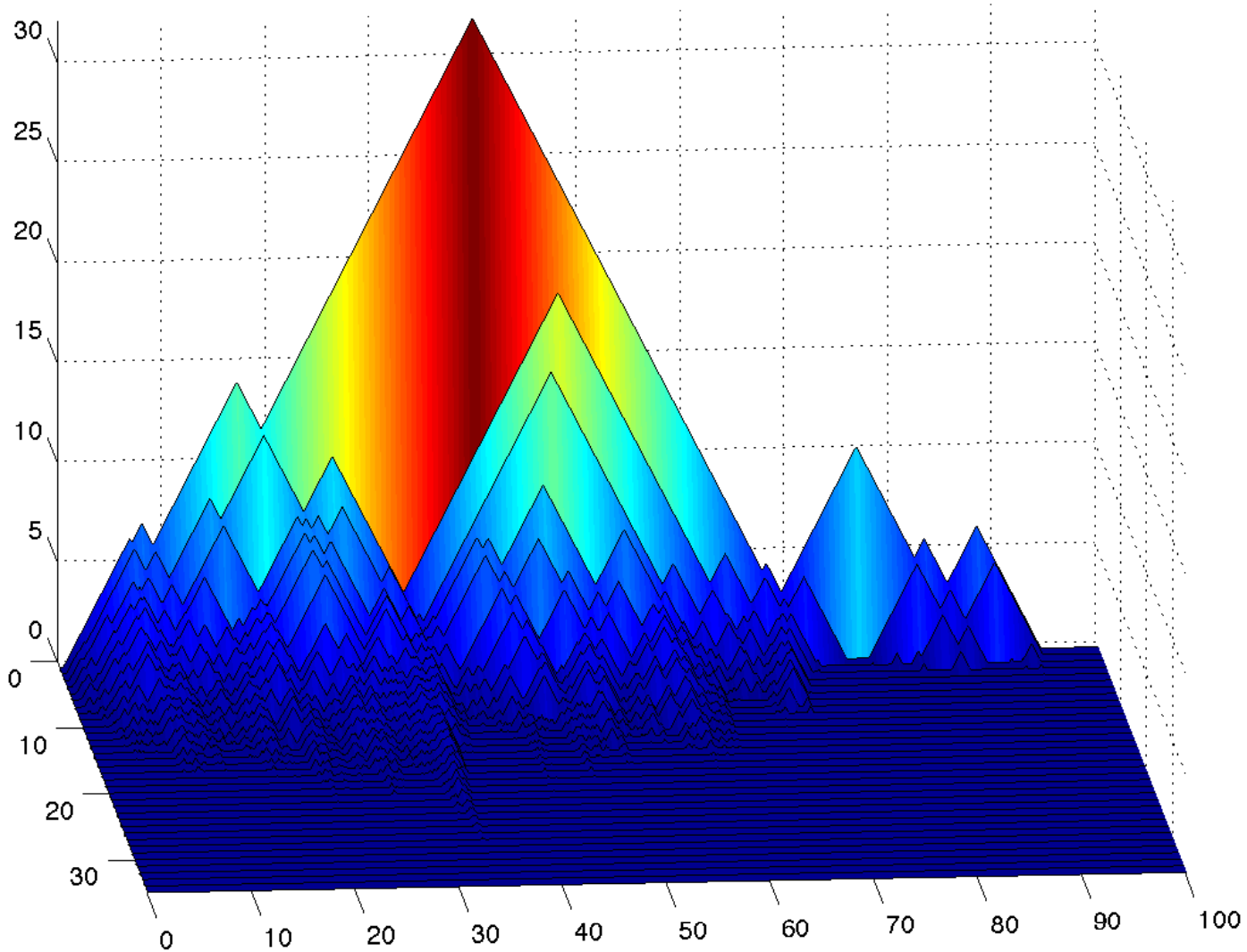
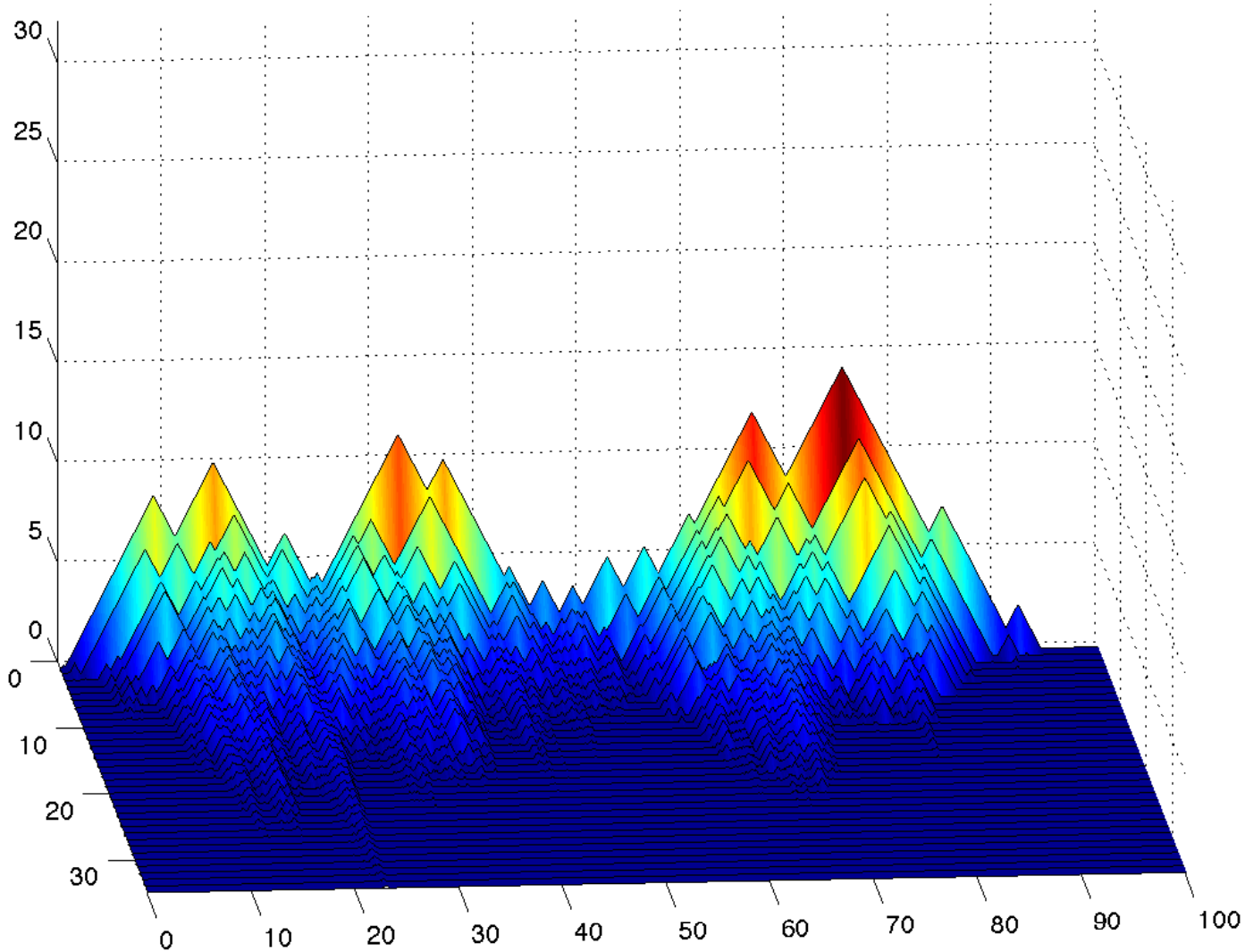
Brain artery persistence landscape



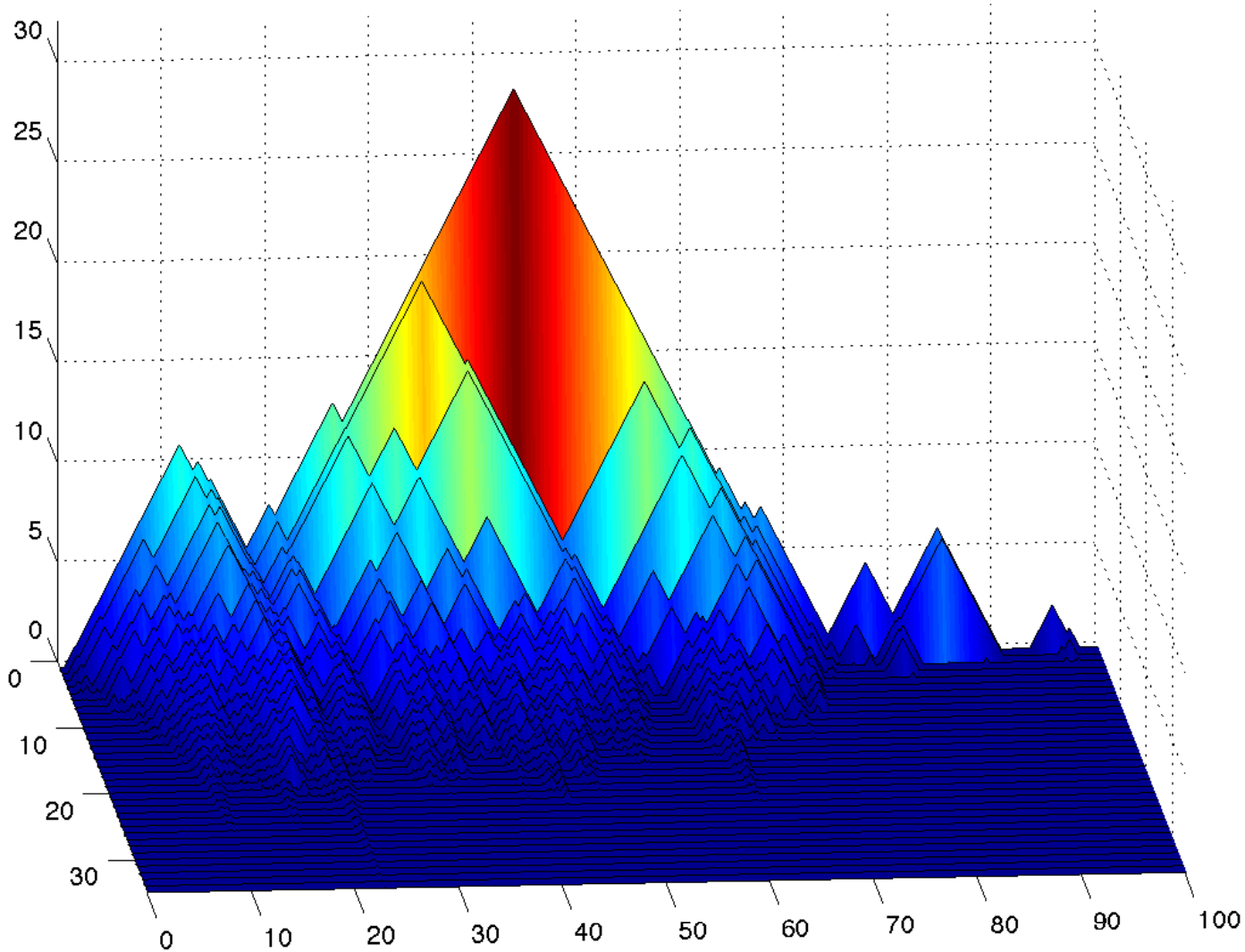
Brain artery persistence landscape



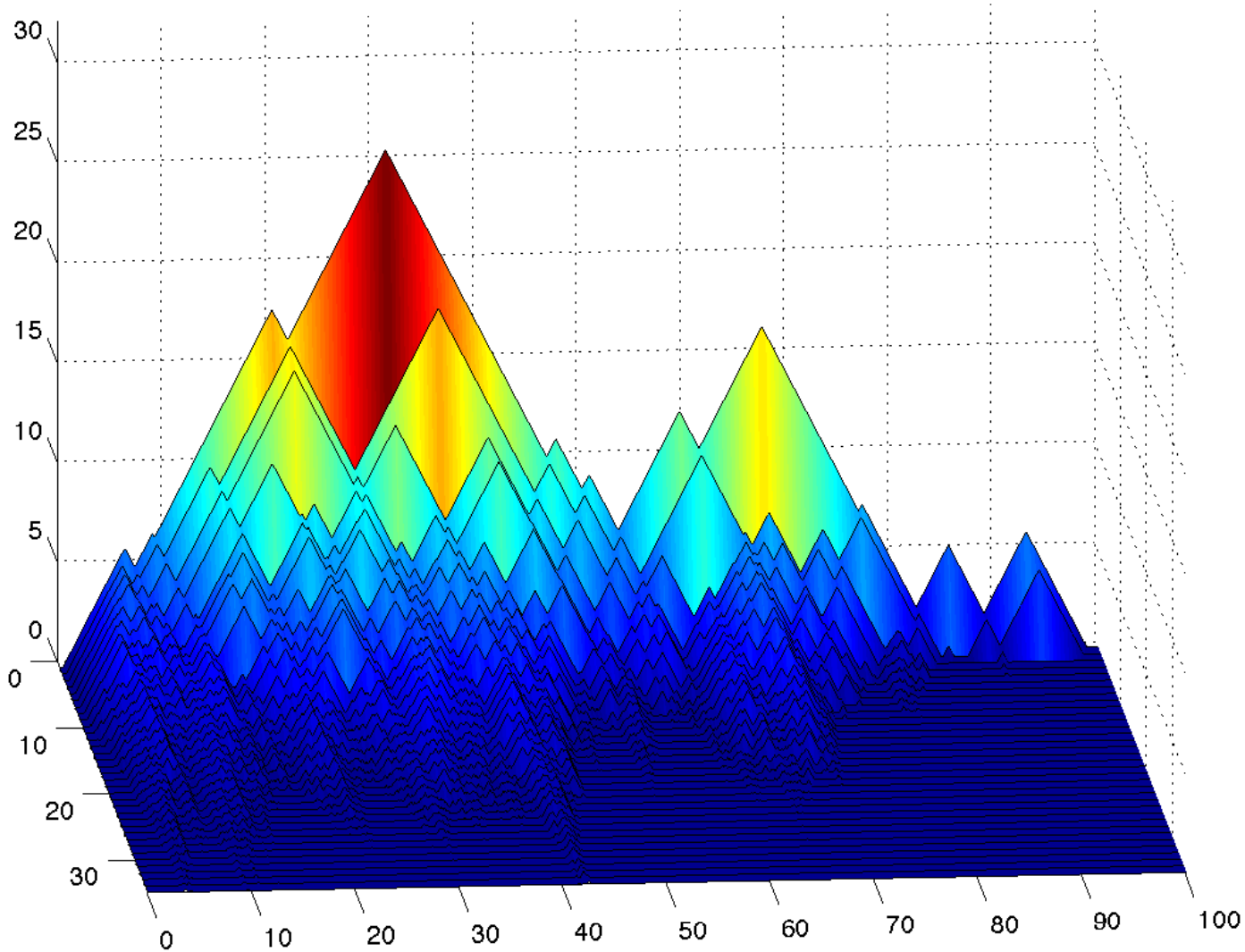
Brain artery persistence landscape



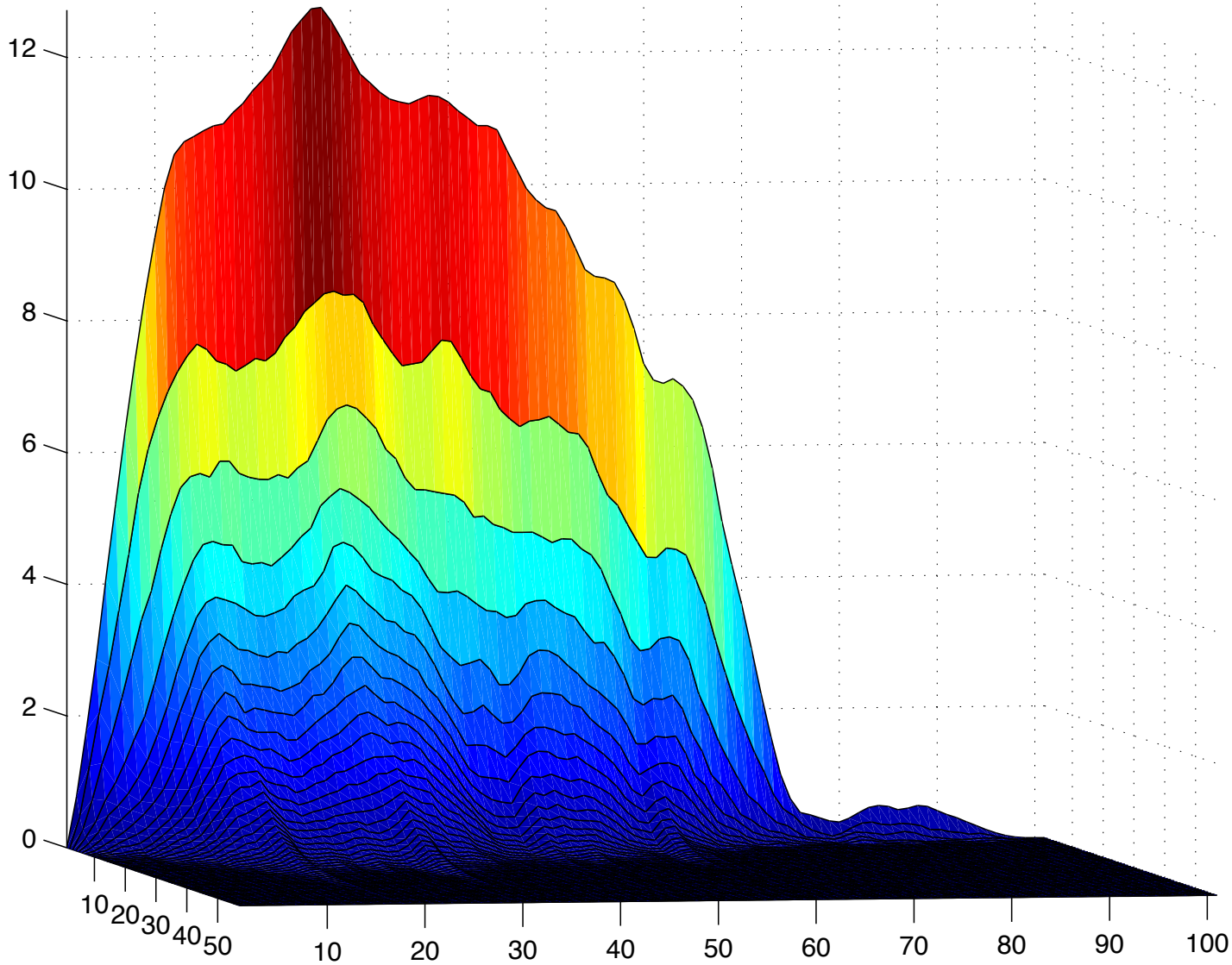
Brain artery persistence landscape



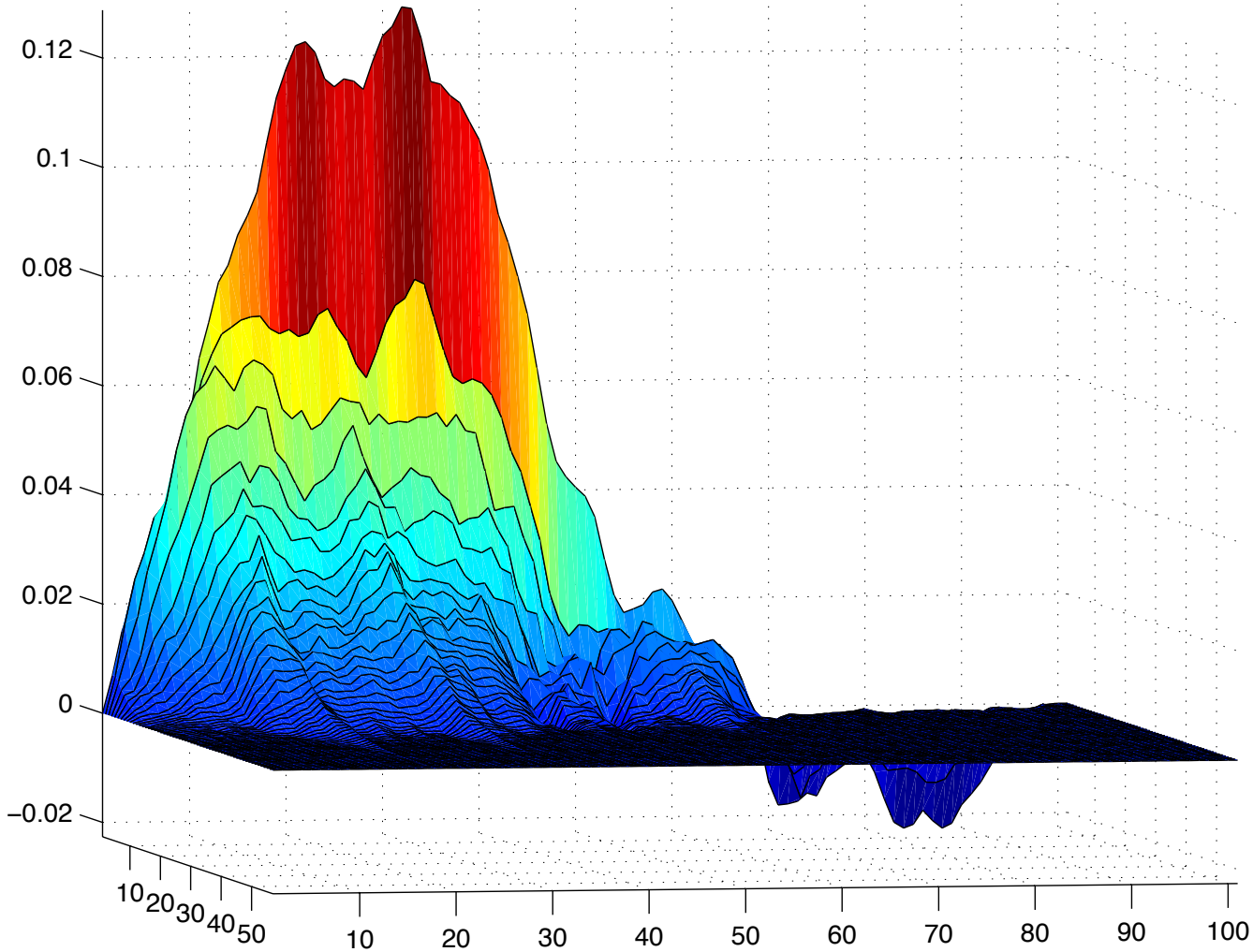
Brain artery persistence landscape



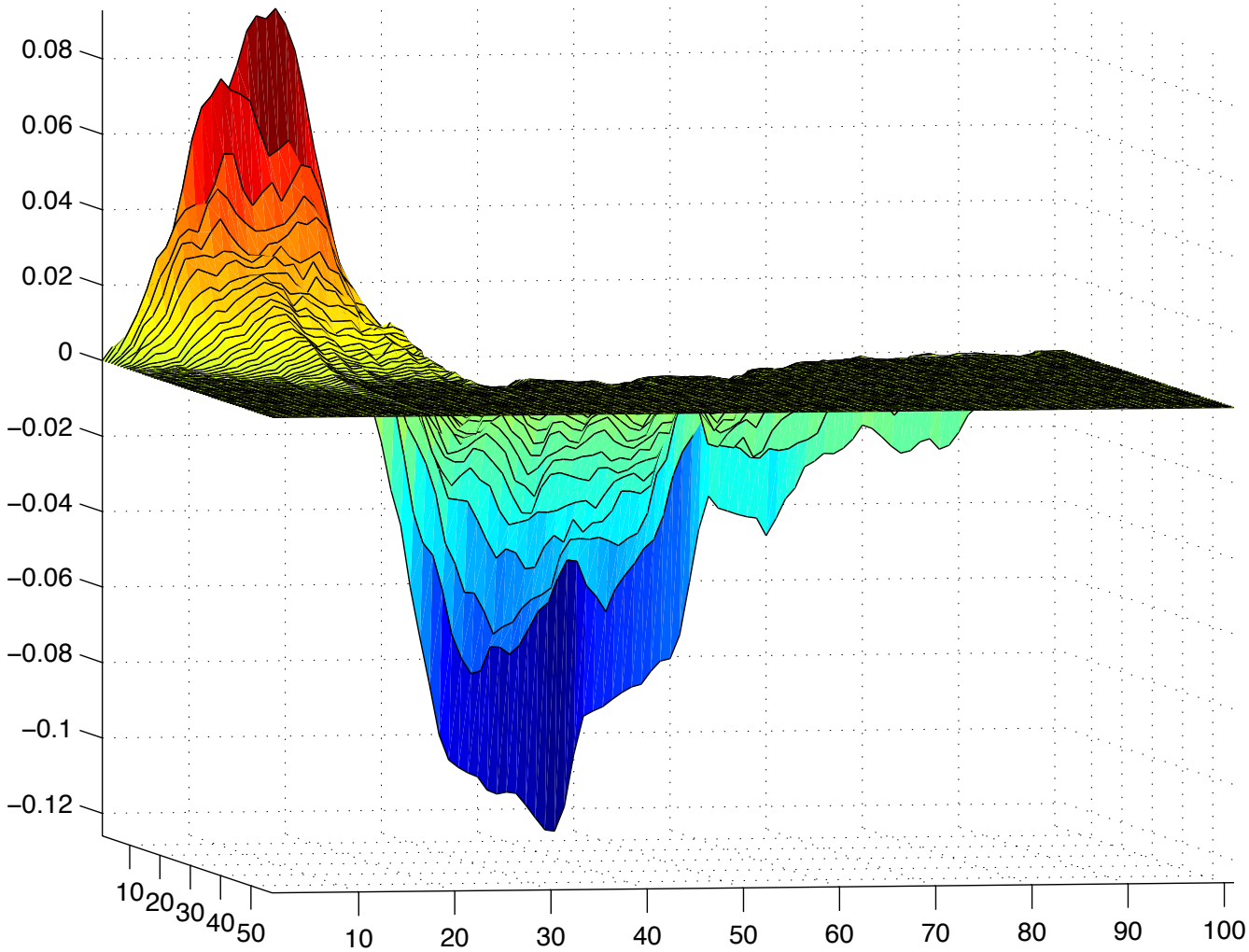
Average landscape for brain arteries



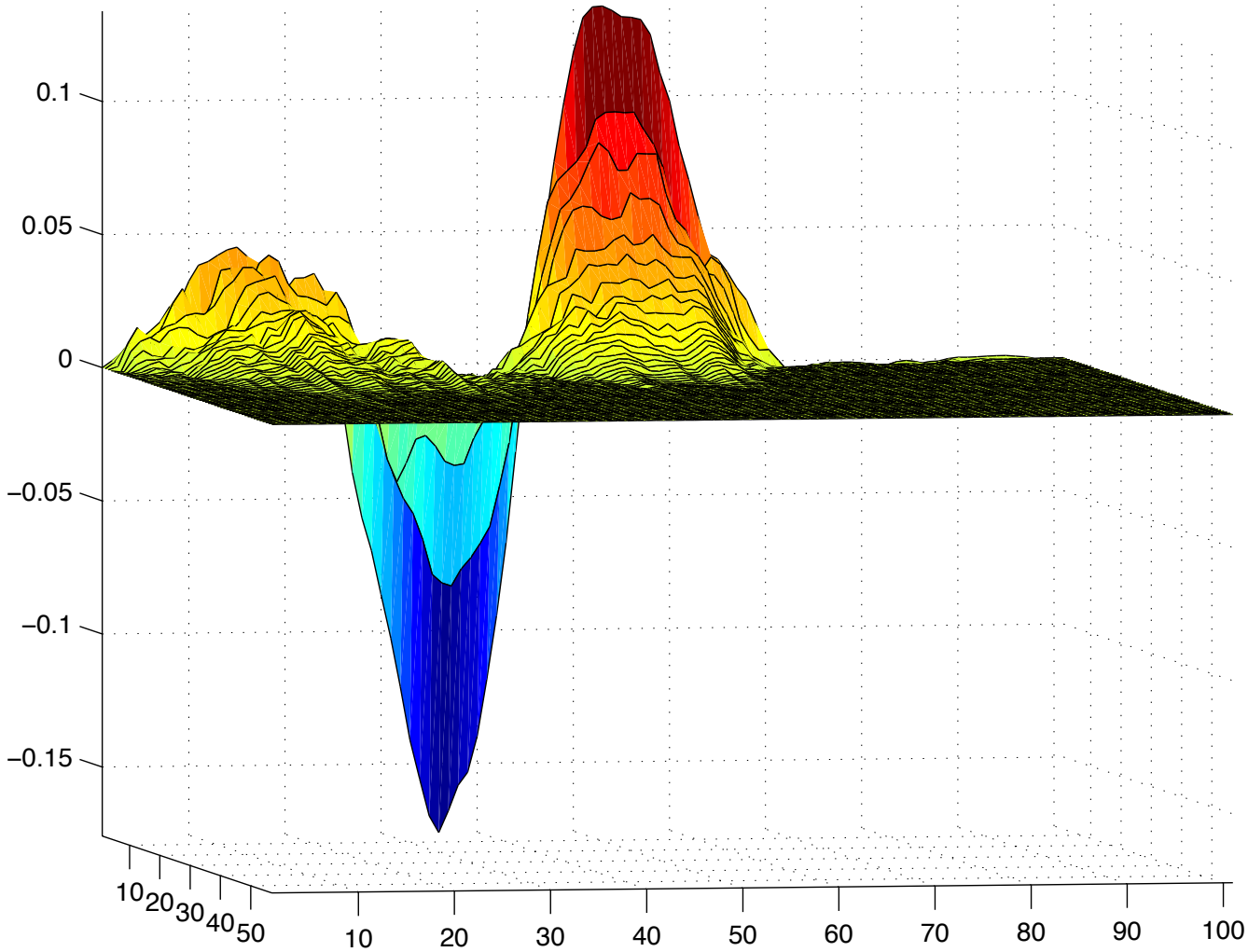
Principal Component Analysis



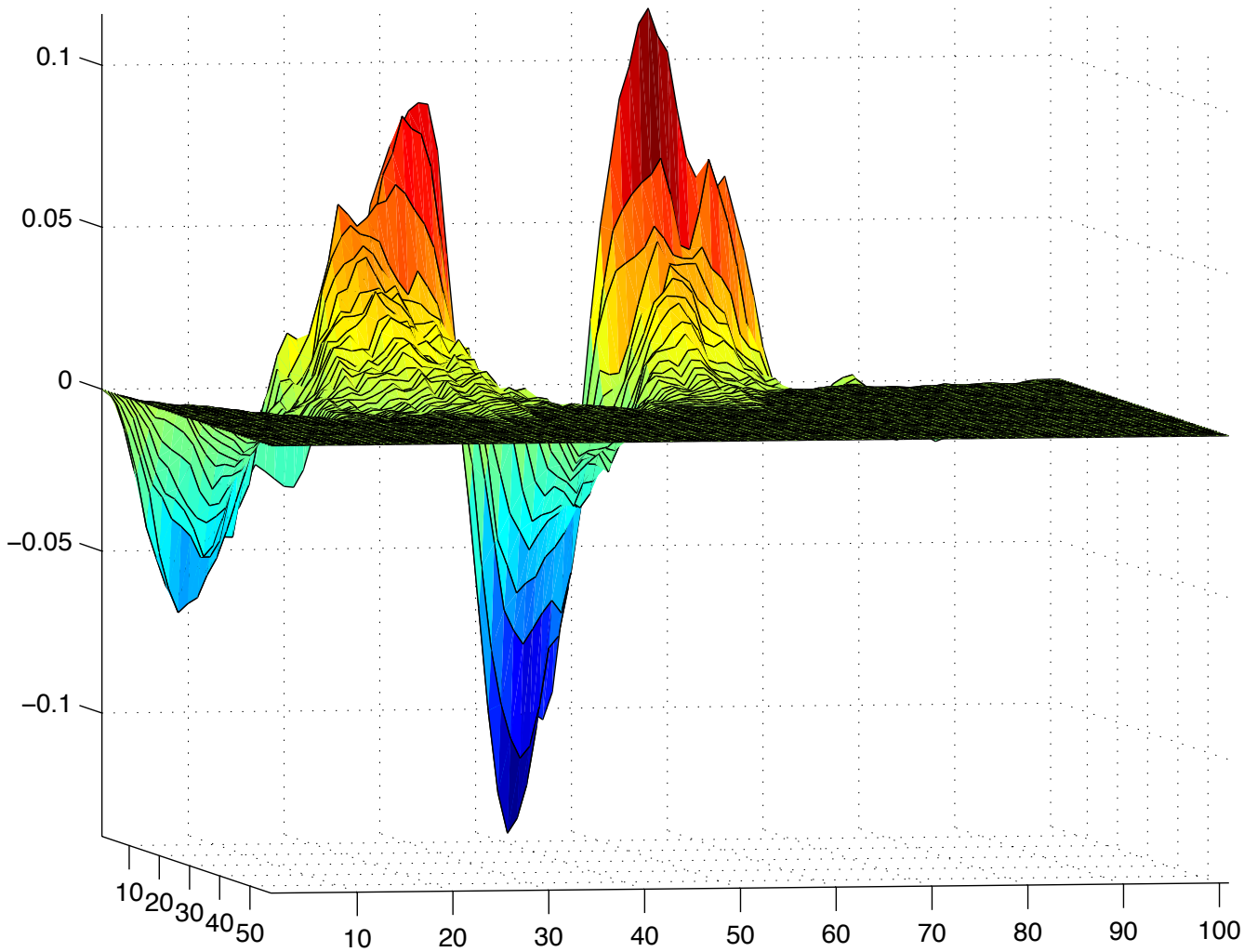
Principal Component Analysis



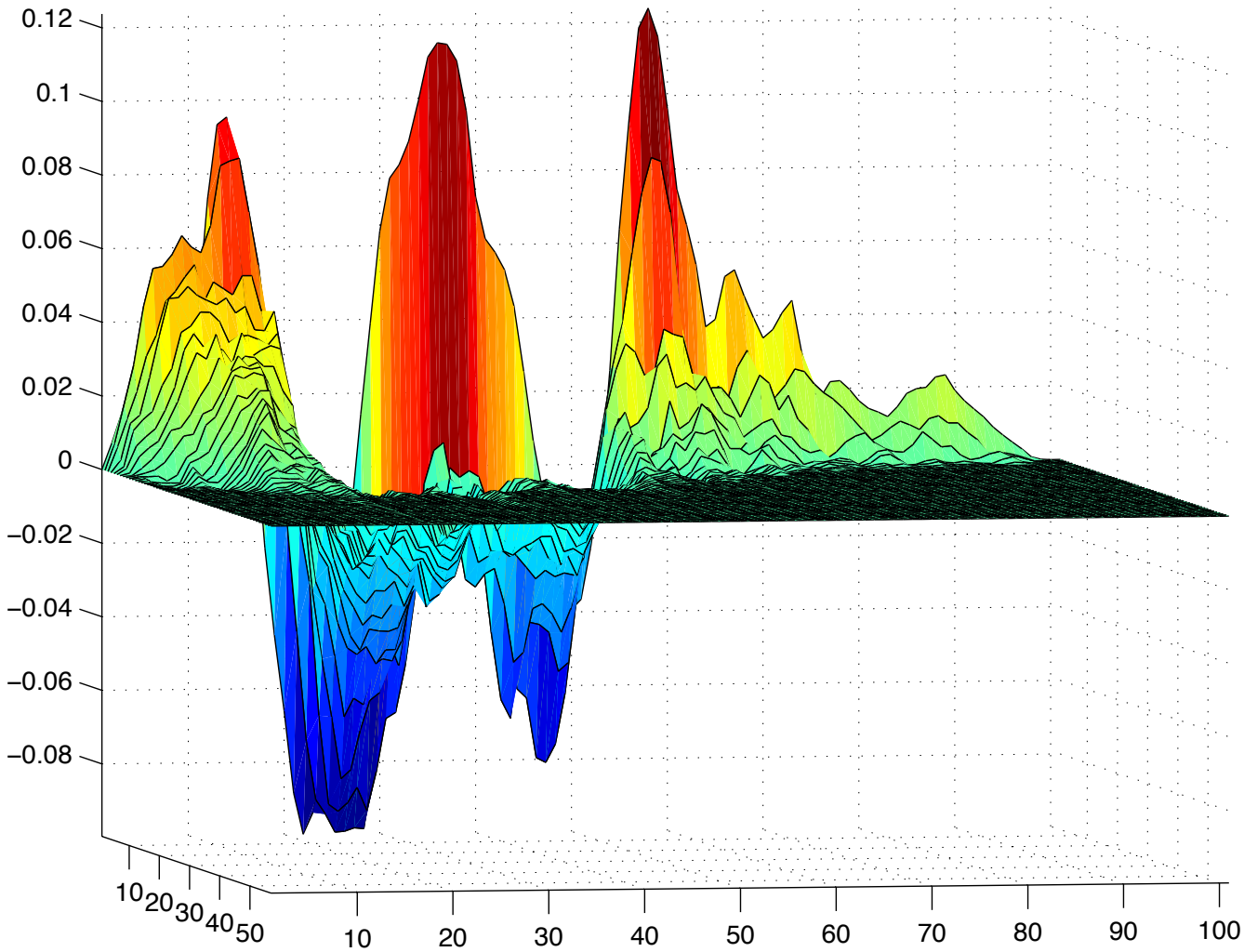
Principal Component Analysis



Principal Component Analysis



Principal Component Analysis



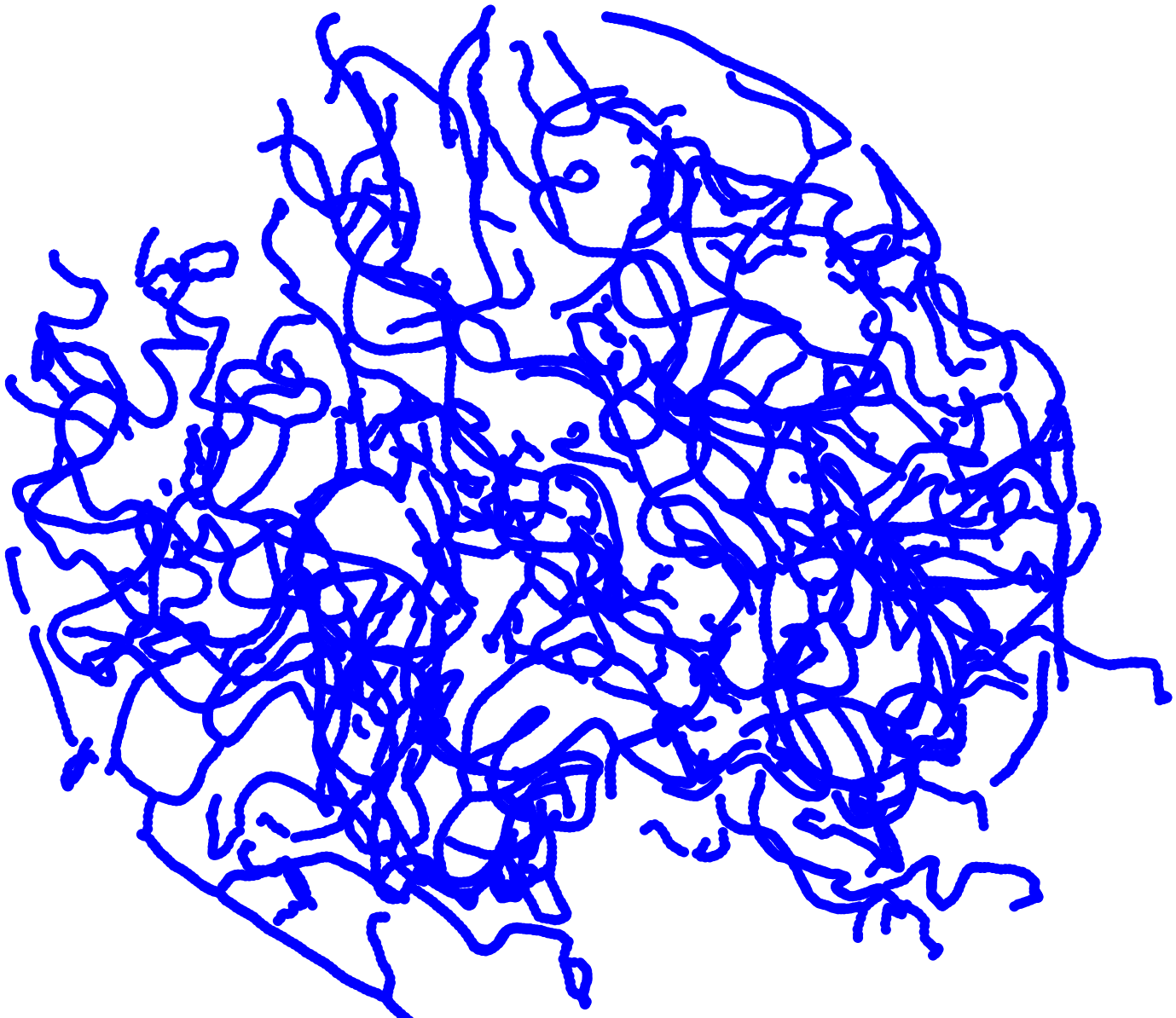
Thickening the arteries

Up to know we have only used H_0.

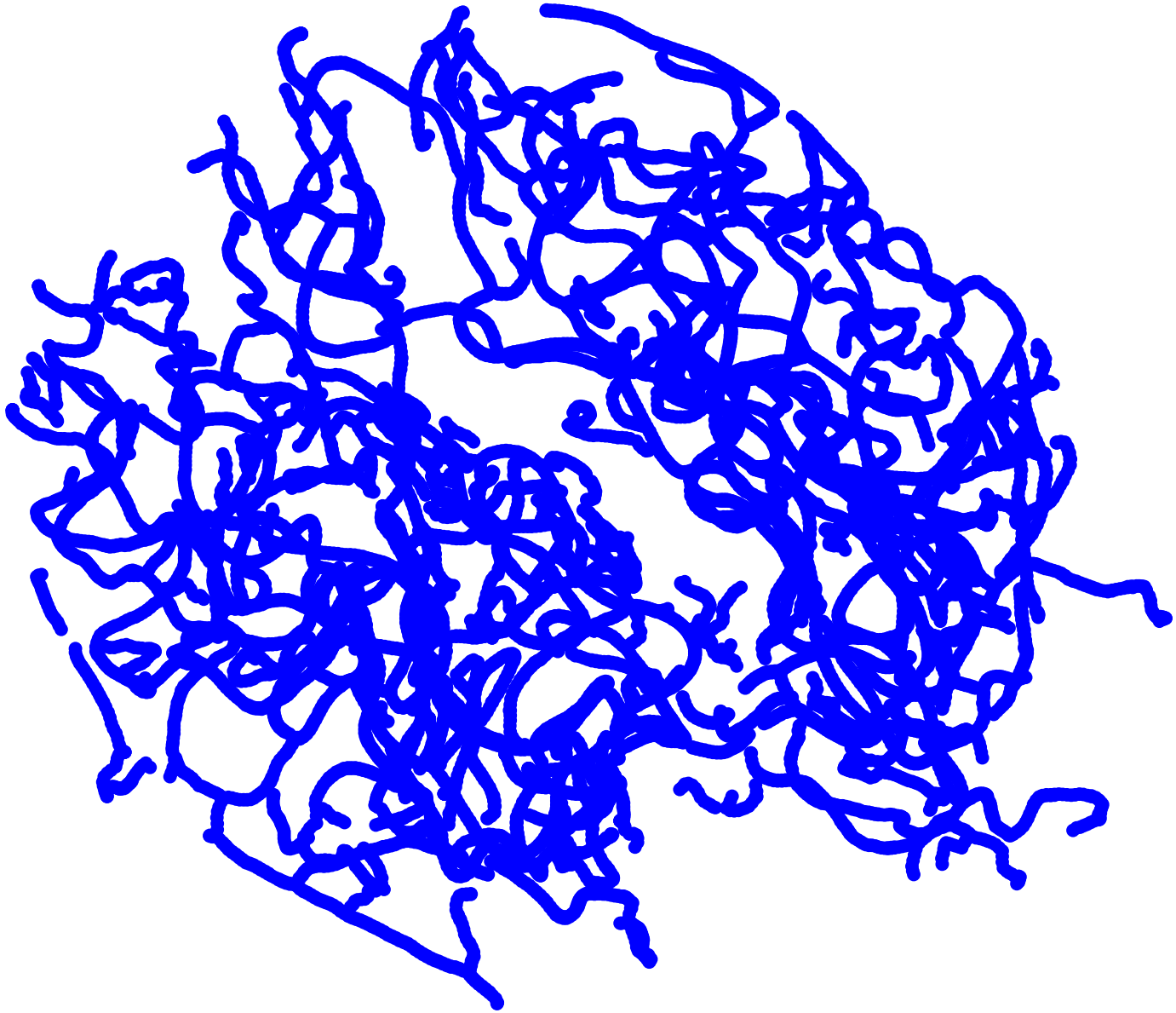
Now we switch to H_1.

We consider a new filtered simplicial complex obtained by 'thickening the arteries'.

Thickening the arteries

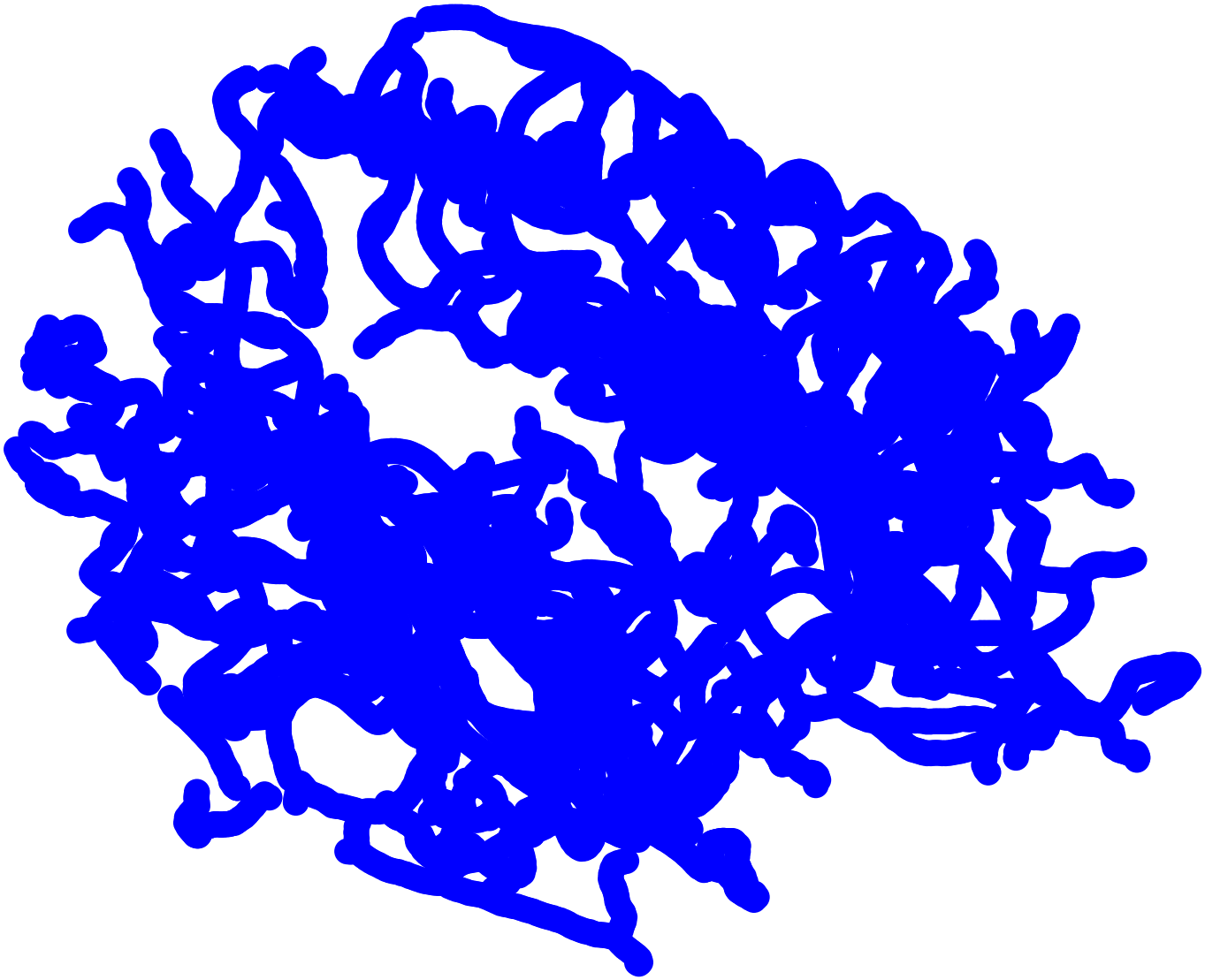


Thickening the arteries

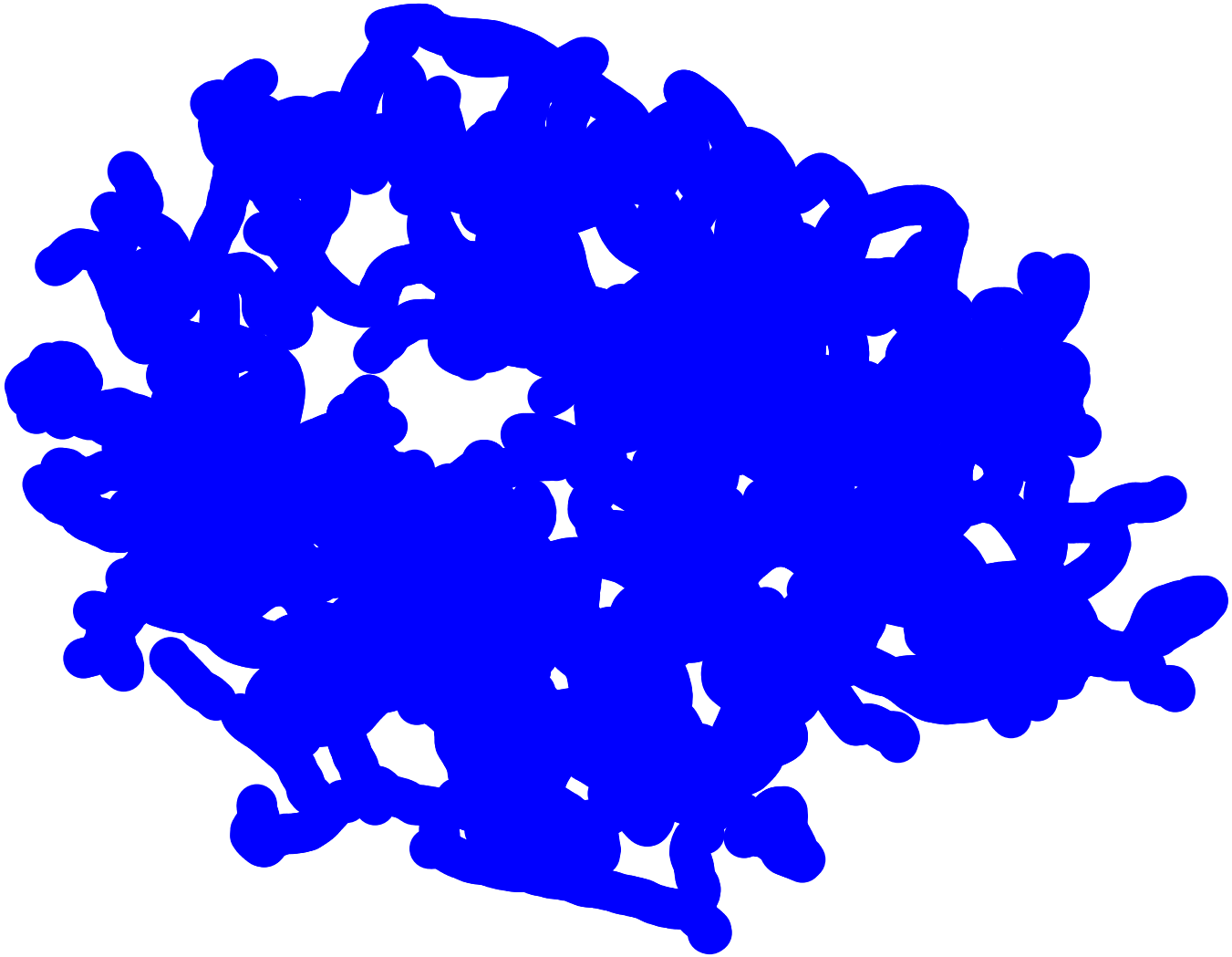


Thickening the arteries

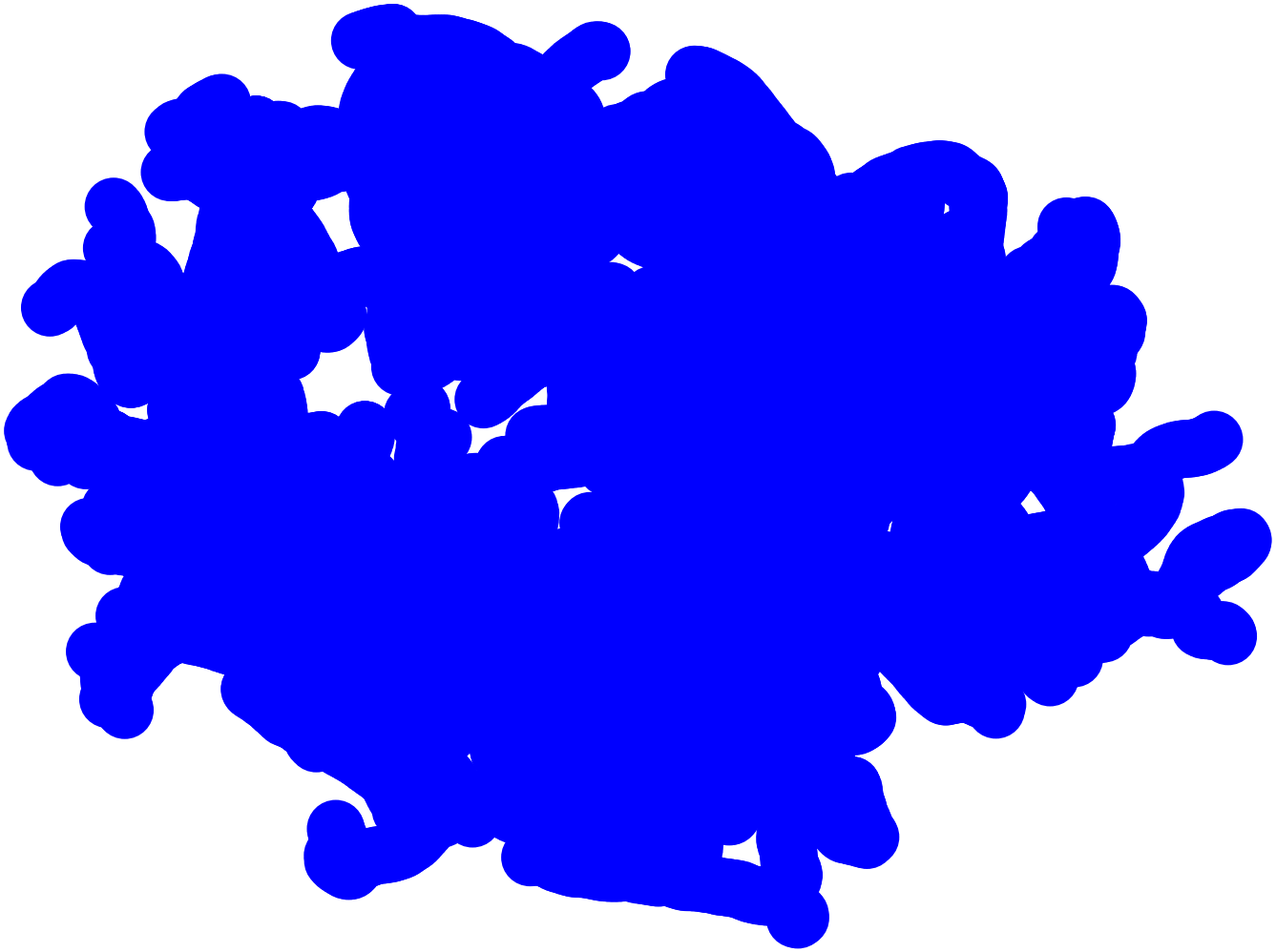
Thickening the arteries



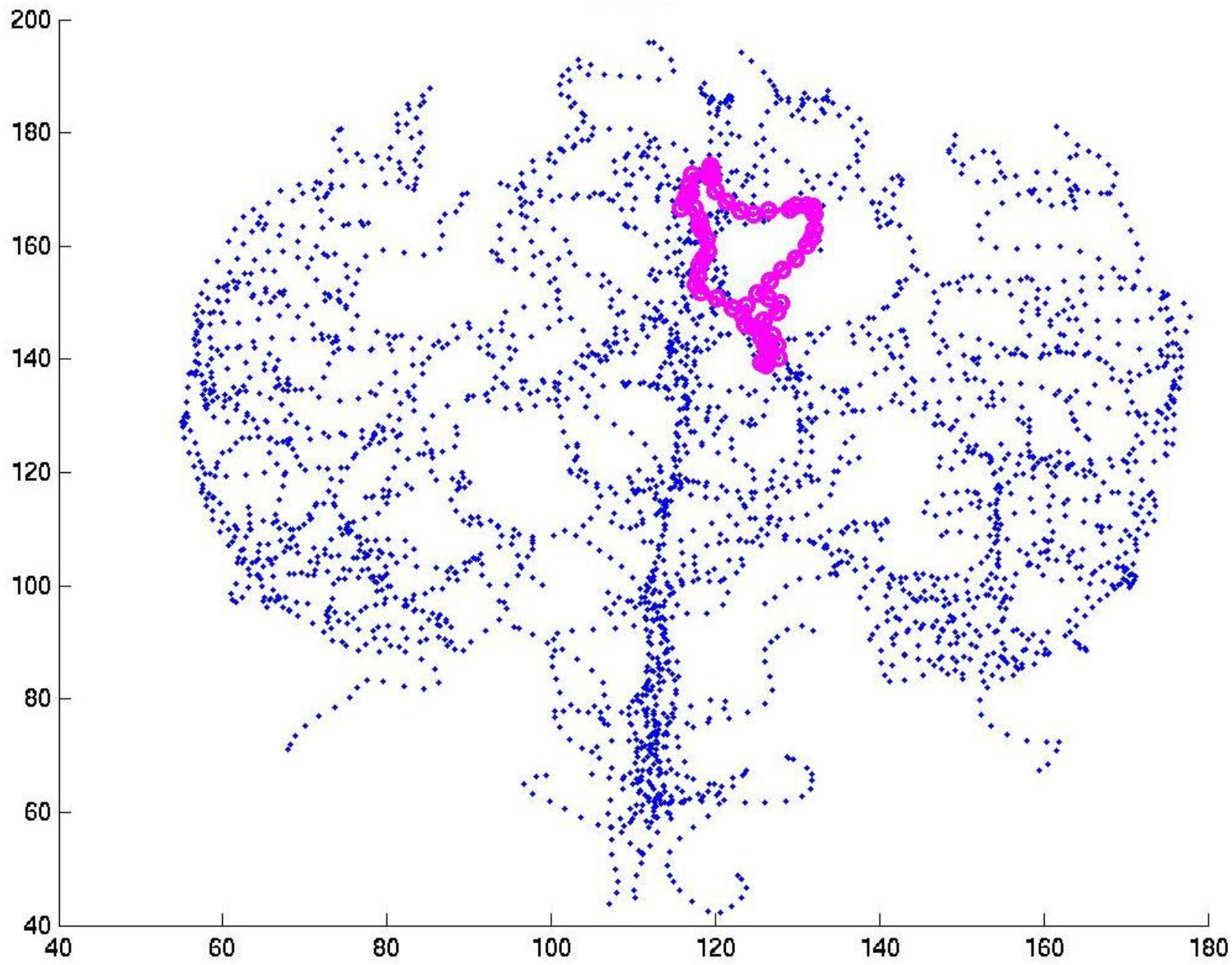
Thickening the arteries



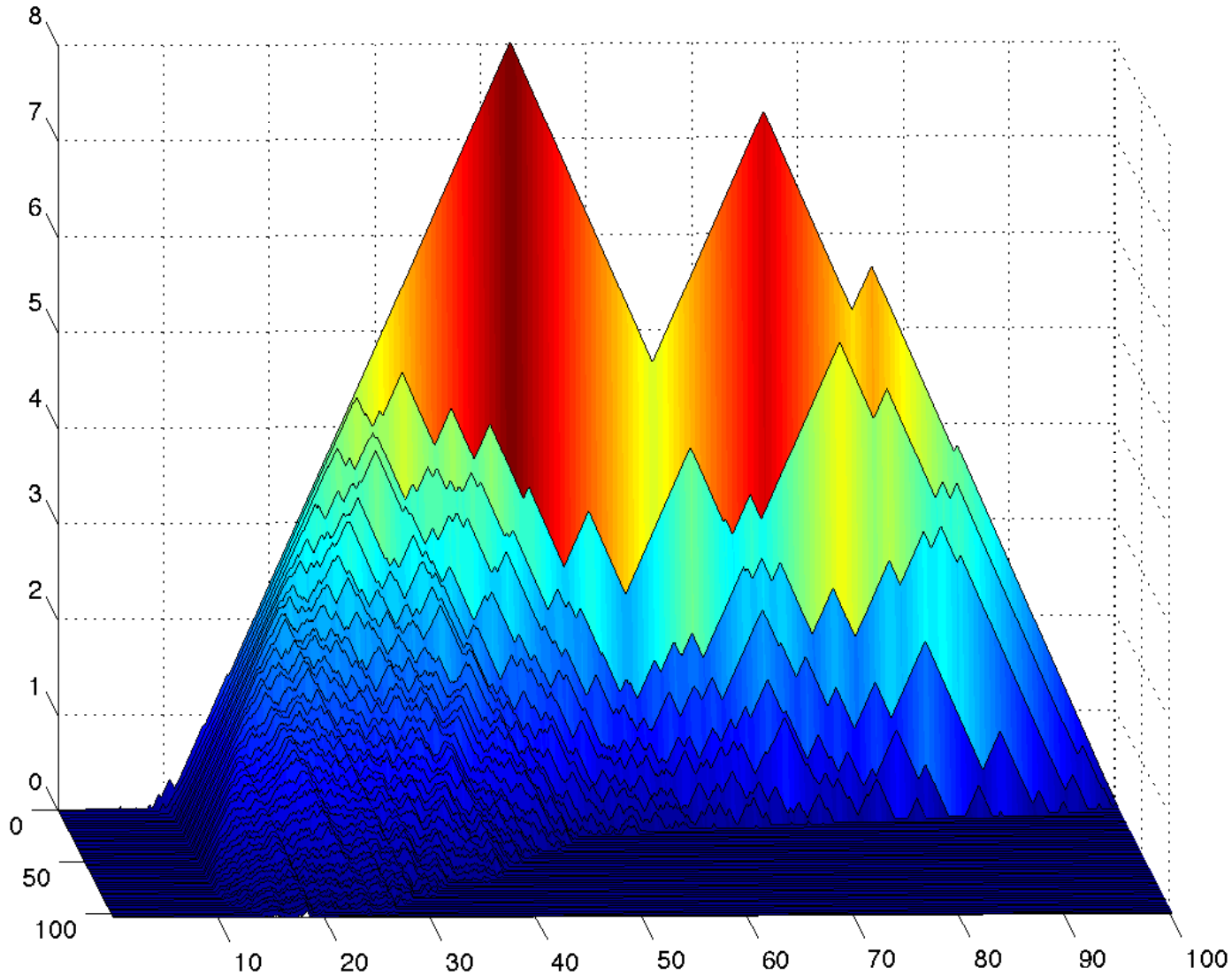
Thickening the arteries



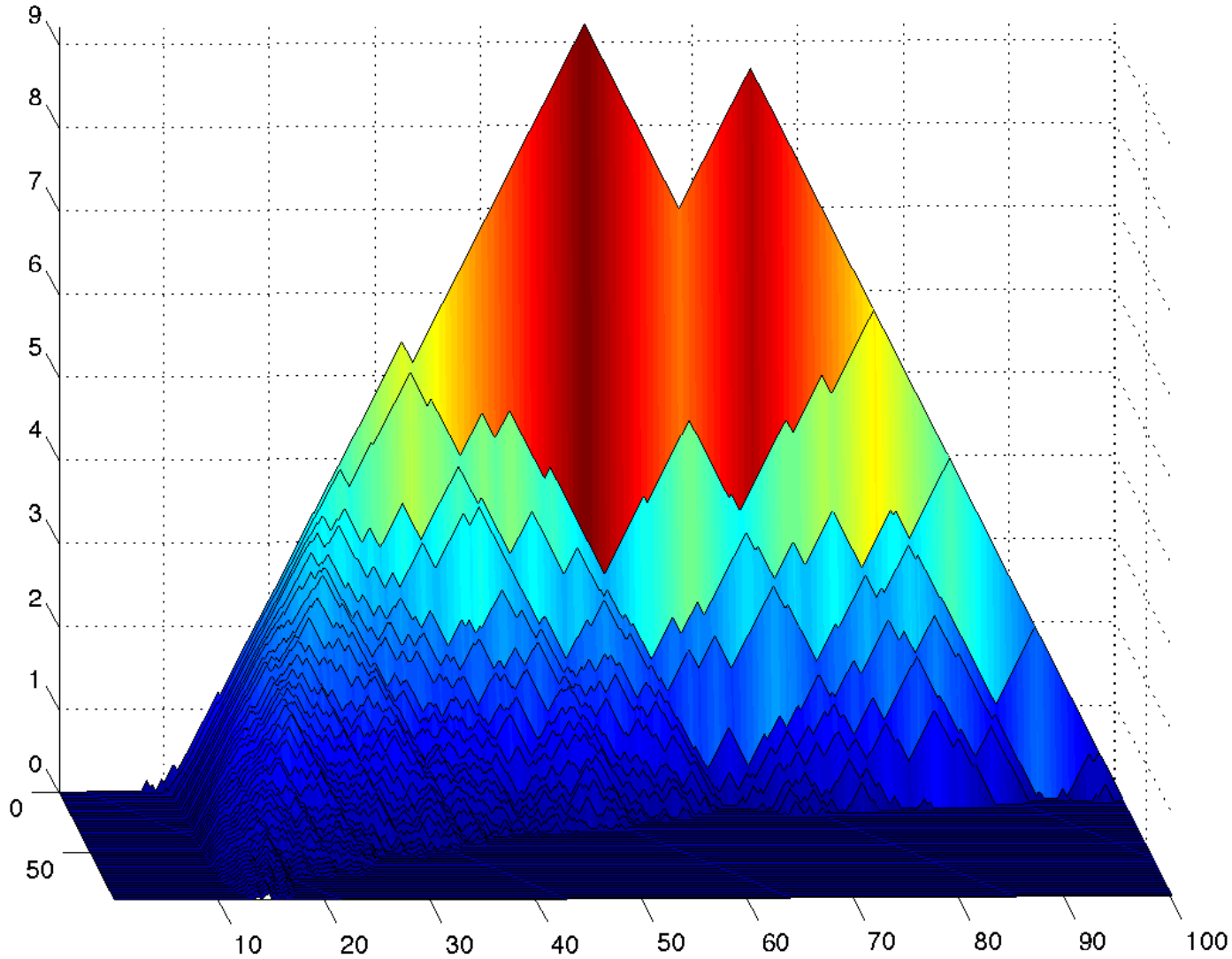
Thickening the arteries



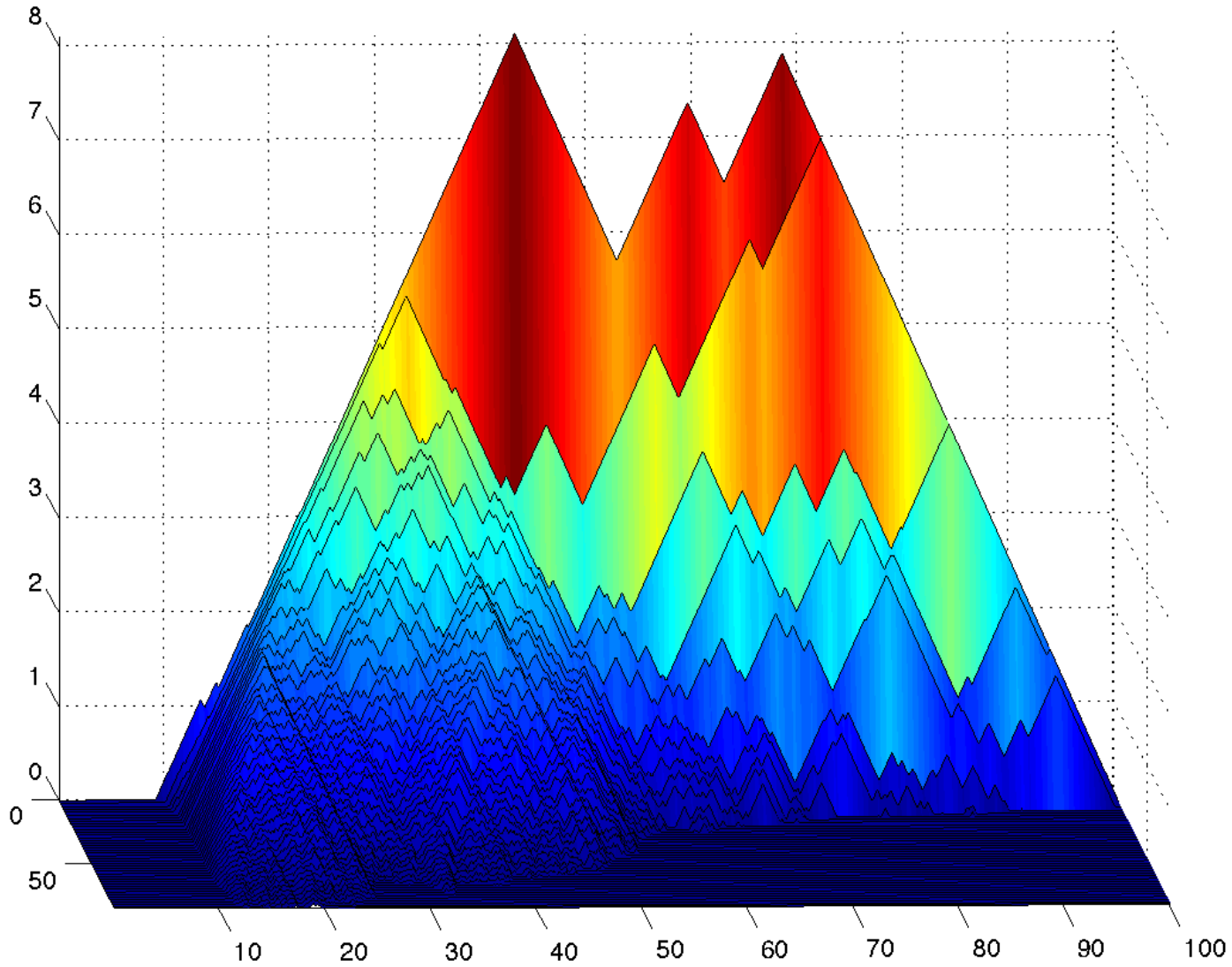
Brain artery H_1 persistence landscape



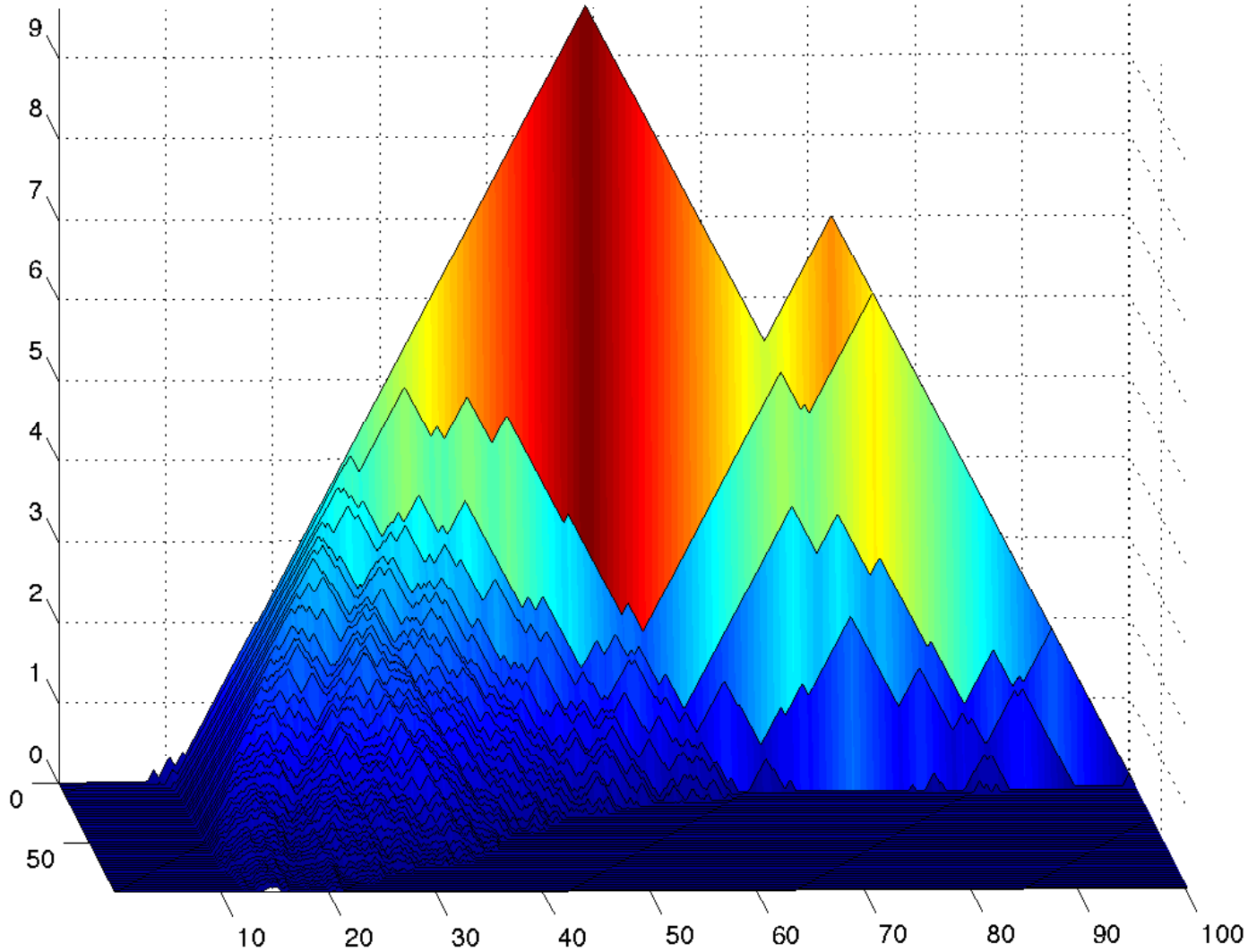
Brain artery H_1 persistence landscape



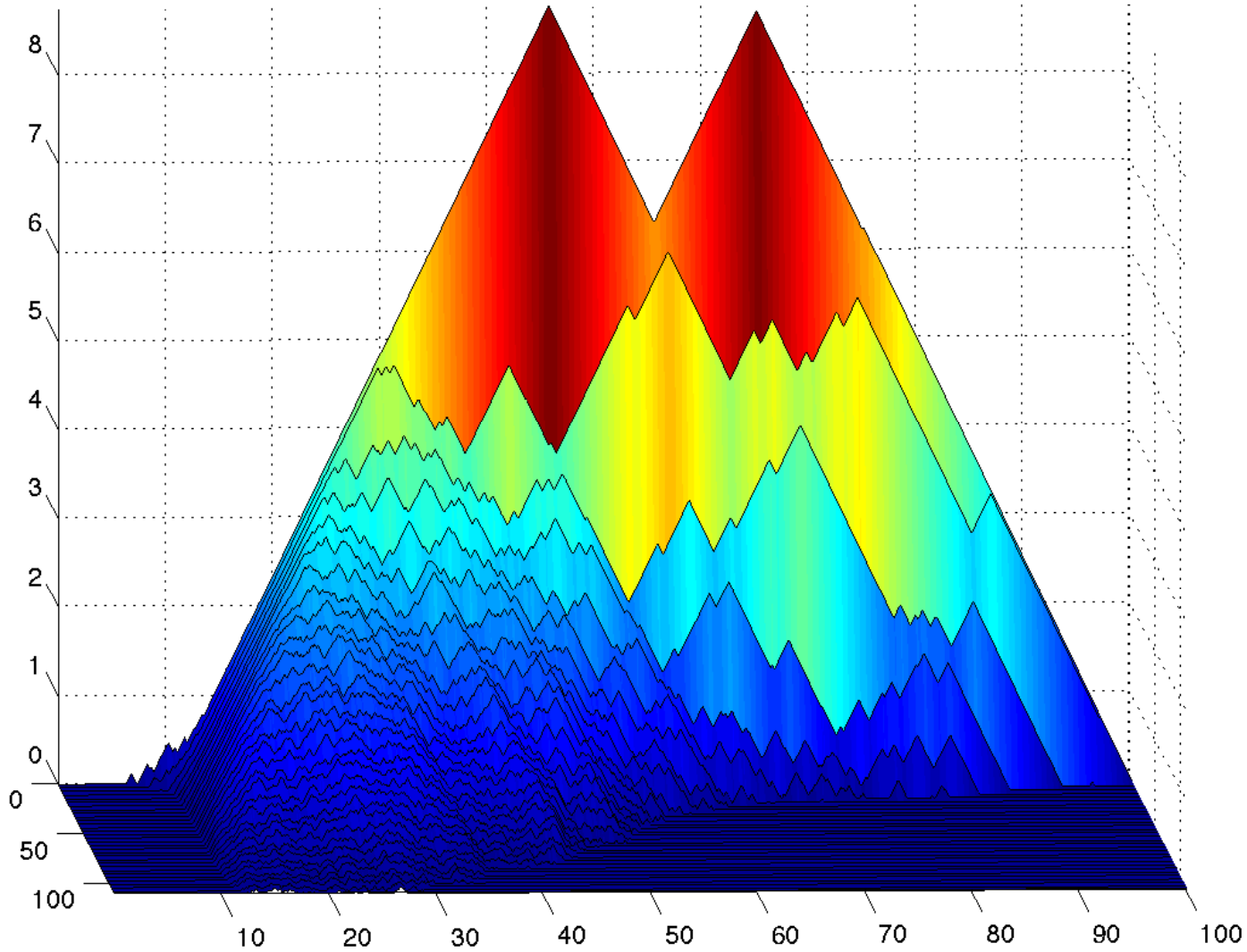
Brain artery H_1 persistence landscape



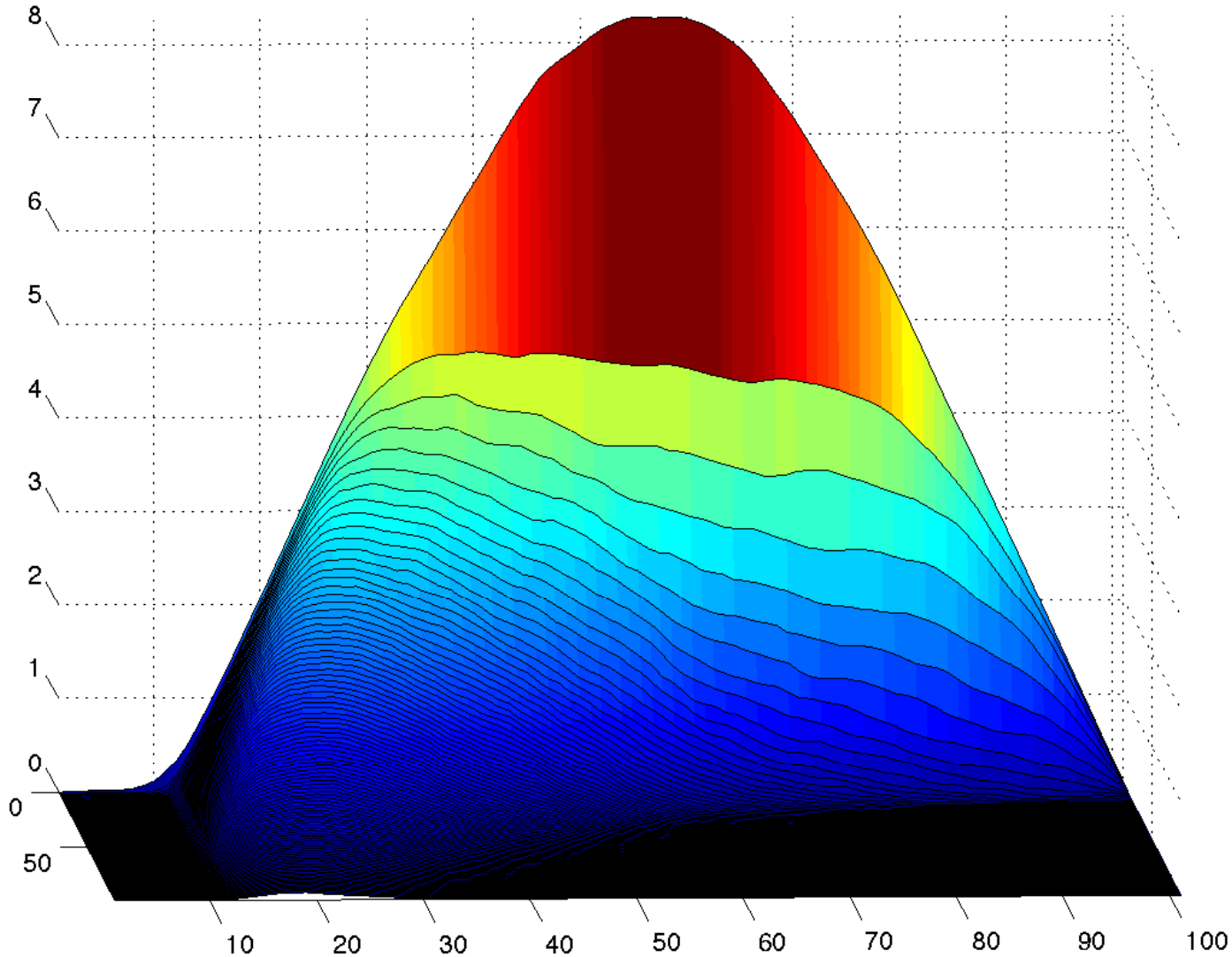
Brain artery H_1 persistence landscape



Brain artery H_1 persistence landscape



Brain artery H_1 average landscape



Correlation with age

Pearson's correlation coefficient, r, of
age with statistics derived from the brain arteries

Previous study without topology, $r = 0.25$

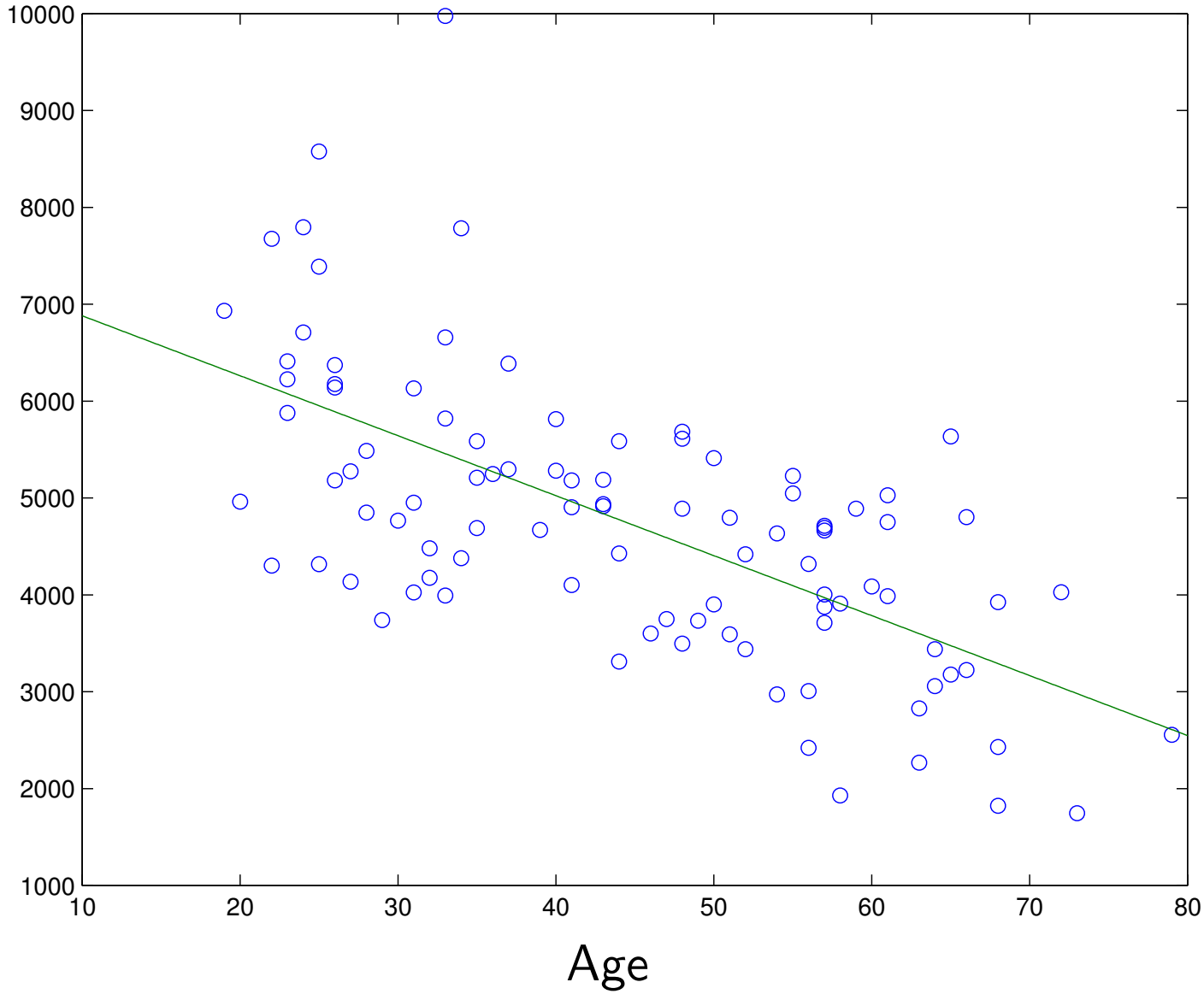
Using 1-norm of H_0 persistence landscape, $r = 0.5077$

Using first principal component of H_0 landscape, $r = 0.5216$

Using first principal component of H_1 landscape, $r = 0.6145$

Using 1-norm of H_1 persistence landscape, $r = 0.6475$
(corresponding p value $\leq 10^{-12}$)

Norm of H_1 persistence landscape vs age

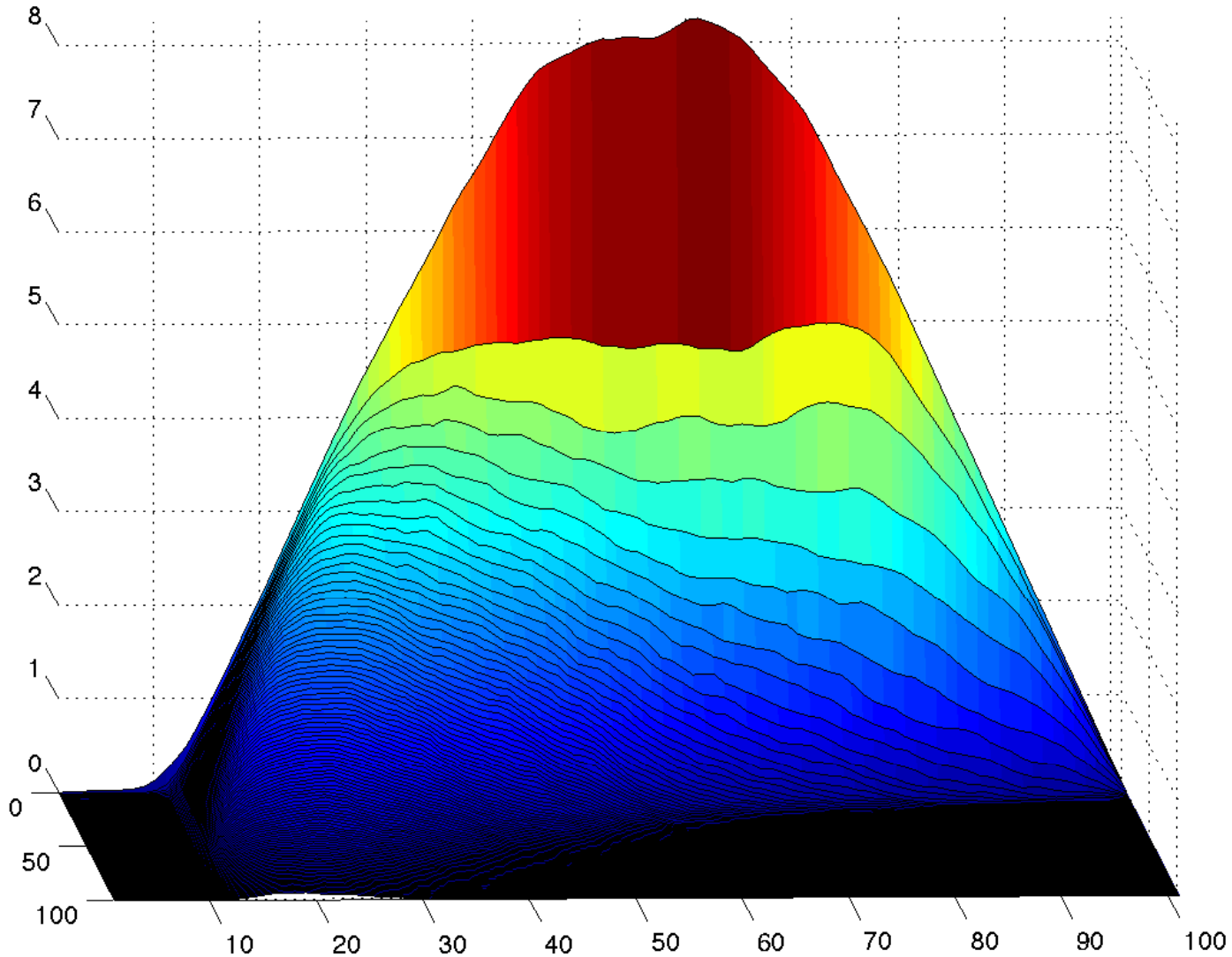


Female and male brain arteries

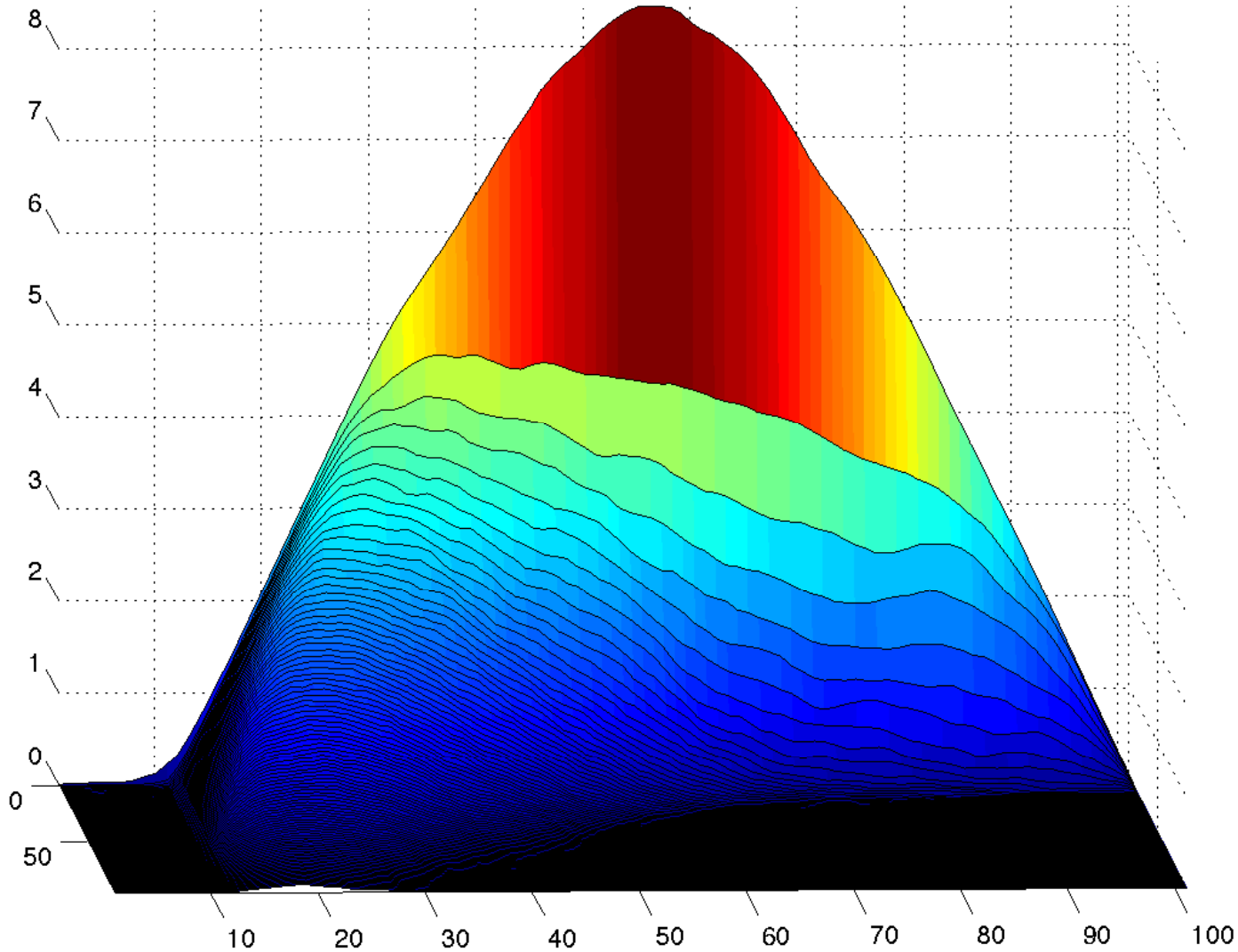
47 Females and 49 Males

Without TDA, previous statistics obtained from the brain arteries could not distinguish between the two.

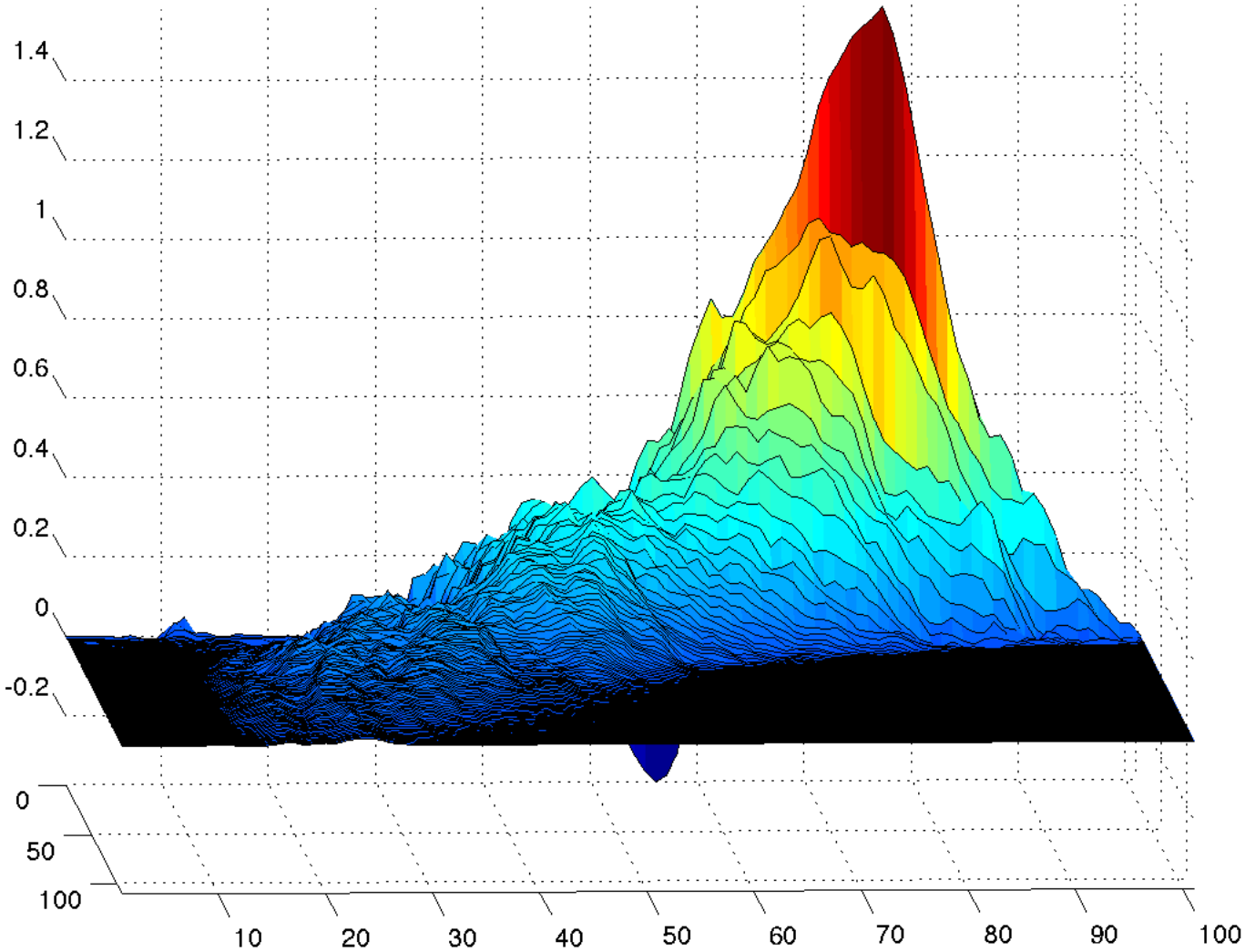
Female H_1 Average Landscape



Male H_1 Average Landscape



H_1 Female – Male



Permutation test

Is this difference significant?

Test statistic: L^2 norm of this difference.

Permutation test:

1. randomly assign M/F labels to the 98 subjects
2. calculate L^2 norm of the difference of their average landscapes
3. repeat 10,000 times
4. p value = proportion in which this norm exceeds the observed norm

p value: 0.0025