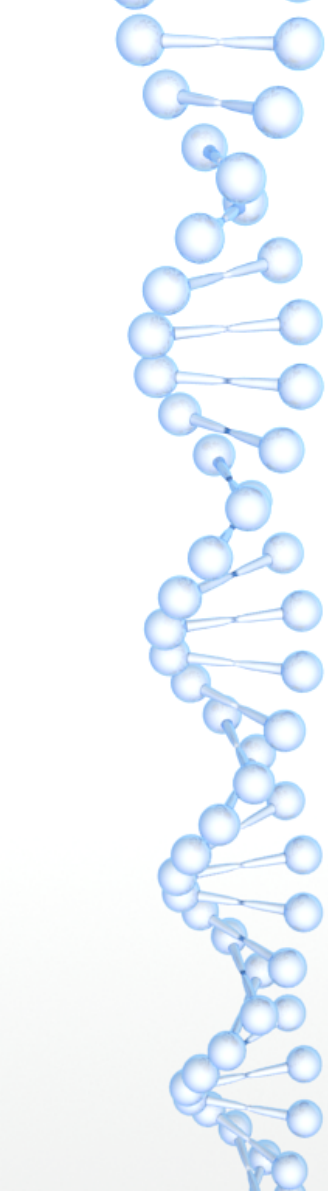
Rate model of the Spreizer network

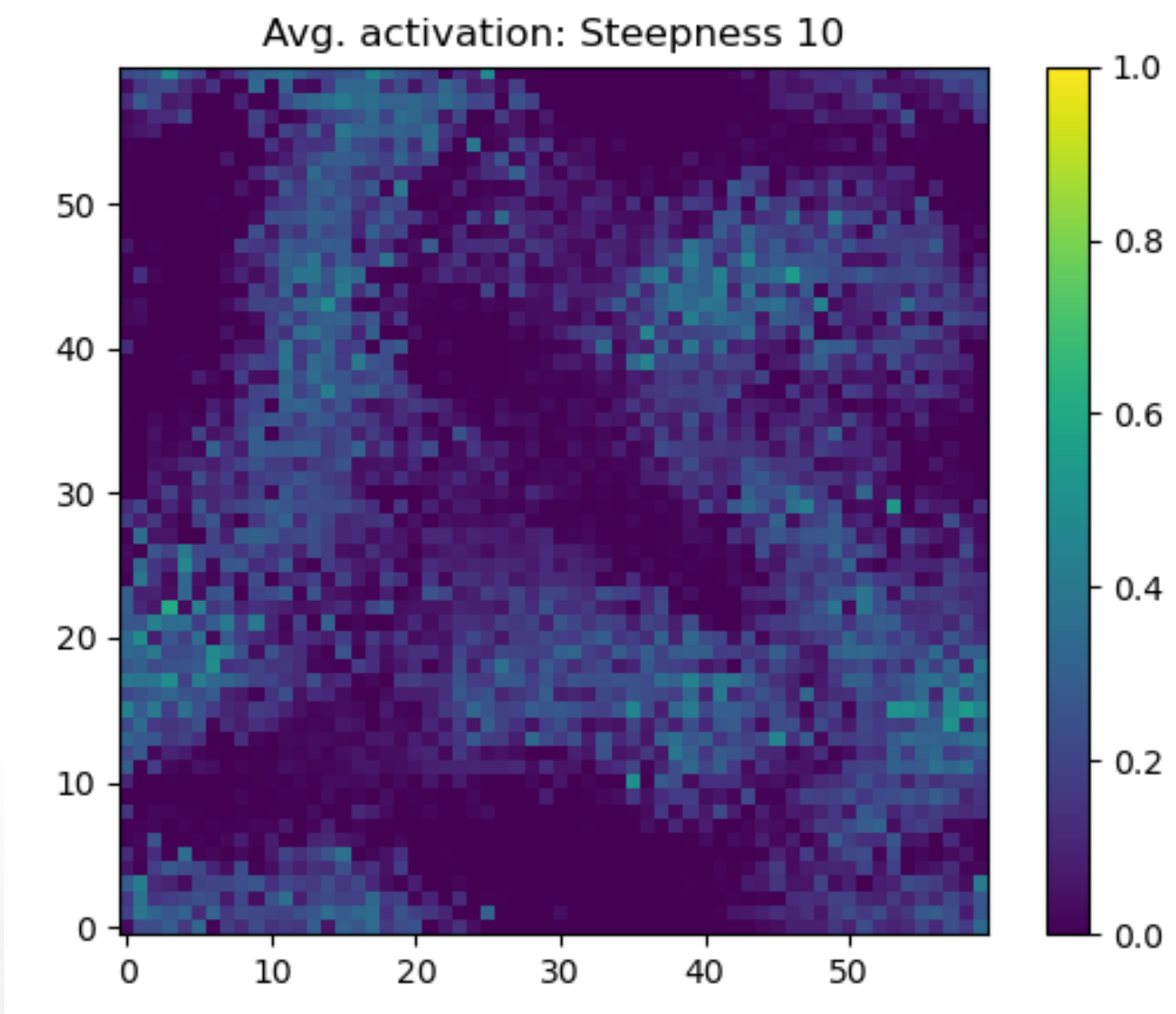
Figures:

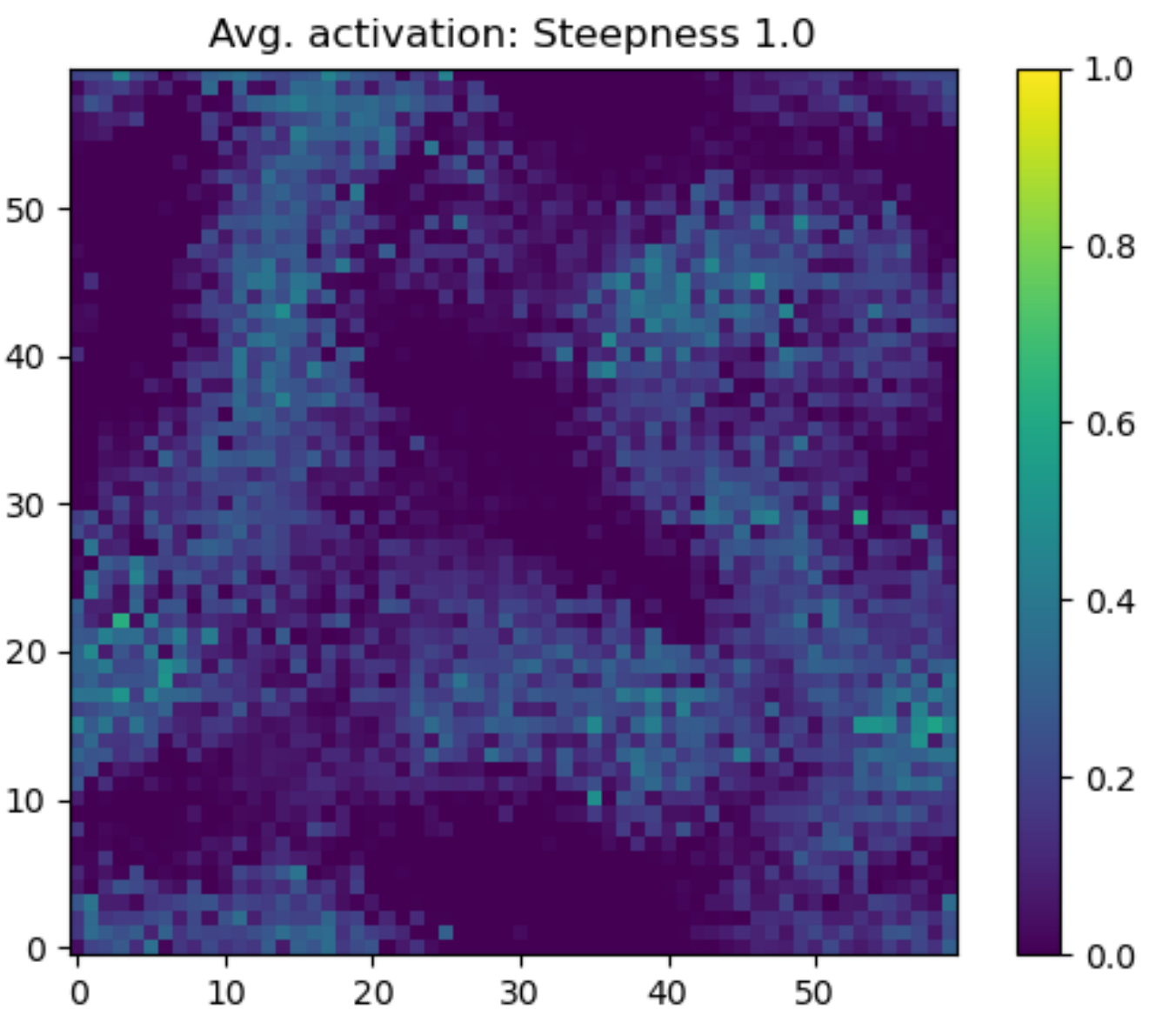
- Steepness influences mean activity
- Dopamine patches

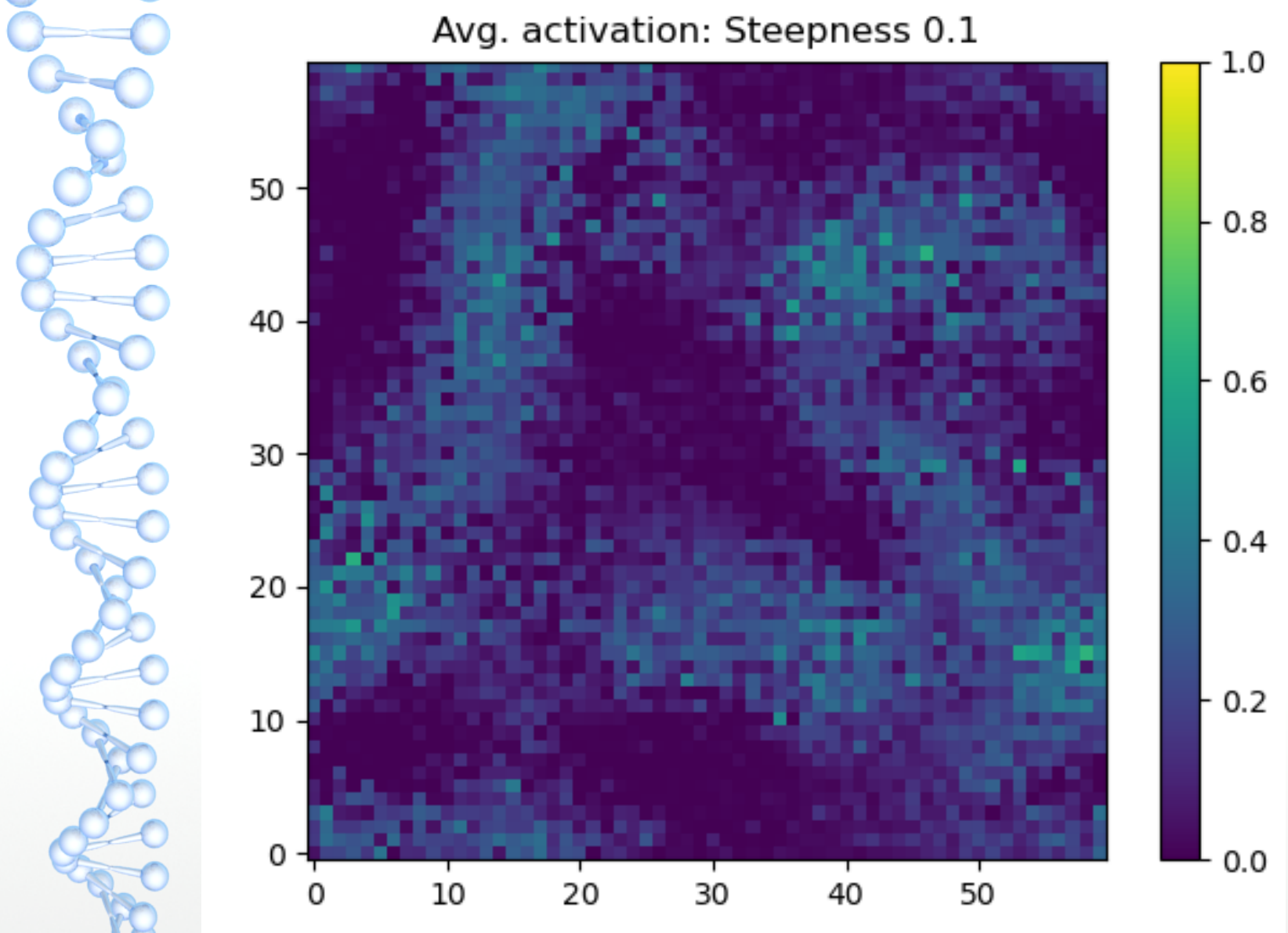


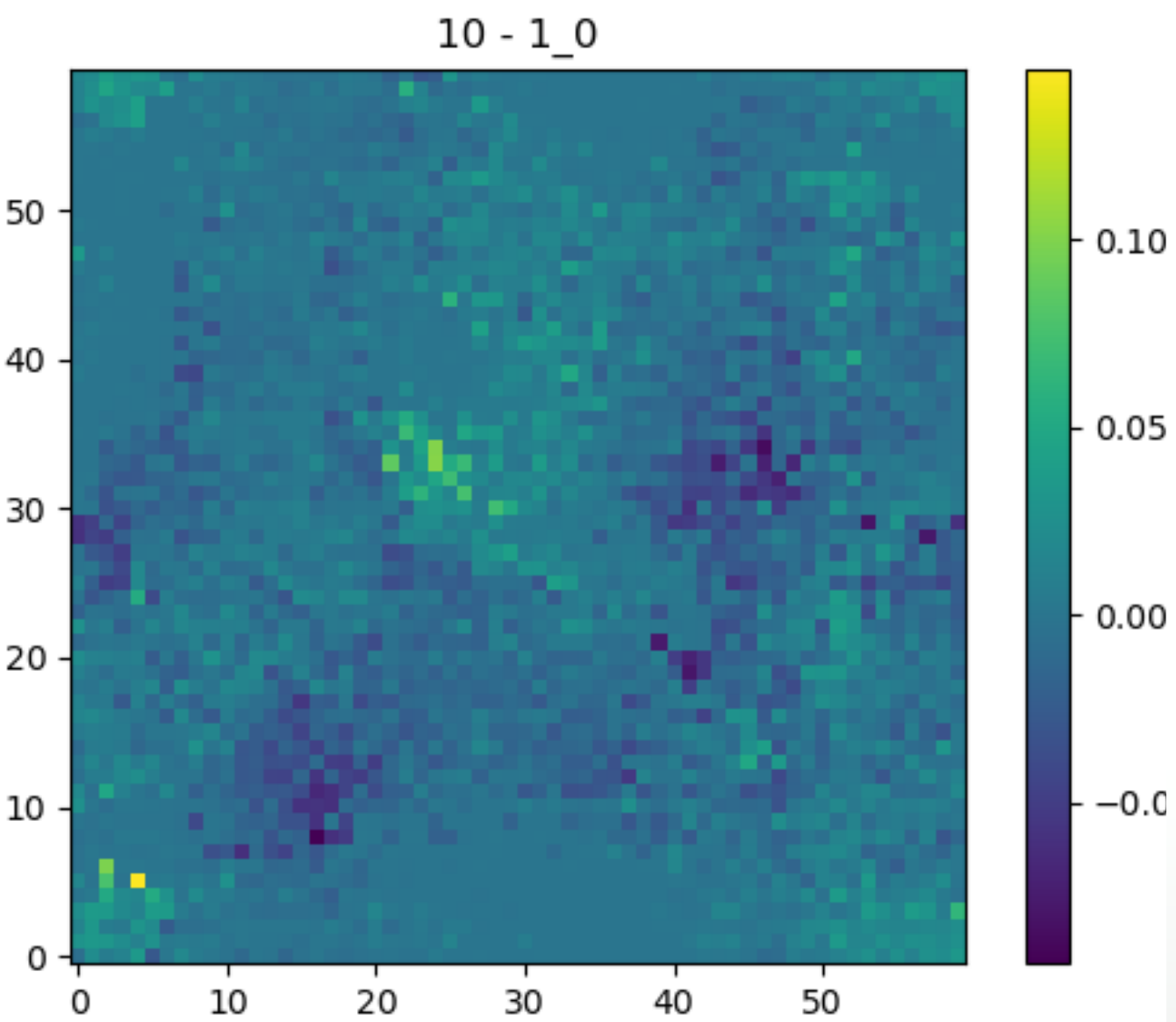
Steepness influences mean activity

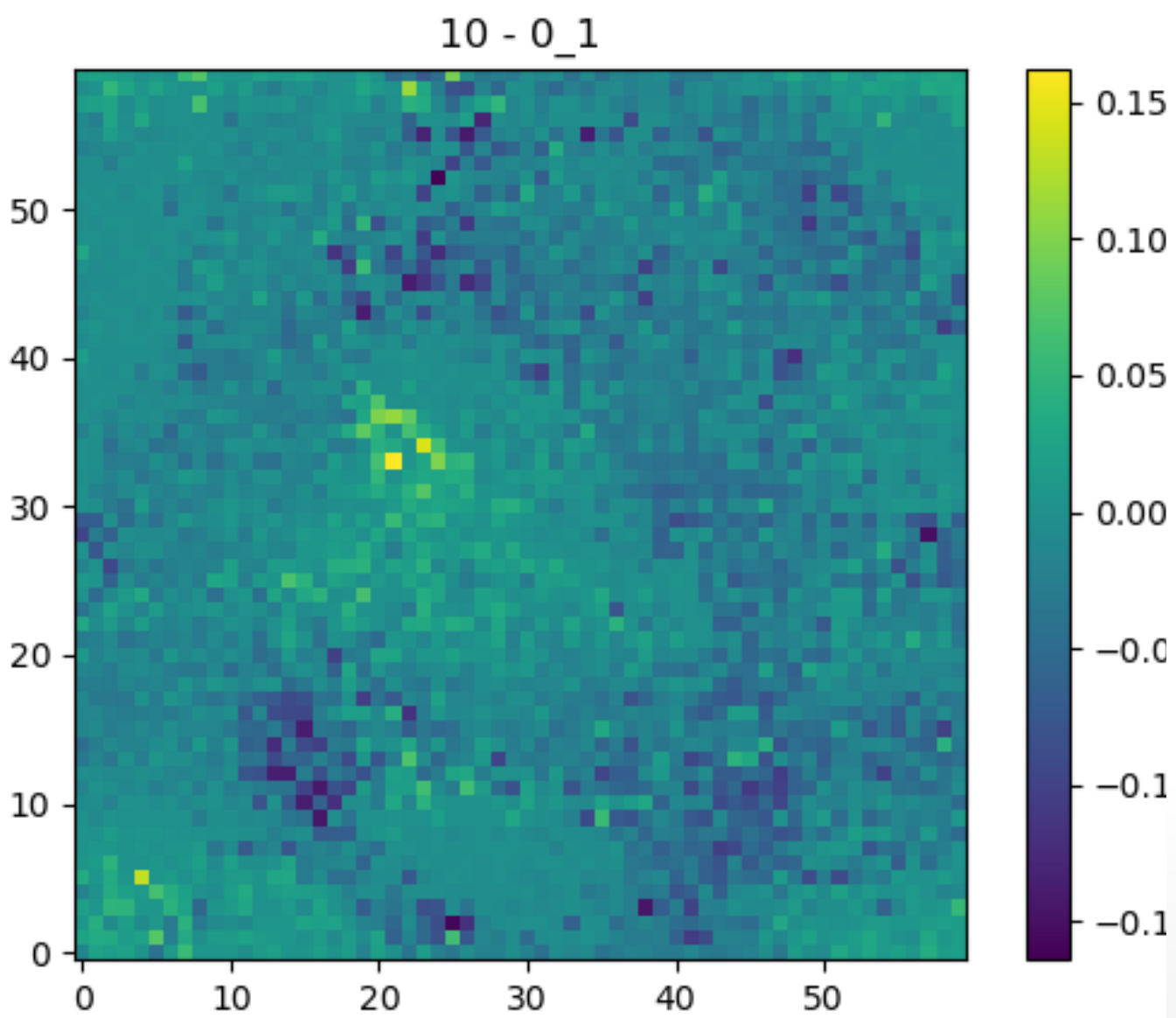
- Three different values for the steepness
  - 10
  - 1.0
  - 0.1

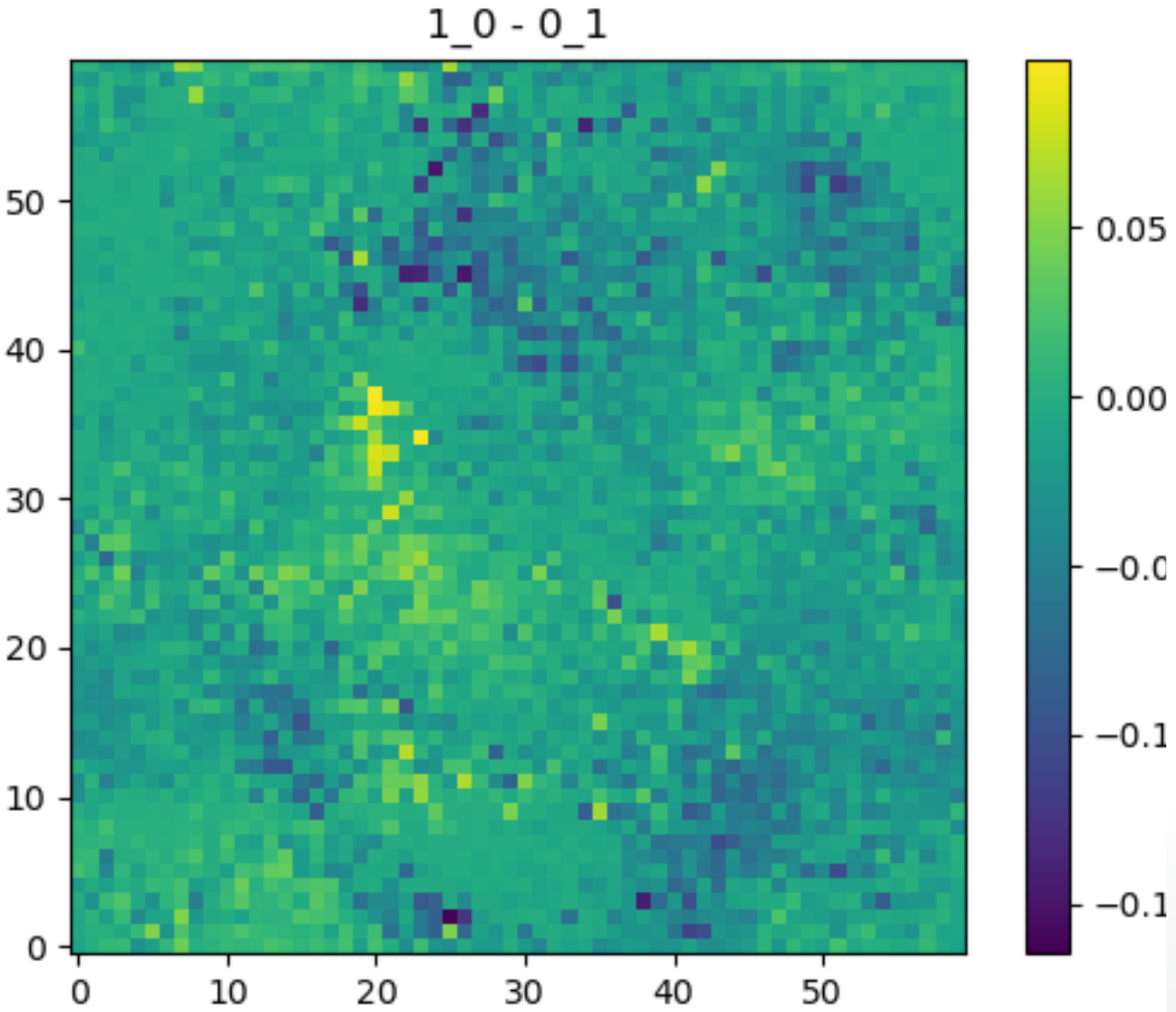

Avg. activation: Steepness 10
0
10
20
30
40
50
0
10
20
30
40
50
1.0
0.8
0.6
0.4
0.2
0.0


Avg. activation: Steepness 1.0
0
10
20
30
40
50
0
10
20
30
40
50
1.0
0.8
0.6
0.4
0.2
0.0


Avg. activation: Steepness 0.1
0
10
20
30
40
50
0
10
20
30
40
50
1.0
0.8
0.6
0.4
0.2
0.0

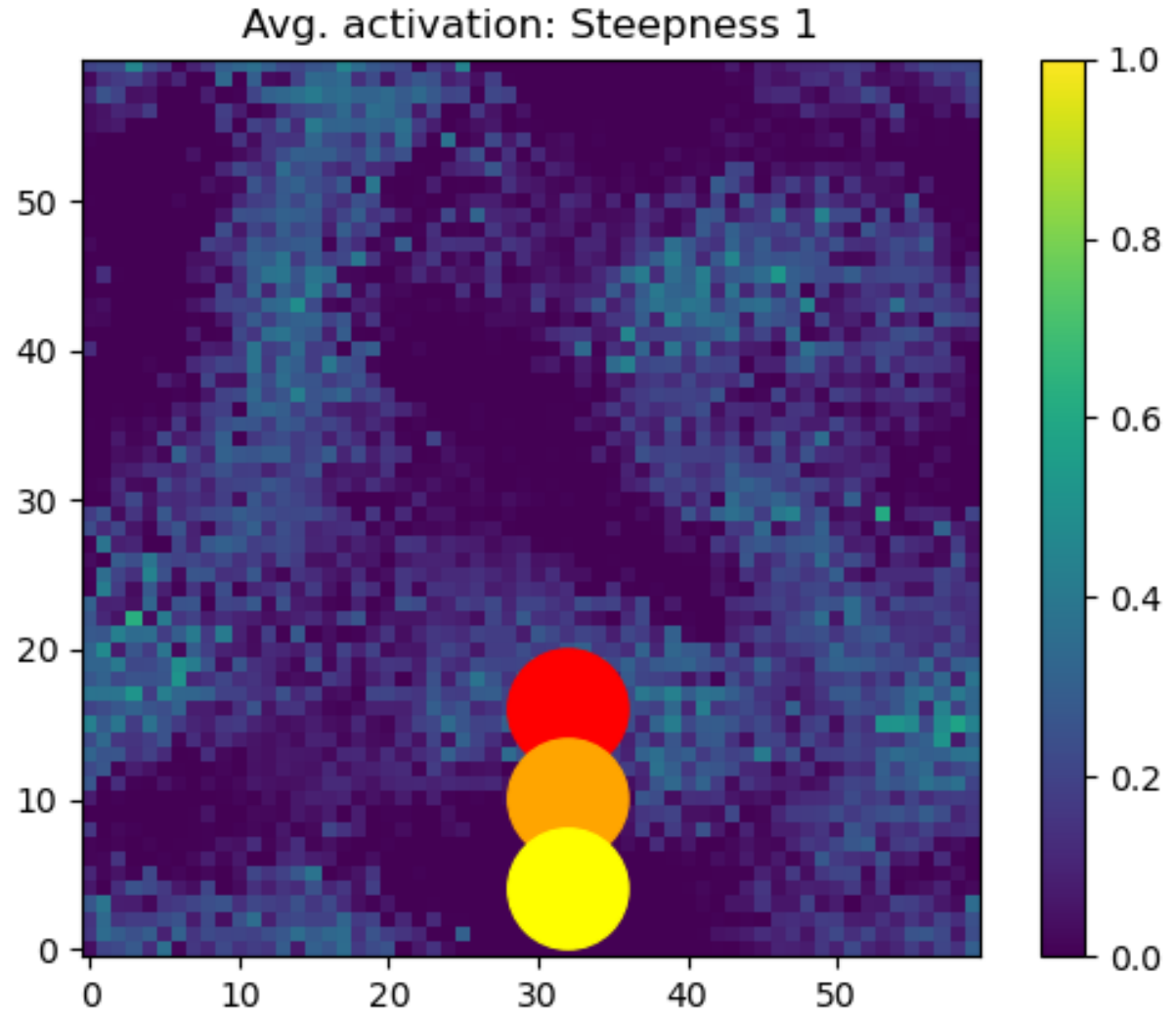

10 - 1_0
0
10
20
30
40
50
0.10
0.05
0.00
−0.0


10 - 0_1
0
10
20
30
40
50
0.15
0.10
0.05
0.00
−0.0
−0.1
−0.1

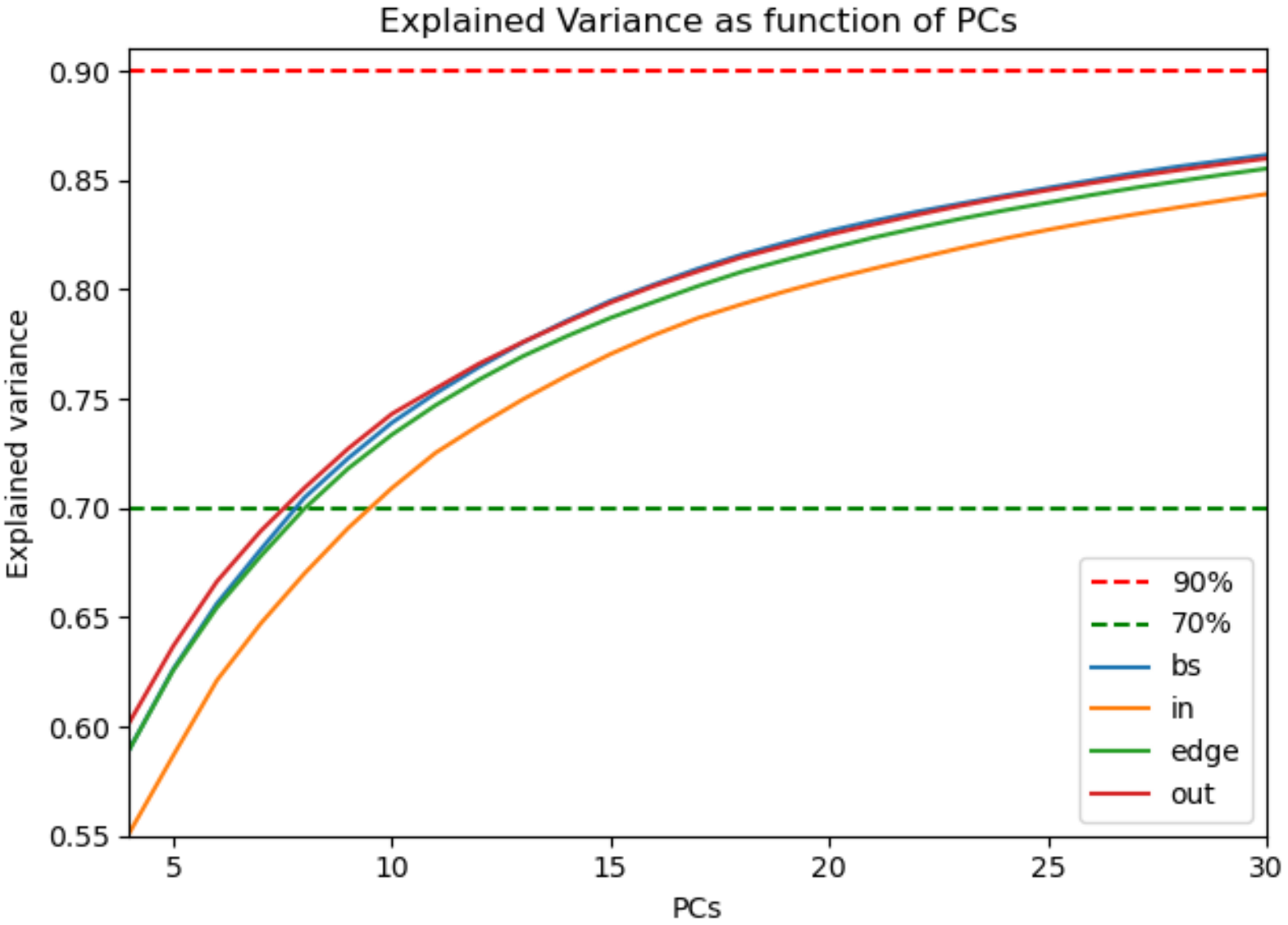

1_0 - 0_1
0
10
20
30
40
50
0.05
0.00
−0.0
−0.1
−0.1

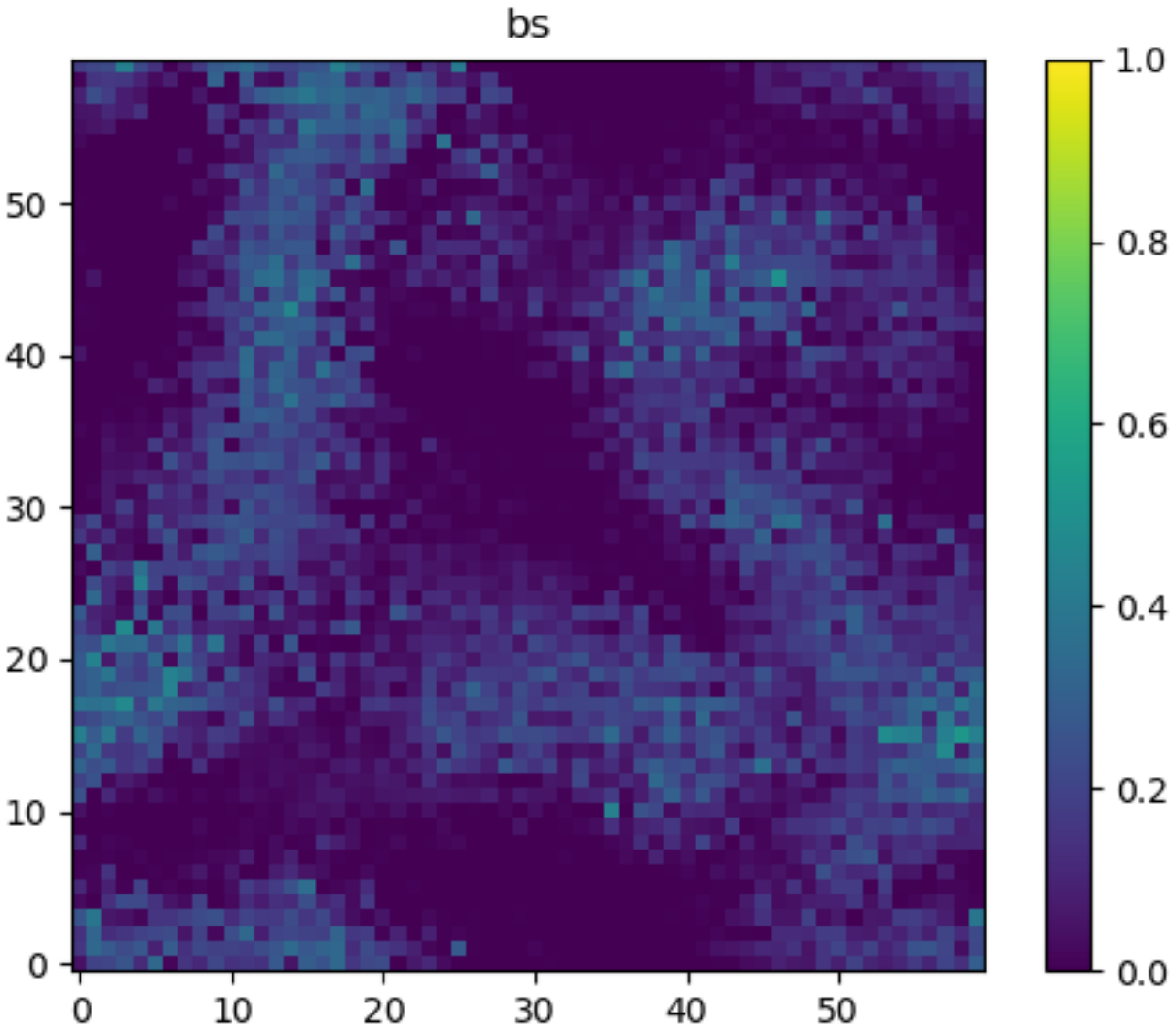
Dopamine patches

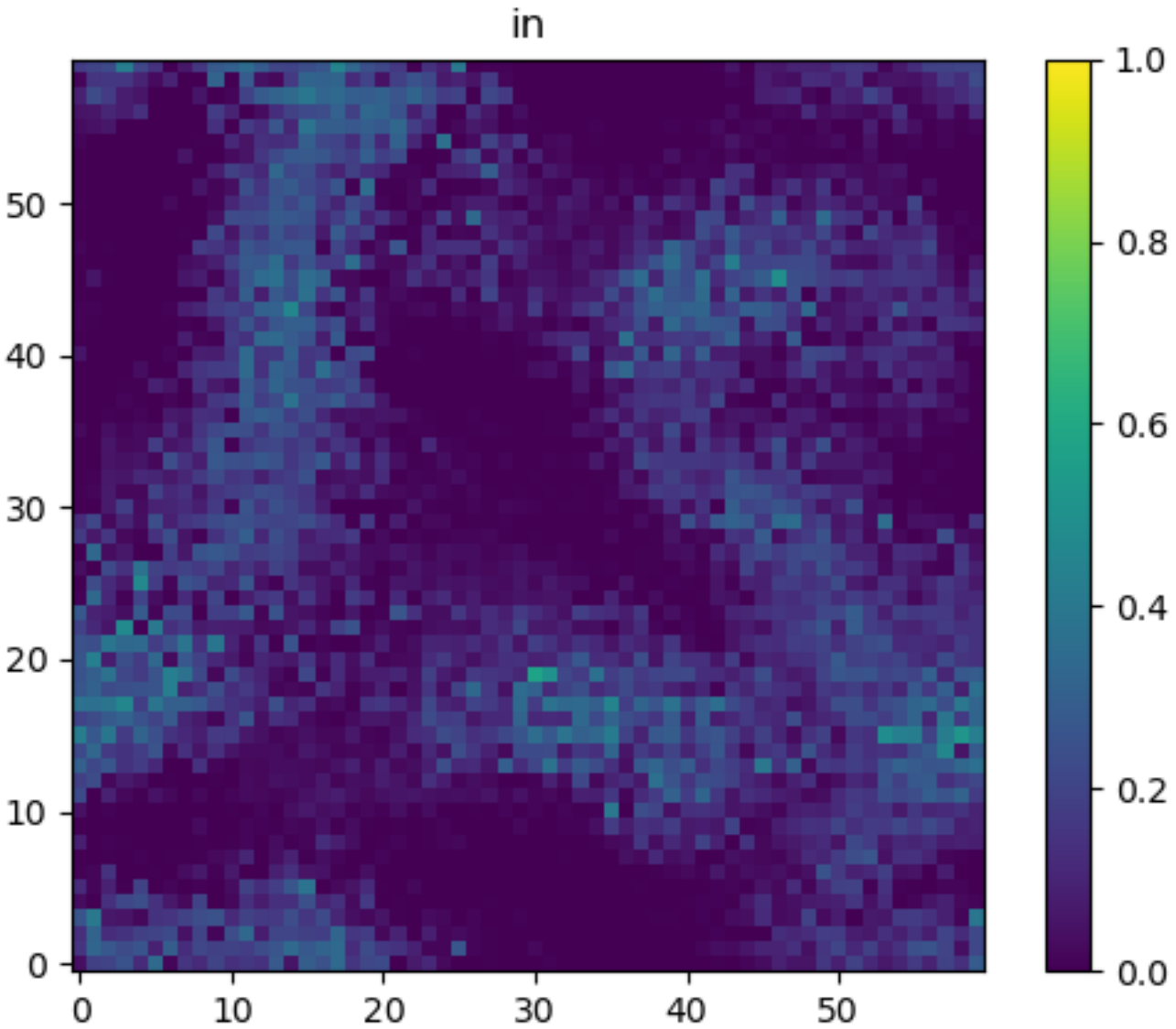
- Three positions
  - In…
  - Near…
  - Out of…
  - … a sequence

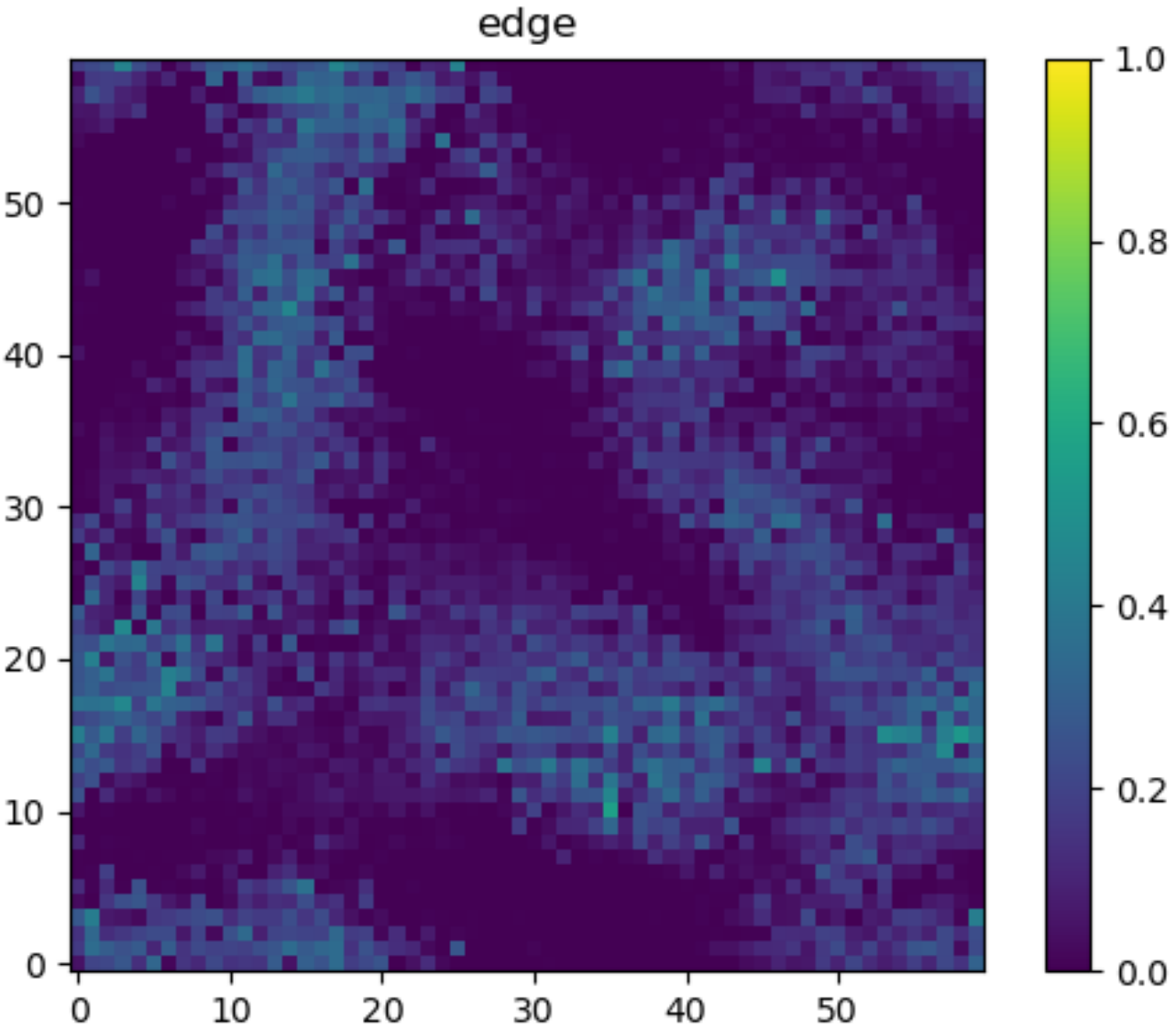


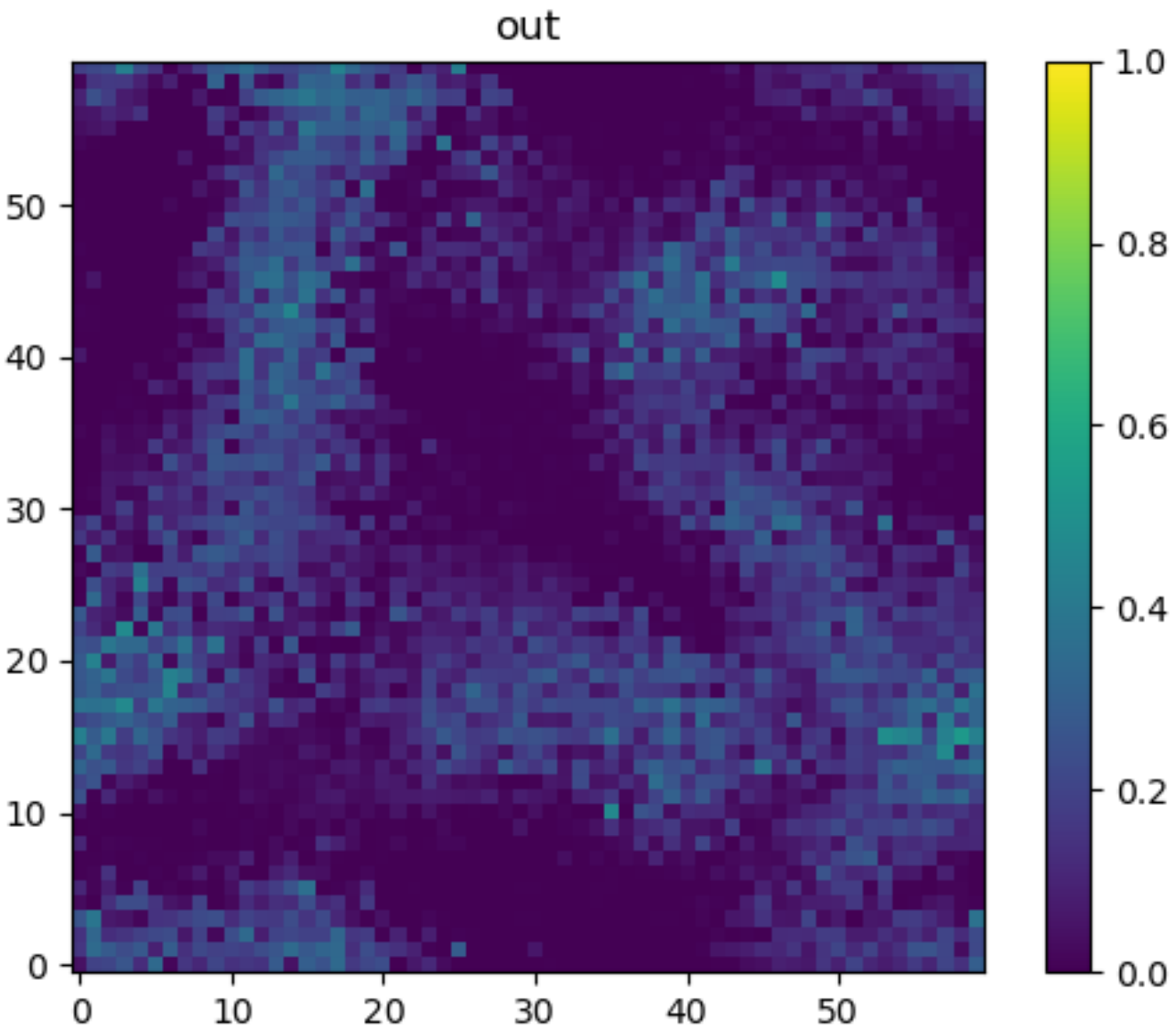
Red: in
Orange: edge
Yellow: out

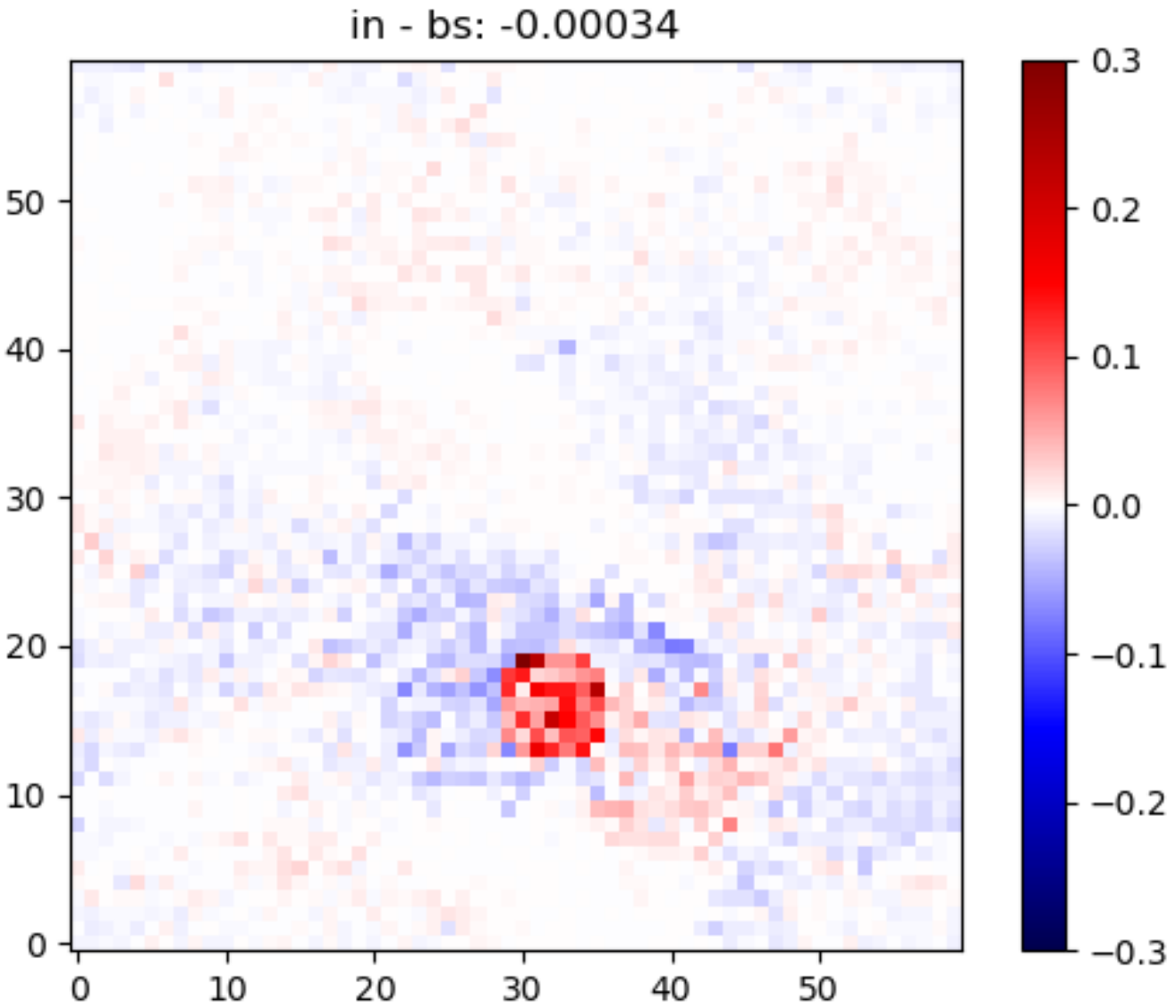

Explained Variance as function of PCs
Explained variance
PCs
0.90
0.85
0.80
0.75
0.70
0.65
0.60
0.55
5
10
15
20
25
30
90%
70%
bs
in
edge
out

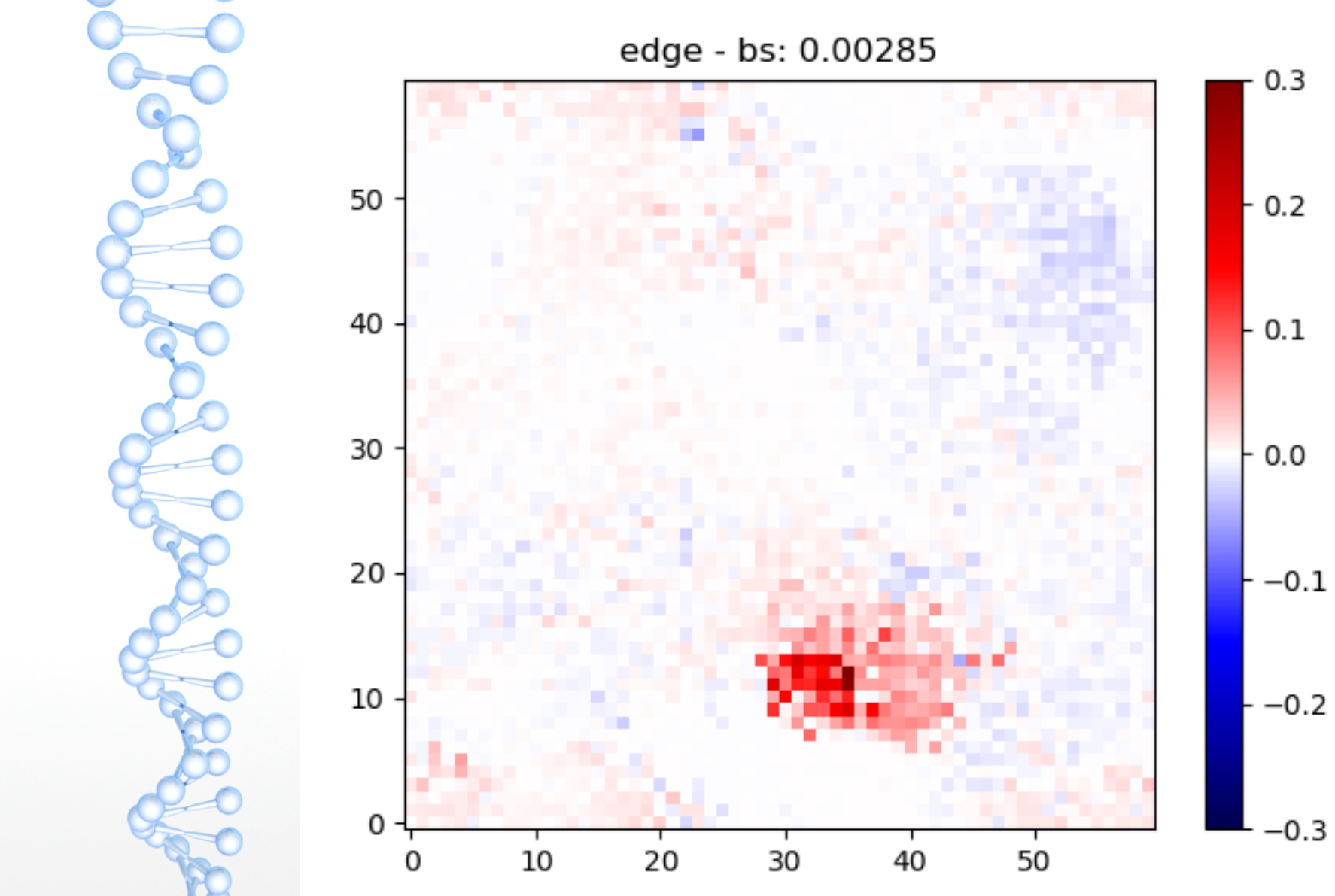

bs
0
10
20
30
40
50
0
10
20
30
40
50
1.0
0.8
0.6
0.4
0.2
0.0

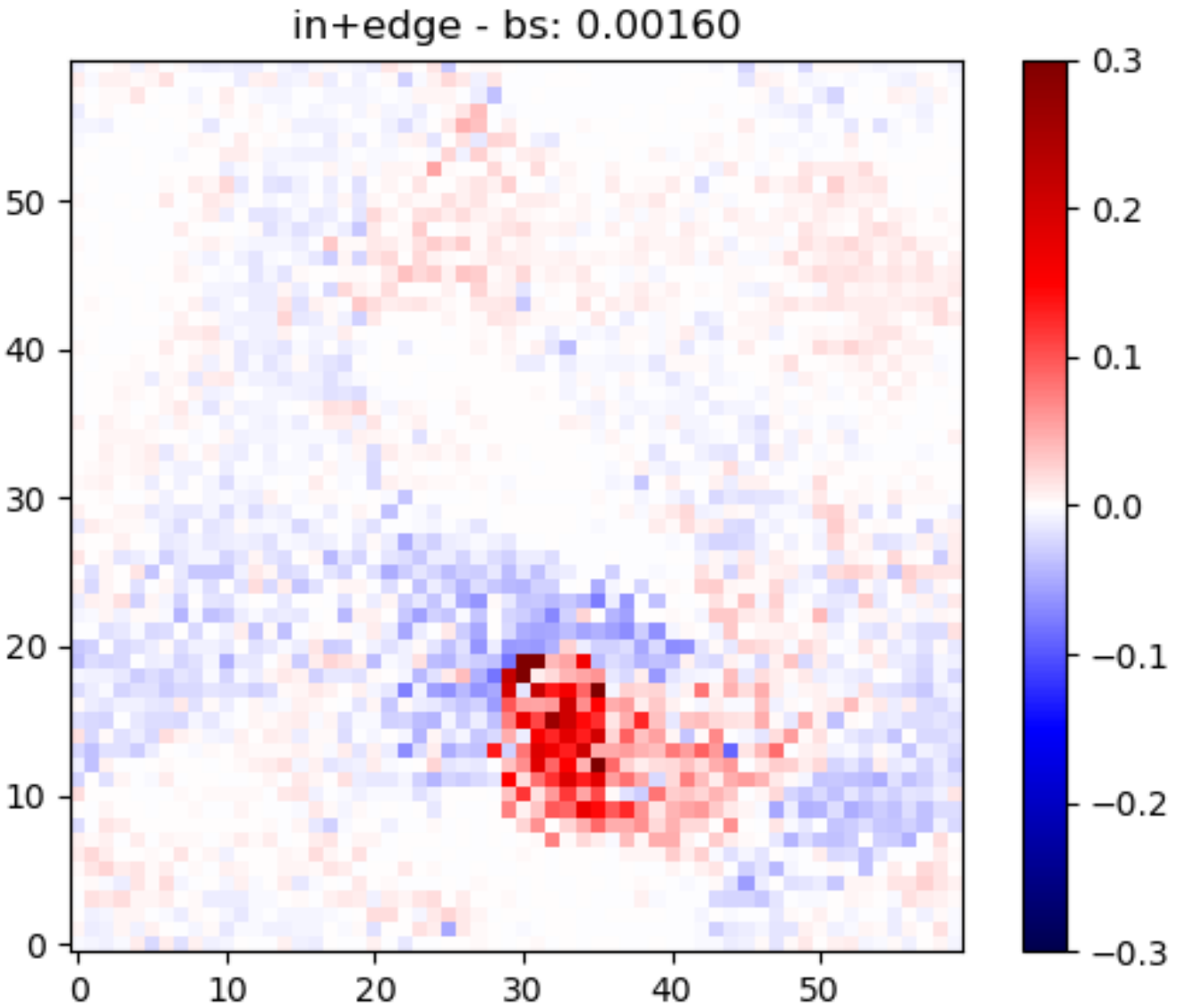

in
0
10
20
30
40
50
0
10
20
30
40
50
1.0
0.8
0.6
0.4
0.2
0.0

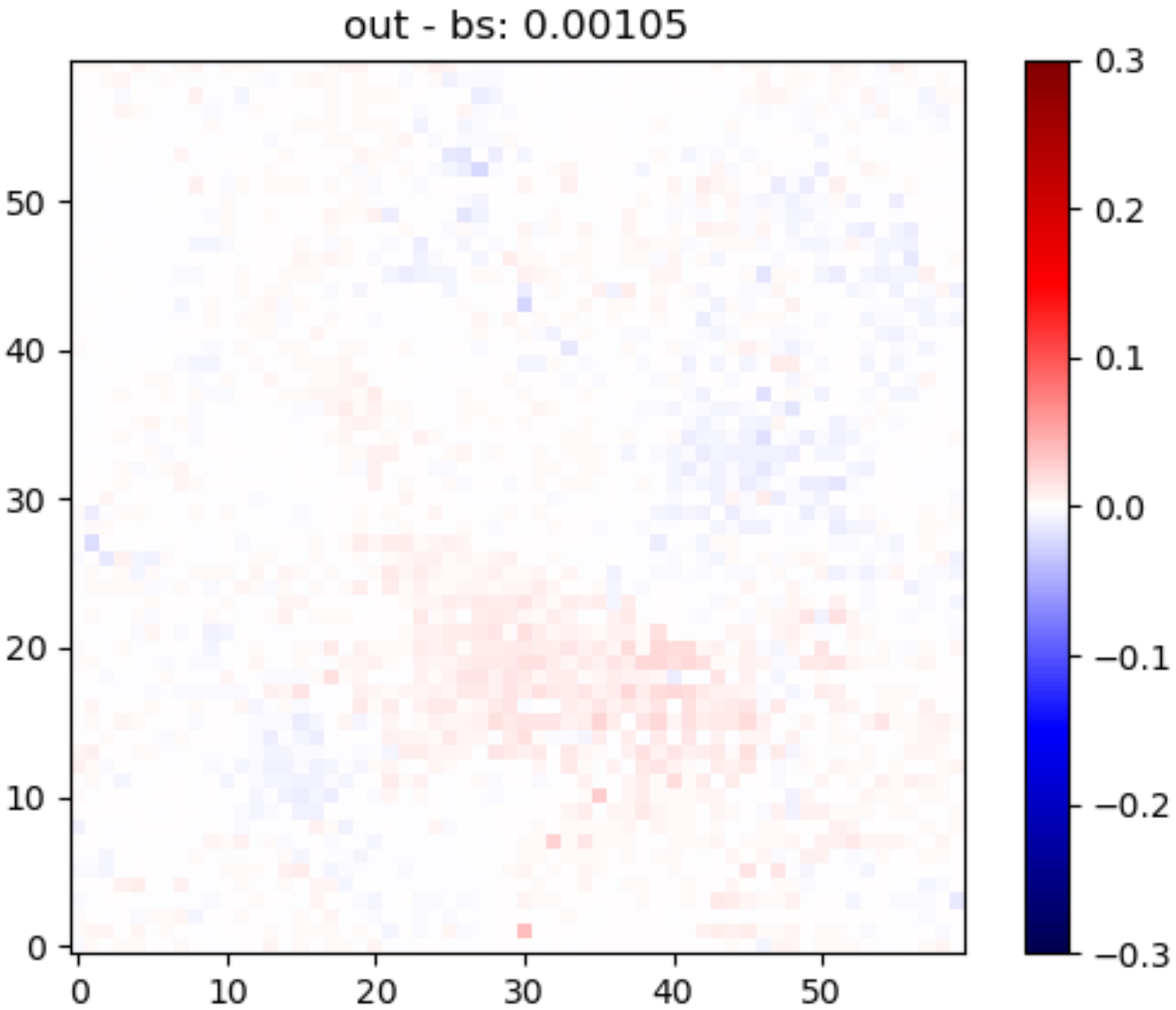

edge
0
10
20
30
40
50
0
10
20
30
40
50
1.0
0.8
0.6
0.4
0.2
0.0

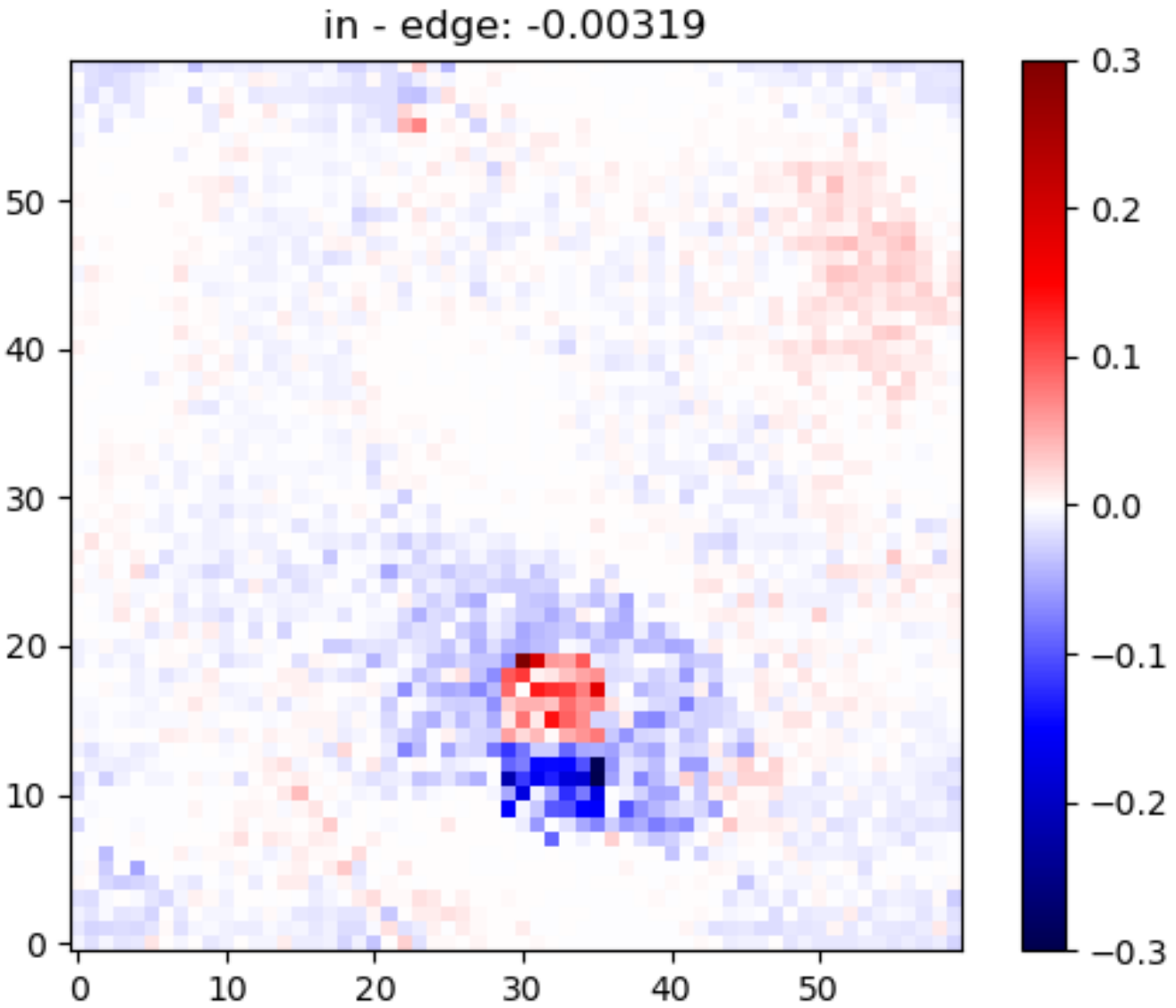

out
0
10
20
30
40
50
0
10
20
30
40
50
1.0
0.8
0.6
0.4
0.2
0.0

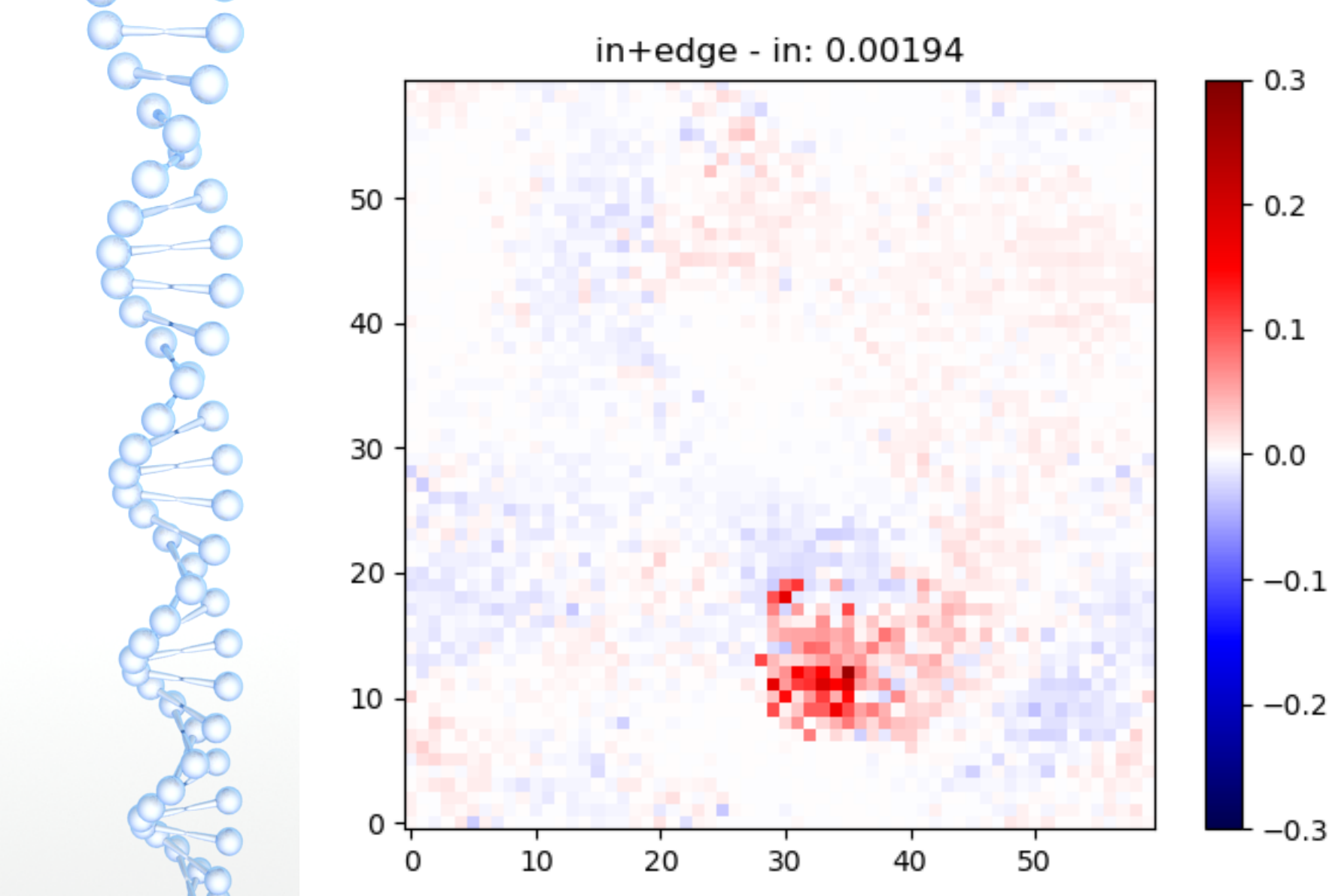

in - bs: -0.00034
0
10
20
30
40
50
0.3
0.2
0.1
0.0
−0.1
−0.2
−0.3

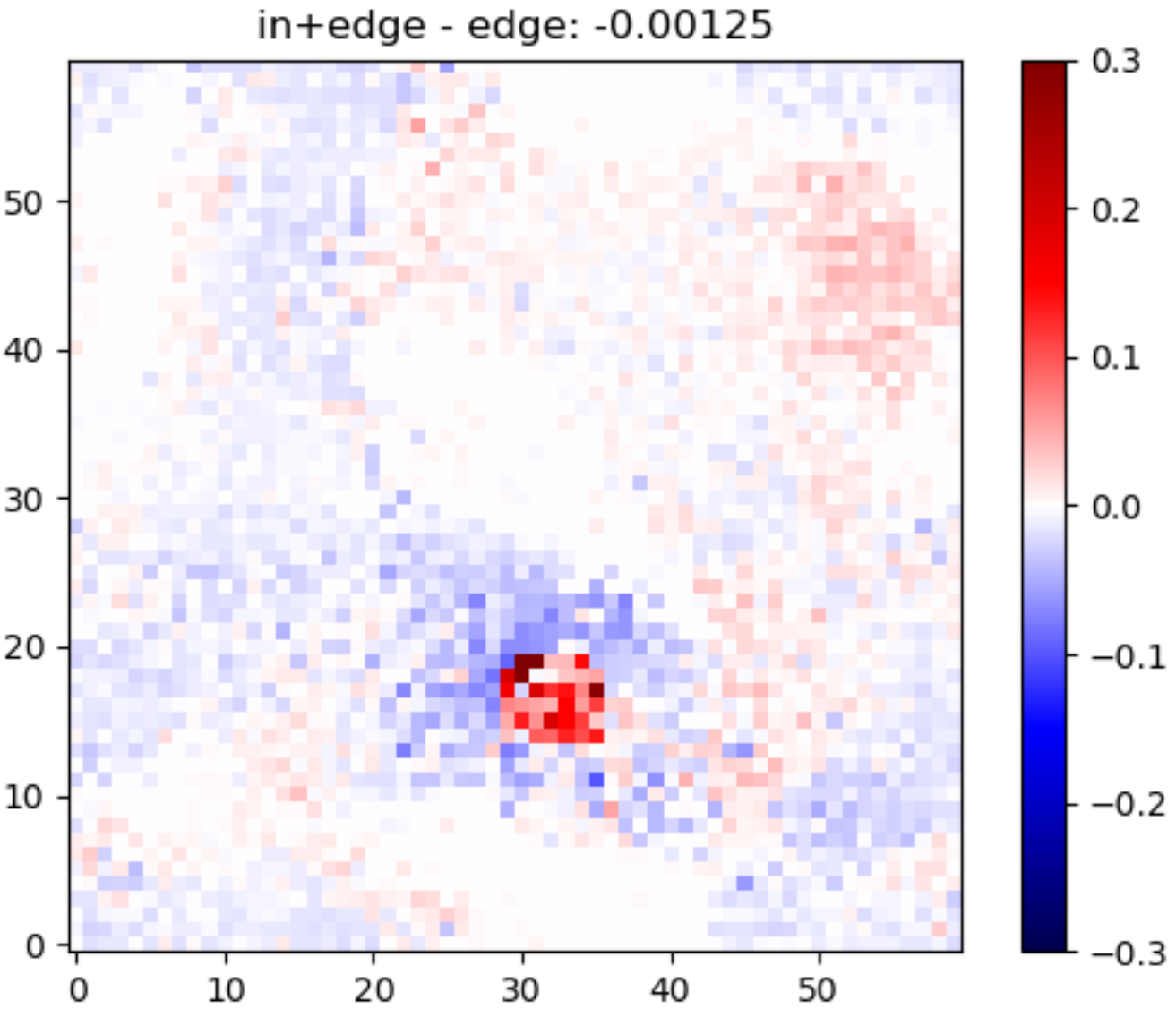

edge - bs: 0.00285
0
10
20
30
40
50
0.3
0.2
0.1
0.0
−0.1
−0.2
−0.3

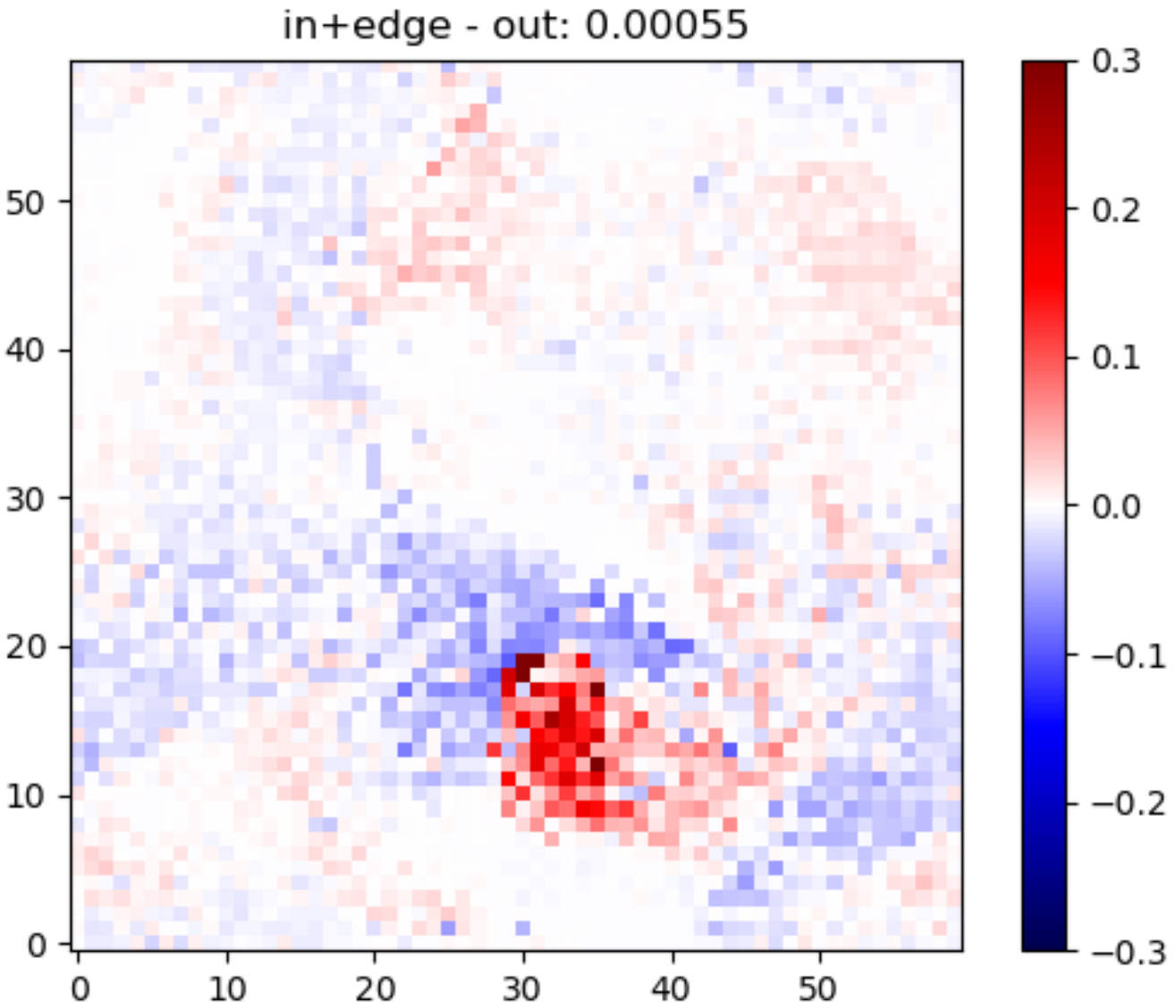

in+edge - bs: 0.00160
0
10
20
30
40
50
0.3
0.2
0.1
0.0
−0.1
−0.2
−0.3

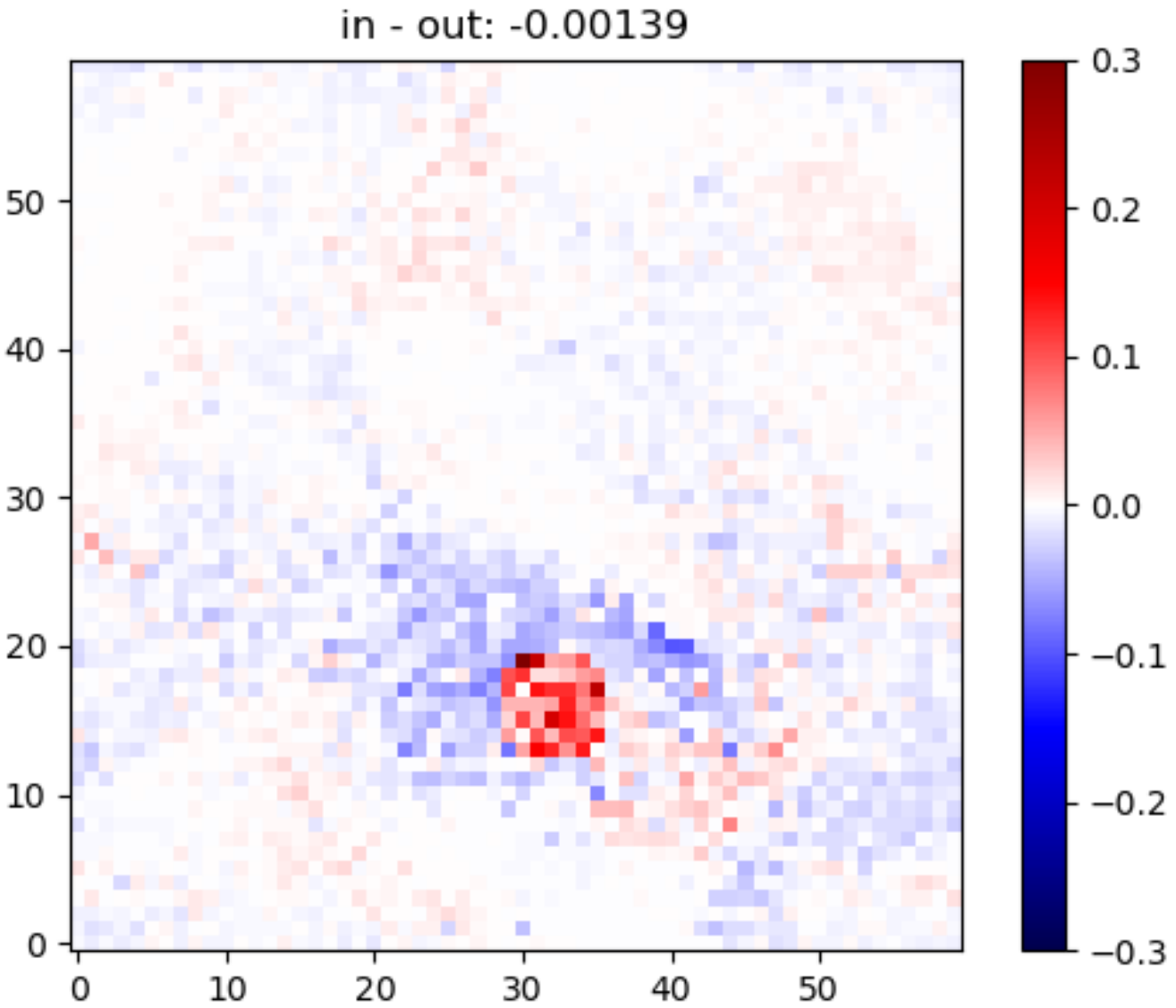

out - bs: 0.00105
0
10
20
30
40
50
0.3
0.2
0.1
0.0
−0.1
−0.2
−0.3

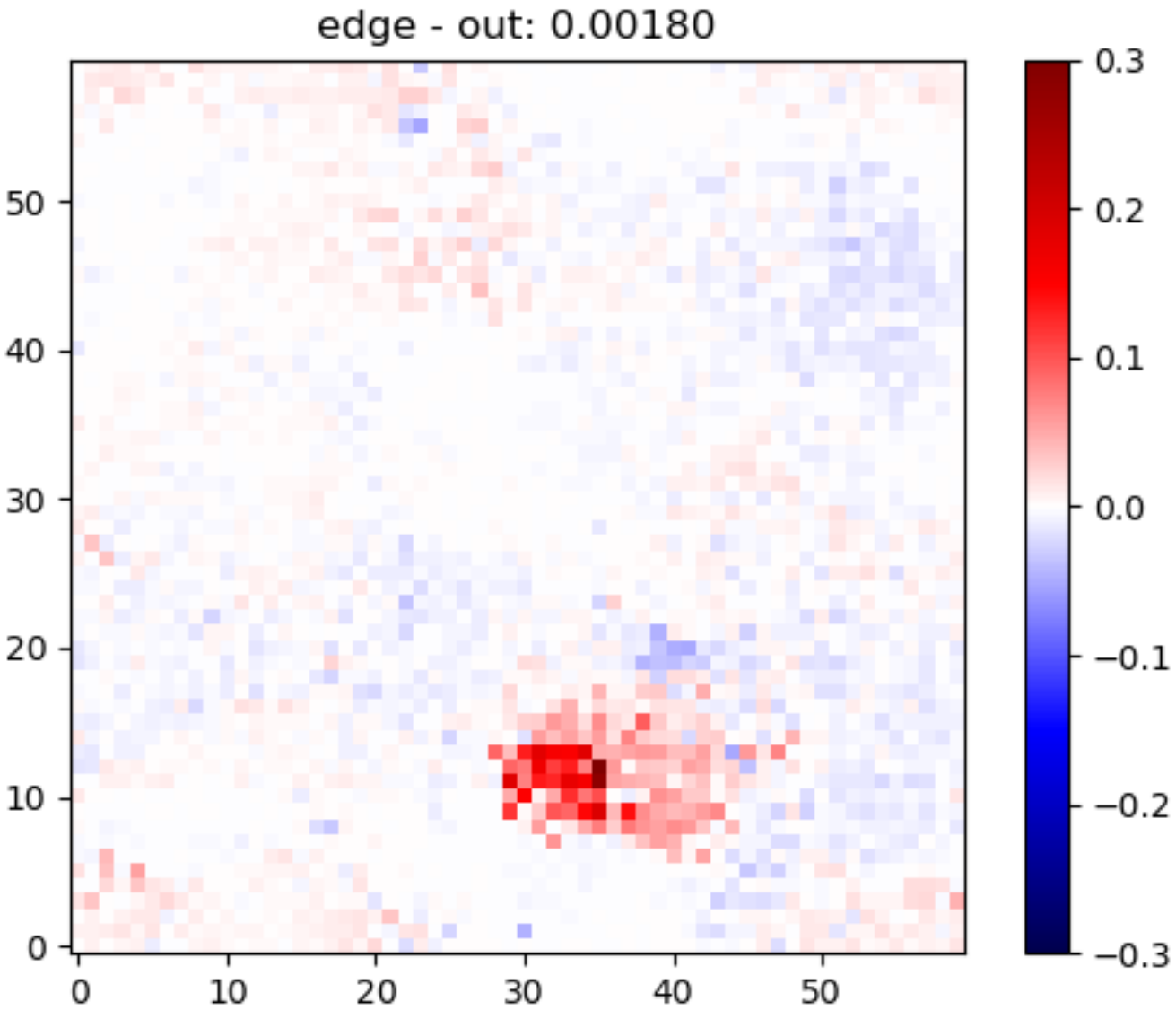

in - edge: -0.00319
0
10
20
30
40
50
0.3
0.2
0.1
0.0
−0.1
−0.2
−0.3


in+edge - in: 0.00194
0
10
20
30
40
50
0.3
0.2
0.1
0.0
−0.1
−0.2
−0.3


in+edge - edge: -0.00125
0
10
20
30
40
50
0.3
0.2
0.1
0.0
−0.1
−0.2
−0.3

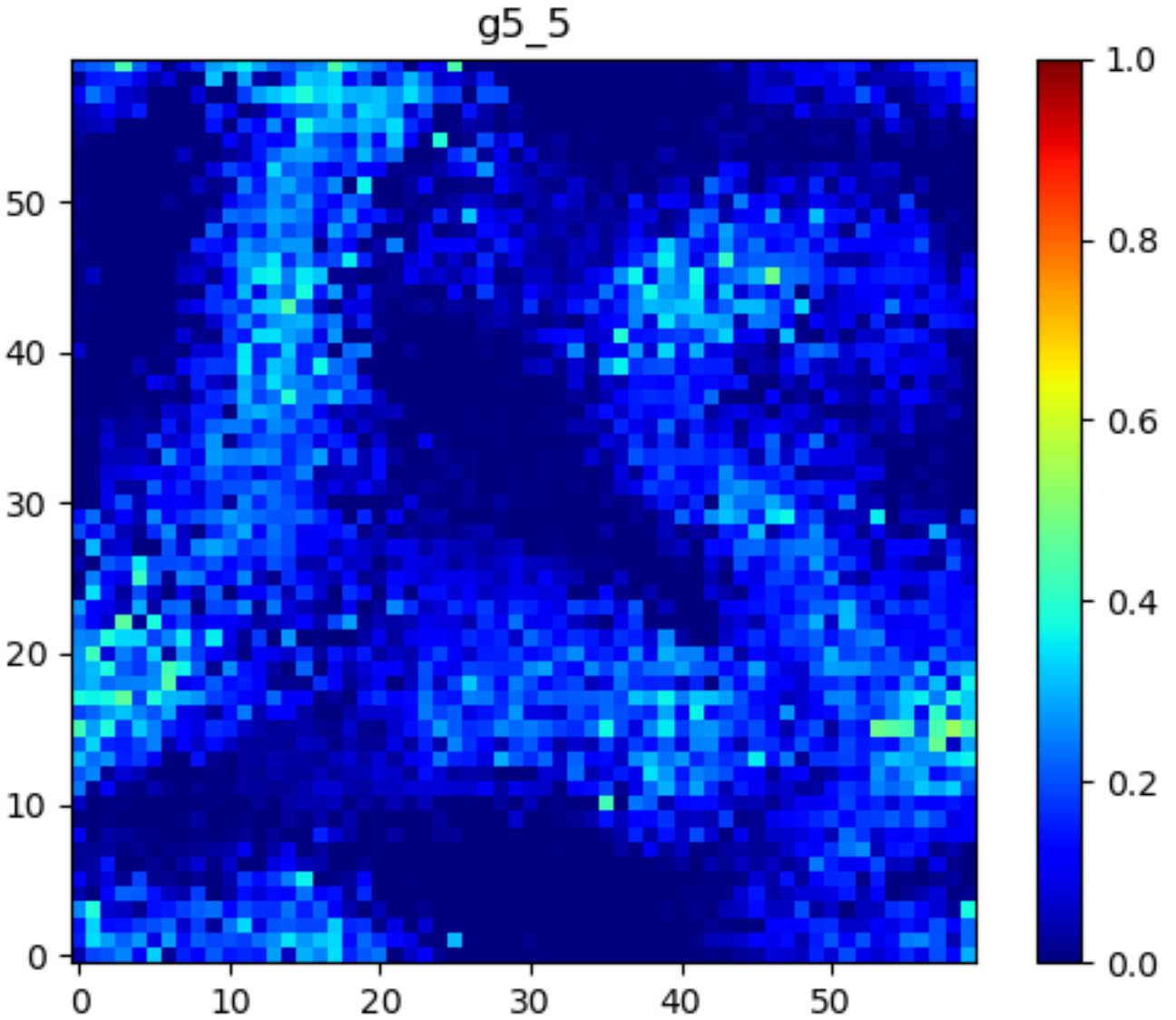

in+edge - out: 0.00055
0
10
20
30
40
50
0.3
0.2
0.1
0.0
−0.1
−0.2
−0.3

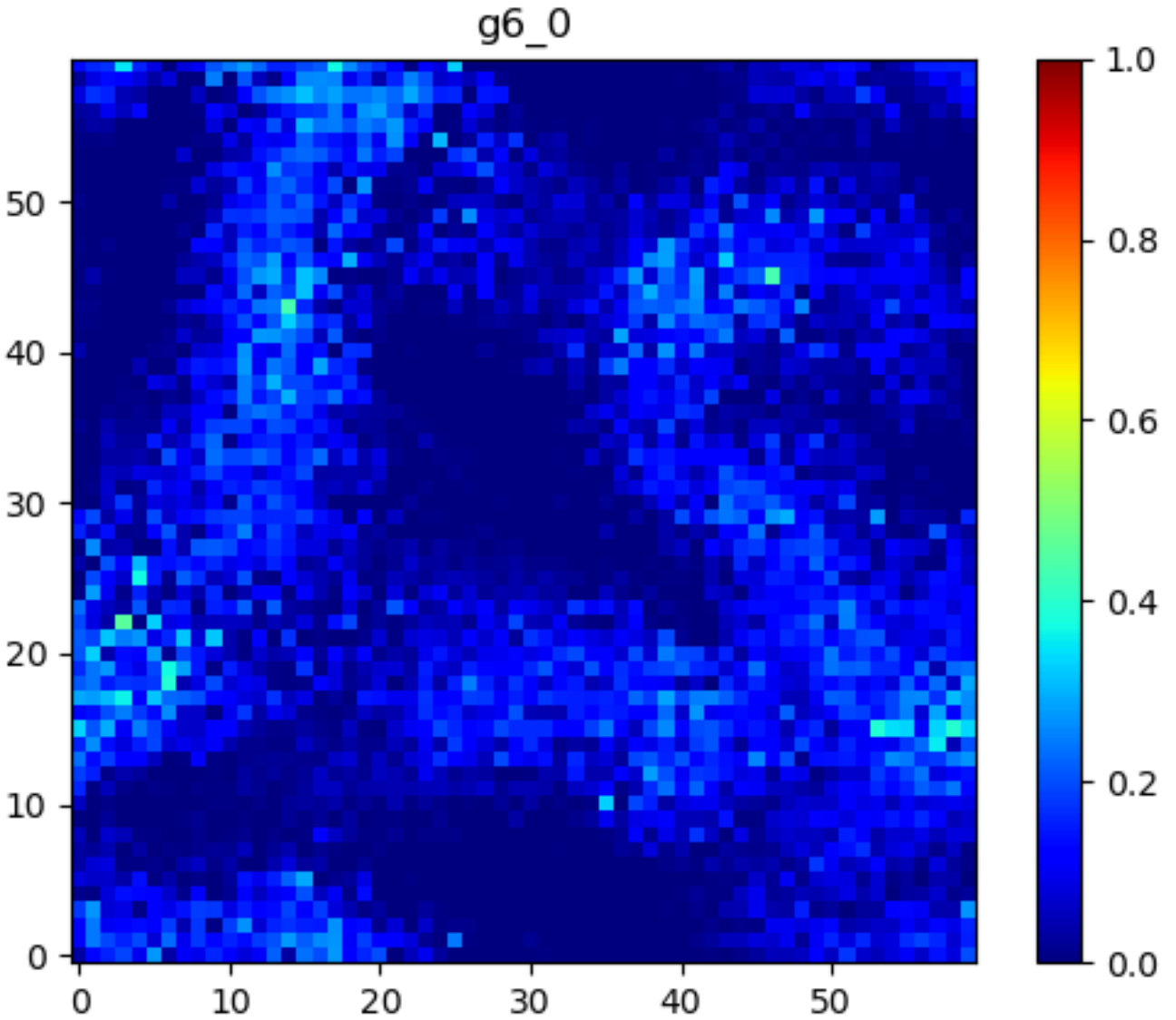

in - out: -0.00139
0
10
20
30
40
50
0.3
0.2
0.1
0.0
−0.1
−0.2
−0.3

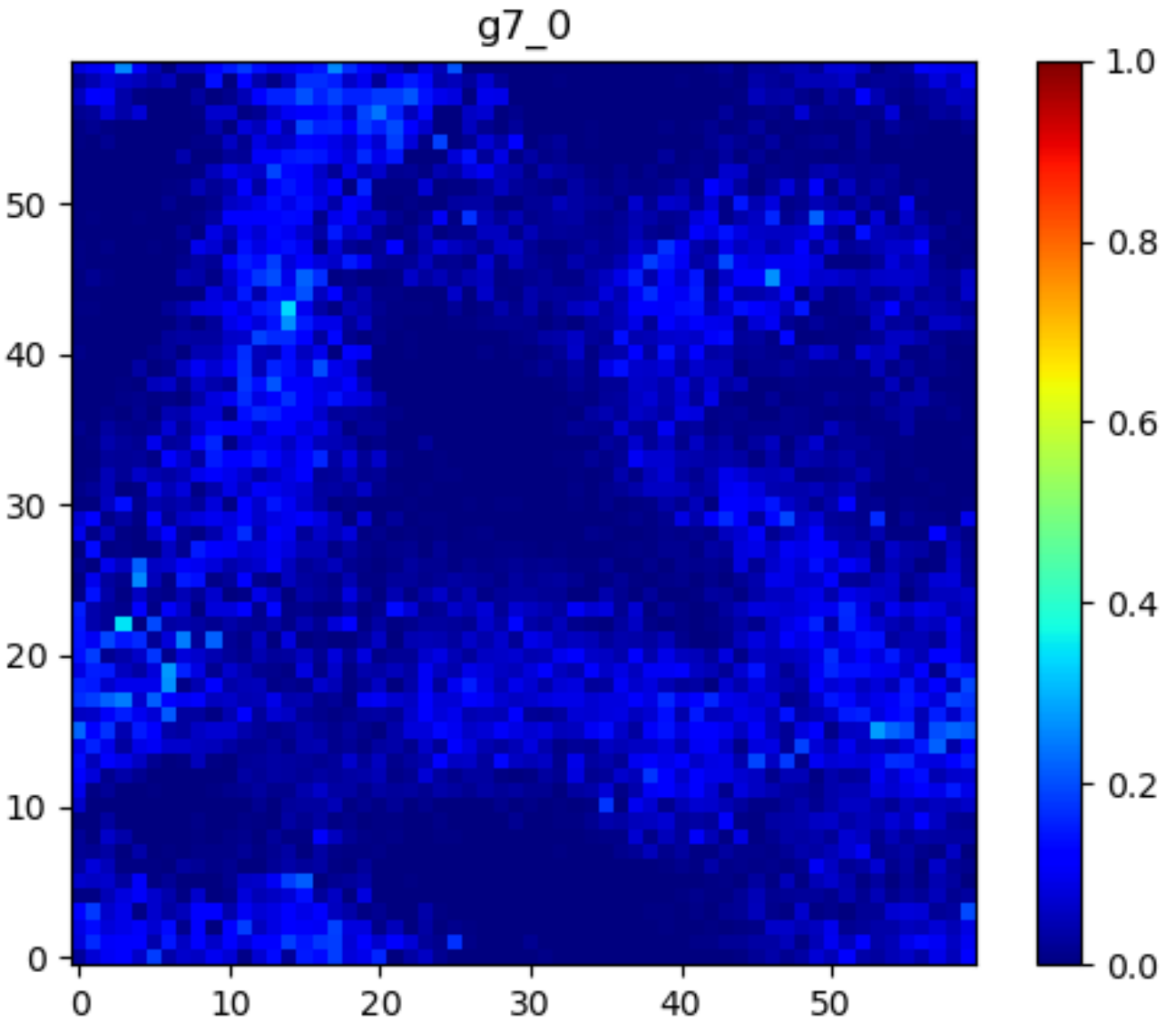

edge - out: 0.00180
0
10
20
30
40
50
0.3
0.2
0.1
0.0
−0.1
−0.2
−0.3

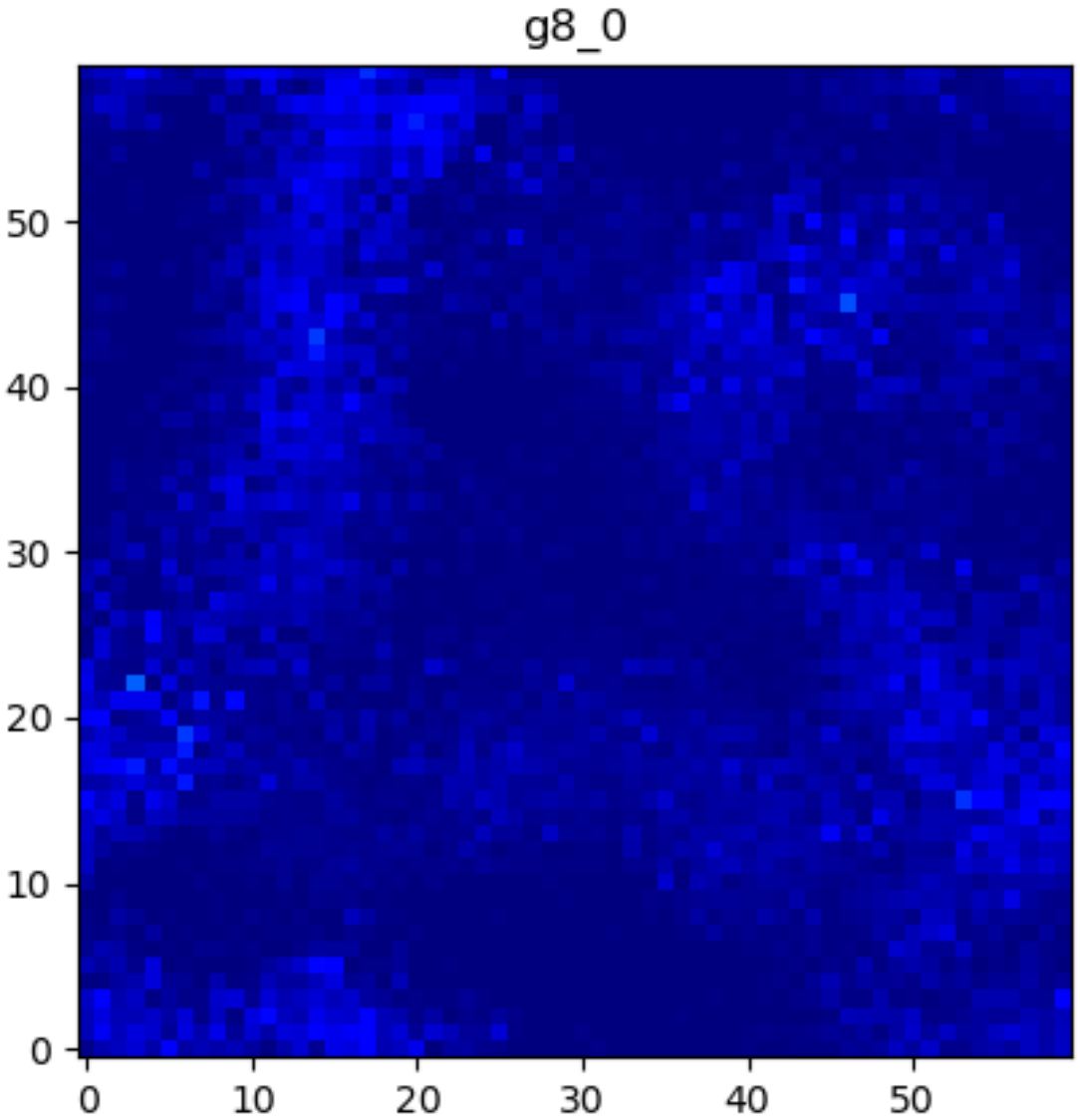
g configuration

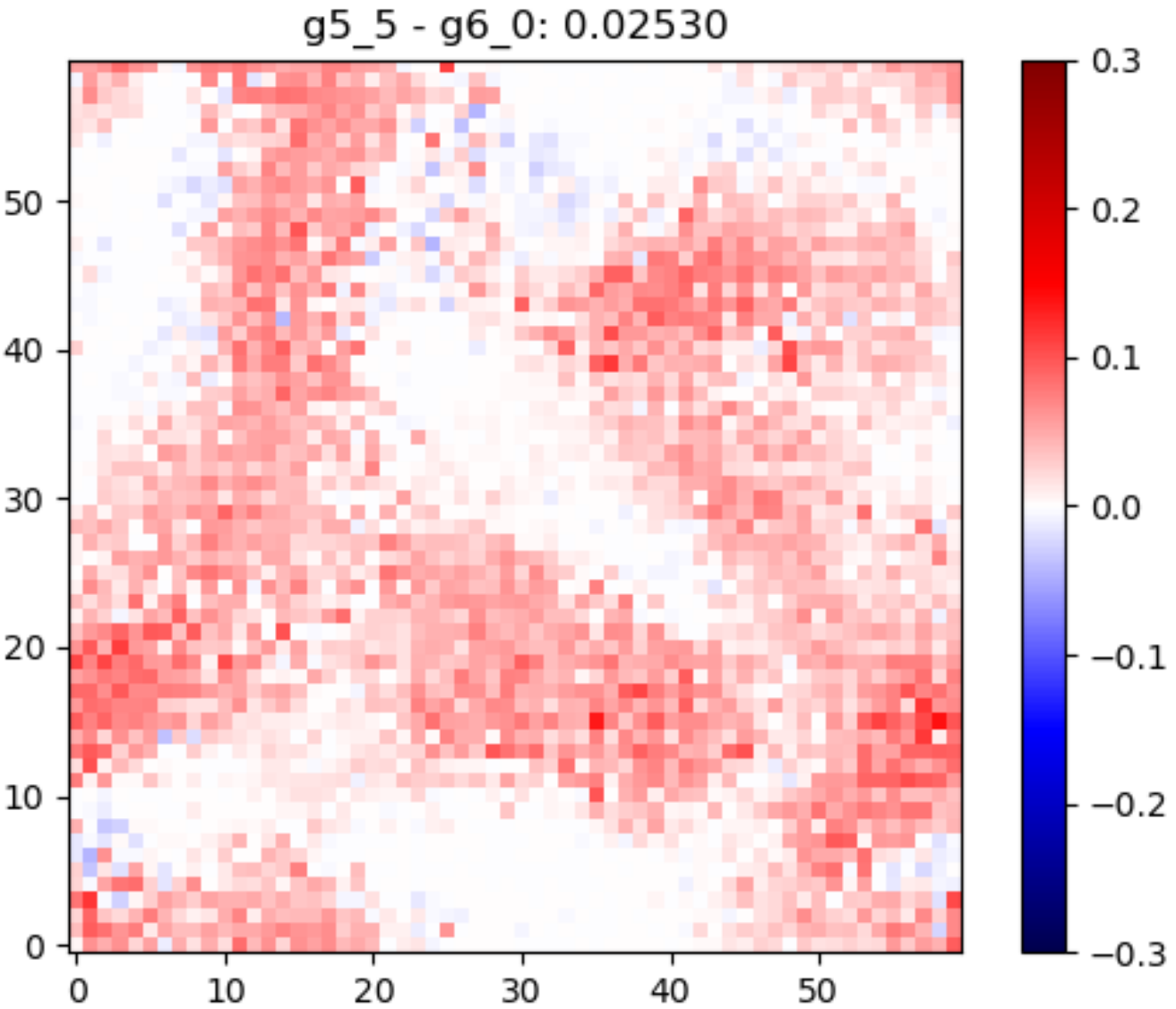
- Different g's as factor of inhibition over excitation
  - 5.5
  - 6.0
  - 7.0
  - 8.0

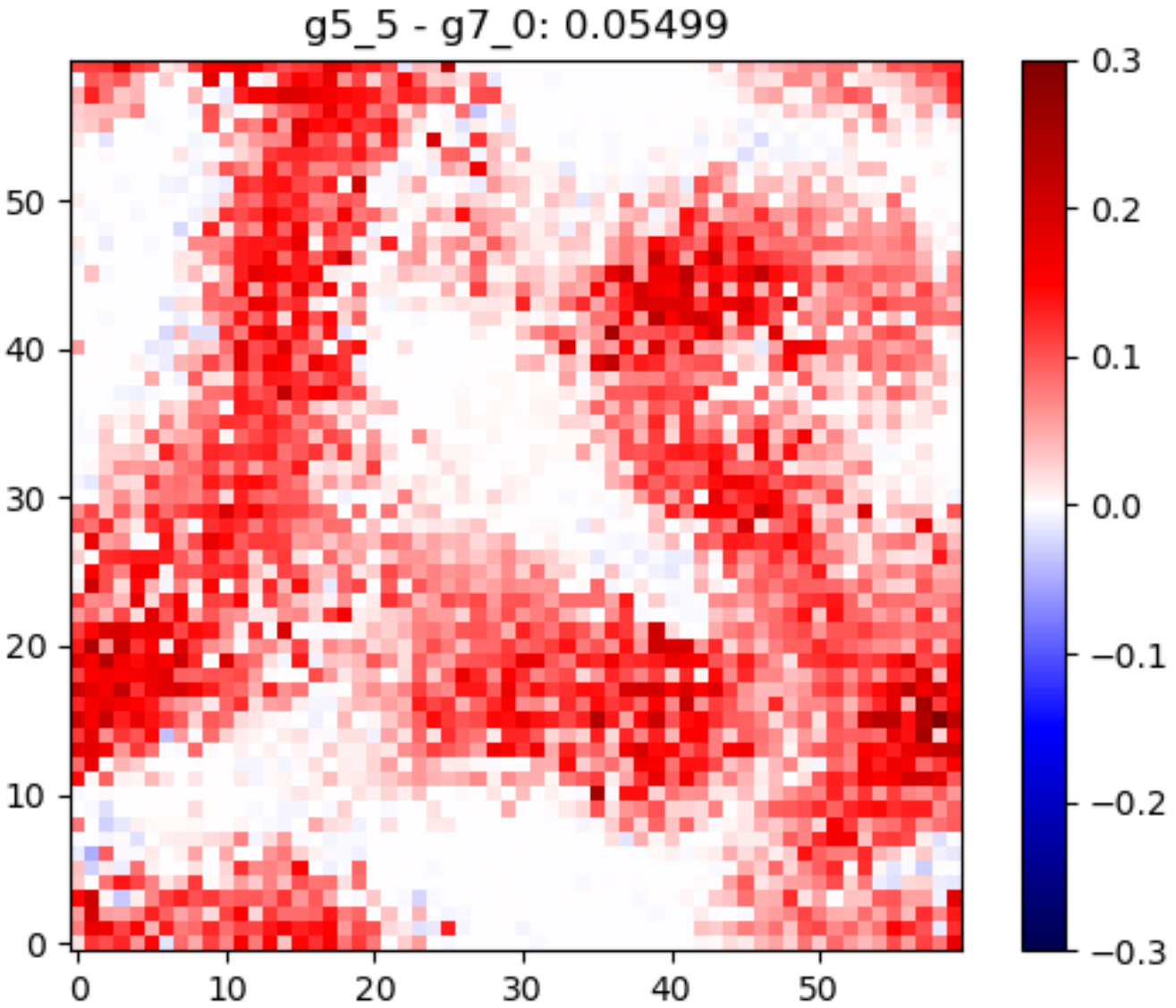

g5_5
0
10
20
30
40
50
1.0
0.8
0.6
0.4
0.2
0.0

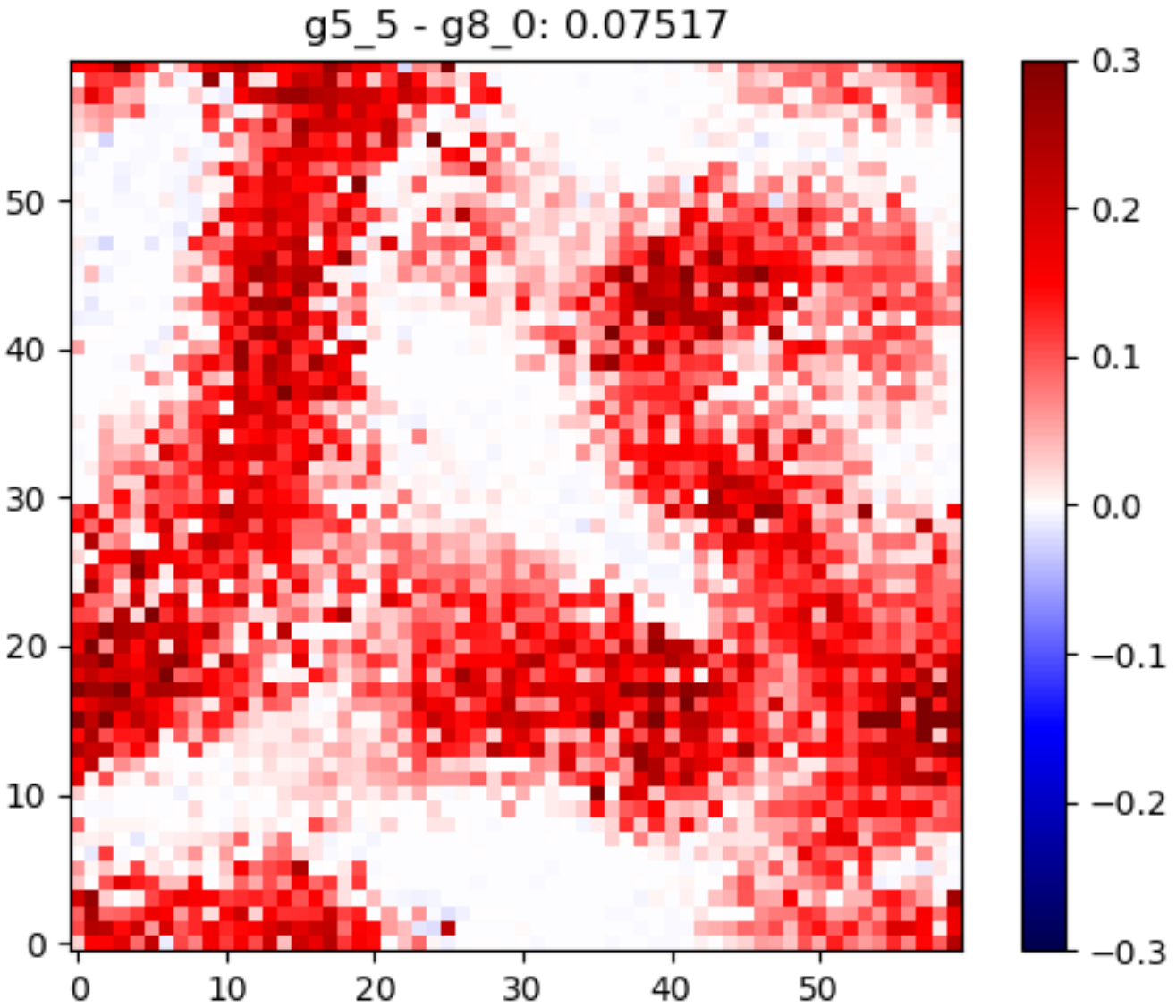

g6_0
0
10
20
30
40
50
1.0
0.8
0.6
0.4
0.2
0.0

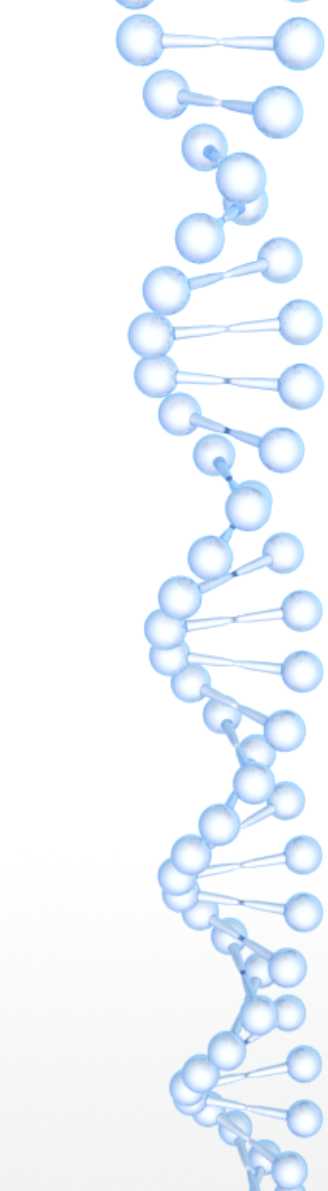

g7_0
0
10
20
30
40
50
1.0
0.8
0.6
0.4
0.2
0.0


g8_0
0
10
20
30
40
50
1.0
0.8
0.6
0.4
0.2
0.0


g5_5 - g6_0: 0.02530
0
10
20
30
40
50
0.3
0.2
0.1
0.0
−0.1
−0.2
−0.3

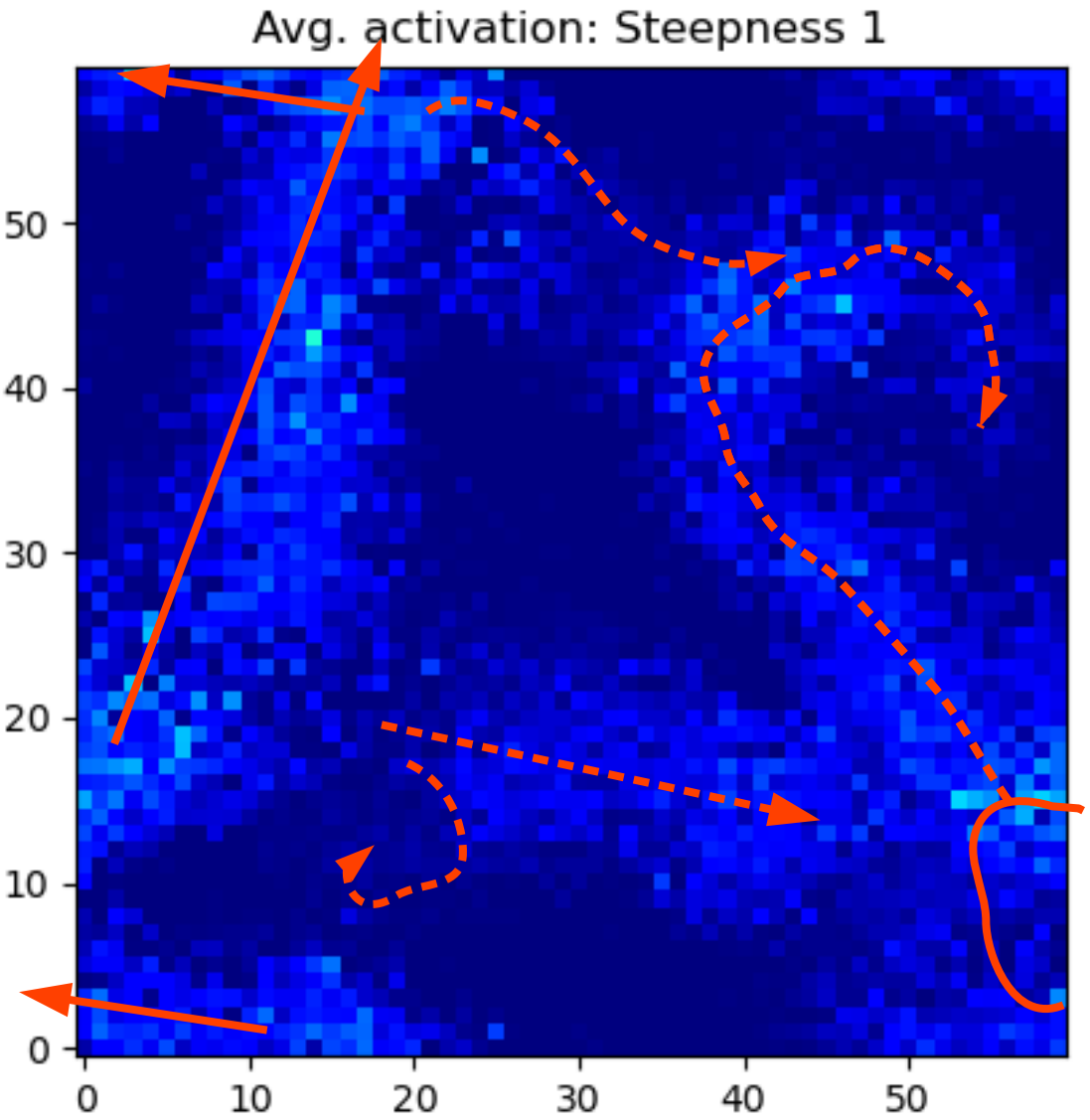

g5_5 - g7_0: 0.05499
0
10
20
30
40
50
0.3
0.2
0.1
0.0
−0.1
−0.2
−0.3


g5_5 - g8_0: 0.07517
0
10
20
30
40
50
0.3
0.2
0.1
0.0
−0.1
−0.2
−0.3



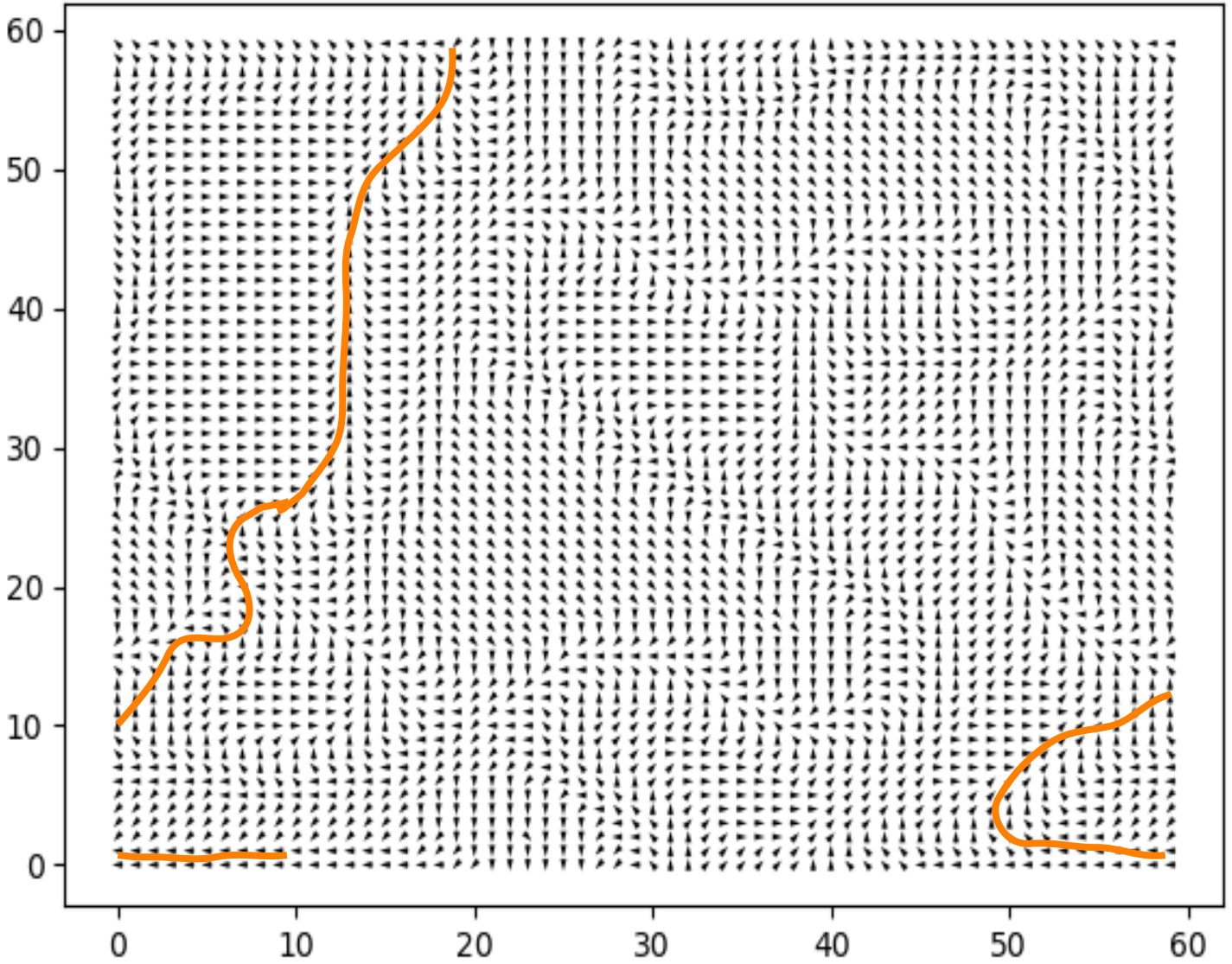
Differences in the Perlin scale

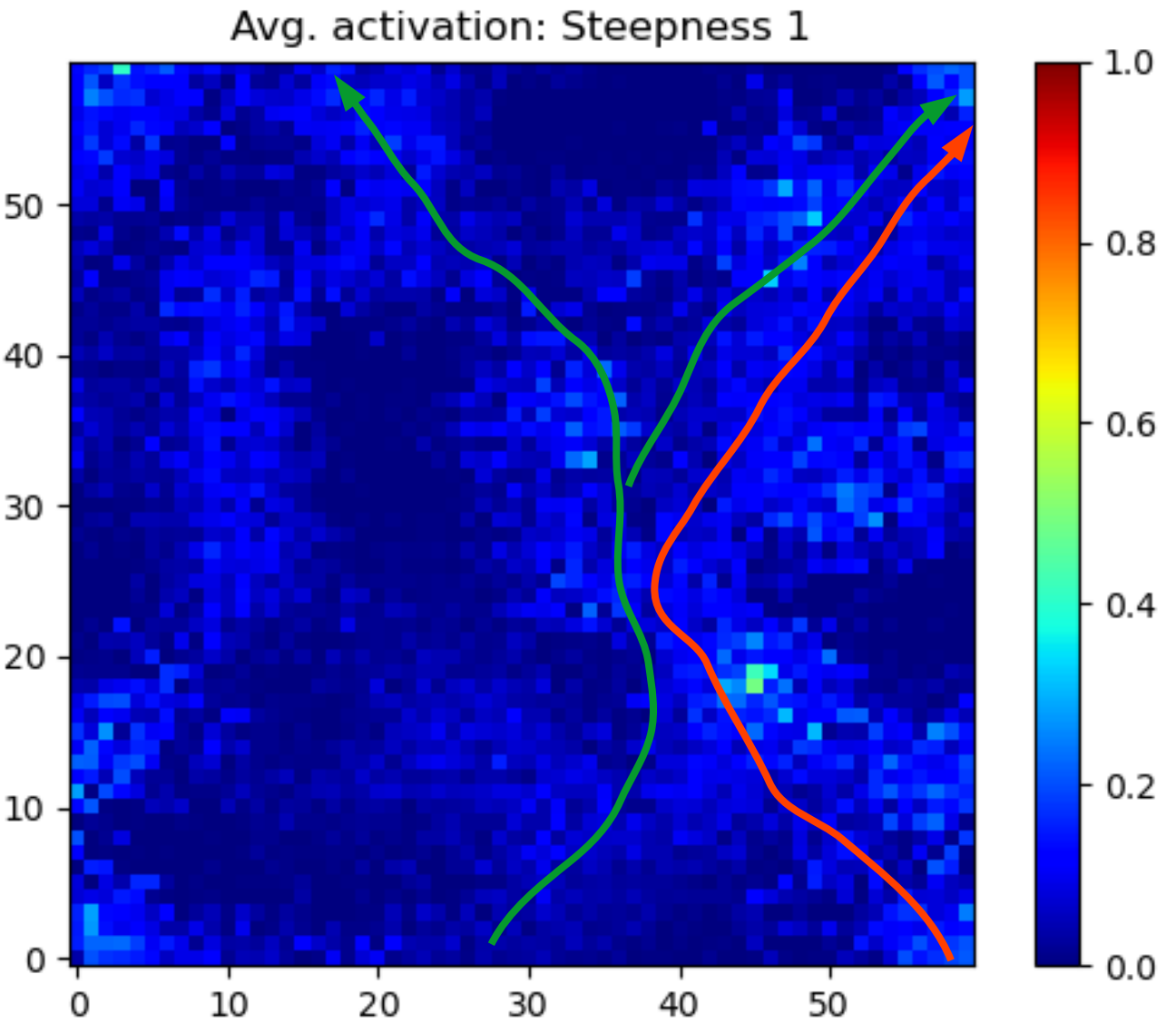
- Perlin scale…
  - … 4 (higher relationship among neurons)
  - … 5 (lower relationship among neurons)
- With J = 2.5 and g = 6



Solid: *main* sequence

Dashed: occasionally occurring sequences


60
50
40
30
20
10
0
0
10
20
30
40
50
60



Solid: *main* sequence

Dashed: occasionally occurring sequences

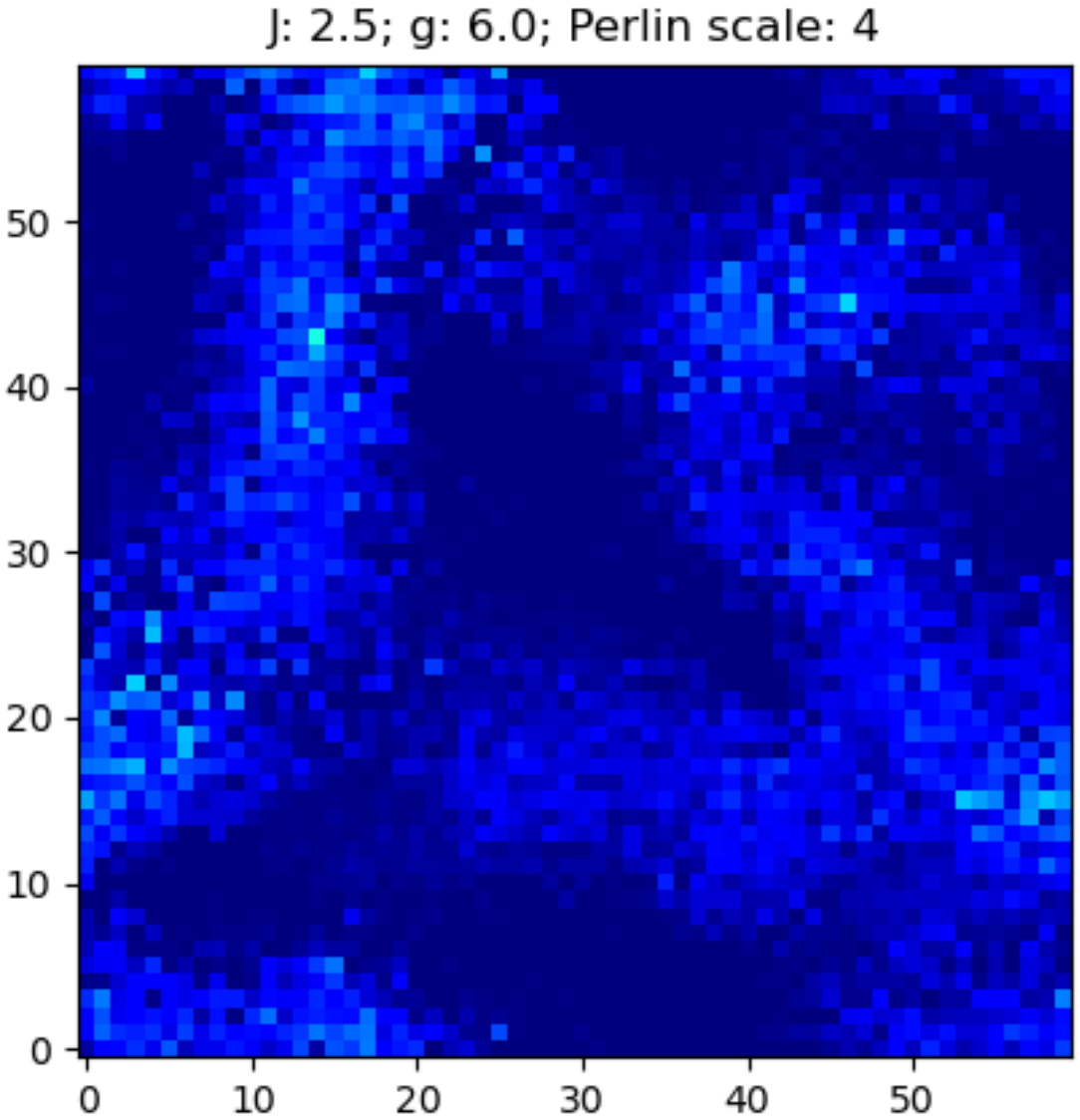
Orange: Main A

Green: Main B

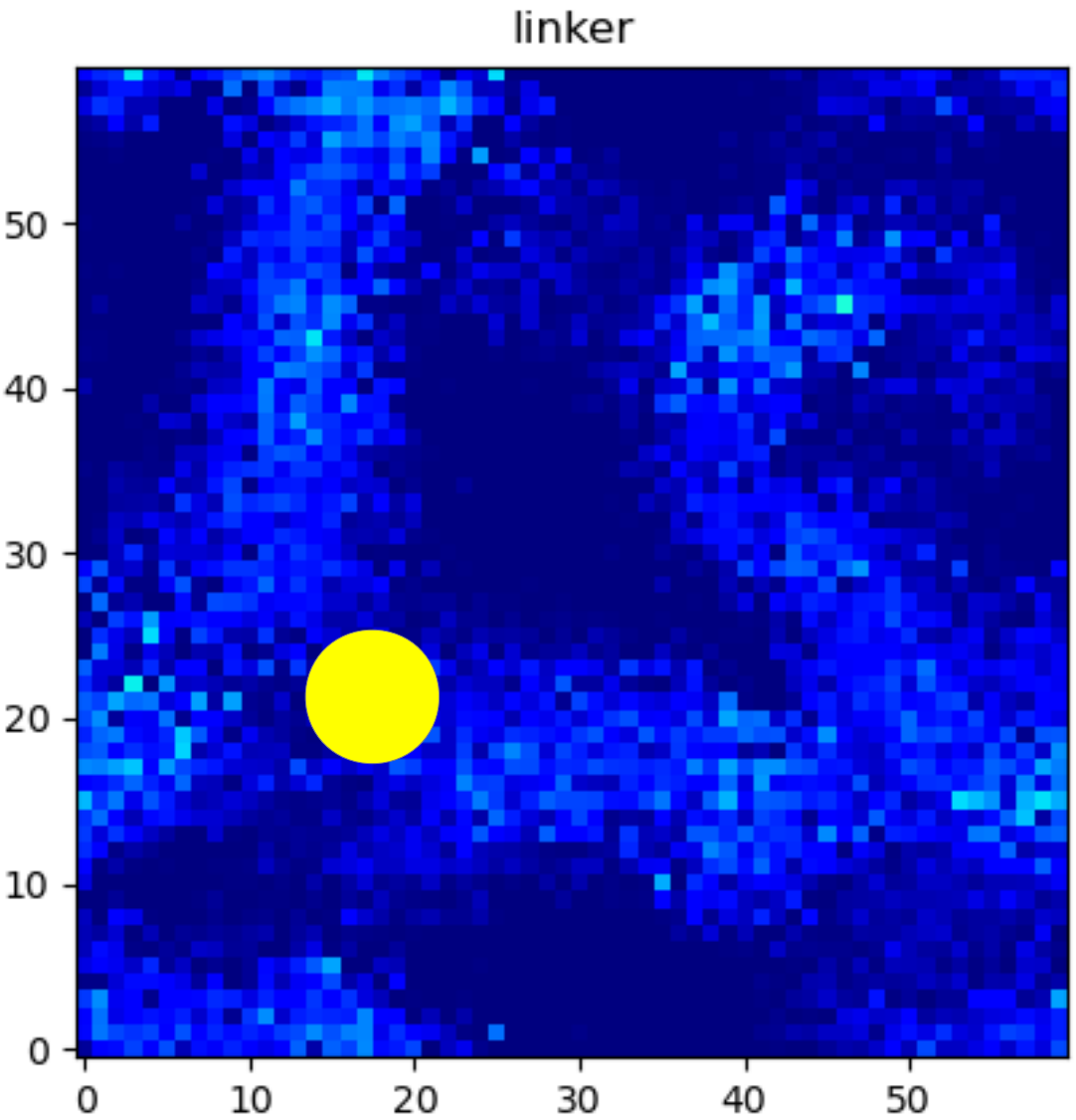
Linker patch

- J = 2.5 and g = 6
- A patch to link/enhance the branch

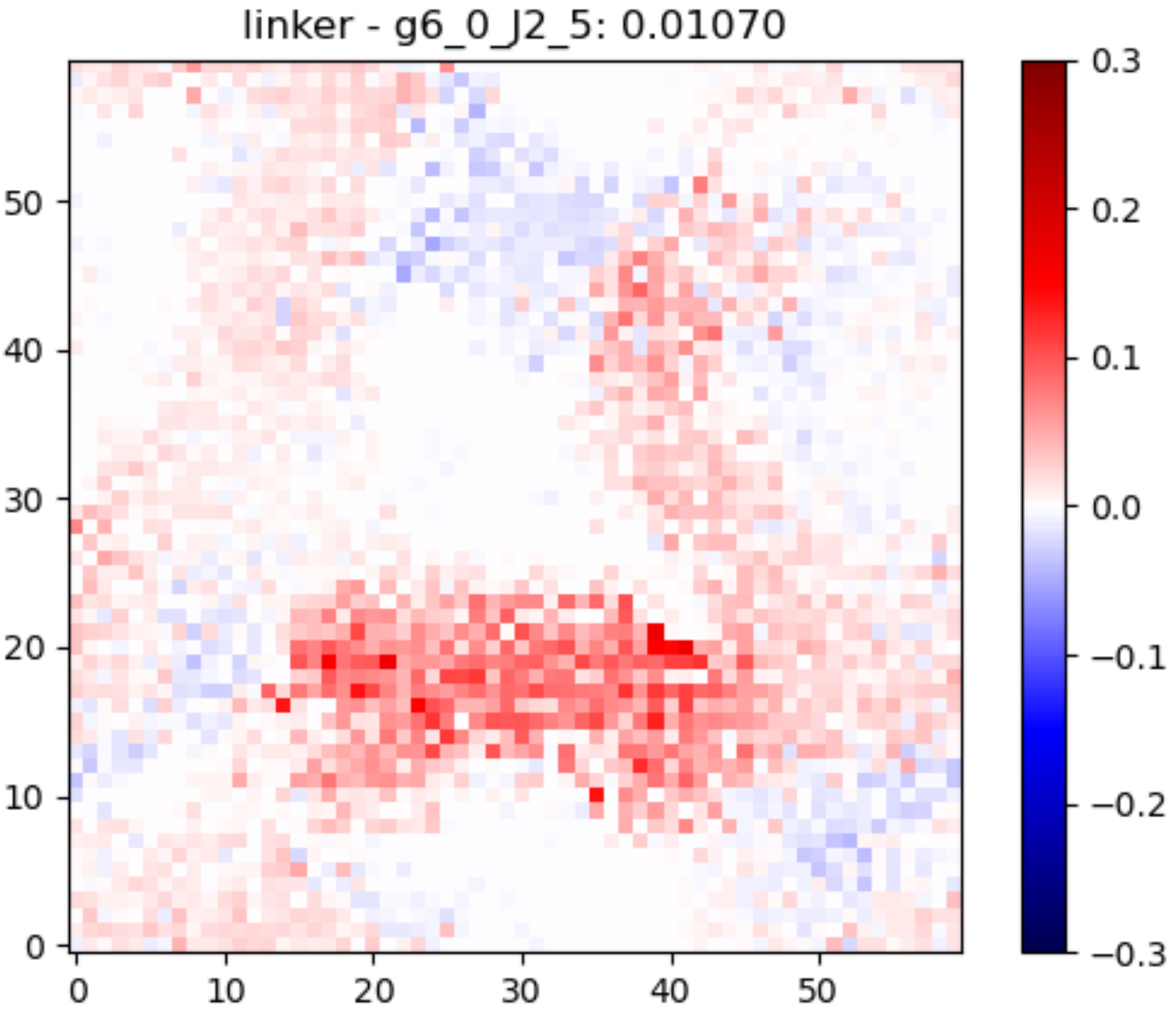
- Results:
  - Much more activation on the branch (activation most of the time → stable activity in that branch)
  - The branch merges to the main sequence at around (45, 18) and leading to a stronger main sequence in general
    - And suppressing a sequence at ~(30, 50) which branches from the left part
    - … but get inhibited stronger from the more activated right sequence.

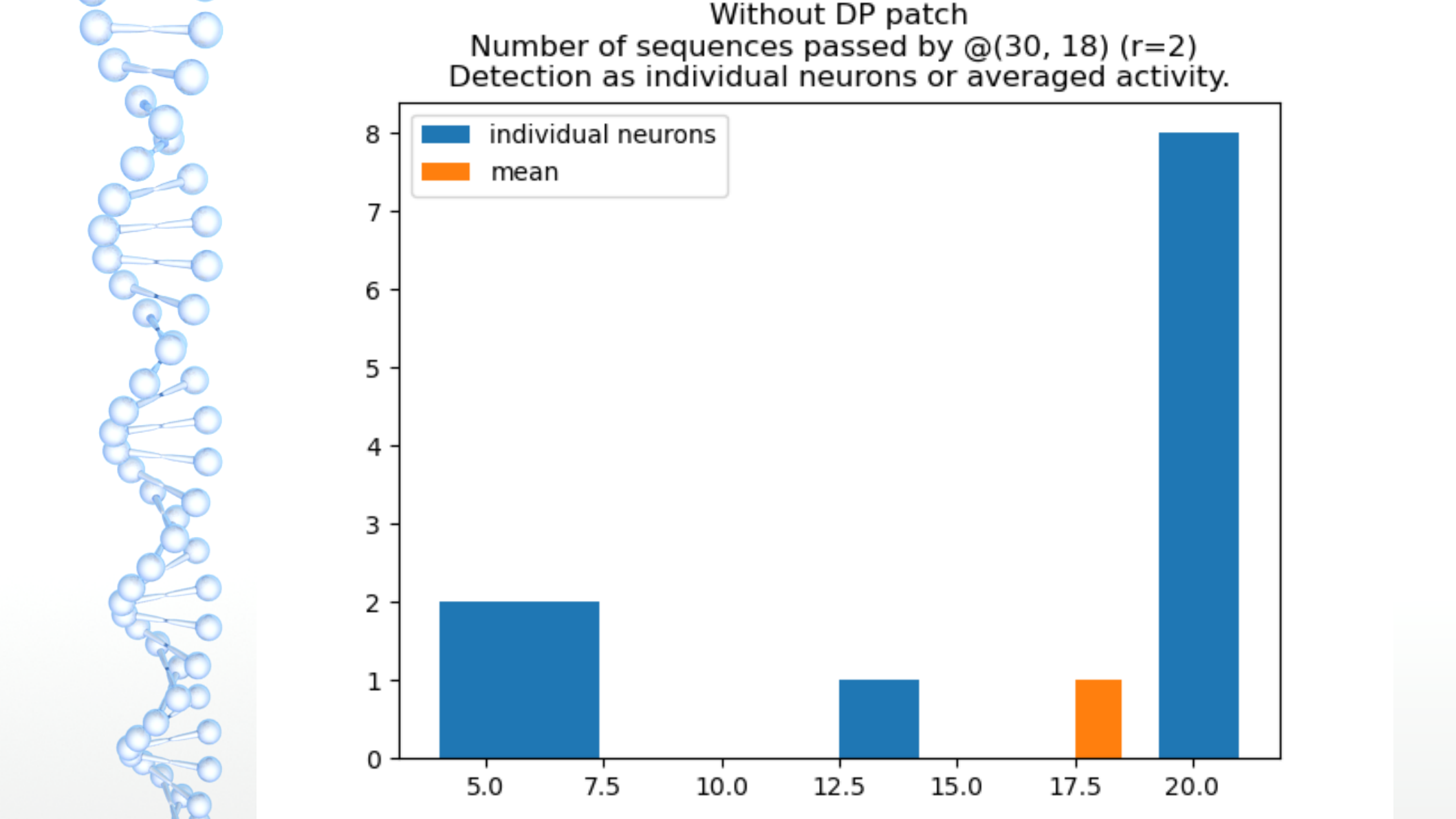

J: 2.5; g: 6.0; Perlin scale: 4
0
10
20
30
40
50
0
10
20
30
40
50
1.0
0.8
0.6
0.4
0.2
0.0

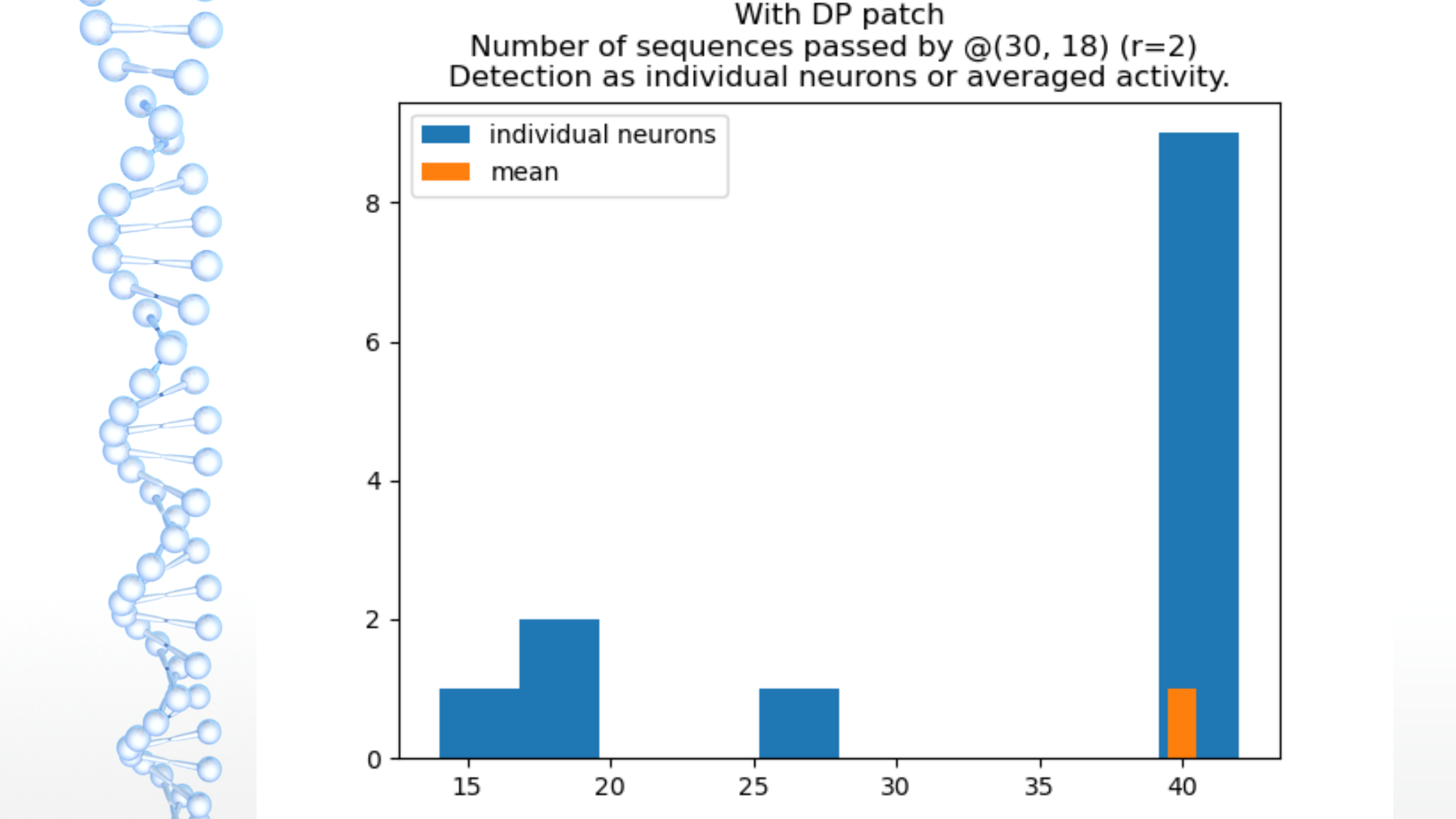
Baseline

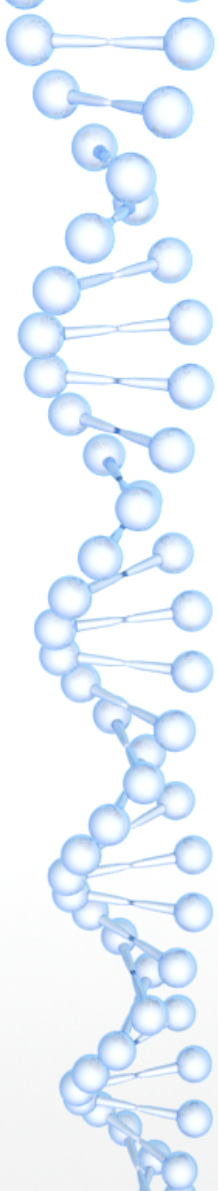


Patch at (18, 20)
with r=4

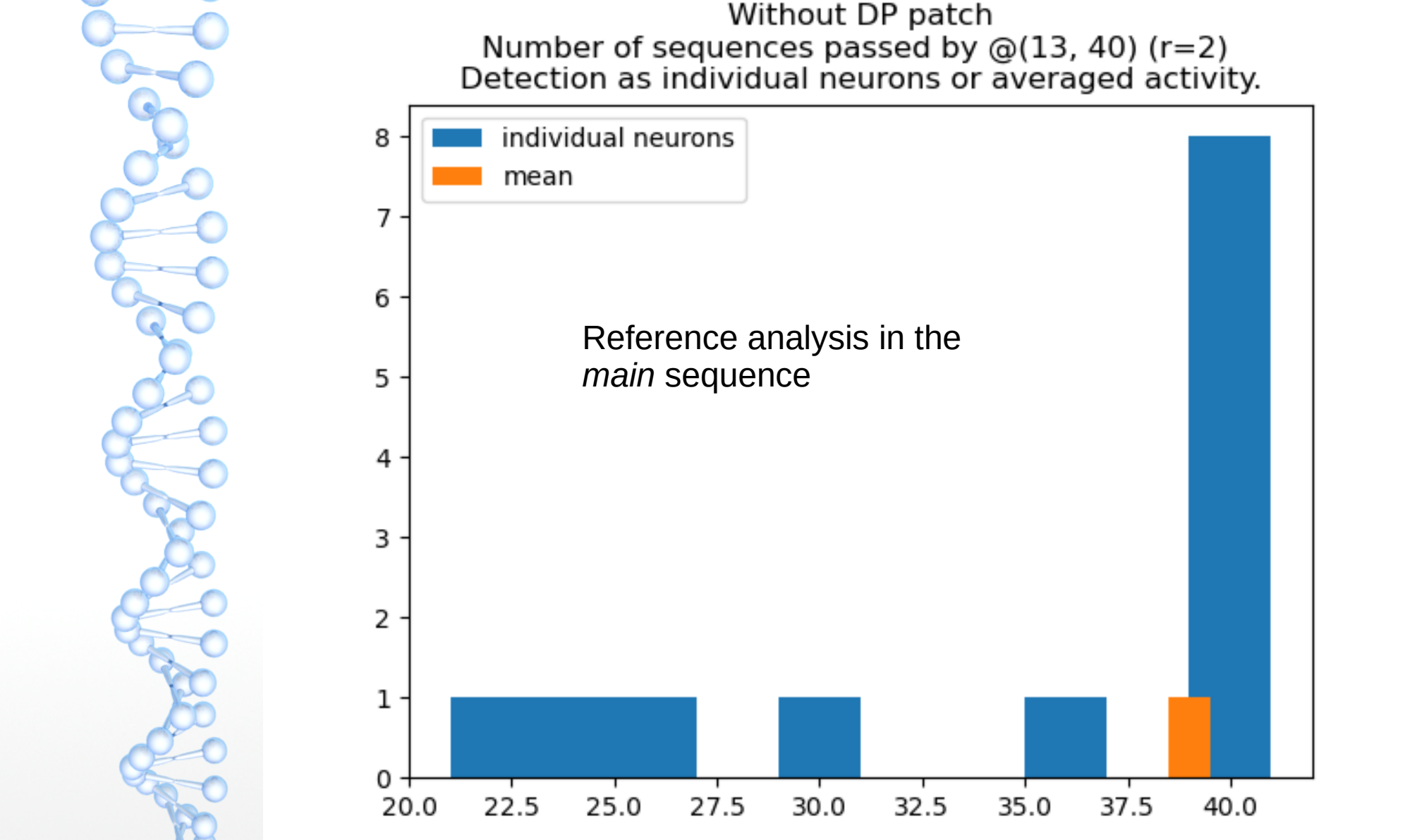

linker - g6_0_J2_5: 0.01070
0
10
20
30
40
50
0.3
0.2
0.1
0.0
−0.1
−0.2
−0.3

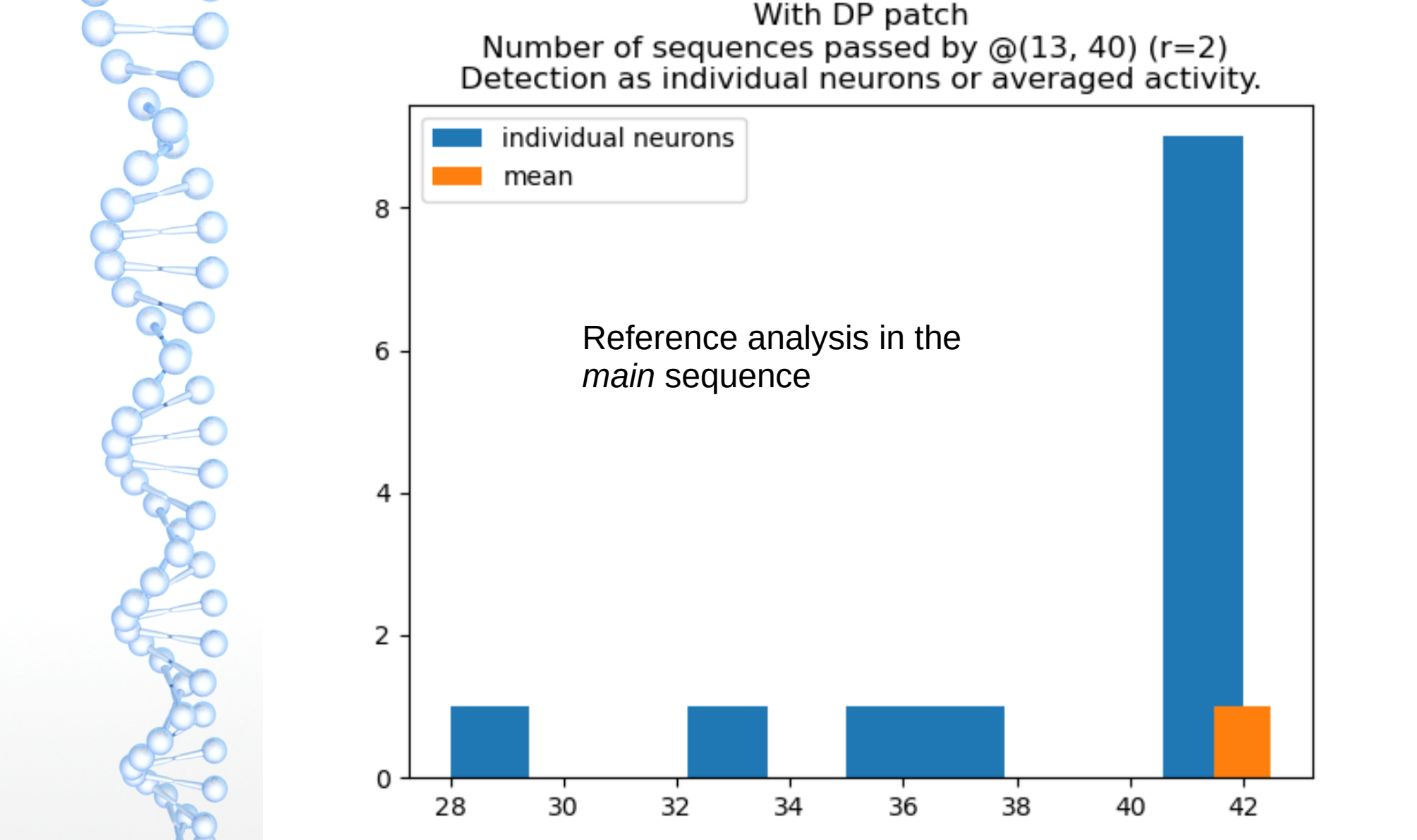

Without DP patch
Number of sequences passed by @(30, 18) (r=2)
Detection as individual neurons or averaged activity.
individual neurons
mean
0
1
2
3
4
5
6
7
8
5.0
7.5
10.0
12.5
15.0
17.5
20.0


With DP patch
Number of sequences passed by @(30, 18) (r=2)
Detection as individual neurons or averaged activity.
individual neurons
mean
0
2
4
6
8
15
20
25
30
35
40



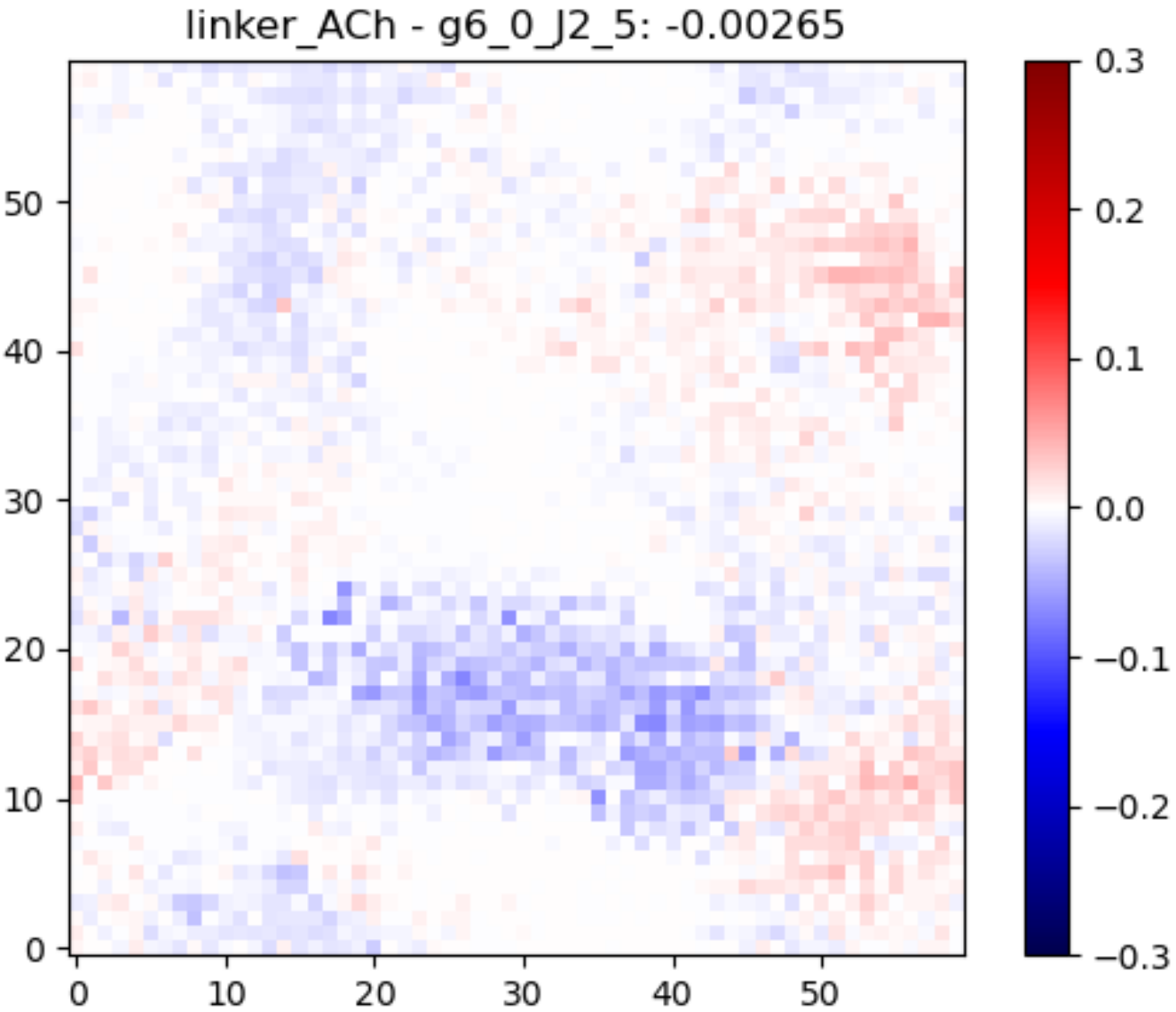
Reference of the “baseline”

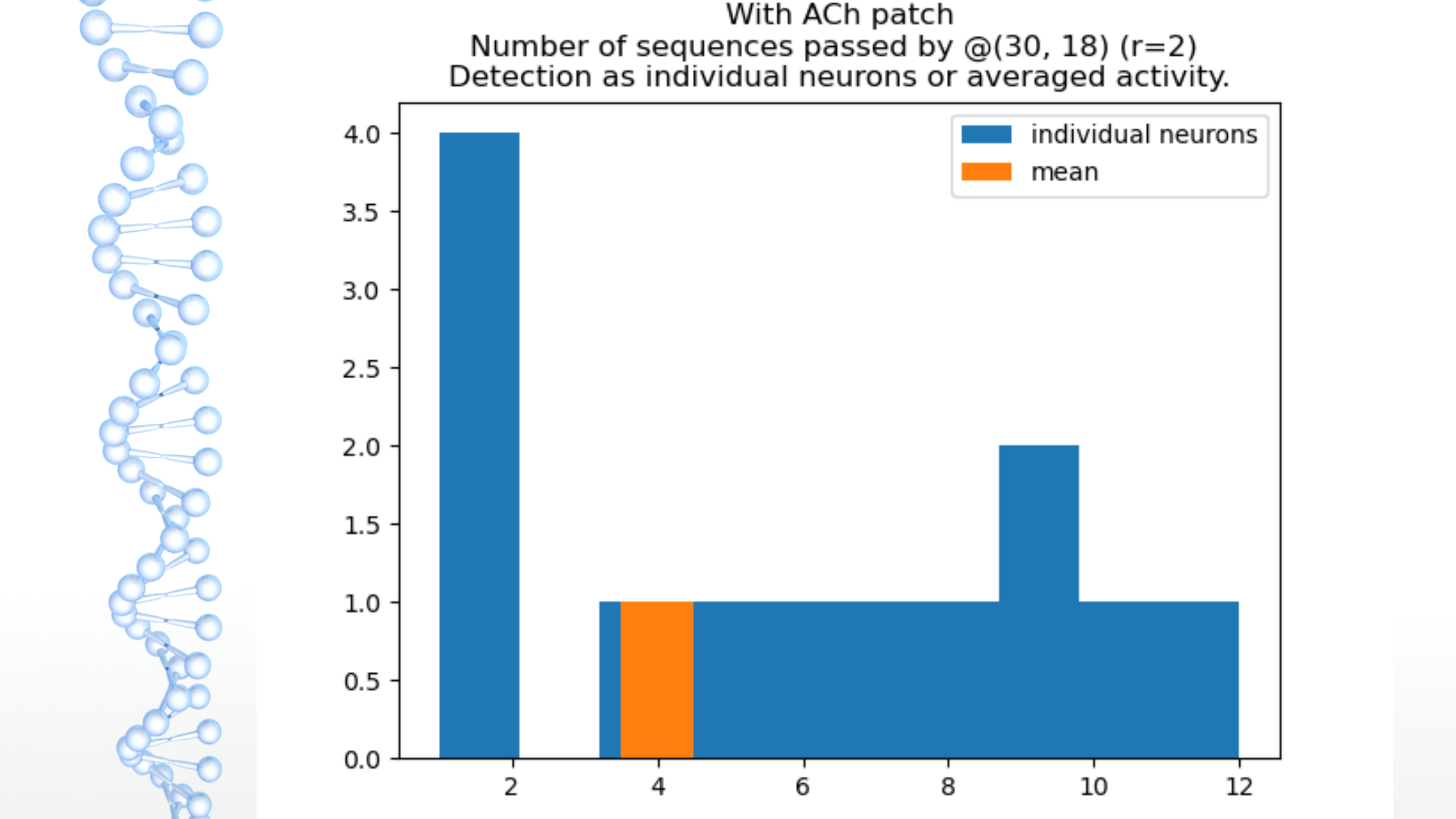

Without DP patch
Number of sequences passed by @(13, 40) (r=2)
Detection as individual neurons or averaged activity.
individual neurons
mean
Reference analysis in the
main sequence
0
1
2
3
4
5
6
7
8
20.0
22.5
25.0
27.5
30.0
32.5
35.0
37.5
40.0


With DP patch
Number of sequences passed by @(13, 40) (r=2)
Detection as individual neurons or averaged activity.
individual neurons
mean
Reference analysis in the
main sequence
0
2
4
6
8
28
30
32
34
36
38
40
42

ACh patch

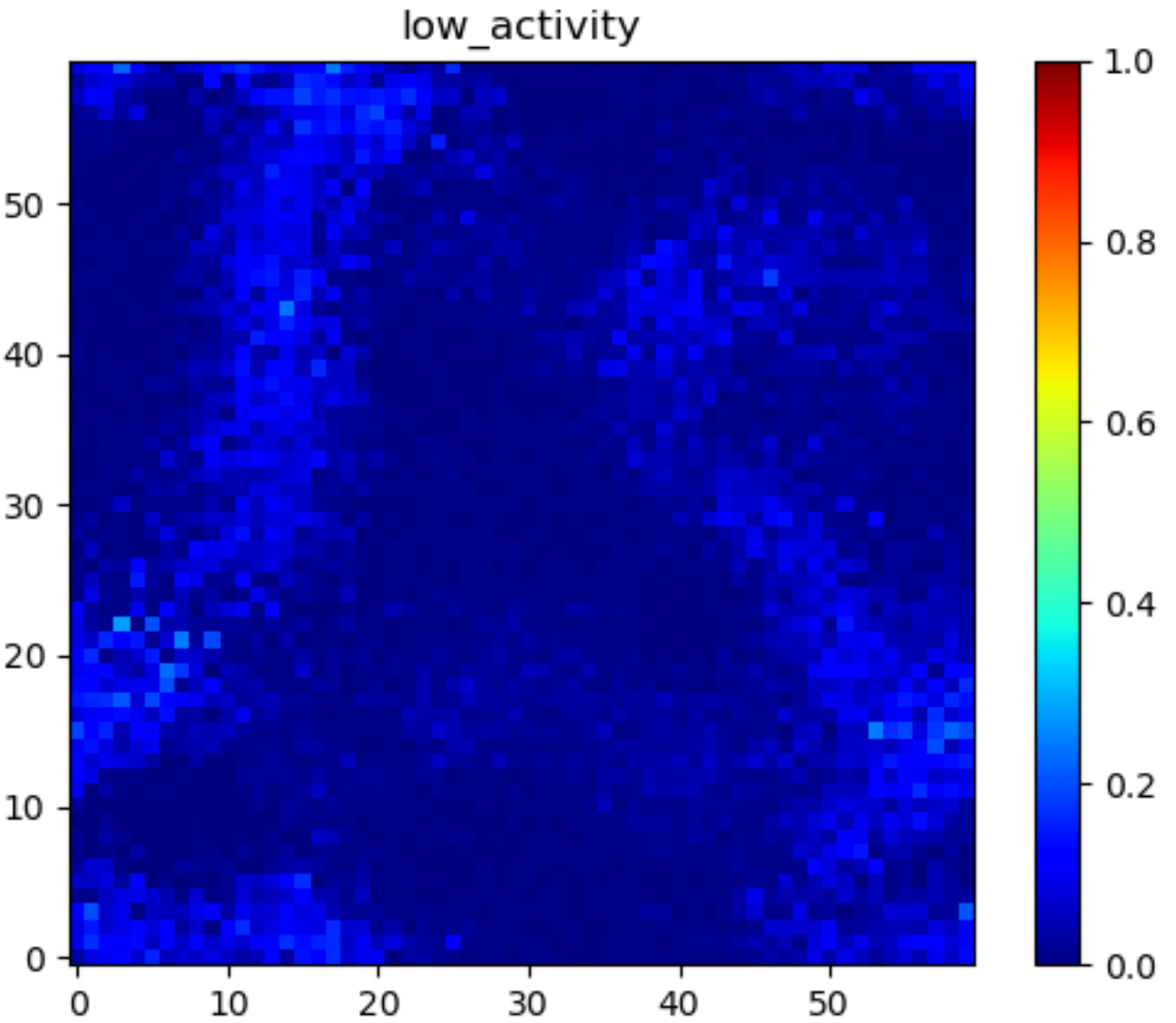
- Reducing the syn. weights by 20%
- Effectively reducing the transmission in a branch


linker_ACh - g6_0_J2_5: -0.00265
0
10
20
30
40
50
0.3
0.2
0.1
0.0
−0.1
−0.2
−0.3

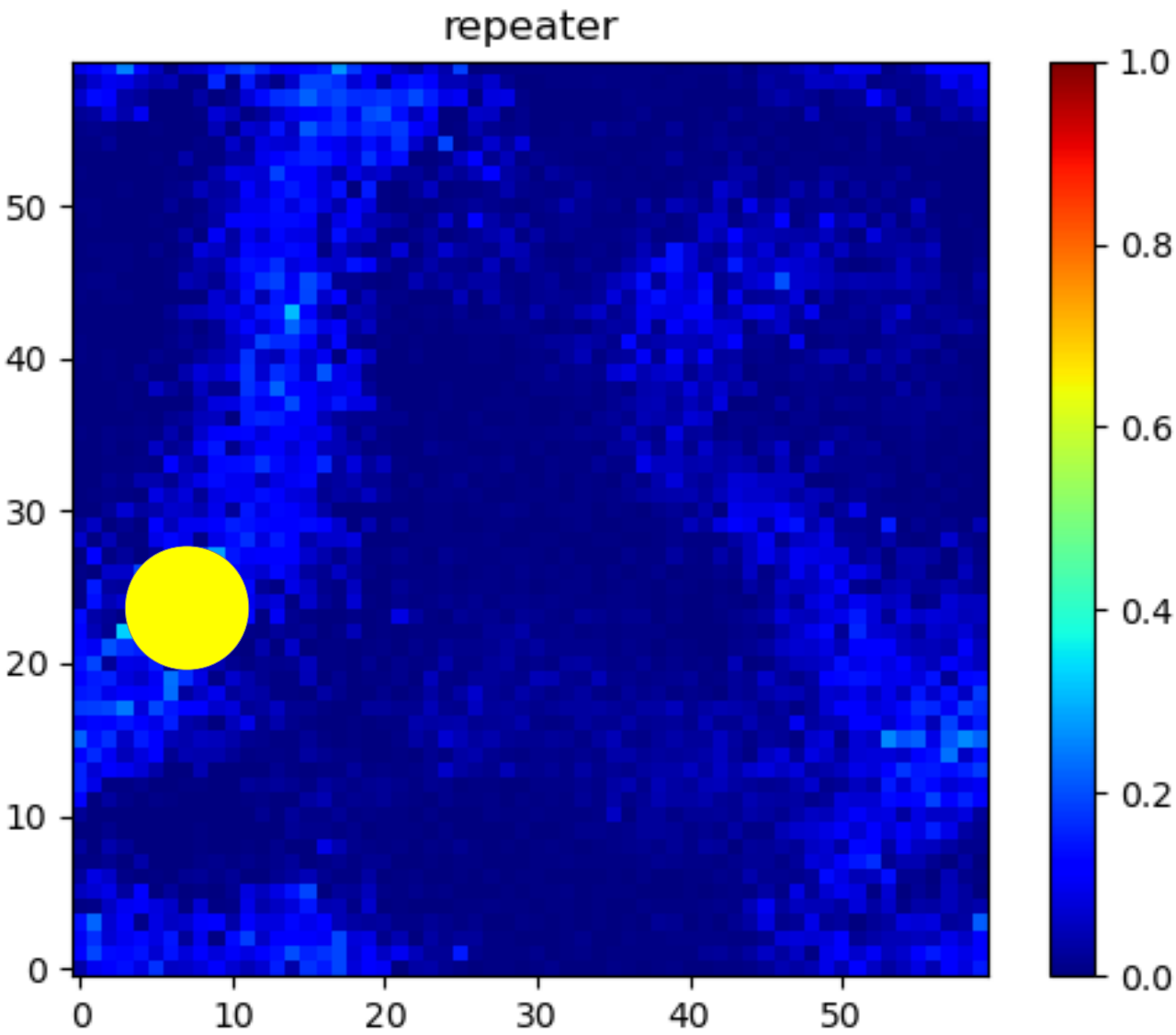

With ACh patch
Number of sequences passed by @(30, 18) (r=2)
Detection as individual neurons or averaged activity.
individual neurons
mean
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
2
4
6
8
10
12

Dopamine as repeater

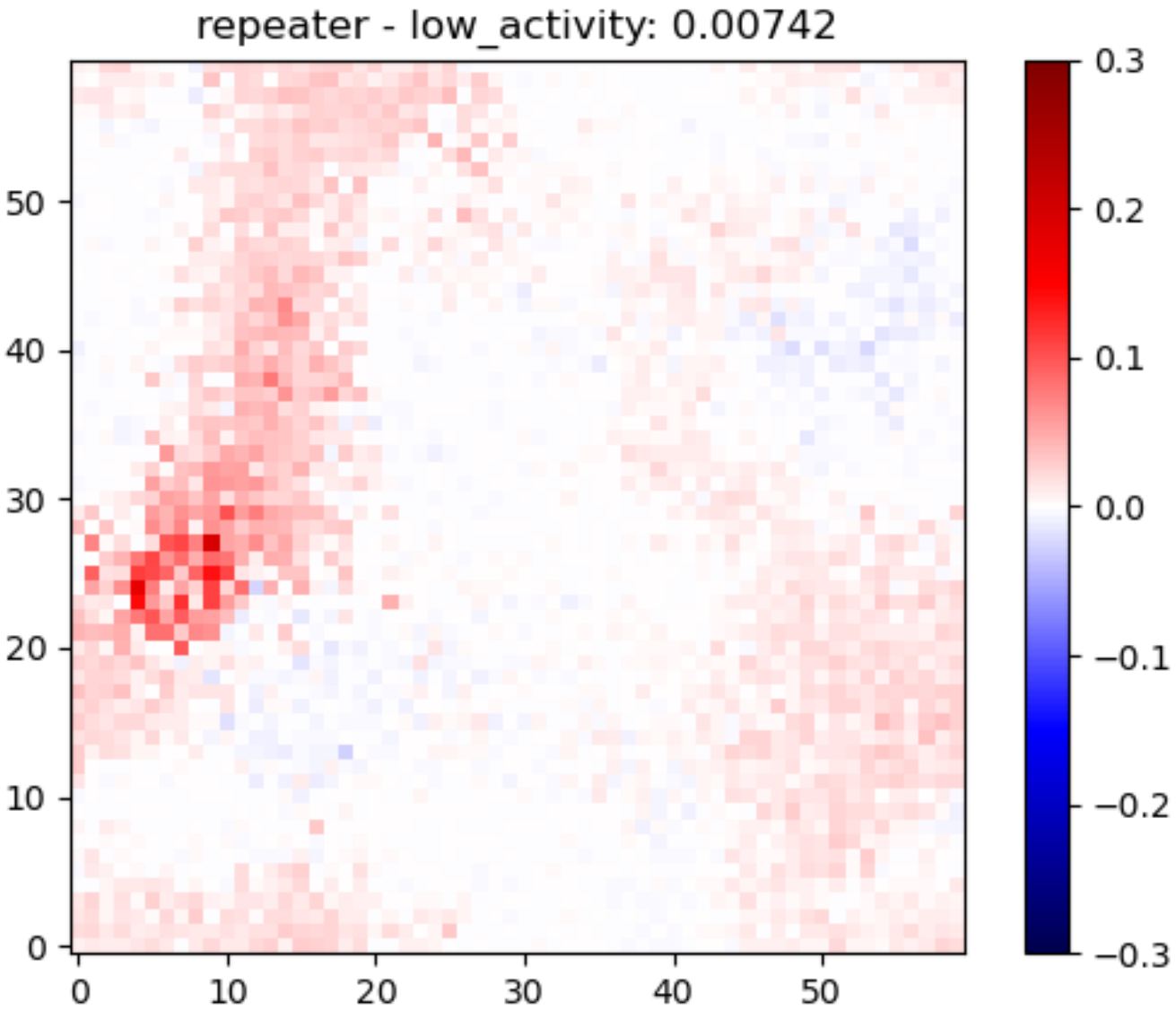
- Using a lower J, and a higher external drive (mean of two instead of zero) → main is fading sometimes
  - Lower avg. activation of the main (slide 51 against slide 52)
  - The higher J (if the main is active once, it is active throughout the simulation, as in the previous *linker* slides) as reference for an active main sequence (slide 56)
  - Low activity → lower number of sequences in the main path (slide 54)
  - Repeater patch → re-activate the stability of the main path resulting in more sequences passing by again (slide 55)

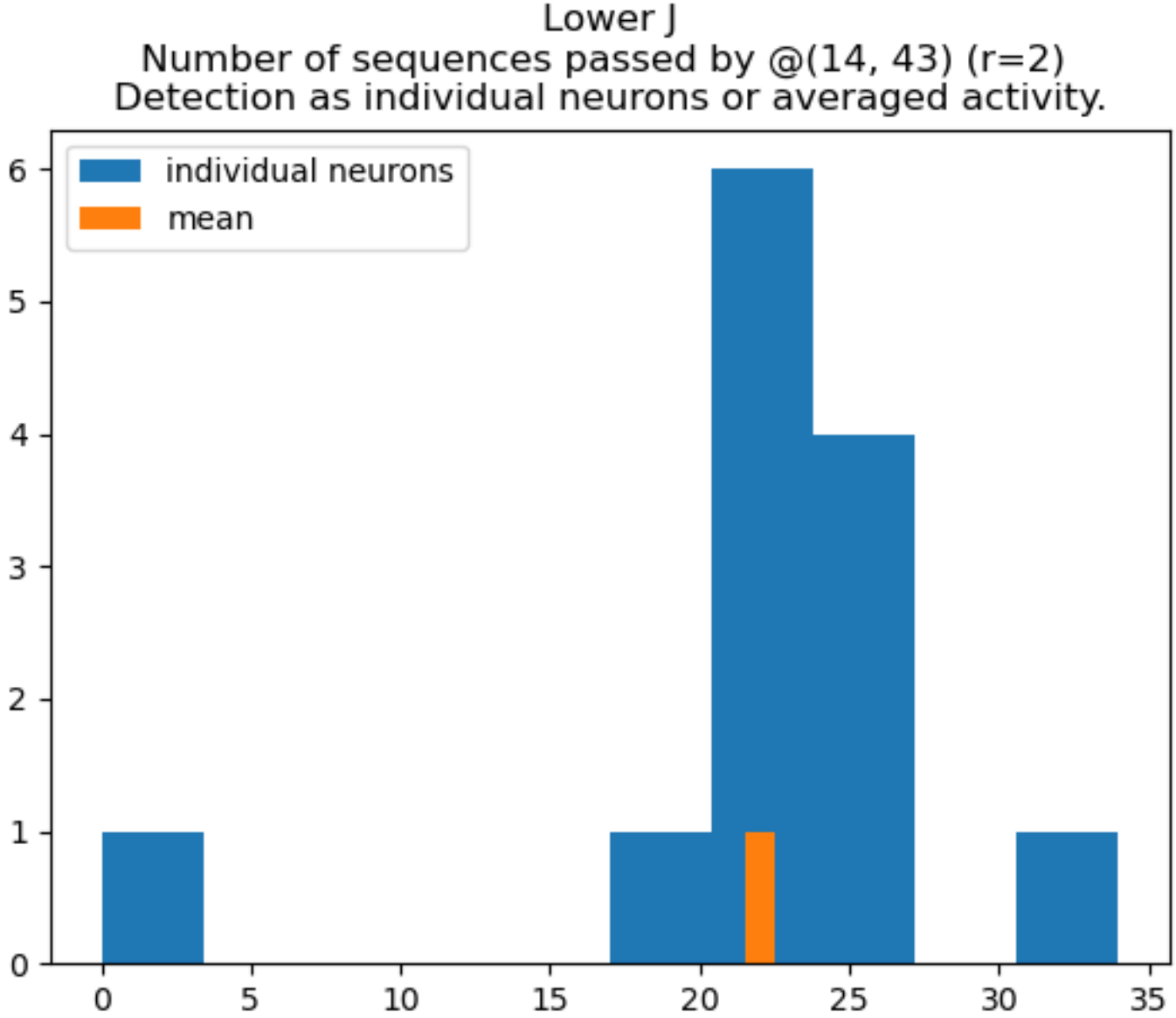


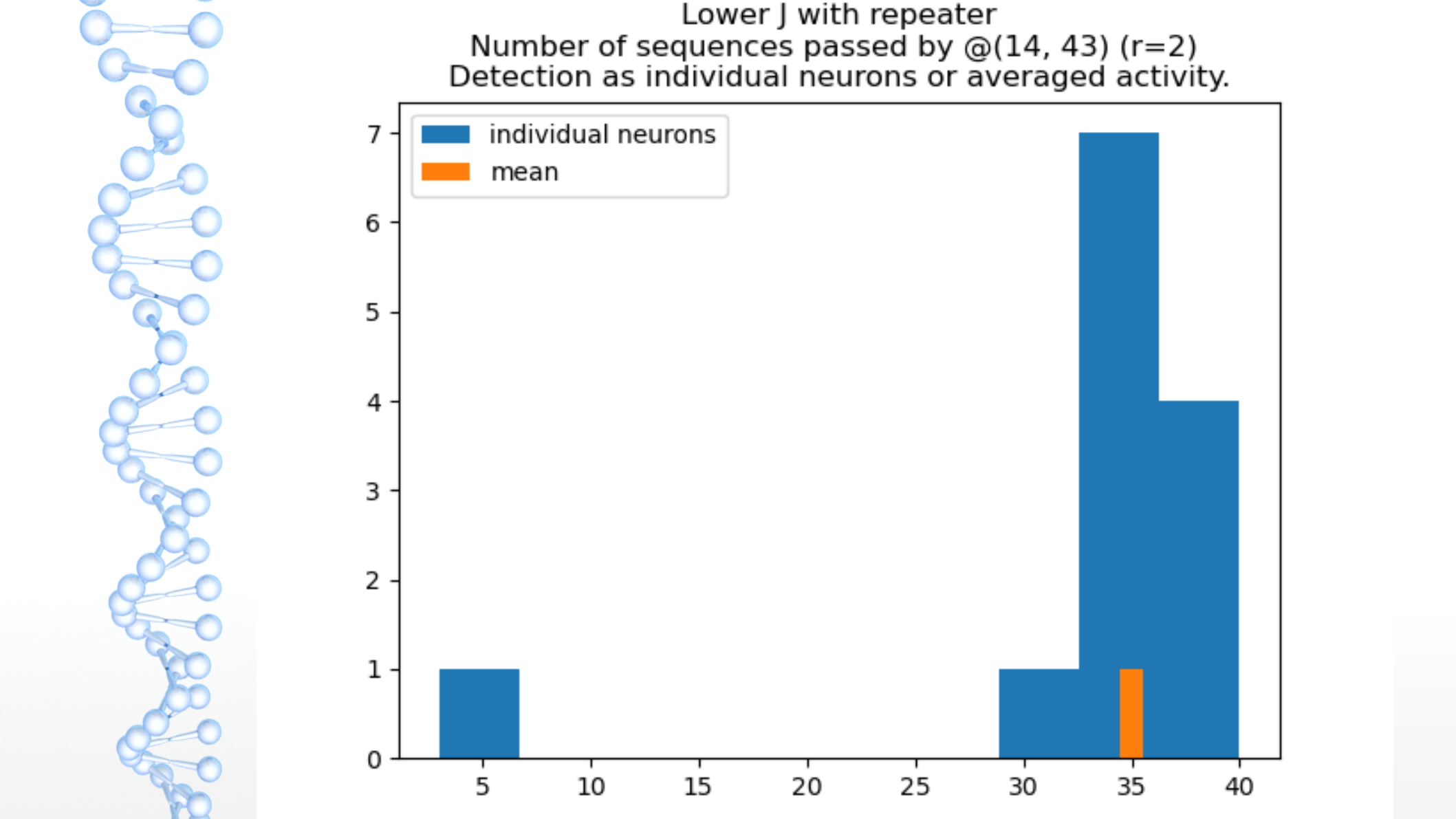
Baseline

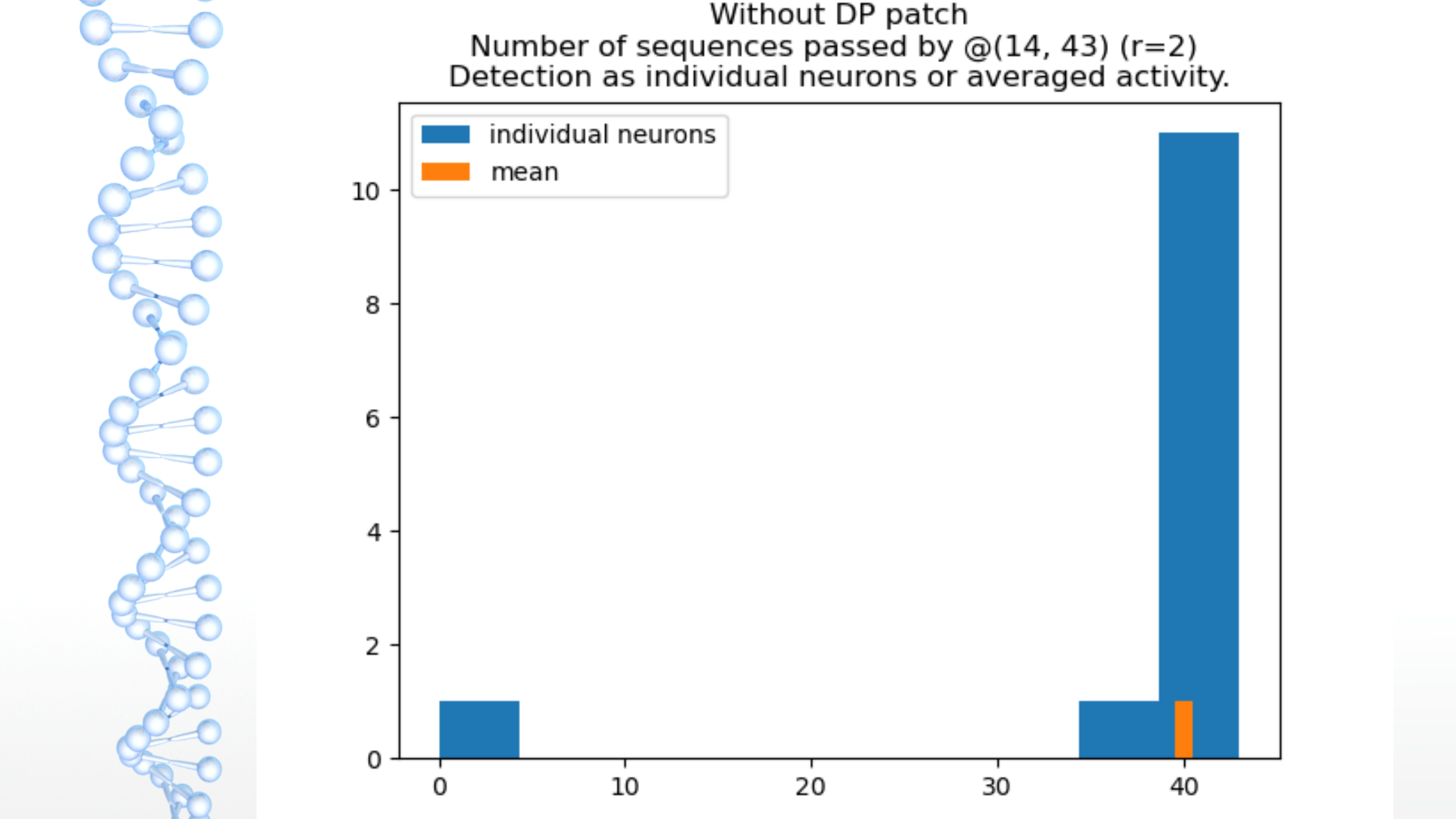


Patch at (7, 24)
with r=4


repeater - low_activity: 0.00742
0
10
20
30
40
50
0.3
0.2
0.1
0.0
−0.1
−0.2
−0.3


Lower J
Number of sequences passed by @(14, 43) (r=2)
Detection as individual neurons or averaged activity.
individual neurons
mean
0
1
2
3
4
5
6
0
5
10
15
20
25
30
35


Lower J with repeater
Number of sequences passed by @(14, 43) (r=2)
Detection as individual neurons or averaged activity.
individual neurons
mean
0
1
2
3
4
5
6
7
5
10
15
20
25
30
35
40


Without DP patch
Number of sequences passed by @(14, 43) (r=2)
Detection as individual neurons or averaged activity.
individual neurons
mean
0
2
4
6
8
10
0
10
20
30
40