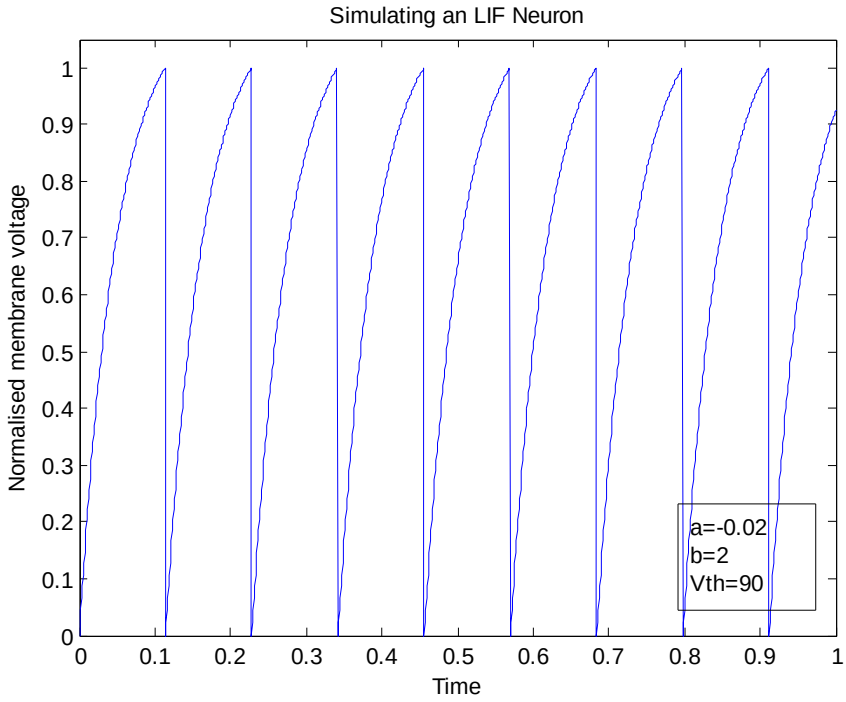
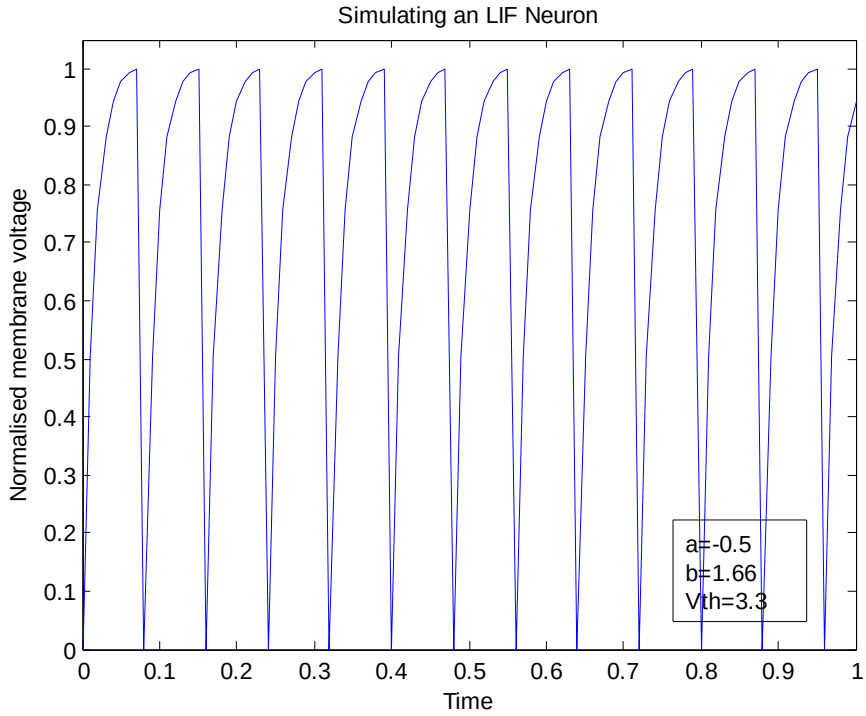
REPORT

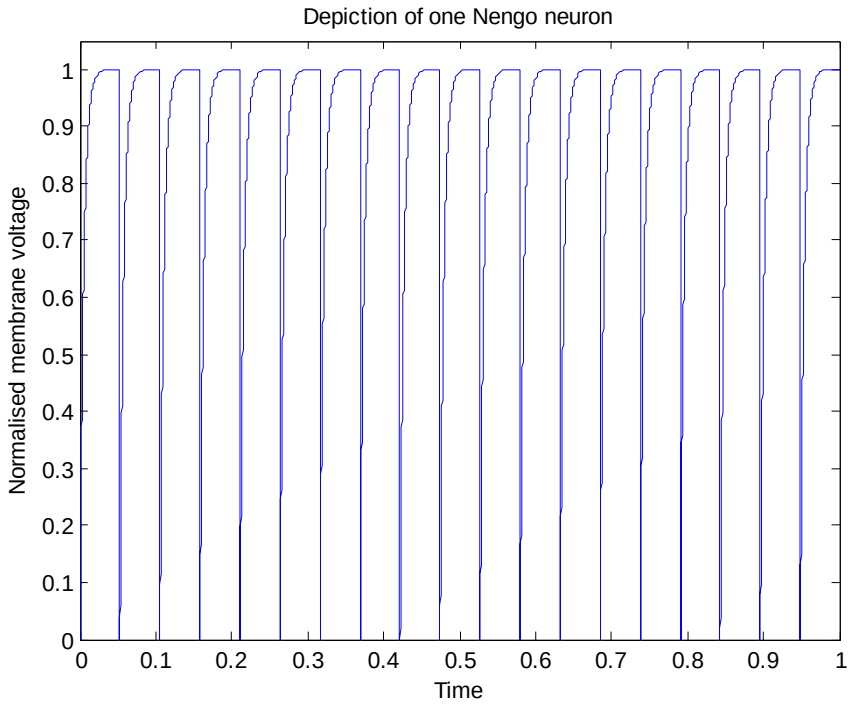
An LIF Neuron

Simulating an LIF Neuron in Matlab

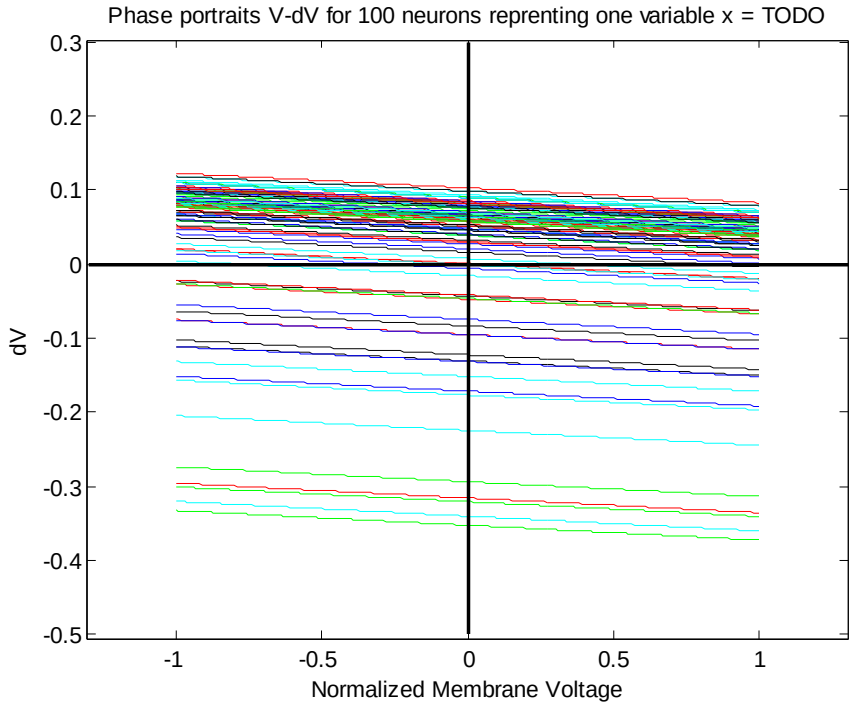




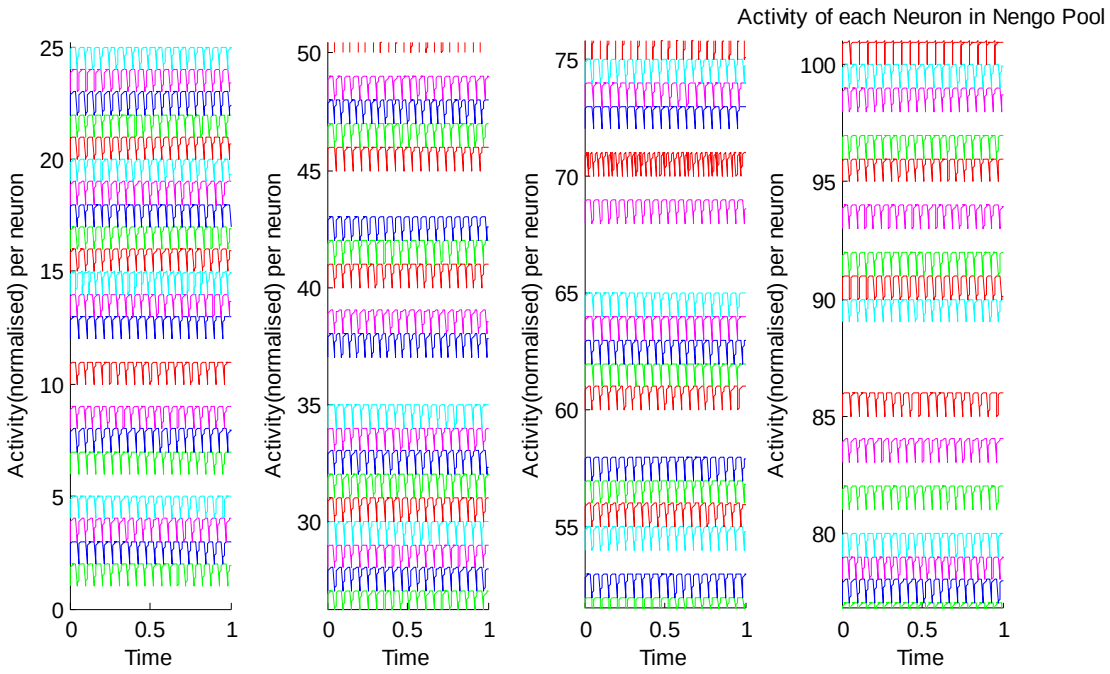
A Nengo LIF neuron using actual parameter values



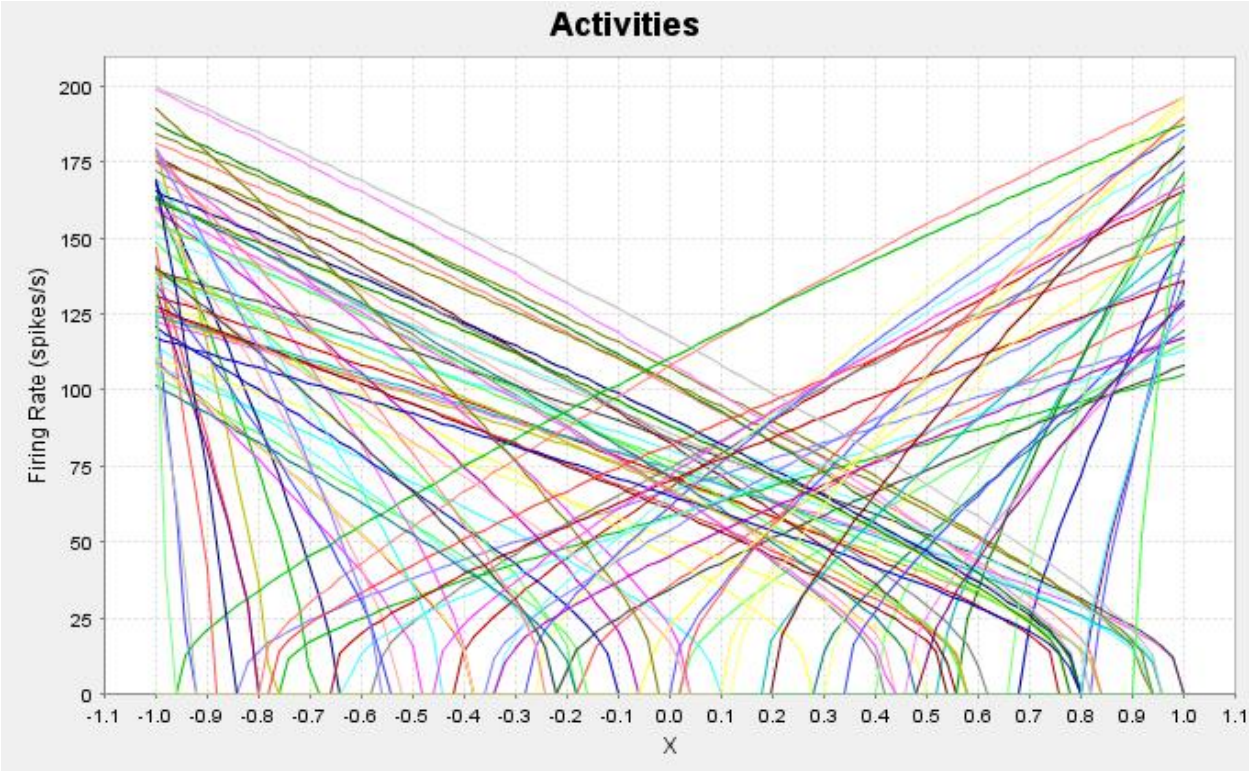
Phase portrait of a pool of 100 Nengo Neurons



Activity of all neurons in a Nengo pool



Firing rates of all neurons in a Nengo Pool



3X3 Matrix Multiplication through Nengo

Matrix A

A= Input Matrix

Order: 3 X 3

0.5	0	1
0	1	0.4
0.5	0.5	0

Matrix B

B=Input Matrix

Order: 3X3

0.4	1	0
0	0.4	1
0.5	0	0

Matrix R: Stores result

R = A * B

Order: 3 X 3

0.7	0.5	0
0.2	0.4	1
0.4	0.7	0.5

These are the expected values after multiplication.

PARAMETER VALUES USED:

TauPSC: 100 ms

TauRef= 2 ms

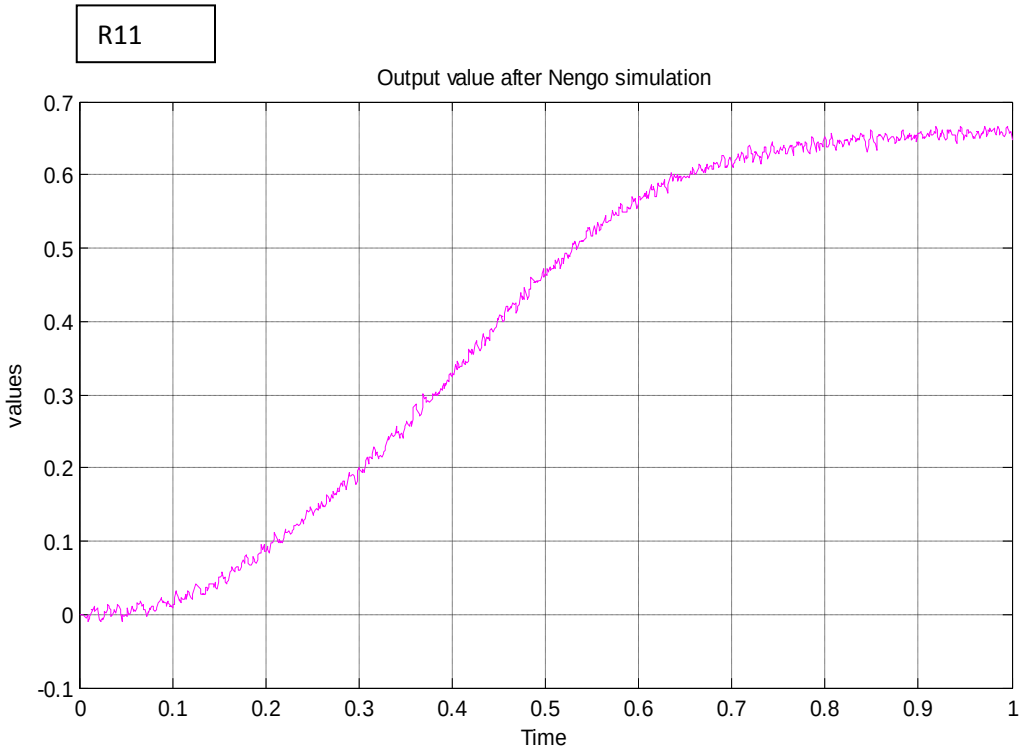
TauRC= 20 ms

Number of neurons in each pool: 100

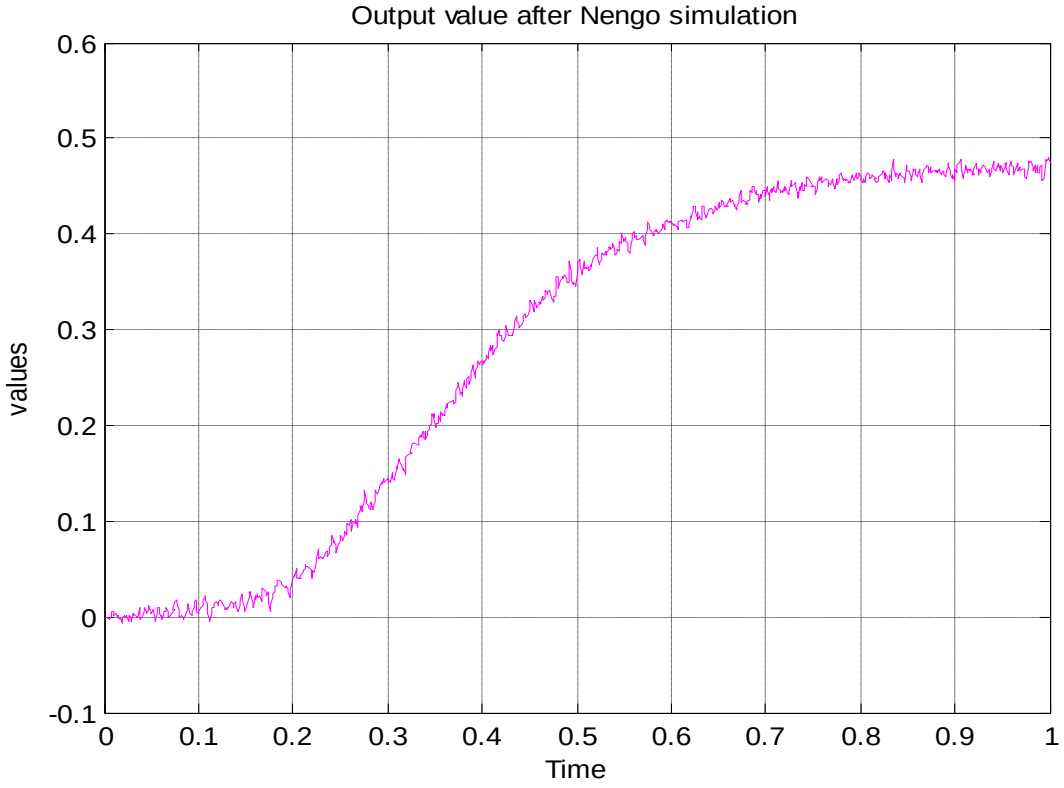
Filter = 0.02

Simulation for: 0 to 1 sec, timestep: 0.001

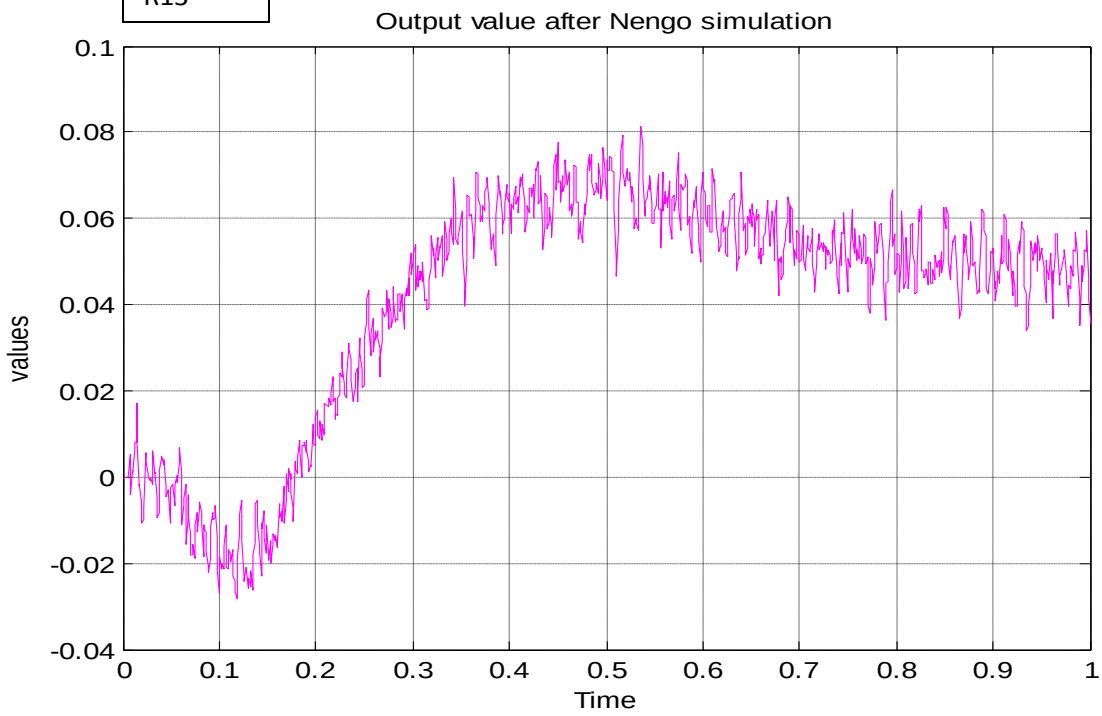
OBTAINED OUTPUT OF MULTIPLICATION

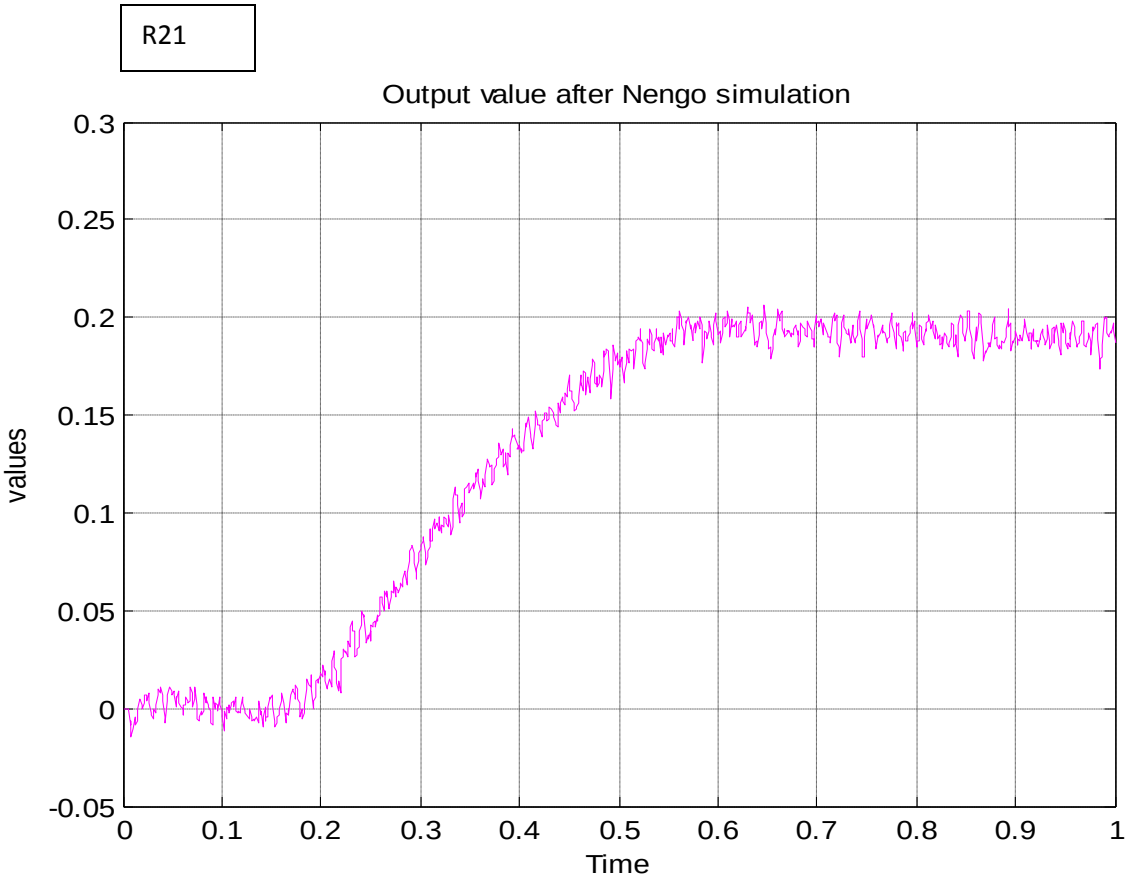


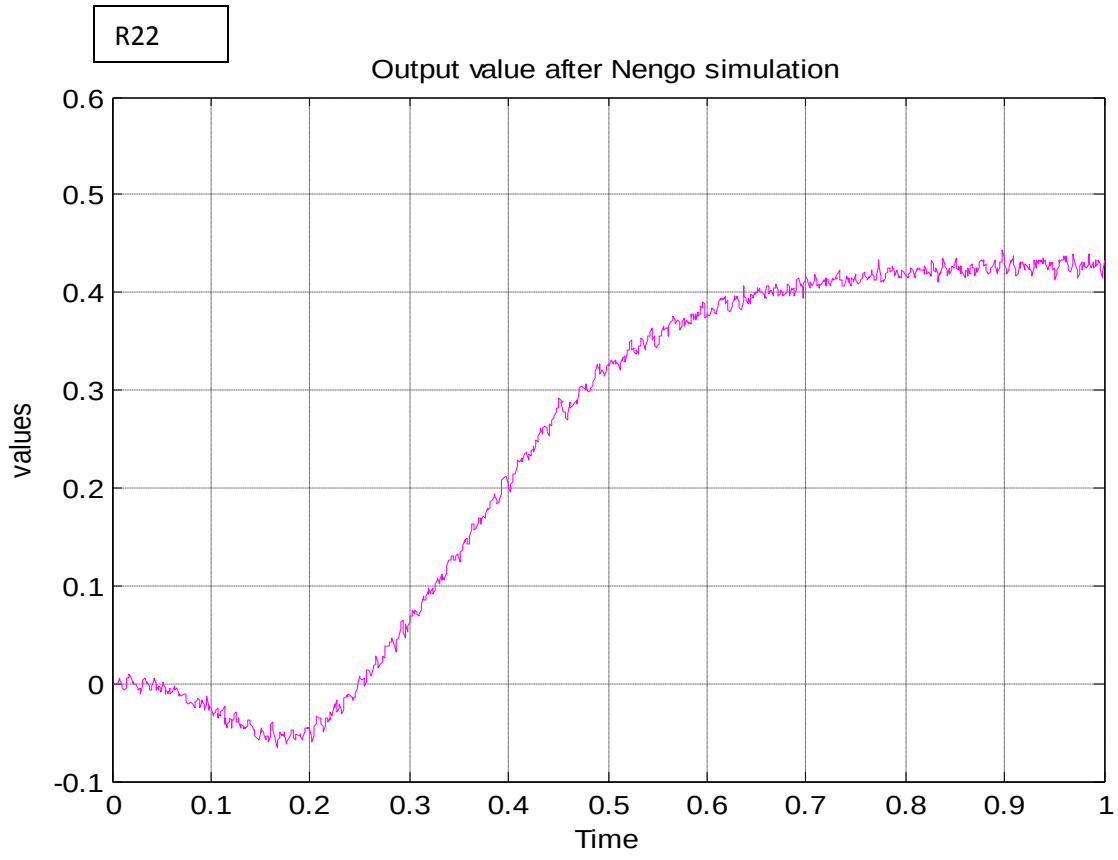
R12:


Output value after Nengo simulation
values
Time
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

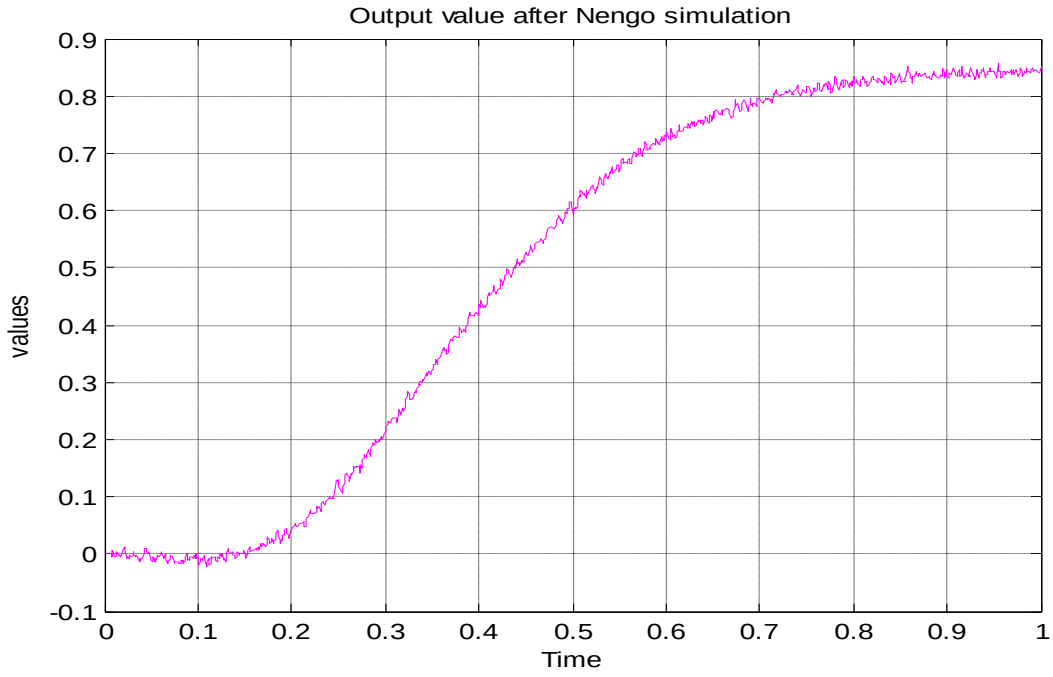
R13


Output value after Nengo simulation
values
Time
0.1
0.08
0.06
0.04
0.02
0
-0.02
-0.04
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

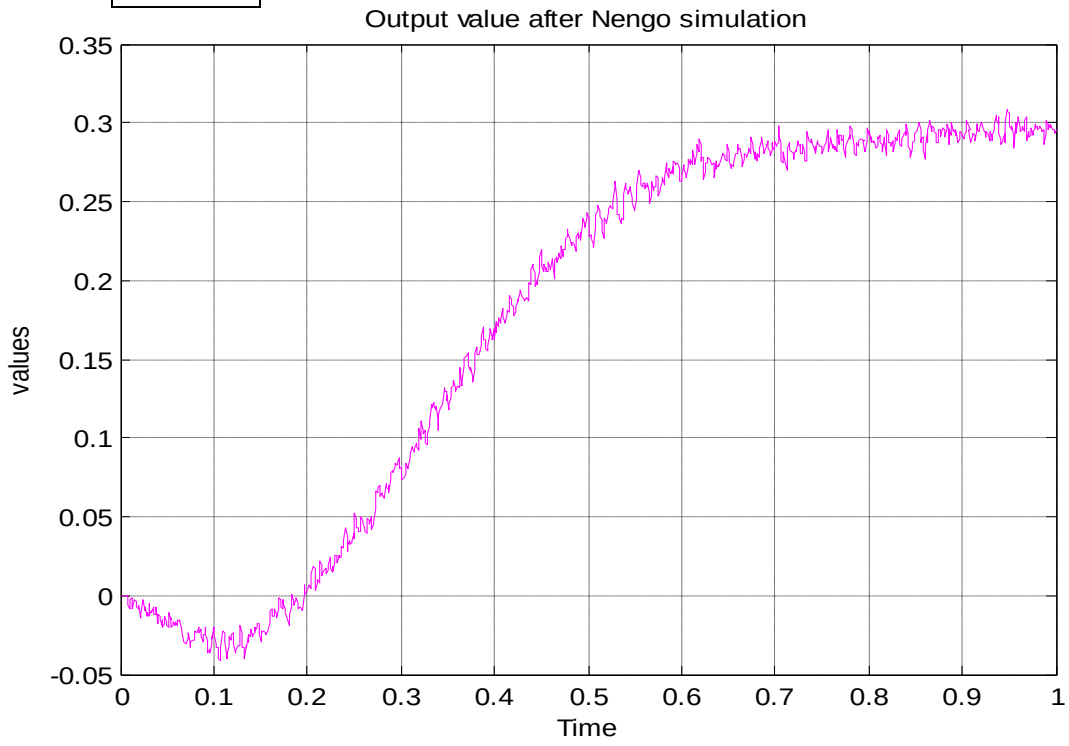

R21
Output value after Nengo simulation
values
Time
0.3
0.25
0.2
0.15
0.1
0.05
0
-0.05
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1


R22
Output value after Nengo simulation
values
Time
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

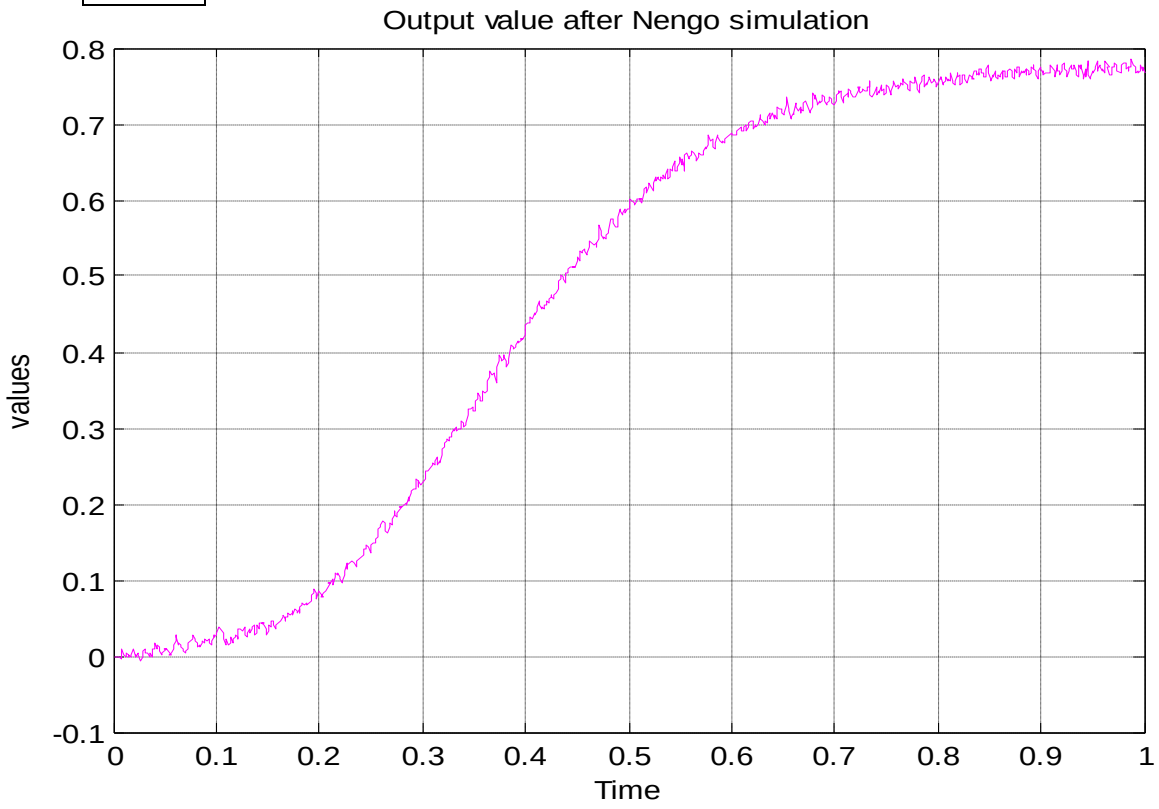
R23


Output value after Nengo simulation
values
Time
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

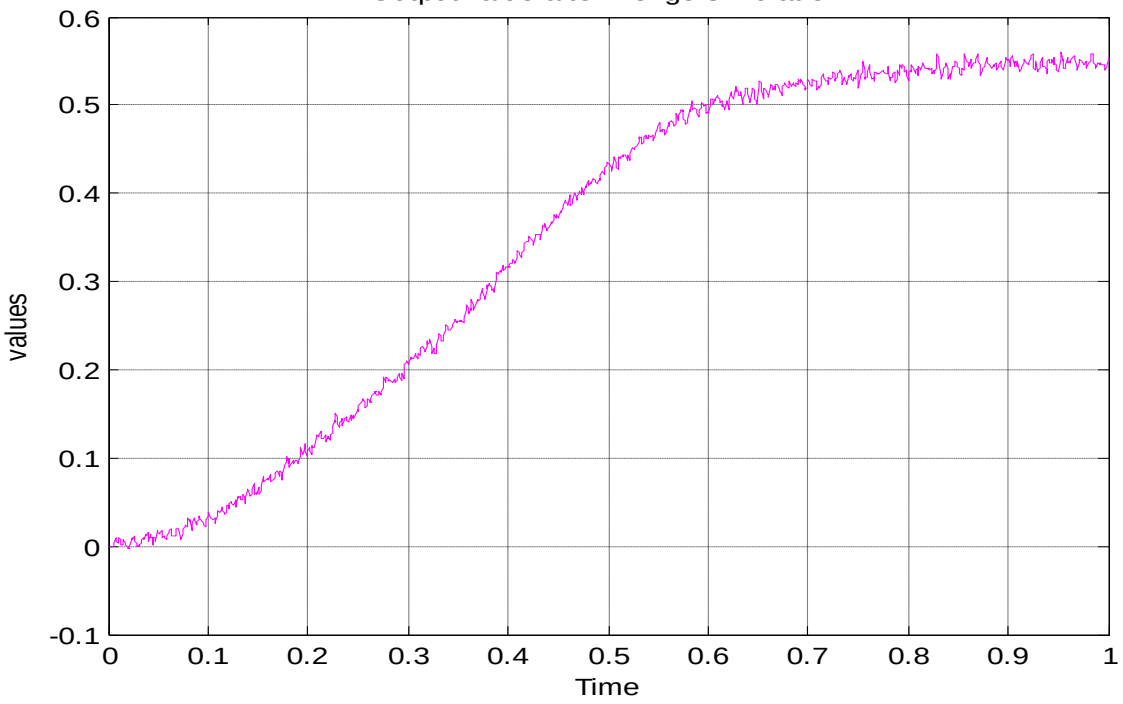
R31


Output value after Nengo simulation
values
Time
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
-0.05
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

R32


Output value after Nengo simulation
values
Time
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

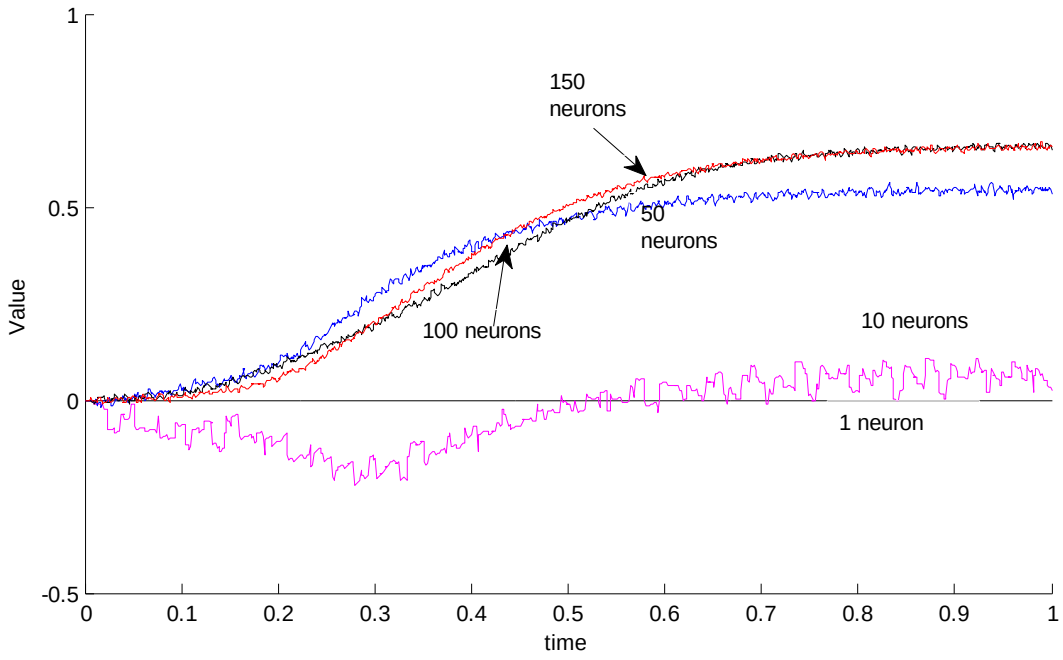
R33


Output value after Nengo simulation
values
Time
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

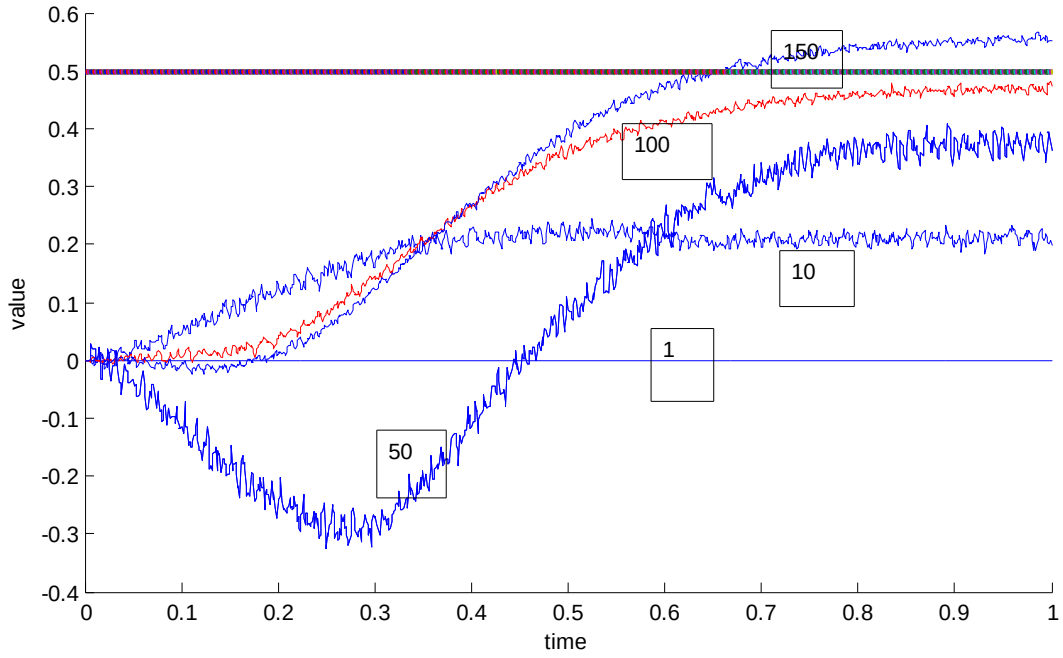
ANALYSING AFFECT OF VARIOUS PARAMETERS ON OUTPUT VALUES

1. Number of neurons

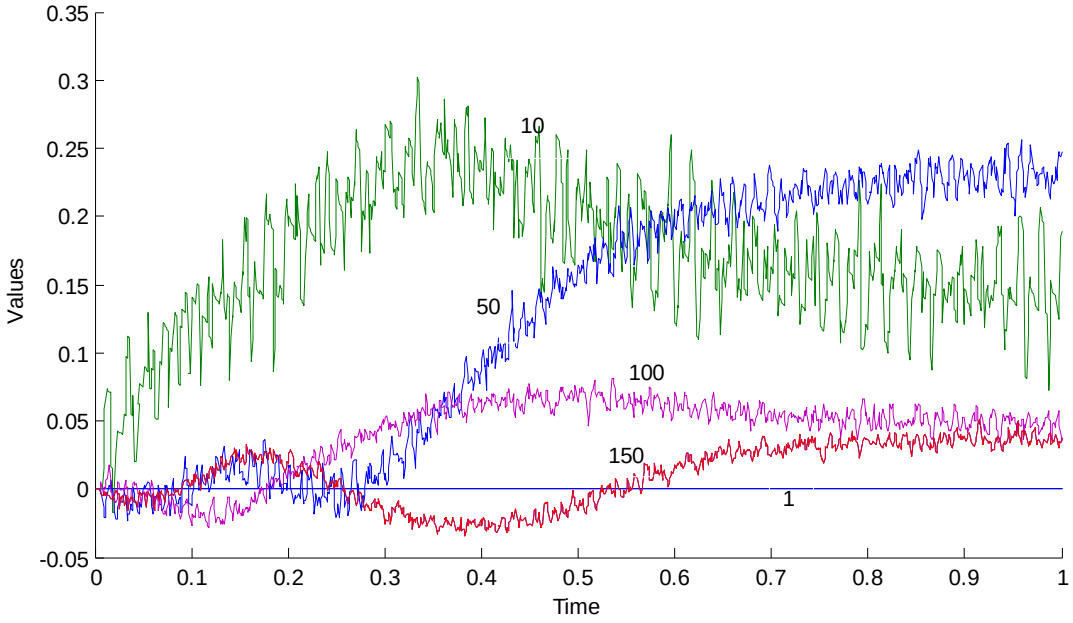
R11



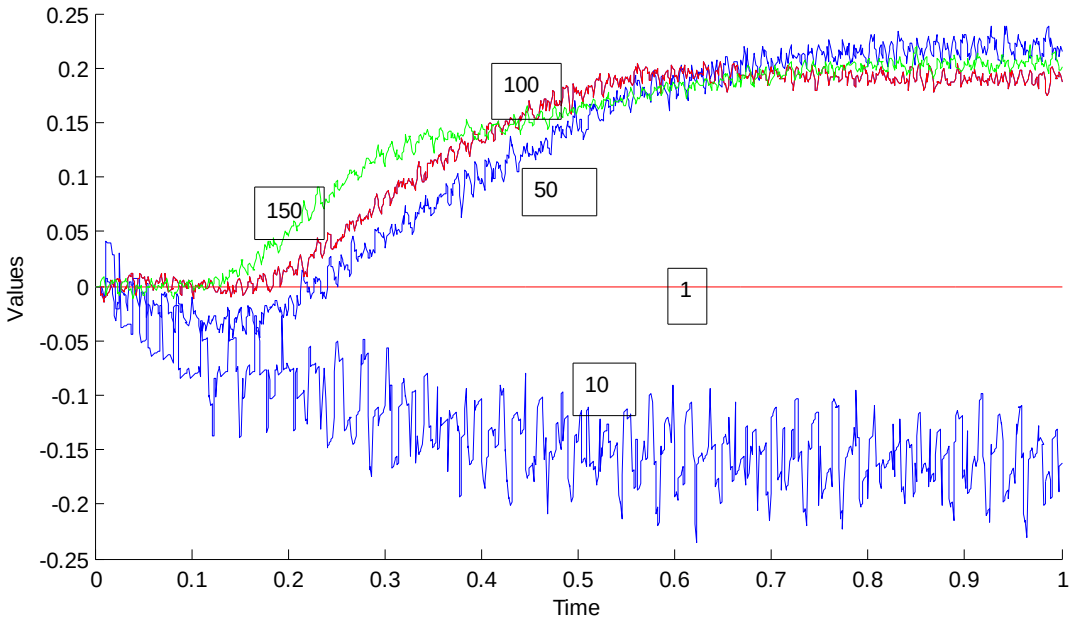
R12



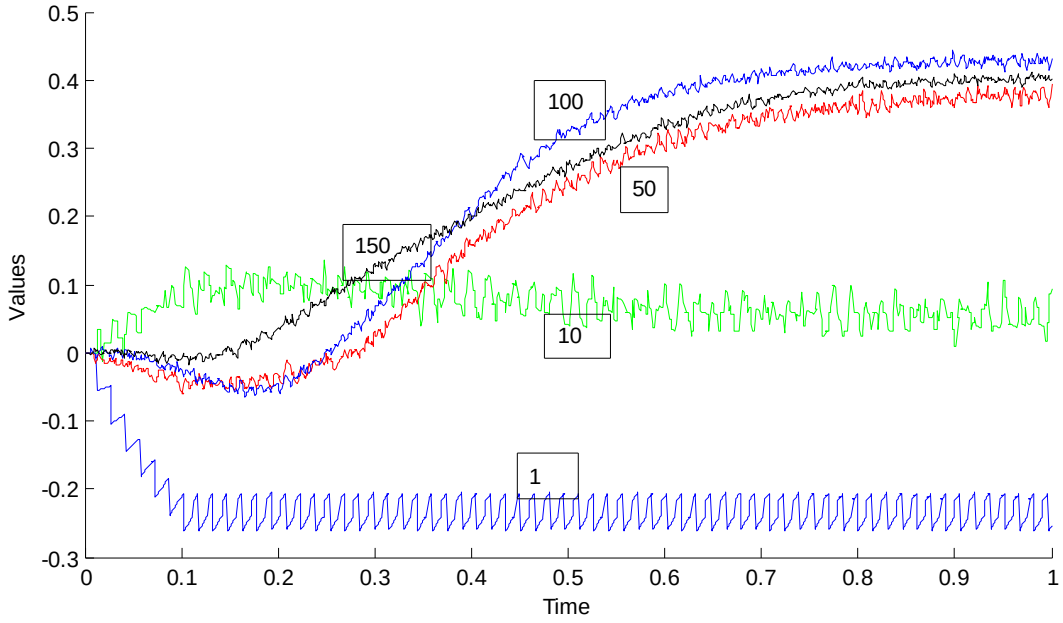
R13


0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
-0.05
Values
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Time
10
50
100
150
1

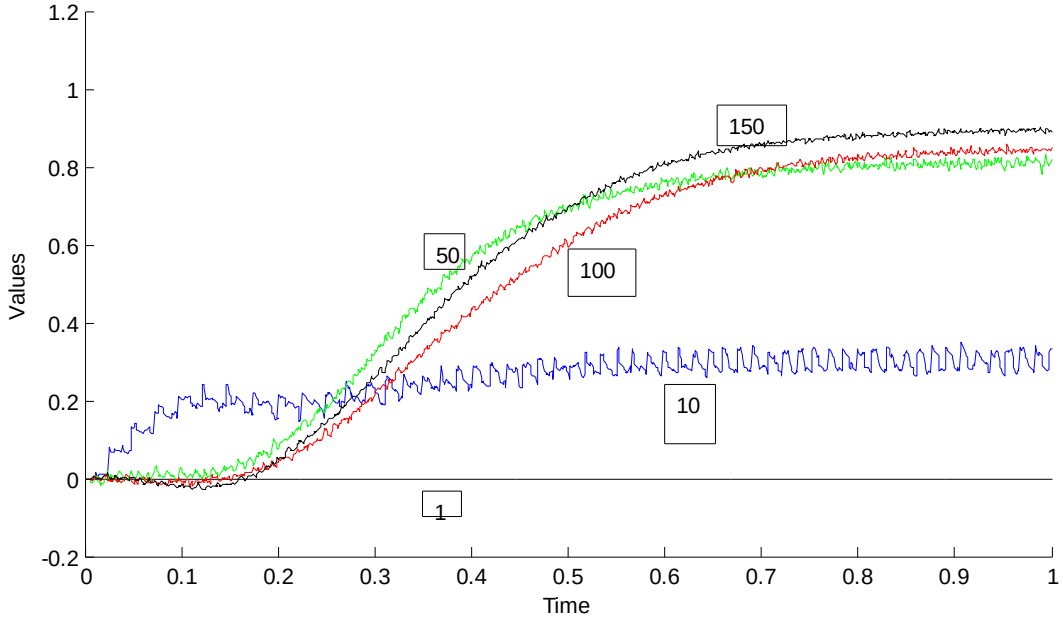
R21


0.25
0.2
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
-0.2
-0.25
Values
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Time
100
150
50
1
10

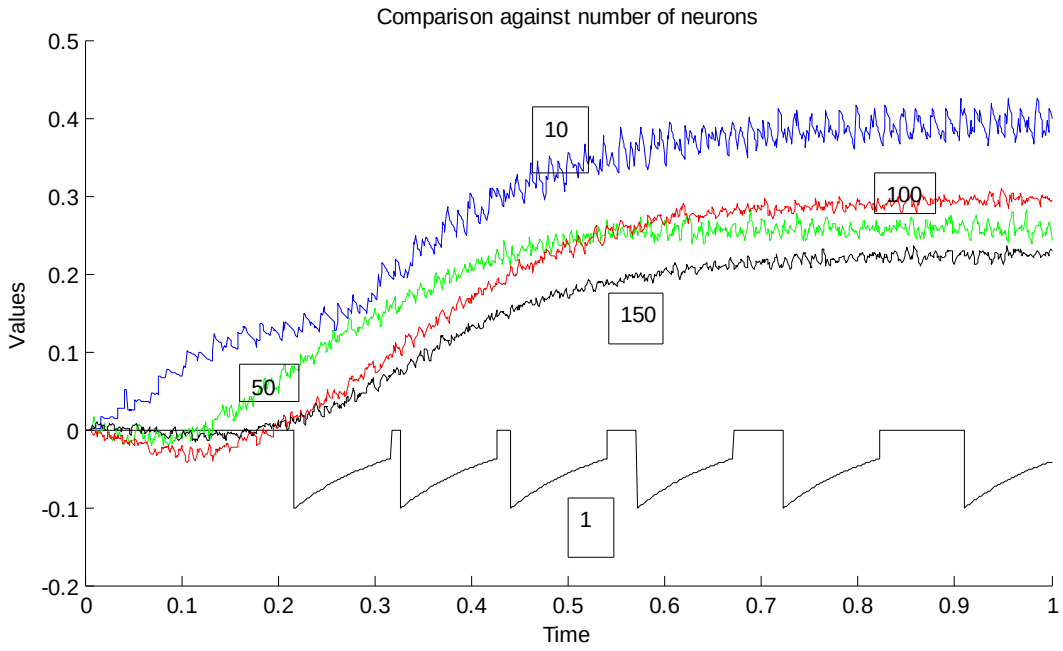
R22


0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
Values
100
50
150
10
1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Time

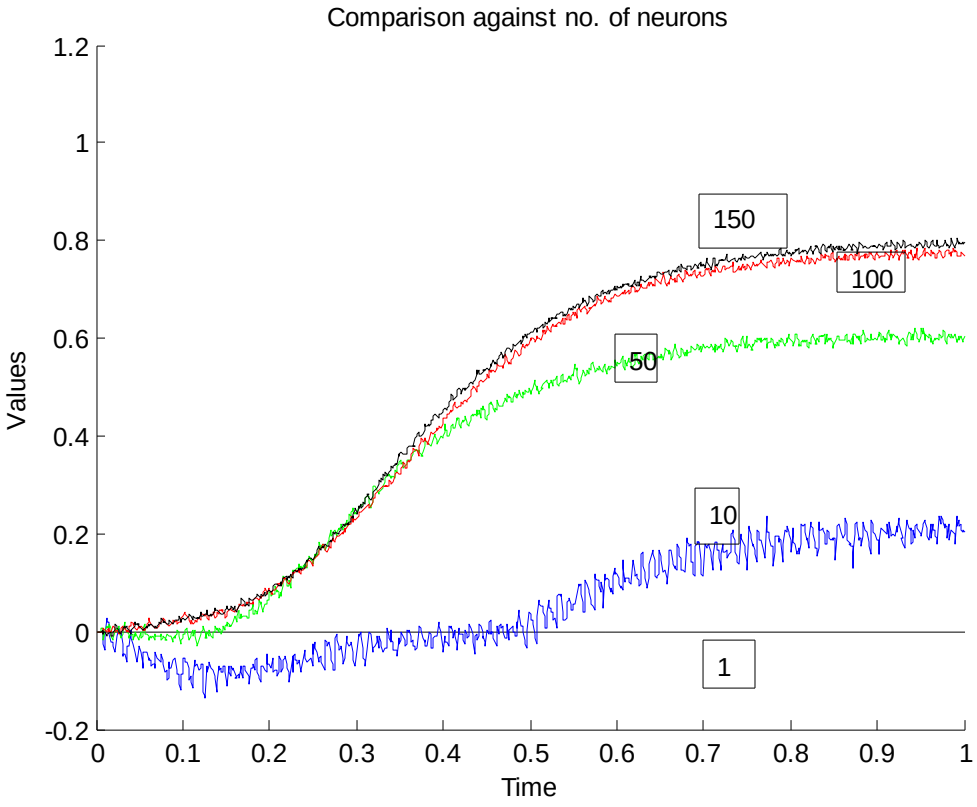
R23


1.2
1
0.8
0.6
0.4
0.2
0
-0.2
Values
150
50
100
10
1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Time

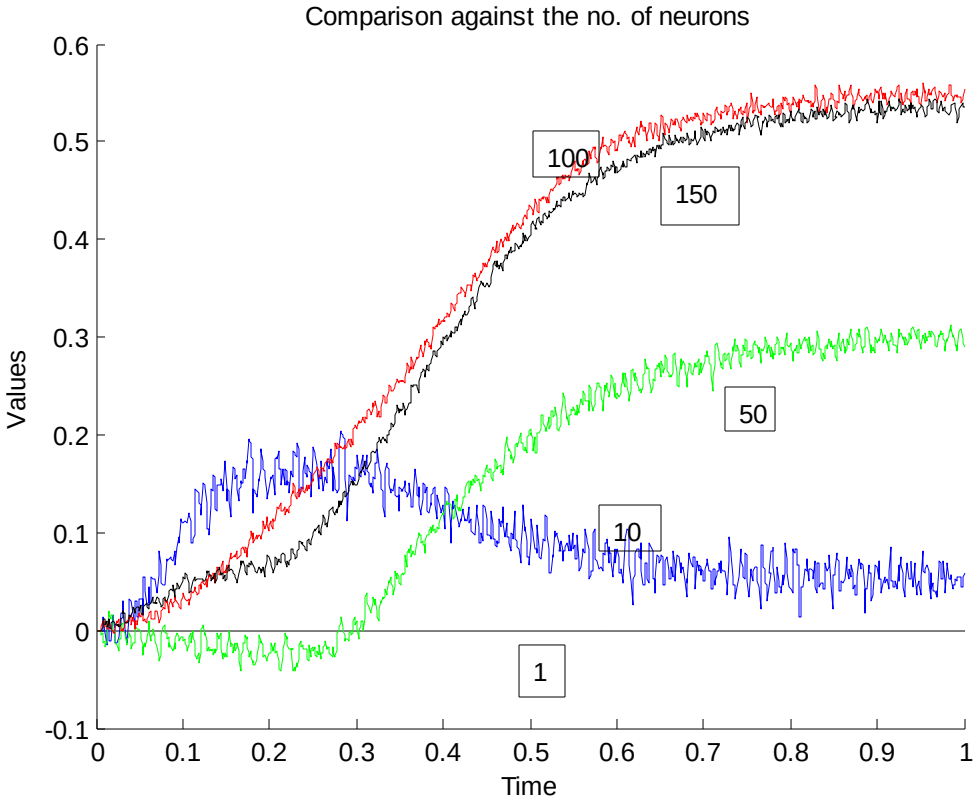
R31


Comparison against number of neurons
Values
Time
10
100
150
50
1

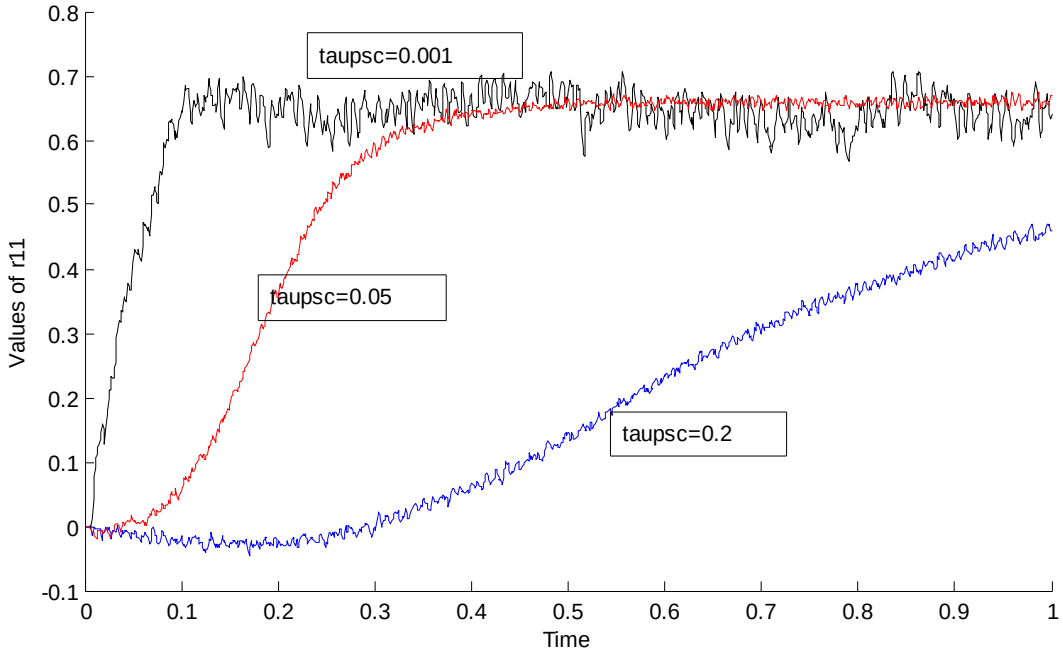
R32

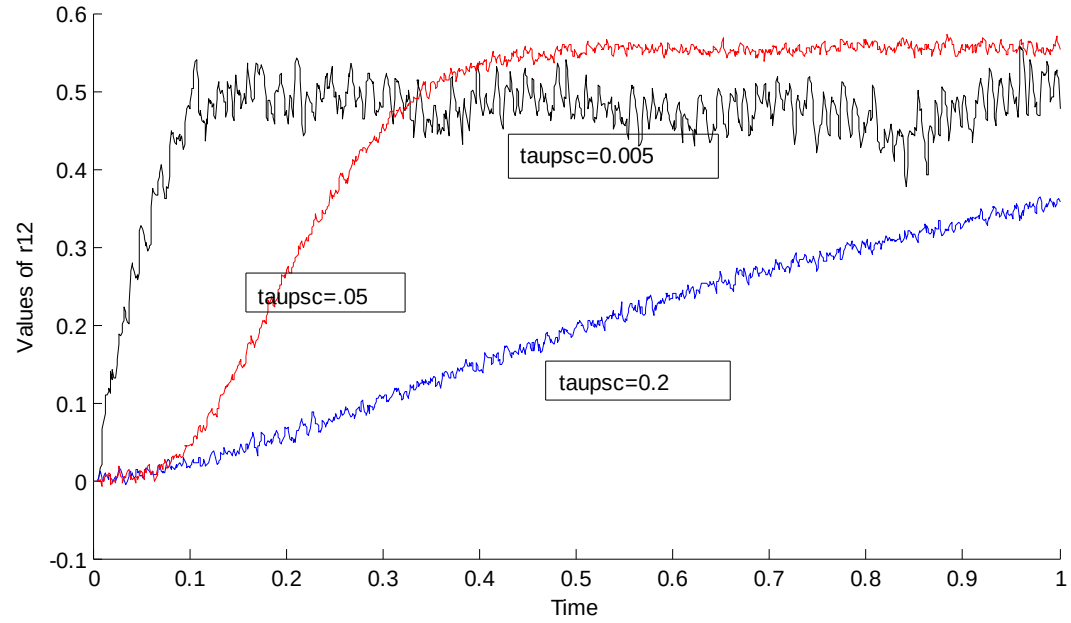

Comparison against no. of neurons
Values
Time
150
100
50
10
1

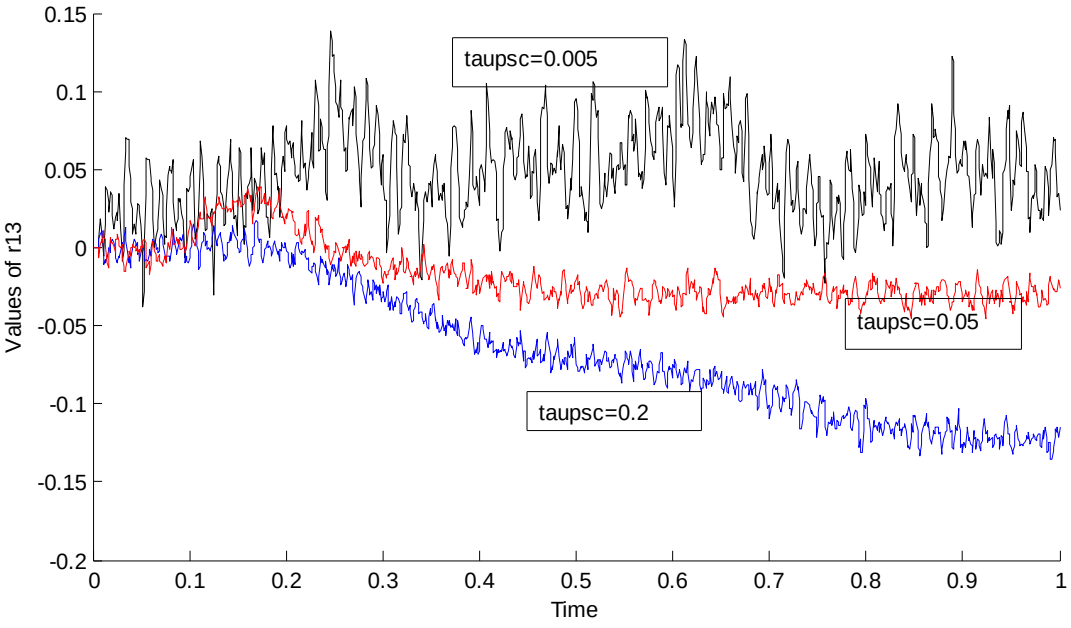
R33

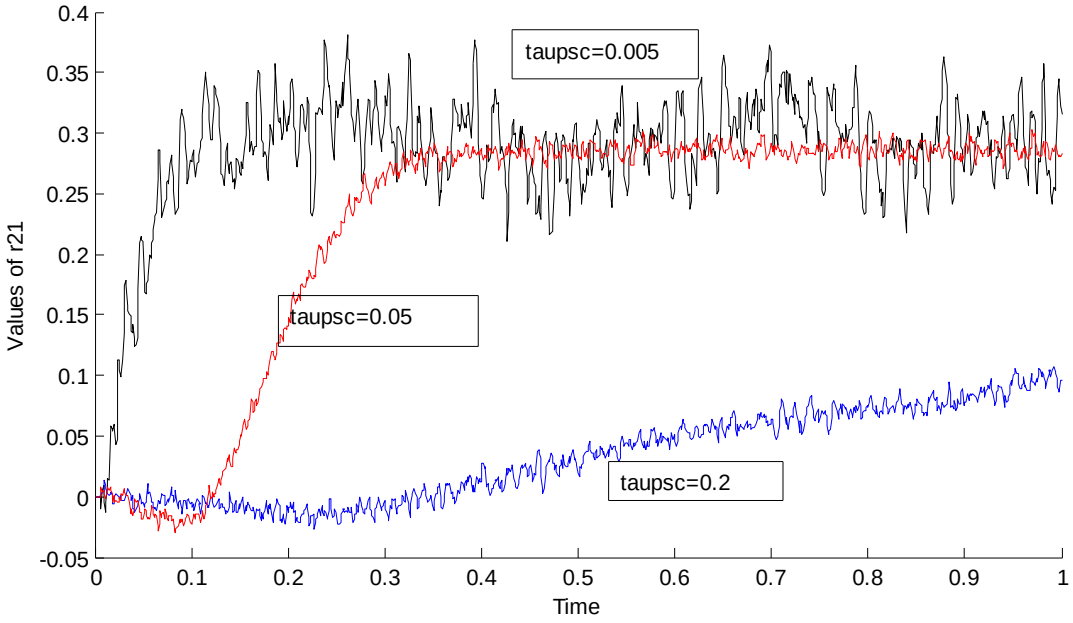


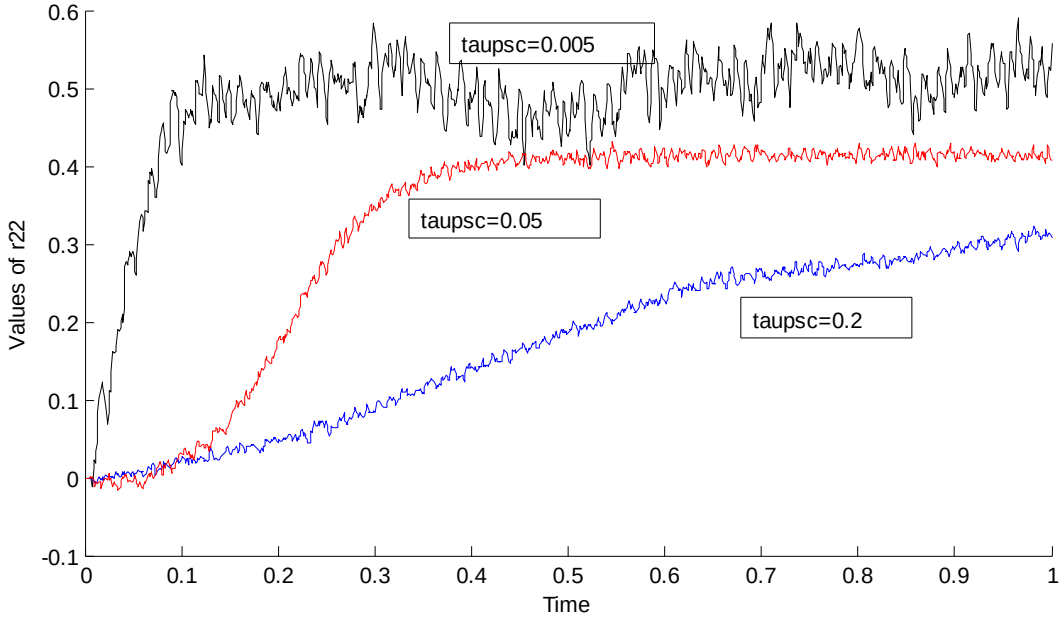
2. TauPSC : POST SYNAPTIC TIME CONSTANT

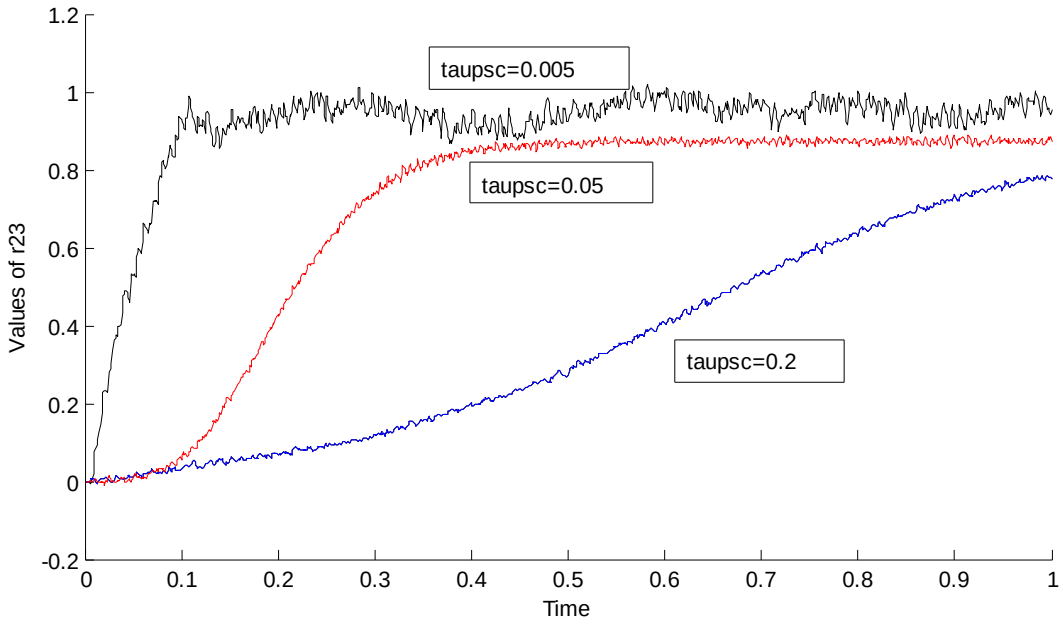


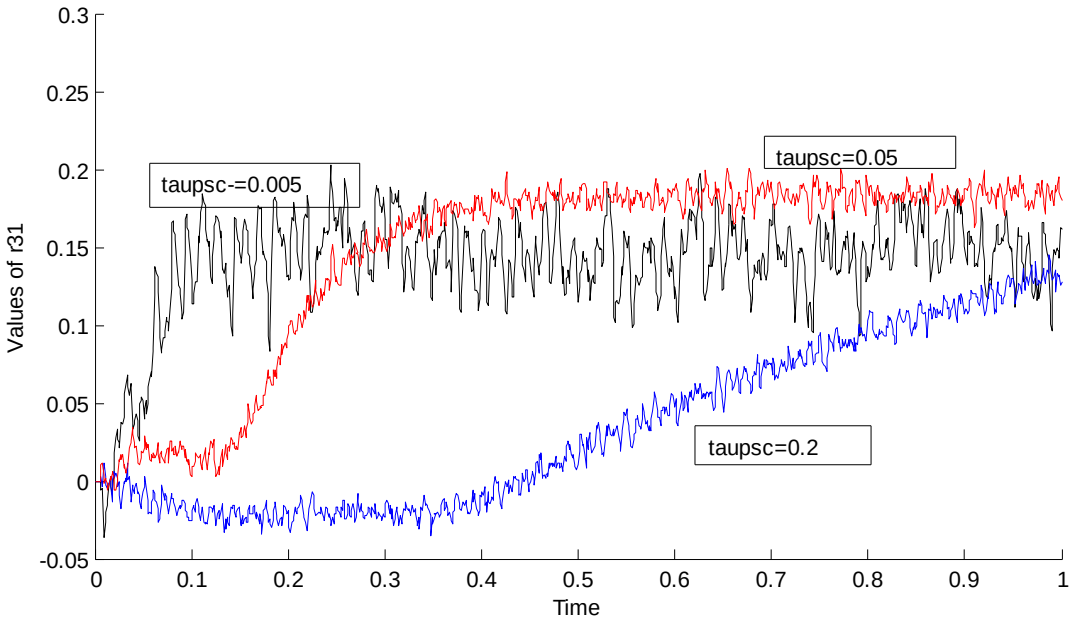

0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
Values of r12
taupsc=0.005
taupsc=.05
taupsc=0.2
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Time

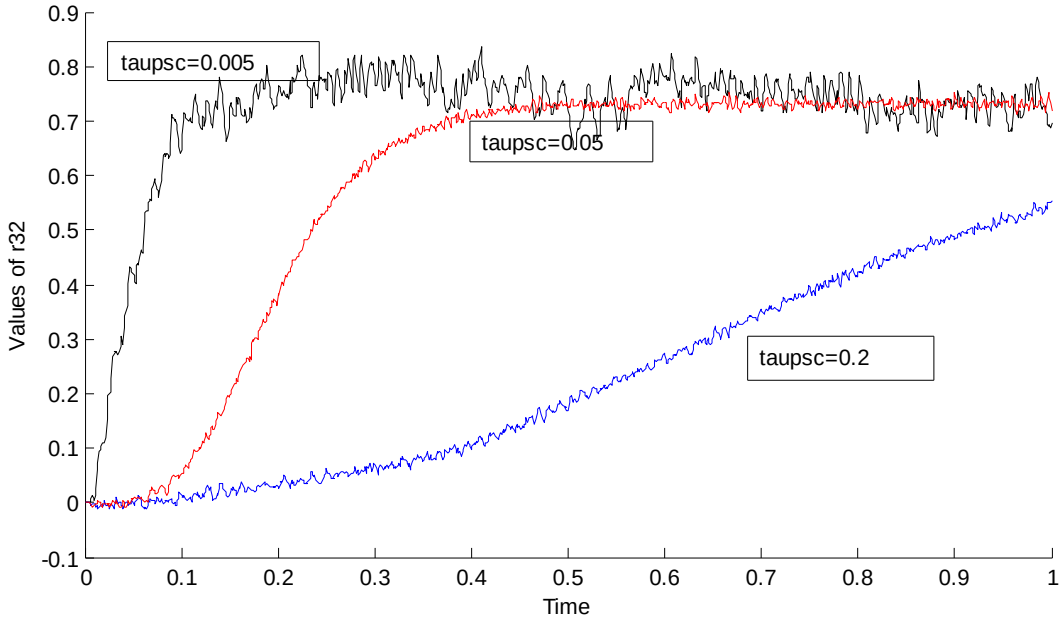

0.15
0.1
0.05
0
-0.05
-0.1
-0.15
-0.2
Values of r13
taupsc=0.005
taupsc=0.05
taupsc=0.2
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Time

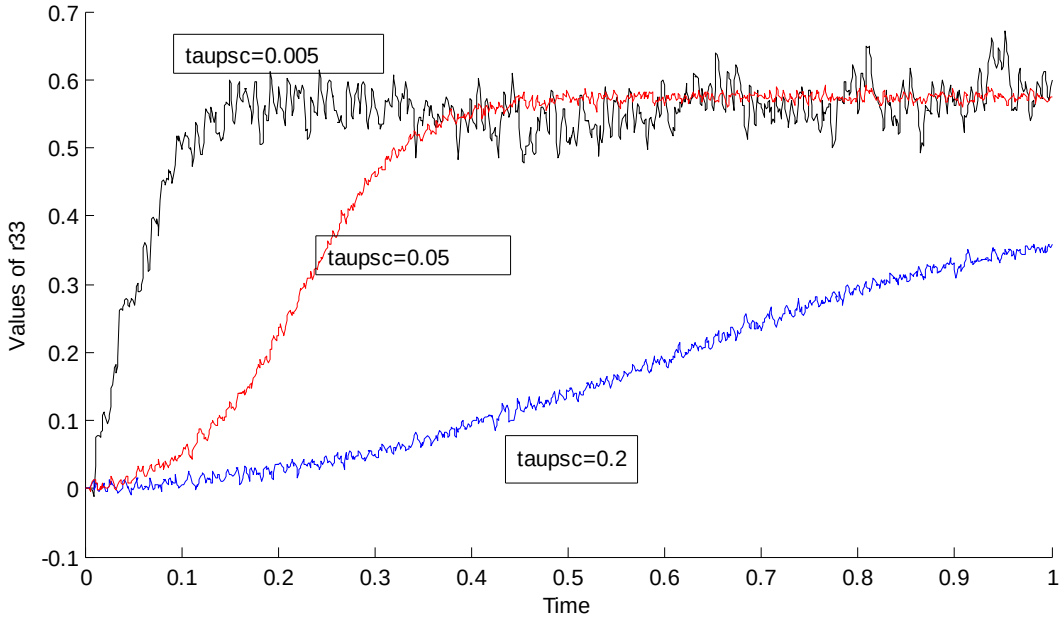

taupsc=0.005
taupsc=0.05
taupsc=0.2
Values of r21
Time
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
-0.05
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1


taupsc=0.005
taupsc=0.05
taupsc=0.2
Values of r22
Time
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

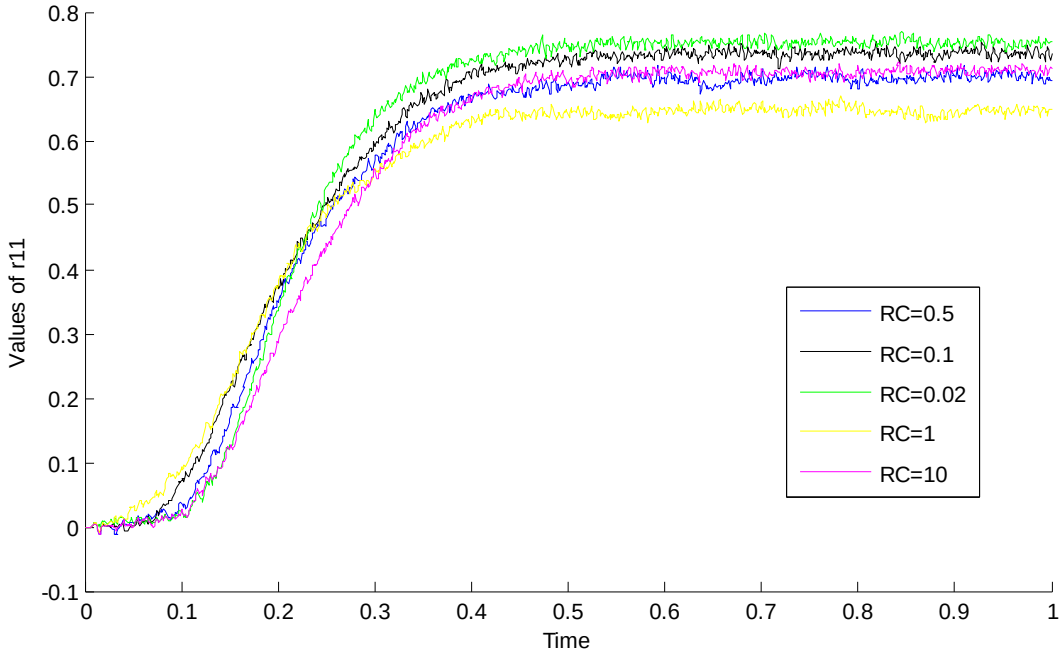

taupsc=0.005
taupsc=0.05
taupsc=0.2
Values of r23
Time
1.2
1
0.8
0.6
0.4
0.2
0
-0.2
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

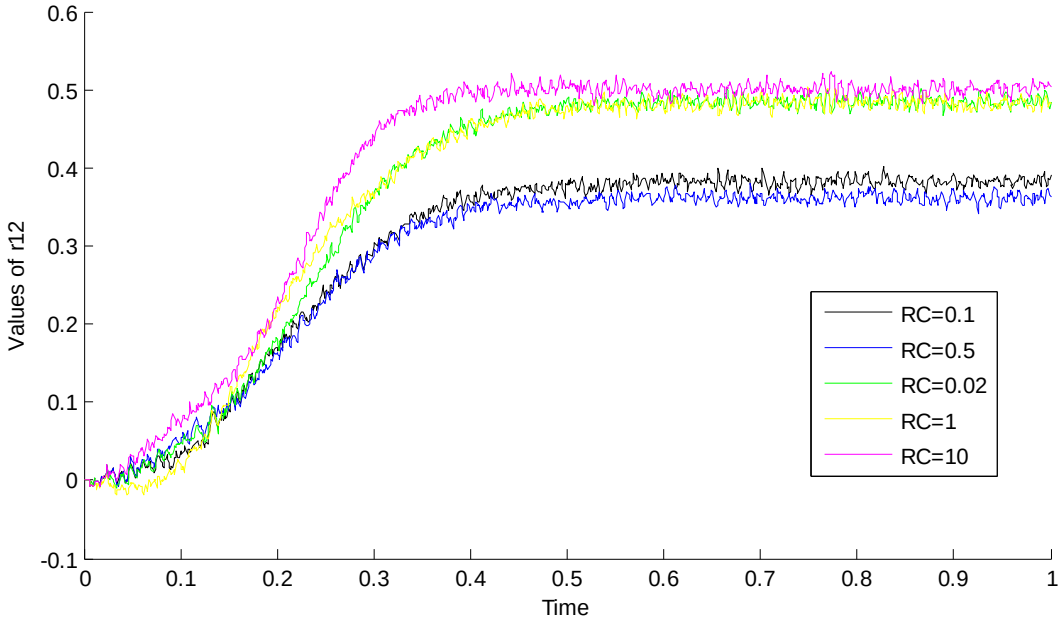

taupsc-=0.005
taupsc=0.05
taupsc=0.2
Values of r31
Time
0.3
0.25
0.2
0.15
0.1
0.05
0
-0.05
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

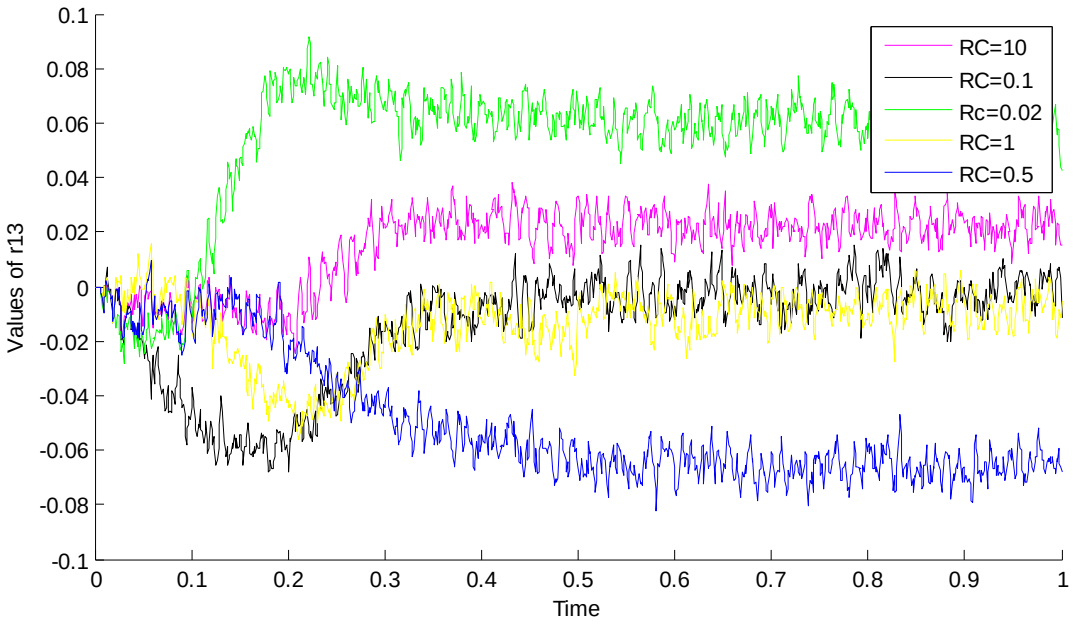

taupsc=0.005
taupsc=0.05
taupsc=0.2
Values of r32
Time
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

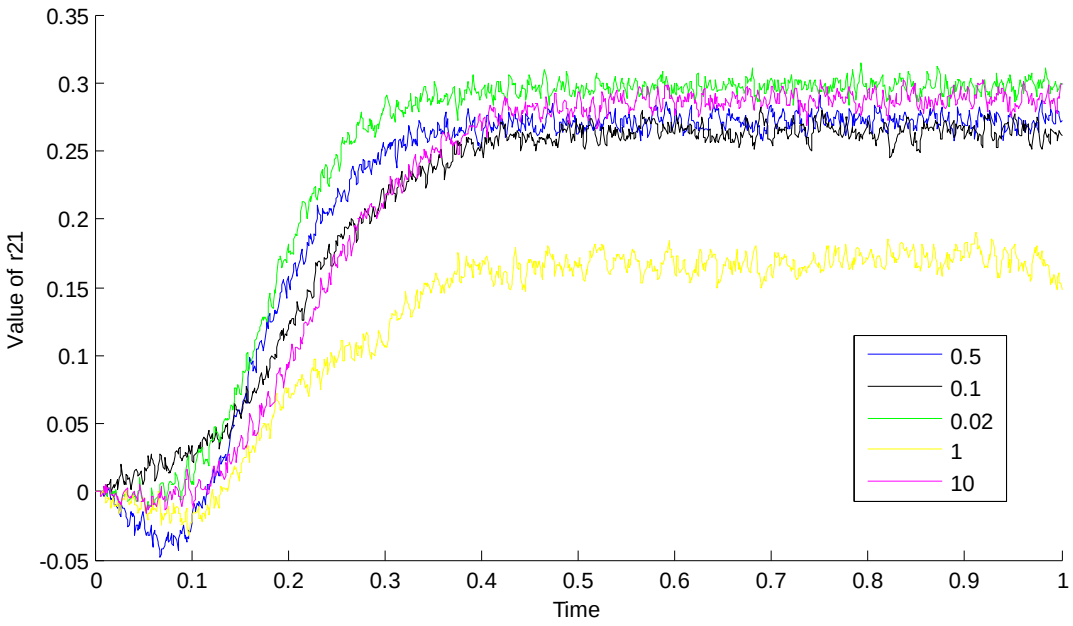

taupsc=0.005
taupsc=0.05
taupsc=0.2
Values of r33
Time
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

3. TauRC

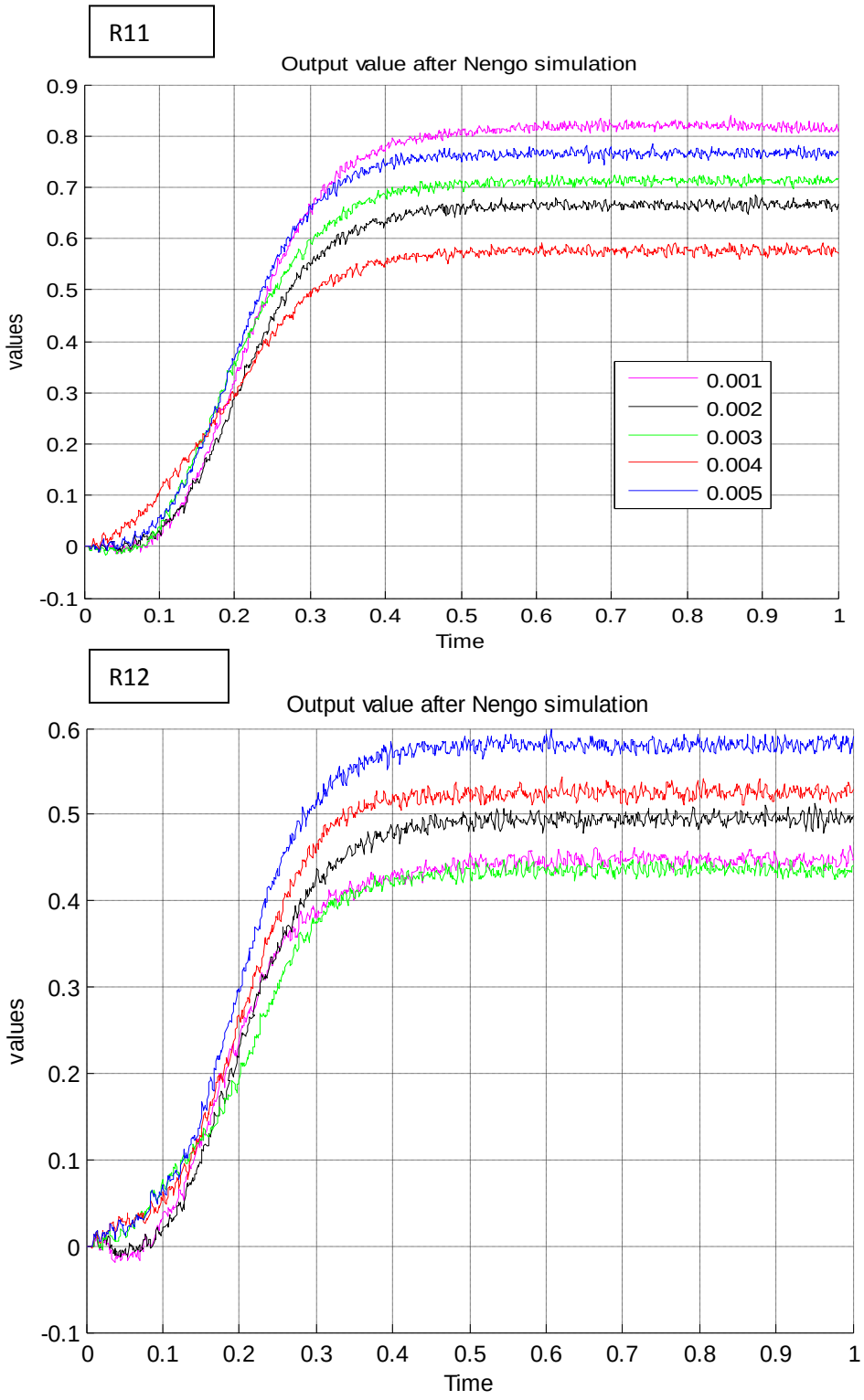

Values of r11
Time
RC=0.5
RC=0.1
RC=0.02
RC=1
RC=10


Values of r12
Time
RC=0.1
RC=0.5
RC=0.02
RC=1
RC=10

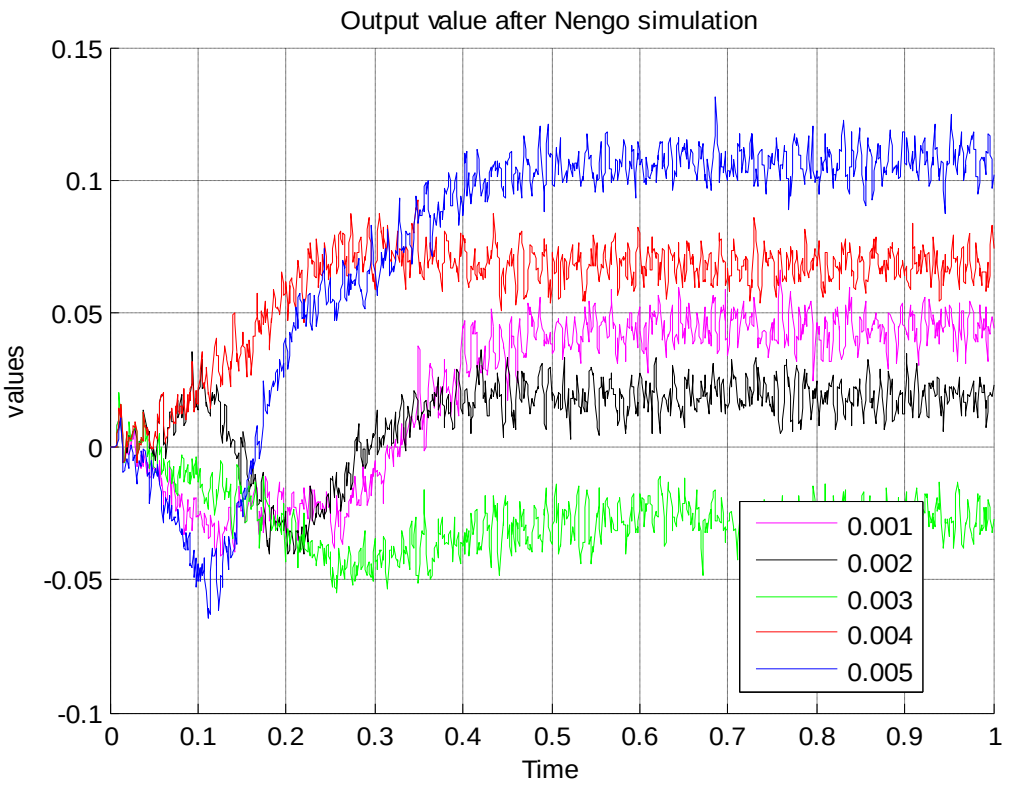

RC=10
RC=0.1
Rc=0.02
RC=1
RC=0.5
Values of r13
Time
0.1
0.08
0.06
0.04
0.02
0
-0.02
-0.04
-0.06
-0.08
-0.1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1


0.5
0.1
0.02
1
10
Value of r21
Time
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
-0.05
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

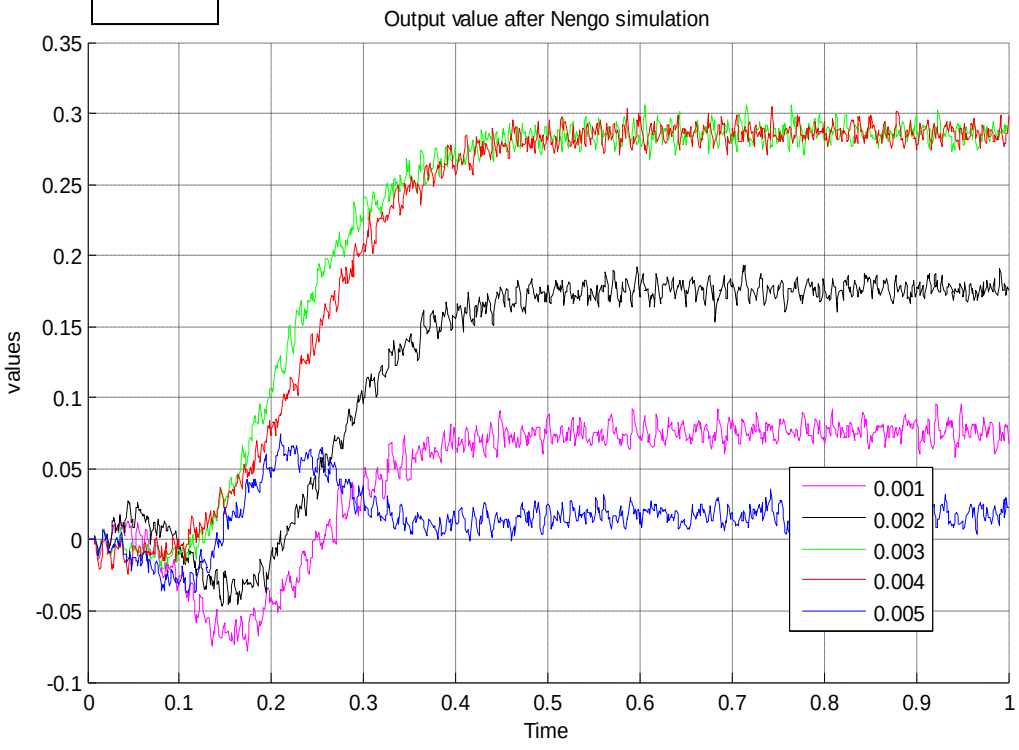
4. TauRef


R11
Output value after Nengo simulation
values
Time
0.001
0.002
0.003
0.004
0.005
R12
Output value after Nengo simulation
values
Time

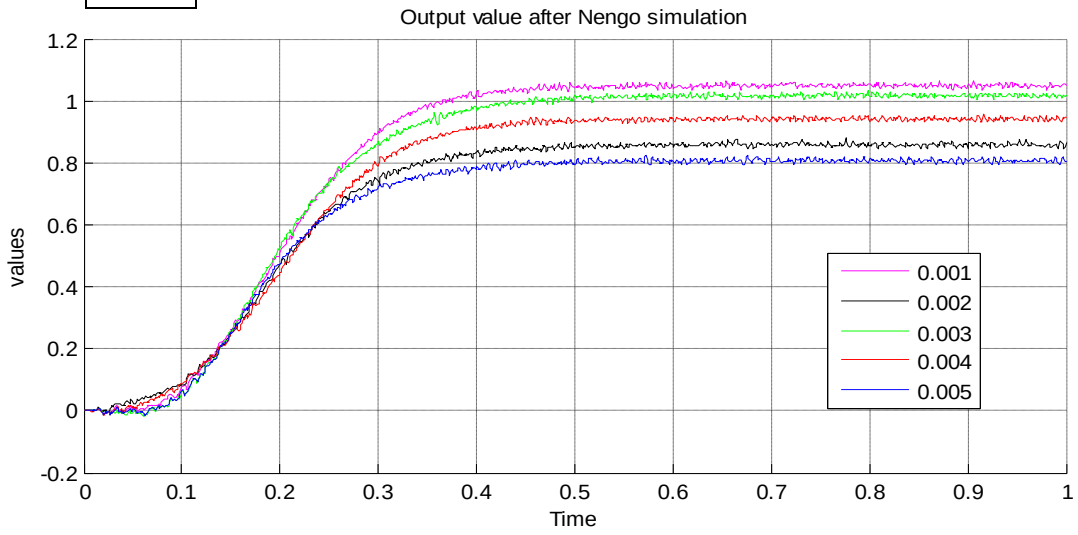
R13


Output value after Nengo simulation
values
Time
0.15
0.1
0.05
0
-0.05
-0.1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.001
0.002
0.003
0.004
0.005

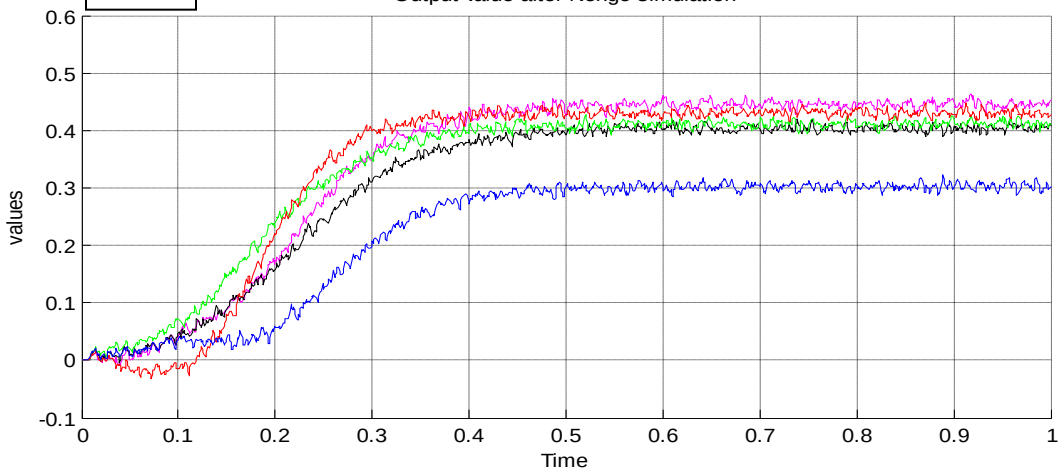
R21


Output value after Nengo simulation
values
Time
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
-0.05
-0.1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.001
0.002
0.003
0.004
0.005

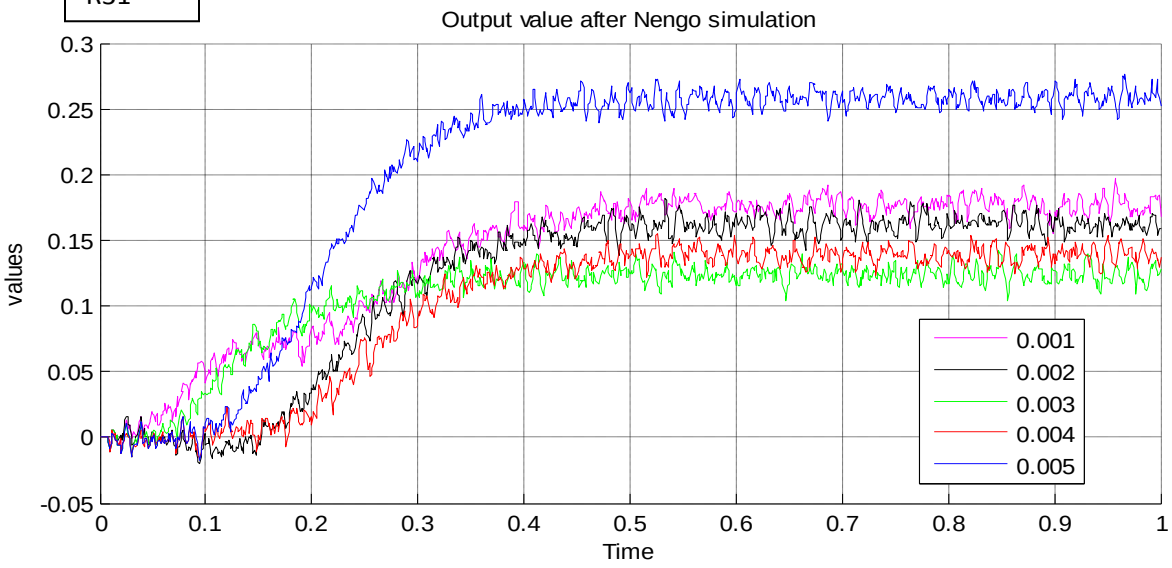
R22


Output value after Nengo simulation
values
Time
0.001
0.002
0.003
0.004
0.005

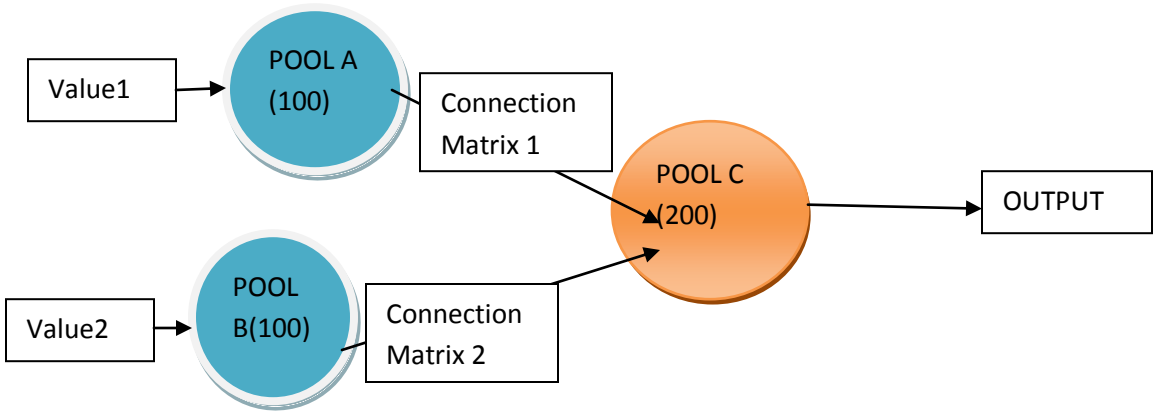
R23

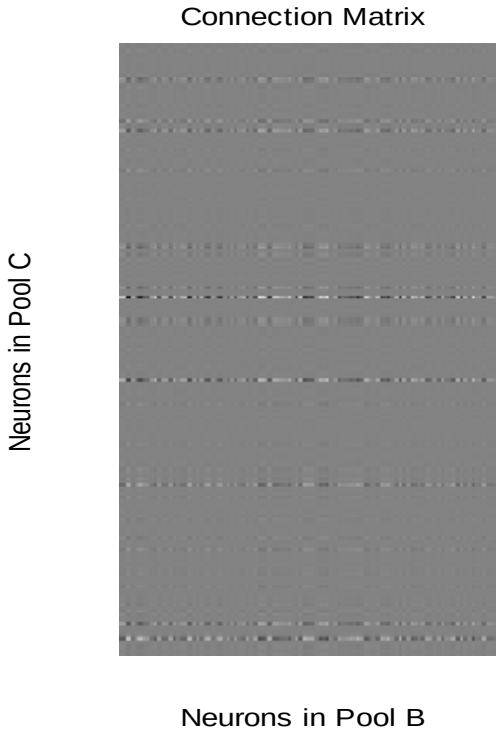

Output value after Nengo simulation
values
Time

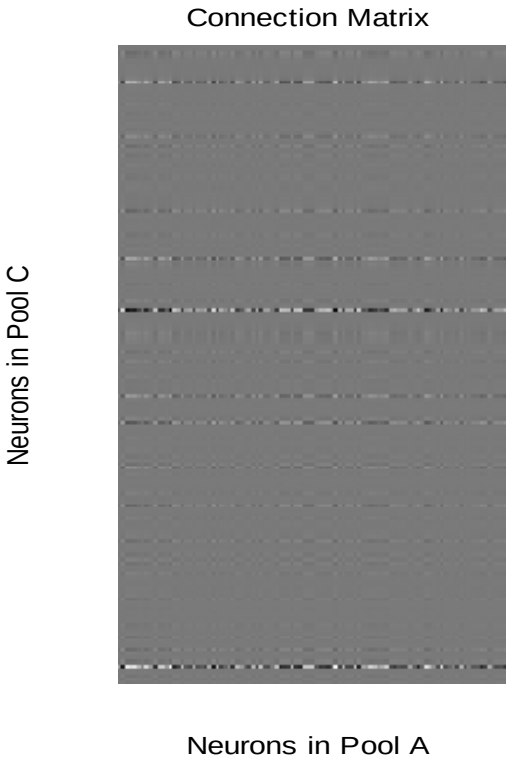
R31


Output value after Nengo simulation
values
Time
0.001
0.002
0.003
0.004
0.005

CONNECTION MATRICES IN A NETWORK MULTIPLYING TWO VARIABLES







Other operations:

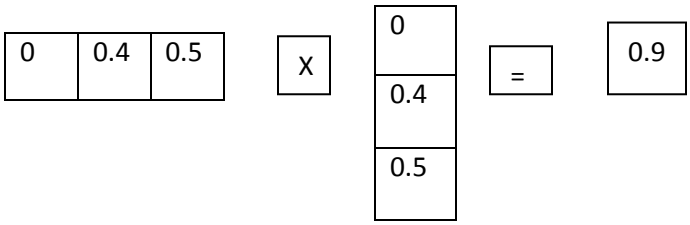
Matrix X Vector

0.5	0	1		0		0.5
0	1	0.4	X	0.4	=	0.6
0.5	0.5	0		0.5		0.2

Vector X Matrix

0	0.4	0.5	X	0.5	0	1	=	0.25	0.65	0.16
				0	1	0.4				
				0.5	0.5	0				

Vector X Vector



Vector X Matrix X Matrix X Vector