Group 2: Problem and results

Di Crescenzo, Gordillo, Mancilla, Morella, Riecke, Ward

Neapolitan proverb:
Dicette 'o pappecio vicino 'a noce: "damme 'o tiempo ca te spertoso"

rough translation:
The flea said to the walnut tree: "give me time, I drill you down!"

Figure 1

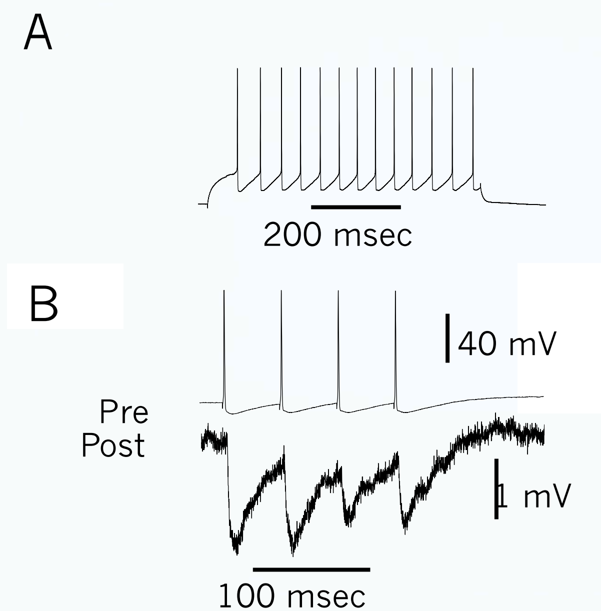


Figure 2

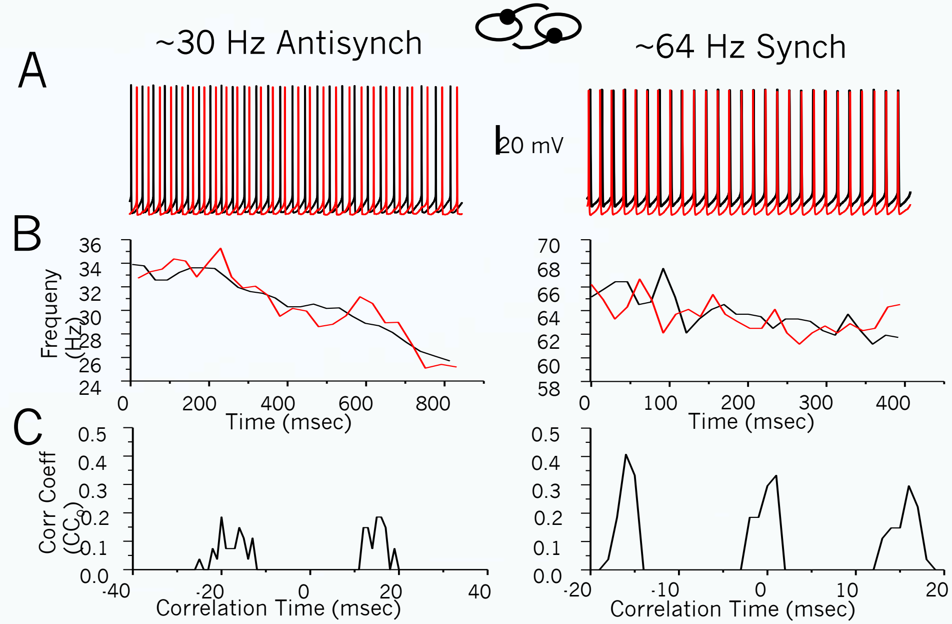
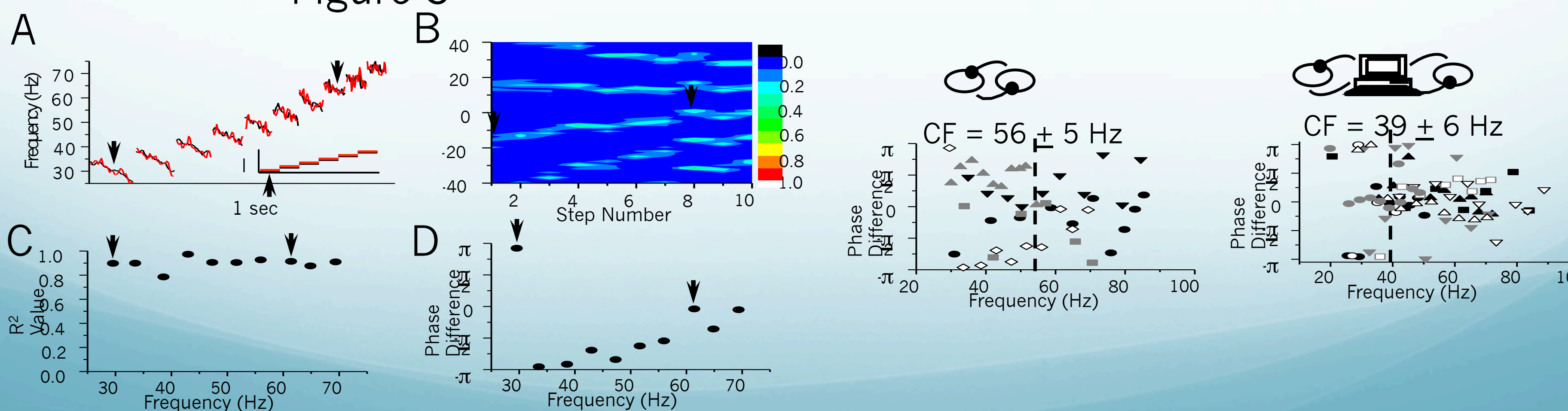
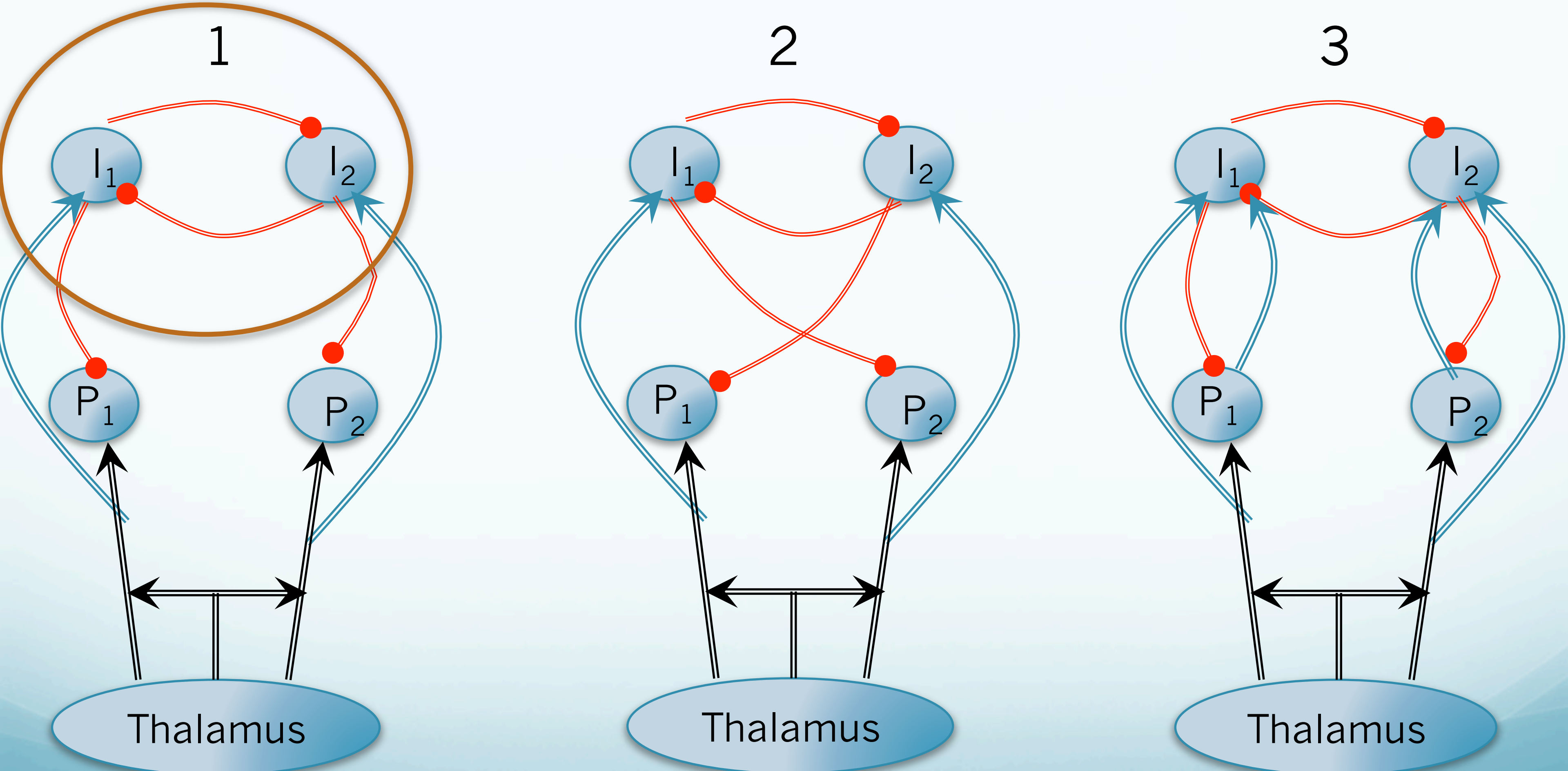


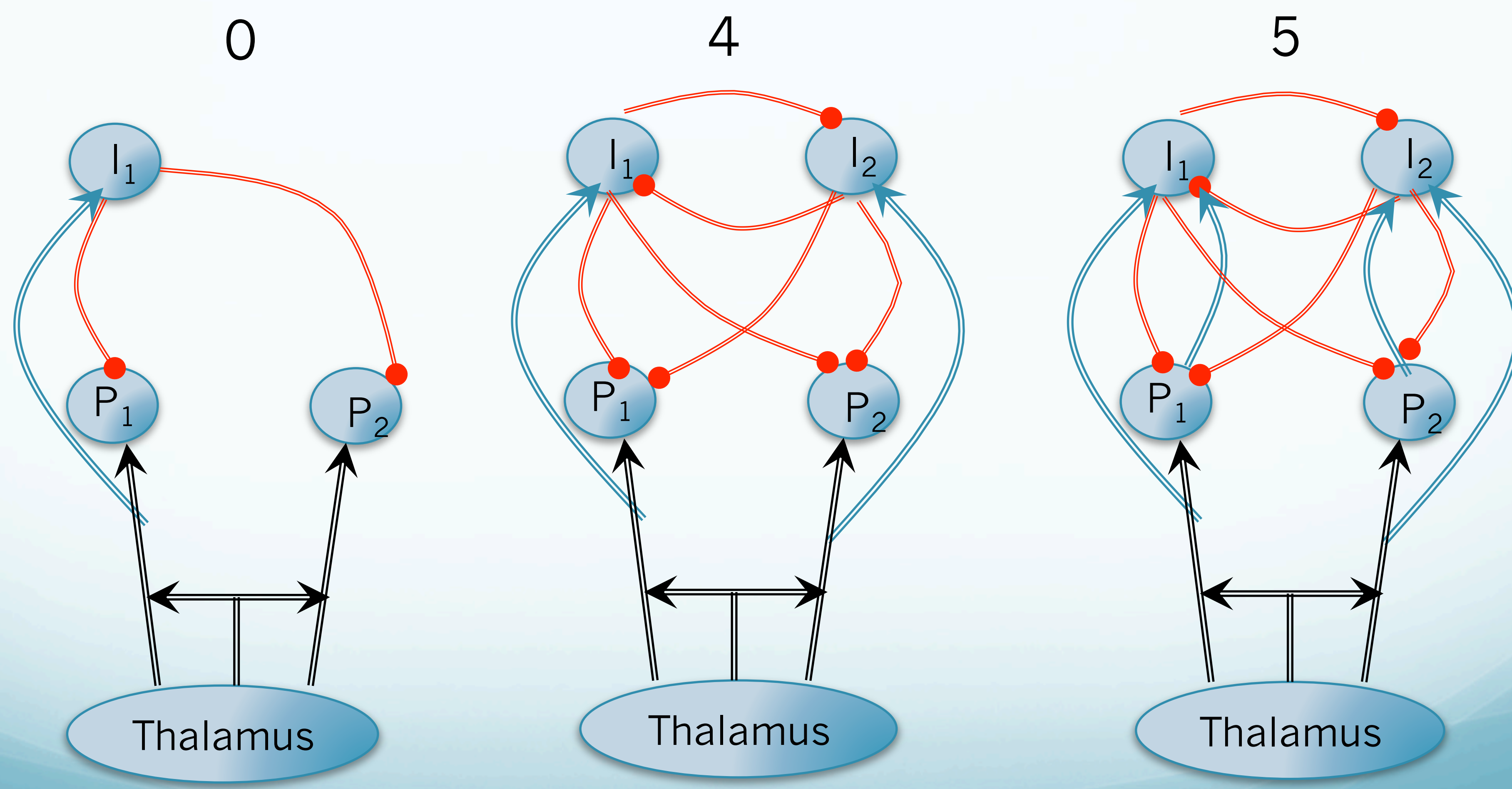
Figure 3



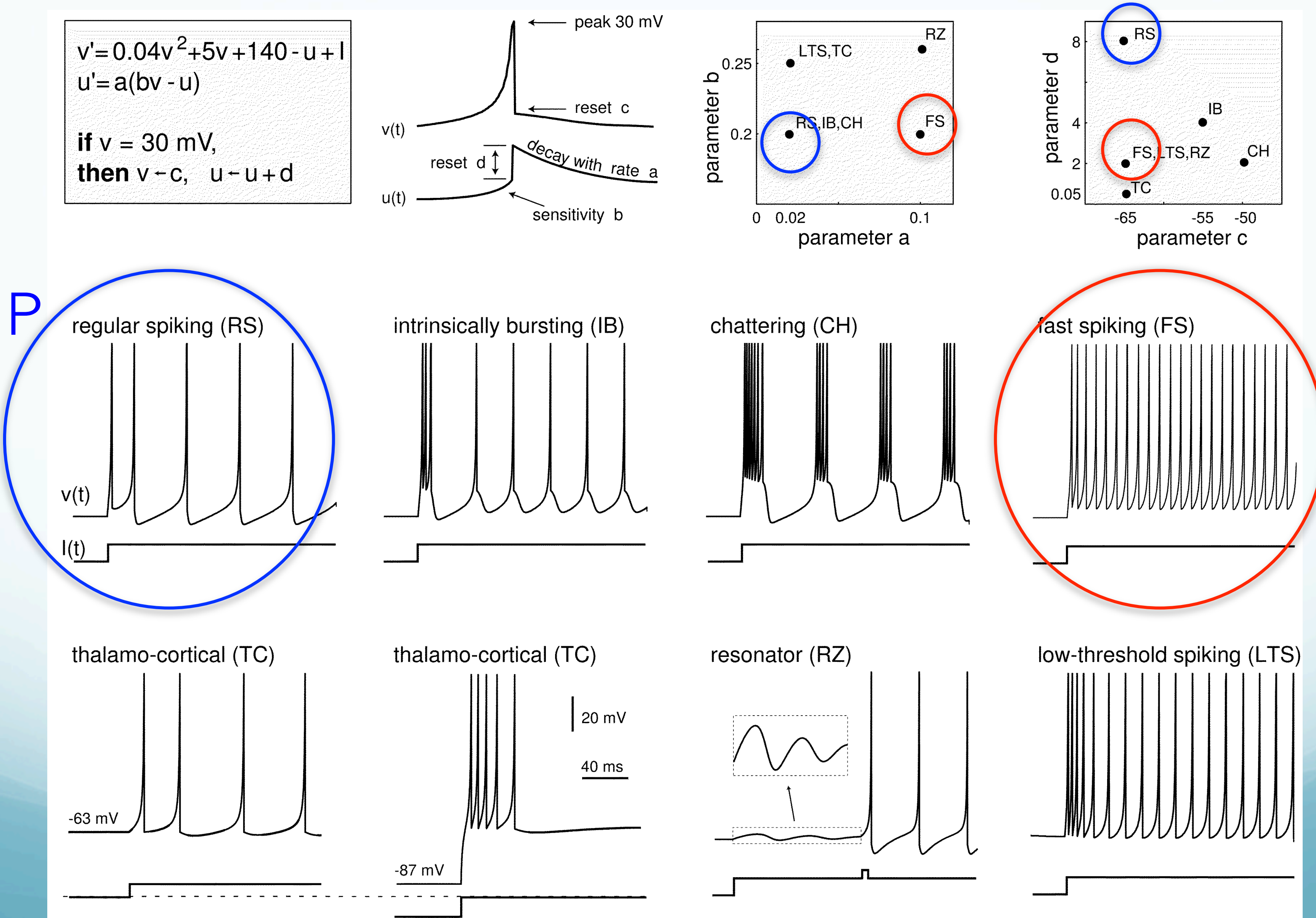
Our network(s)



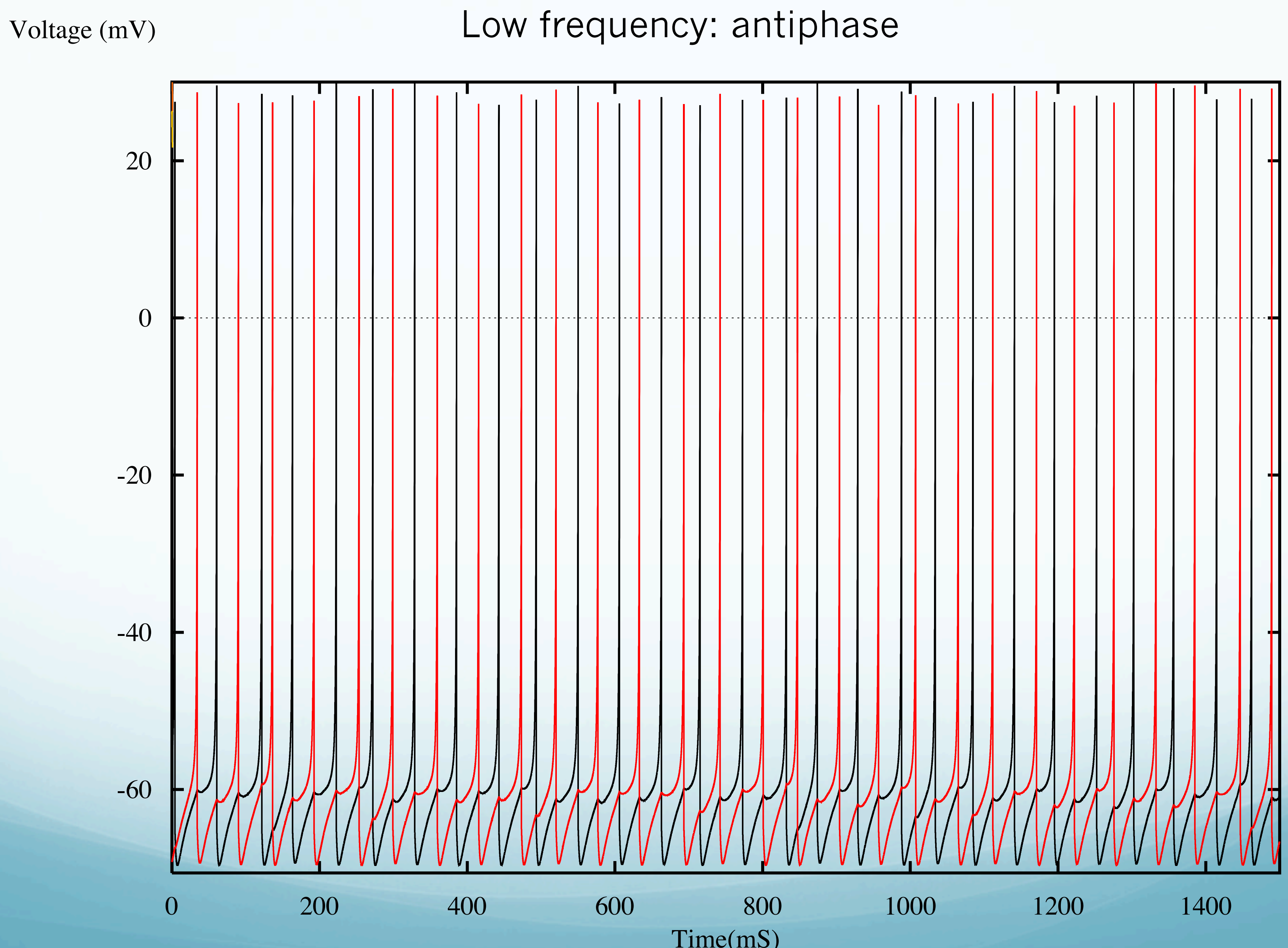
Other Models



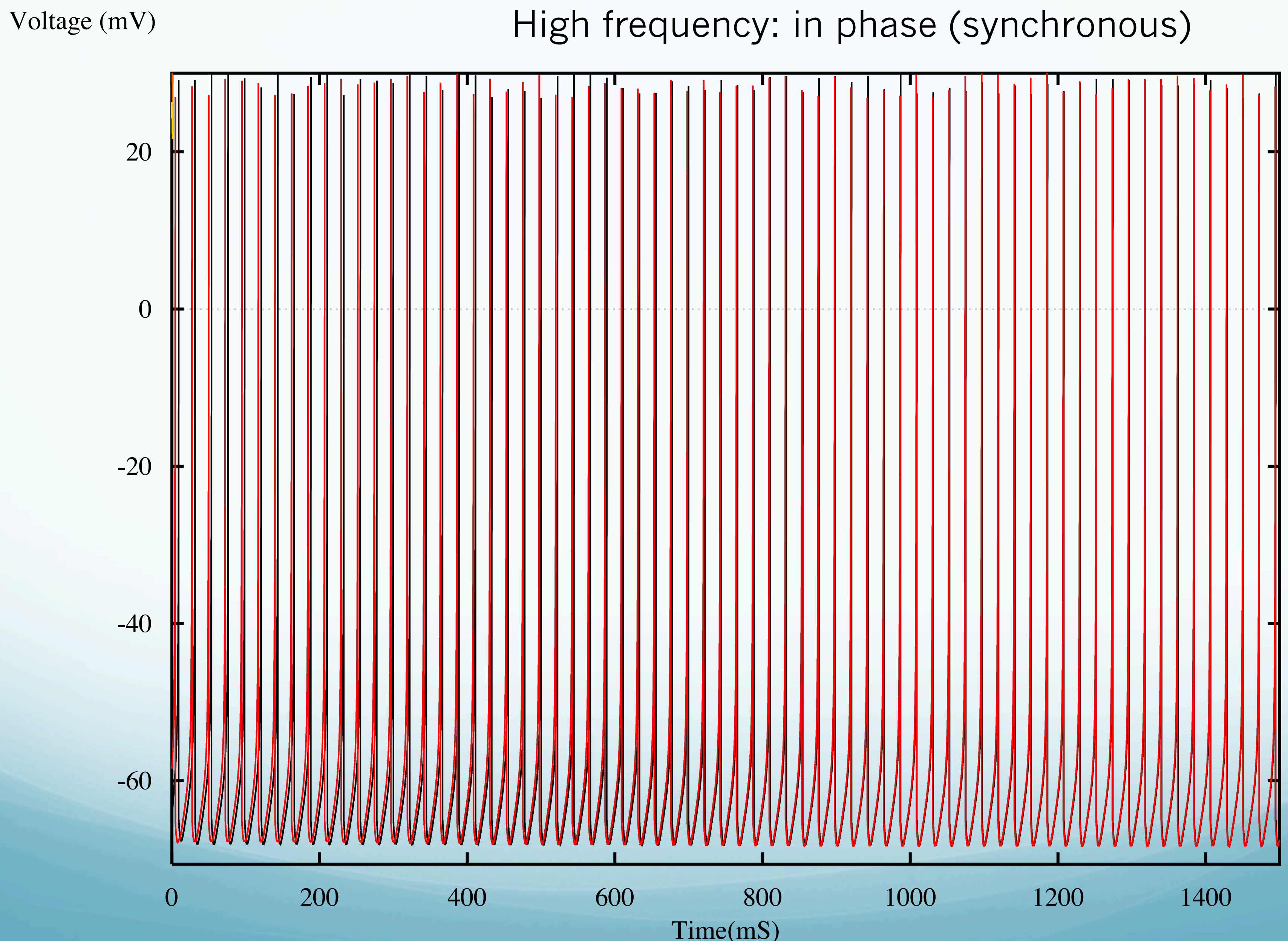
Izhikevich neurons



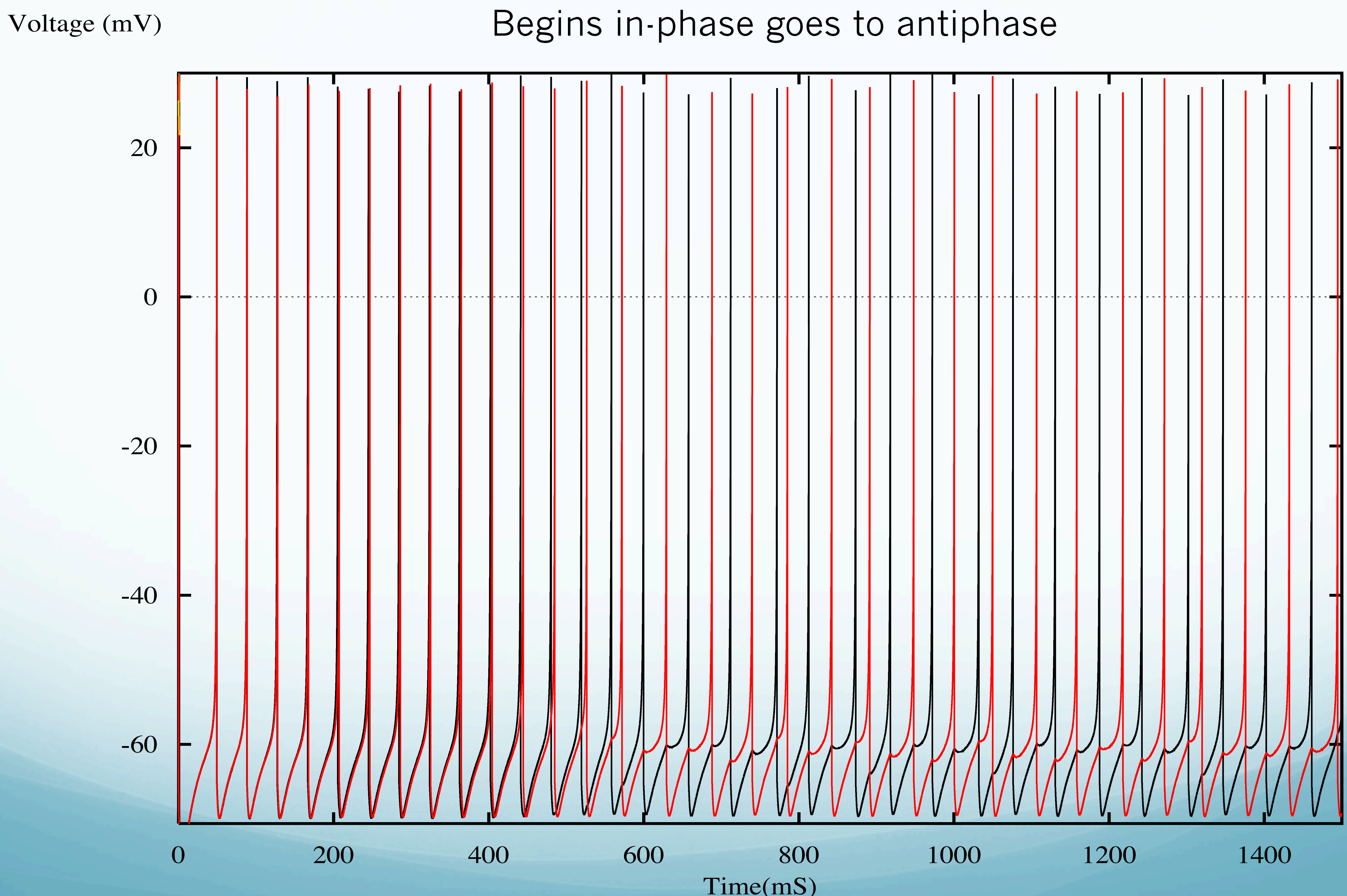
Coupled I neurons only: The Sashi implementation



Coupled I neurons only: The Sashi implementation



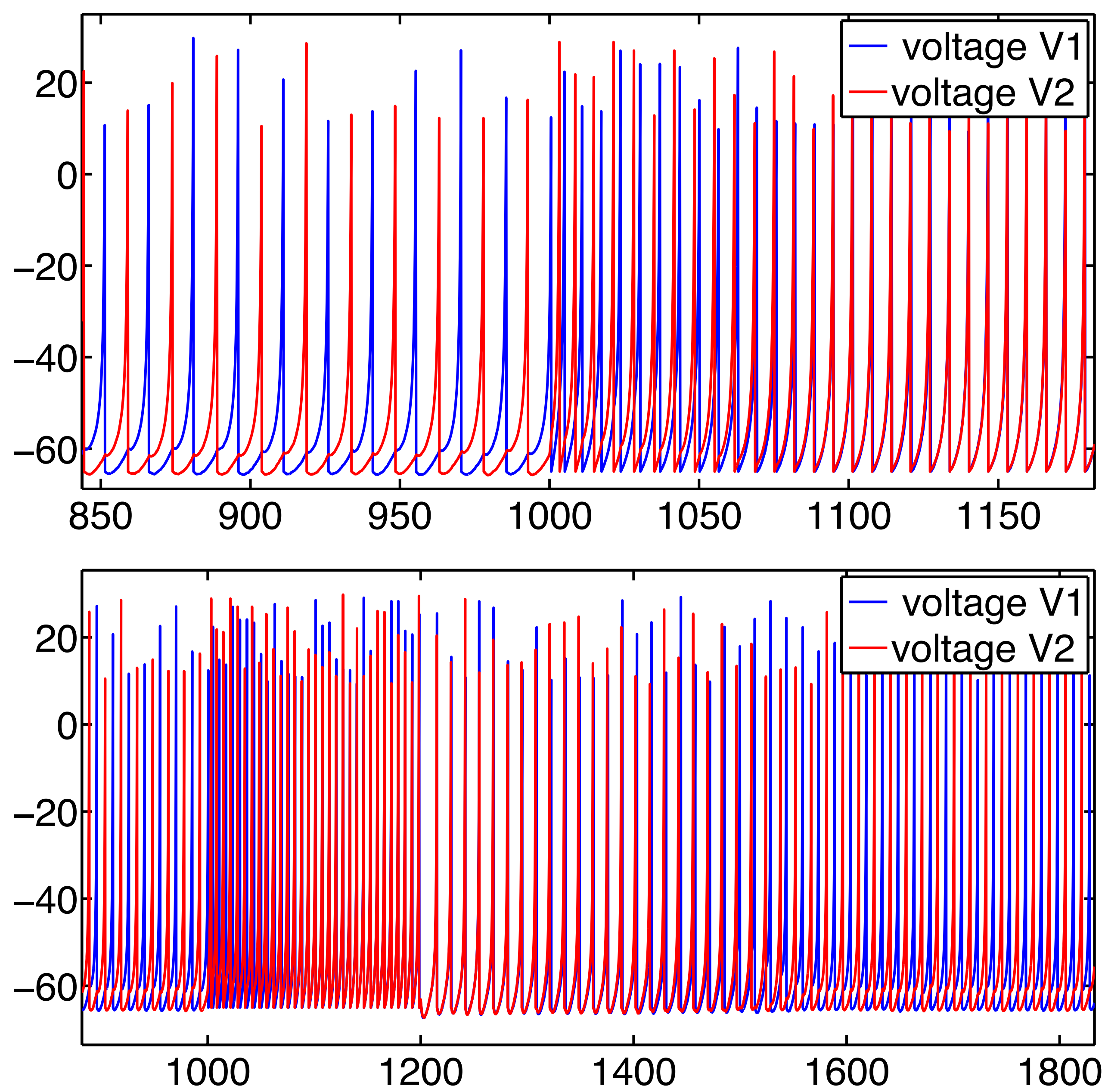
Coupled I neurons only: The Sashi implementation



Coupled I neurons only: The Hermann Implementation

Blue I_1

Red I_2



Increased drive at 1000, decreased at 1200

To do

- Implement with output of each I to each P
- Implement with only one I with output to both Ps
- Implement synapse with stochastic failure, not simply noisy exponential decay (Brent)

Stochastic synapse model of Lu & Trussell, 2000, Neuron (sans Ca^{2+})

- Two populations of vesicles: Full and Empty
- Total = N = 150
- Update N_i re N_{i-1} as
  $N_i = N - [N - (1 - P_{f(i-1)}) N_{i-1}] e^{-\Delta t/\tau_{rec}}$ i=1,2,3,...
- Number of quanta released from a binomial with probability of success = $P_{f(i)}$.
- Quantal release has current input effect of

$$I = I_Q \bullet e^{\frac{-t}{\tau_Q}}$$

Tsodyks et al 2000 synapse model modified

$$\frac{dx(t)}{dt} = \frac{z(t)}{\tau_r} - ux(t)$$

$$\frac{dy(t)}{dt} = -\frac{y(t)}{\tau_p} + ux(t)$$

$$\frac{dz(t)}{dt} = \frac{y(t)}{\tau_p} - \frac{z(t)}{\tau_r}$$

$$take \quad ux(t) \sim Poisson\, as\, n \rightarrow \infty ??$$

x is recovered
y is active
z is inactive

Stochastic synapse: Hermann Implementation

- Two vesicle site states: Active (F_t) and Inactive (E_t)
- $N_{tot} = F_t + E_t$
- Number of vesicles released

$$N_{rt} = \text{binomial}\ (p_r, F_t)$$

$$IPSC_t = Ae^{-t/\tau_1} - Be^{-t/\tau_2}$$

$$p_r = \frac{C}{1 + e^{-\left(\frac{V - V_h}{k}\right)}}$$

$$C = 0.05$$

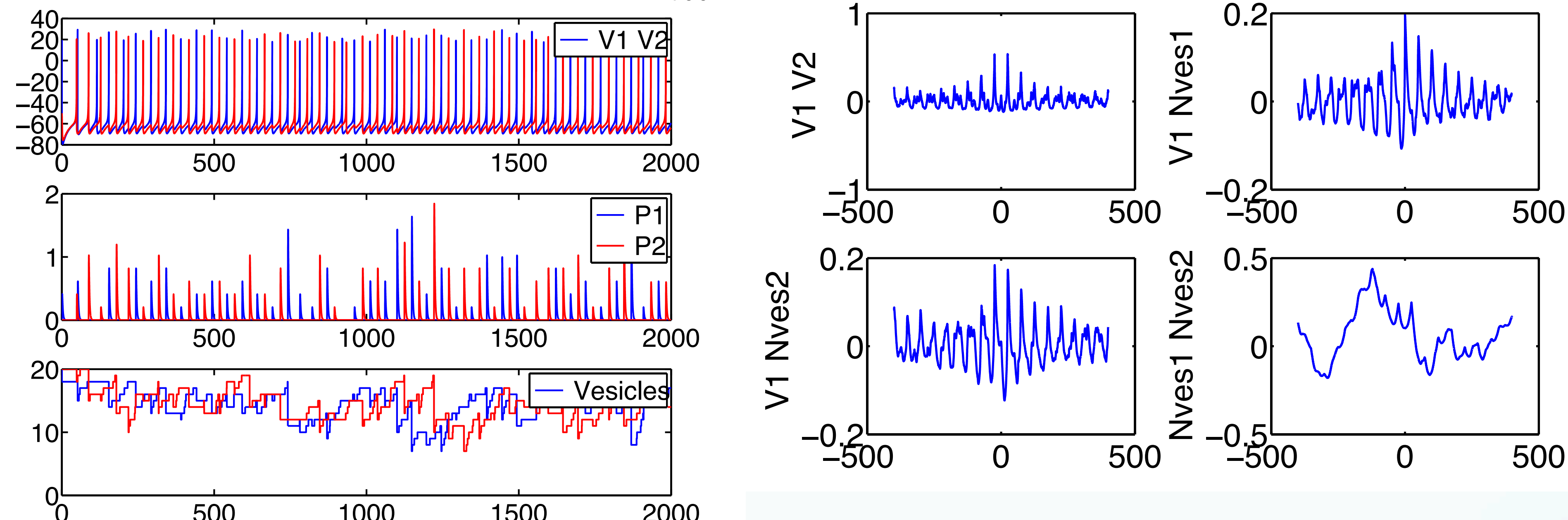
$$A = f(N_r)$$

$$B = g(N_r)$$

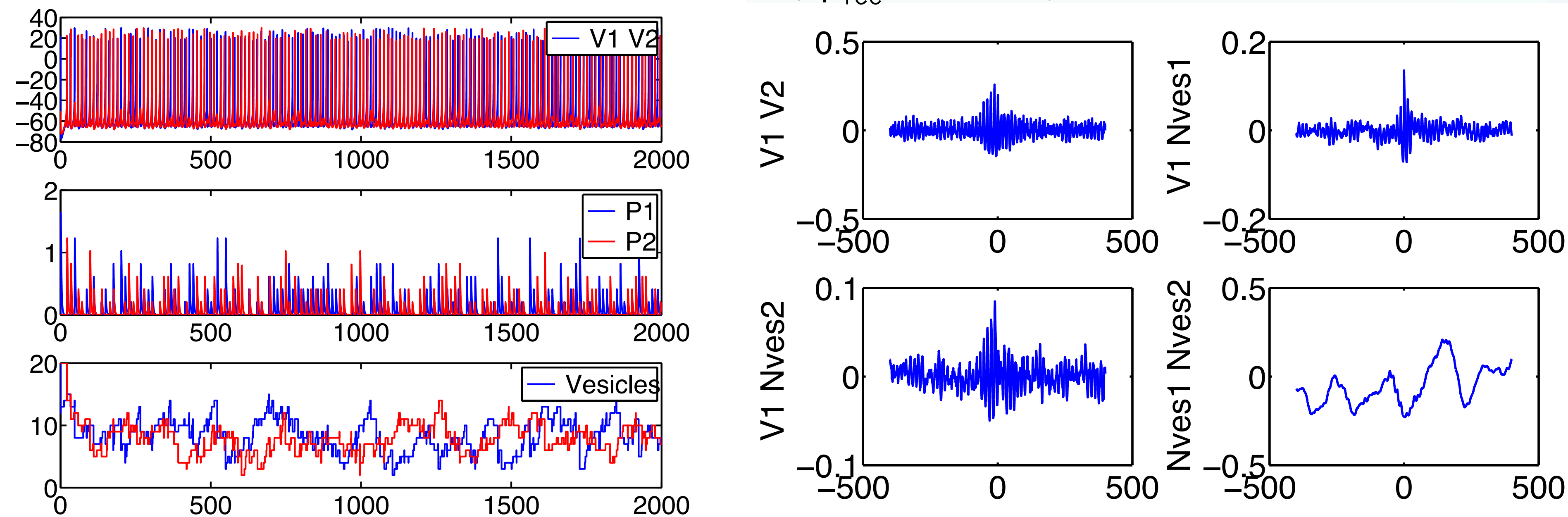
- $F_t = F_{t\text{-}1} + \text{binomial}\ (p_{rec}, E_t)$

Stochastic synapses: Hermann Implementation

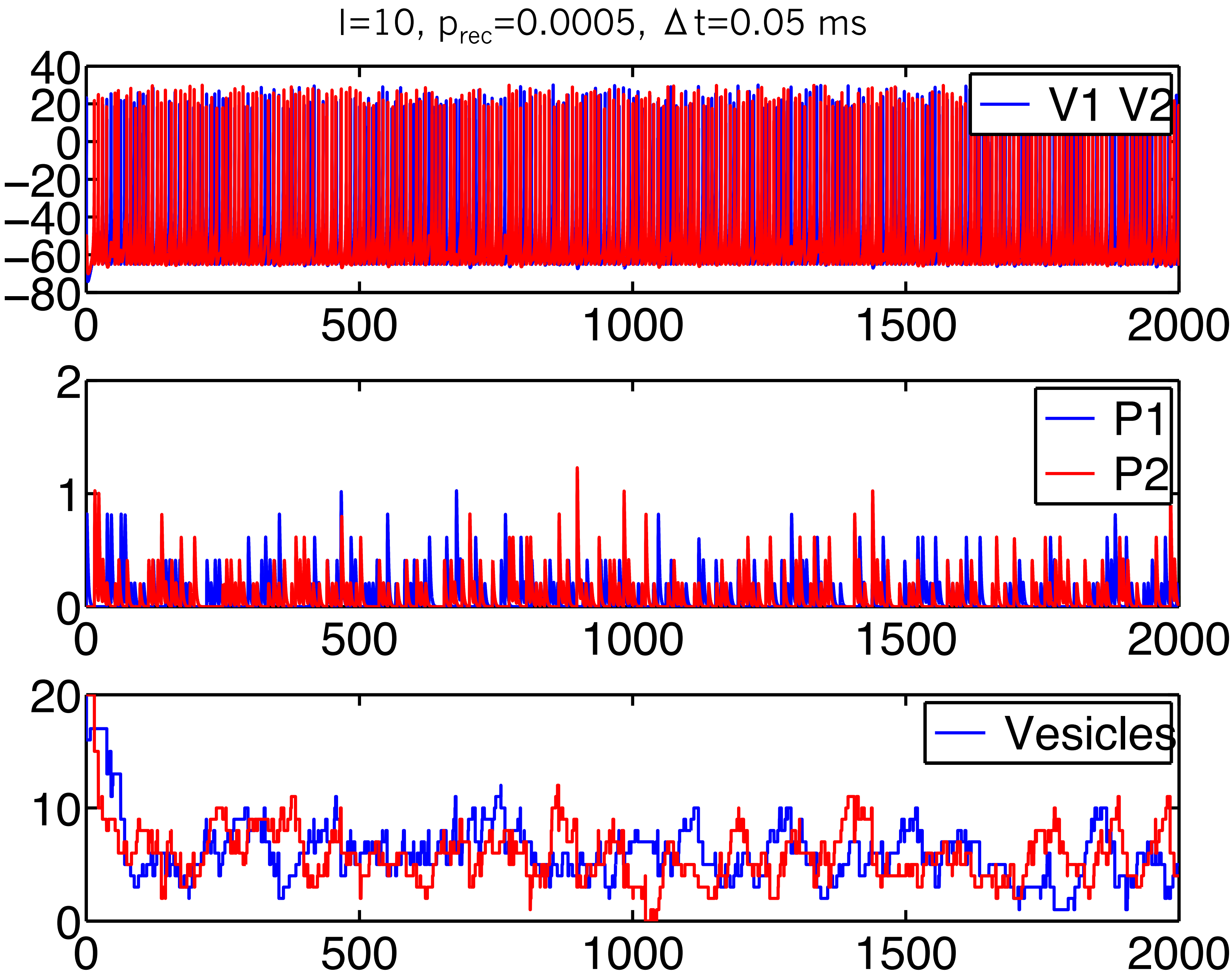
I=4, p_{rec}=0.0005, Δt=0.05 ms



I=7, p_{rec}=0.0005, Δt=0.05 ms

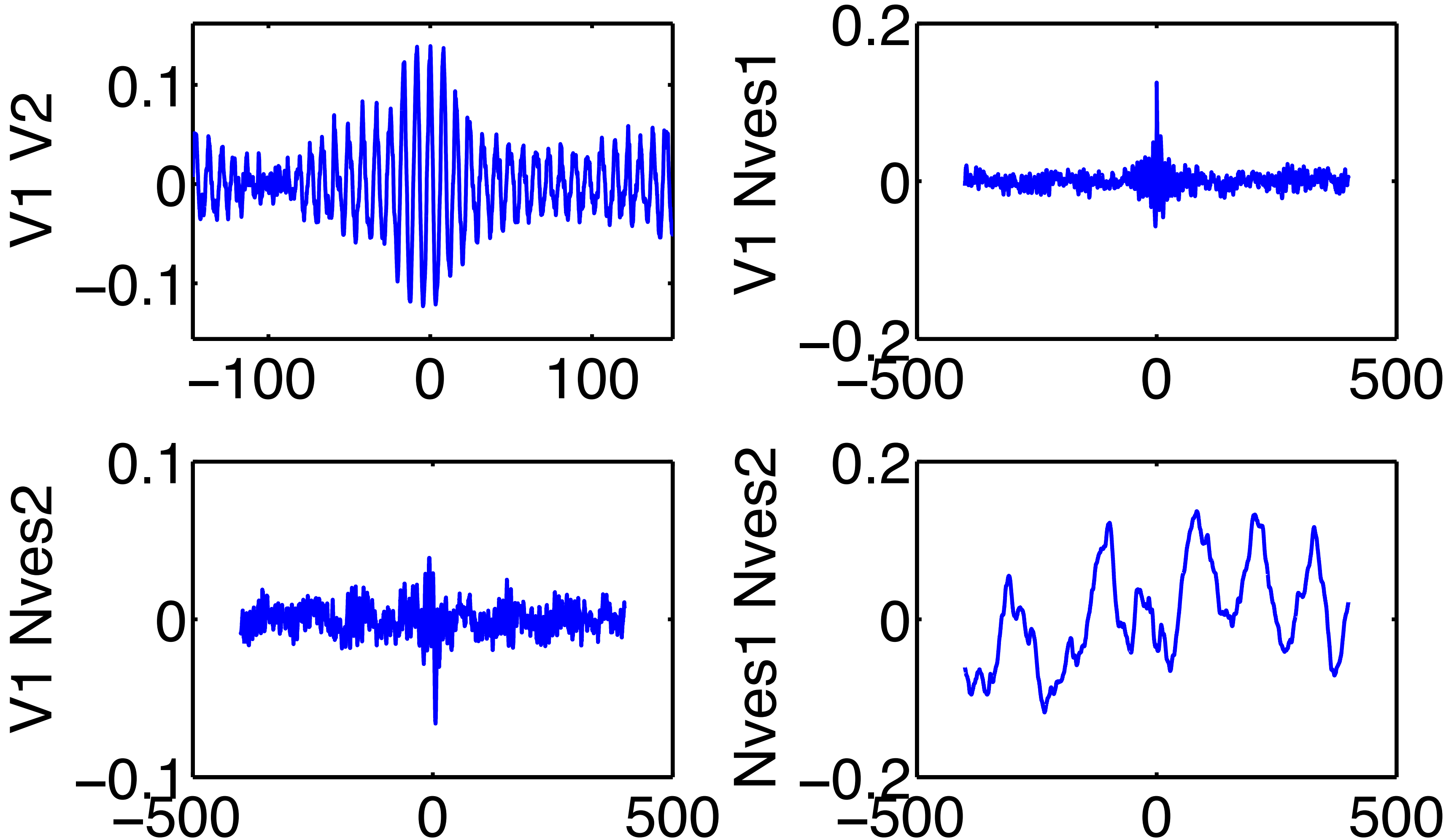


Stochastic synapses: Hermann Implementation

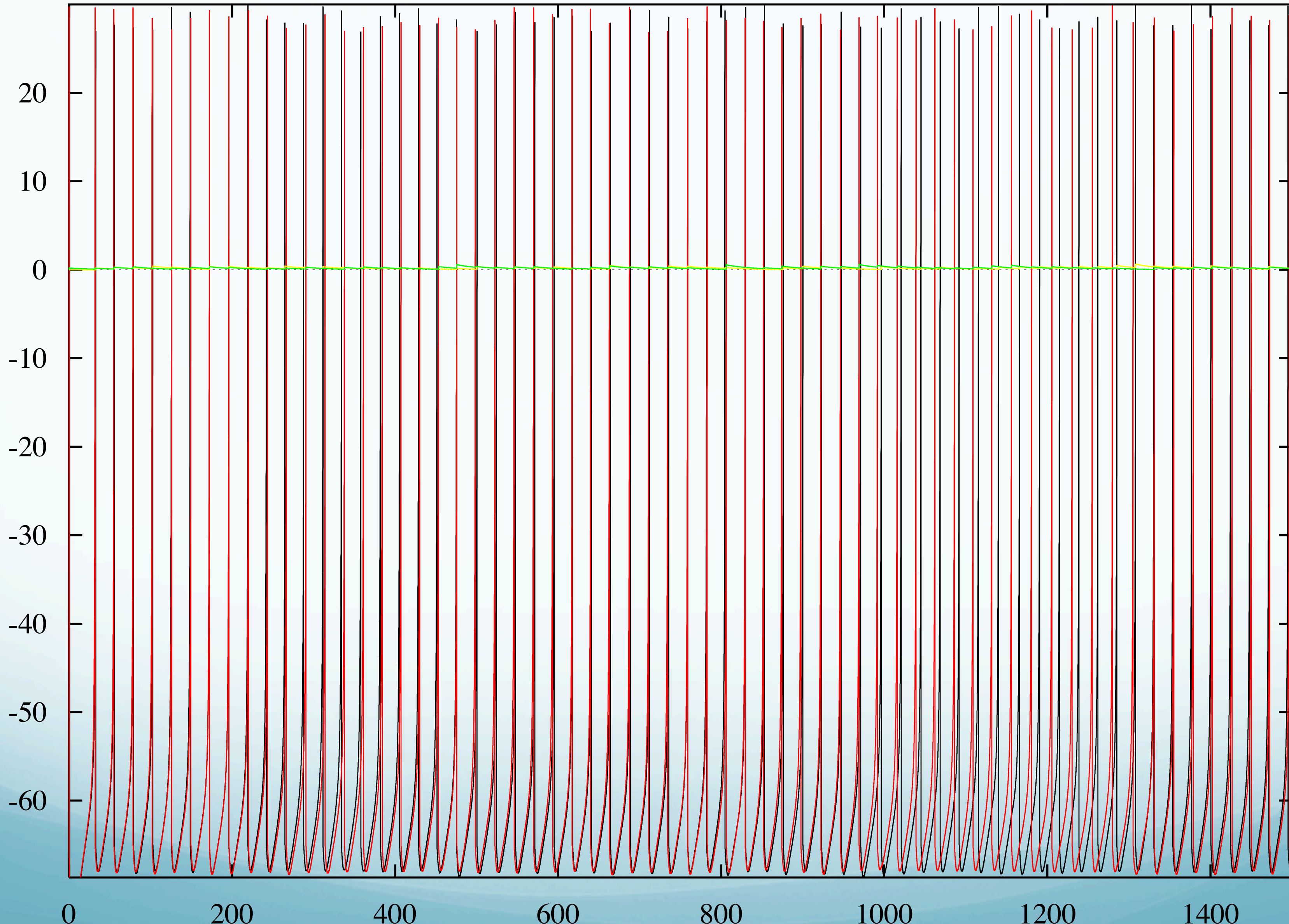


Stochastic synapses: Hermann Implementation

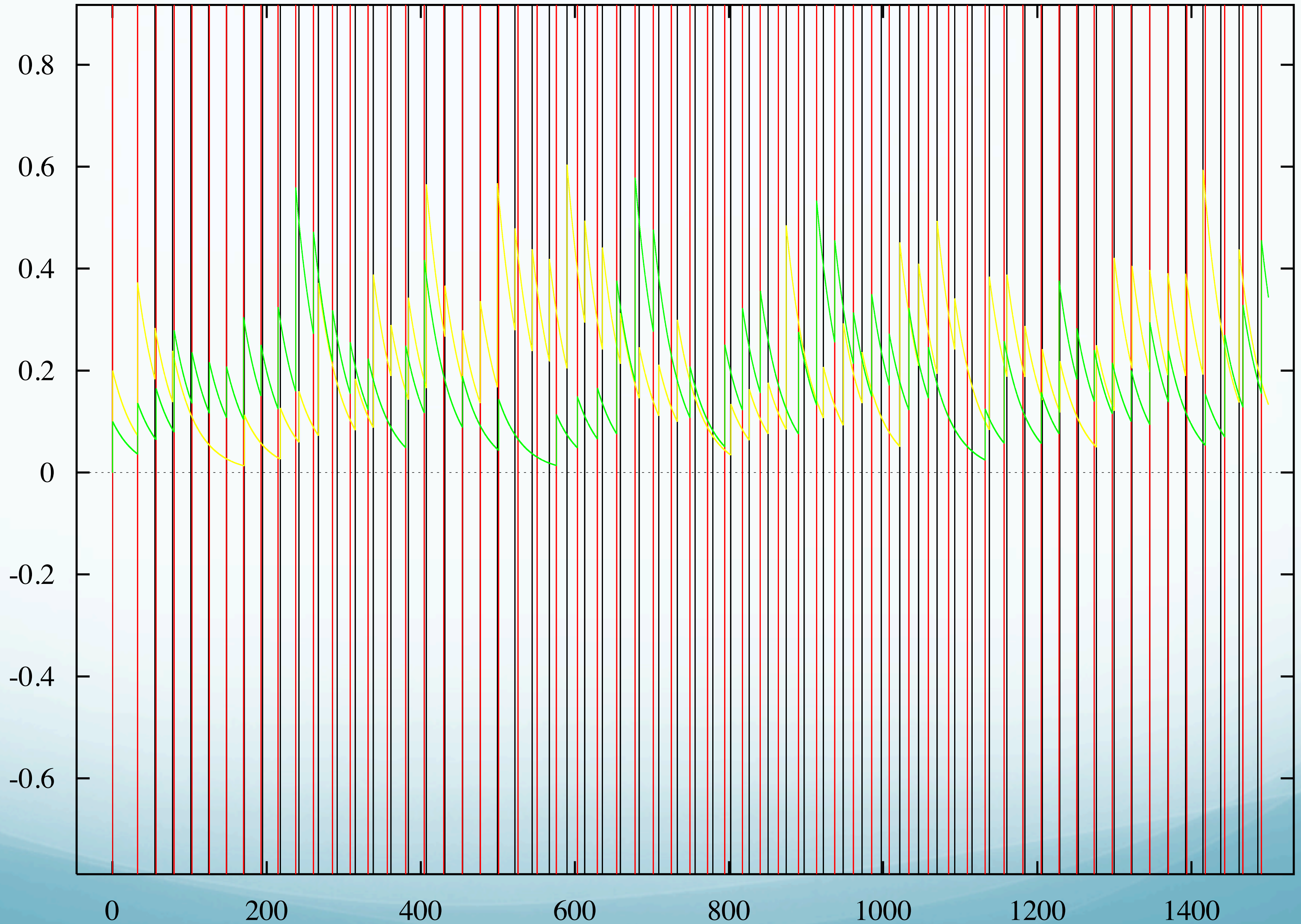
I=10, p_{rec}=0.0005, Δt=0.05 ms



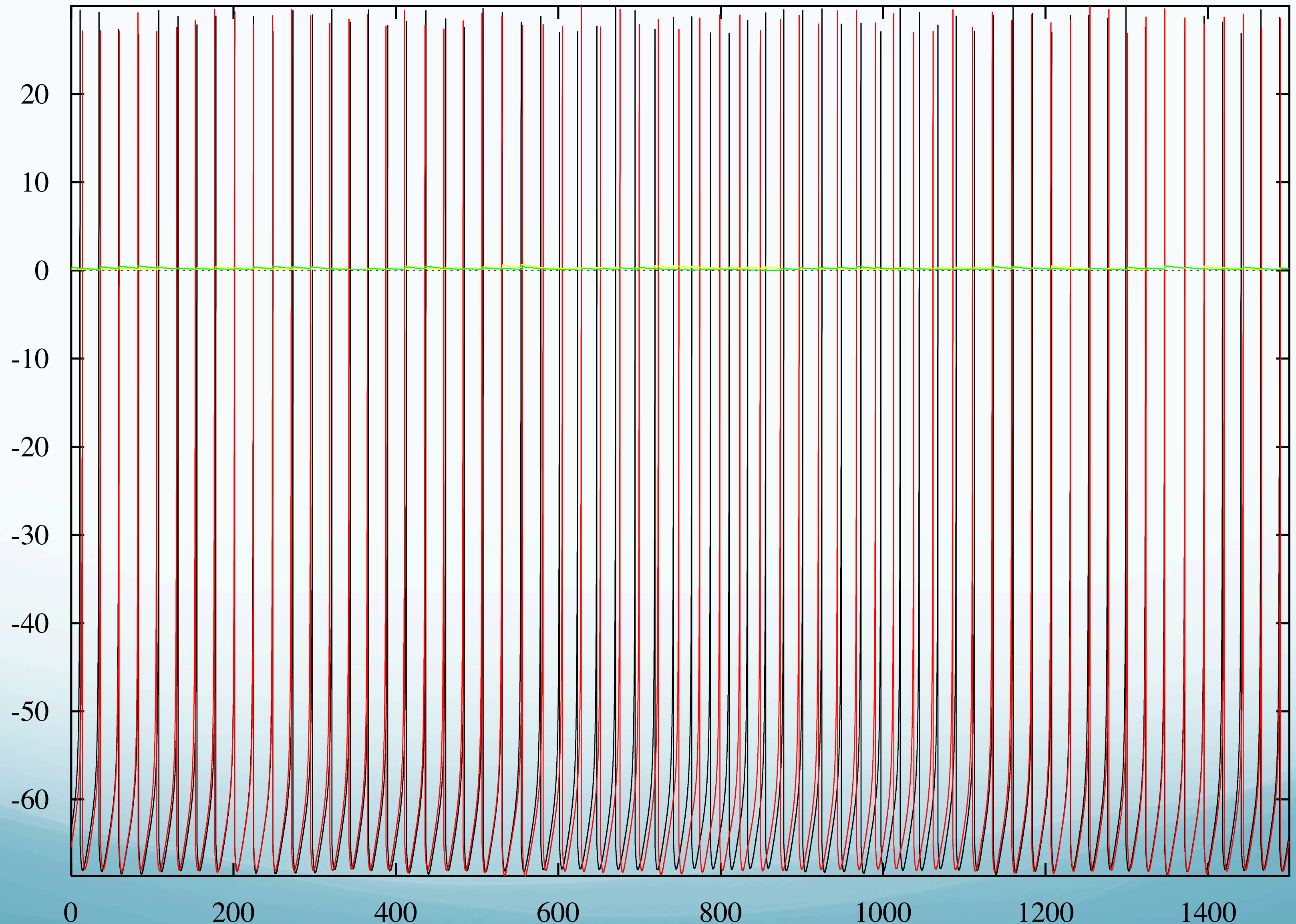
Stochastic synapses: Sashi Implementation



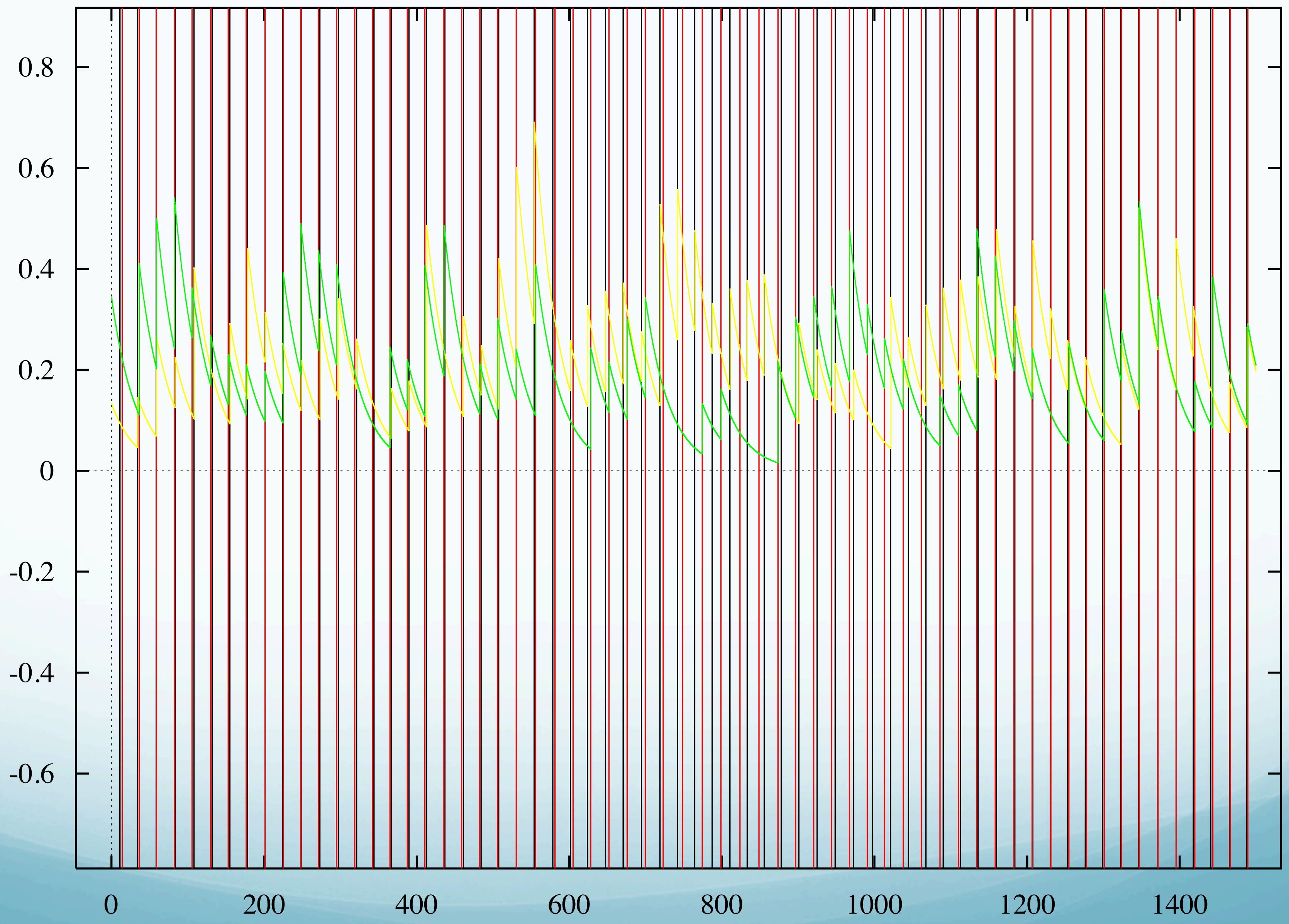
Stochastic synapses: Sashi Implementation



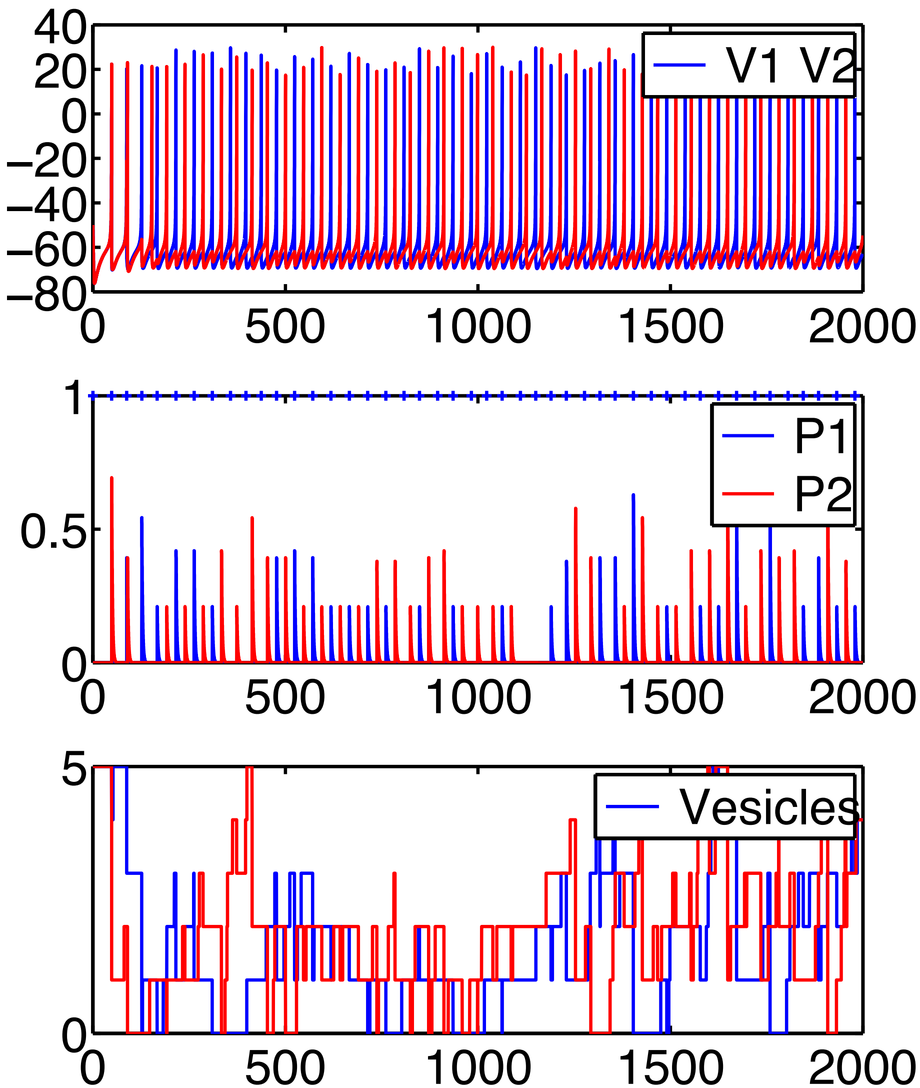
Stochastic synapses: Sashi Implementation

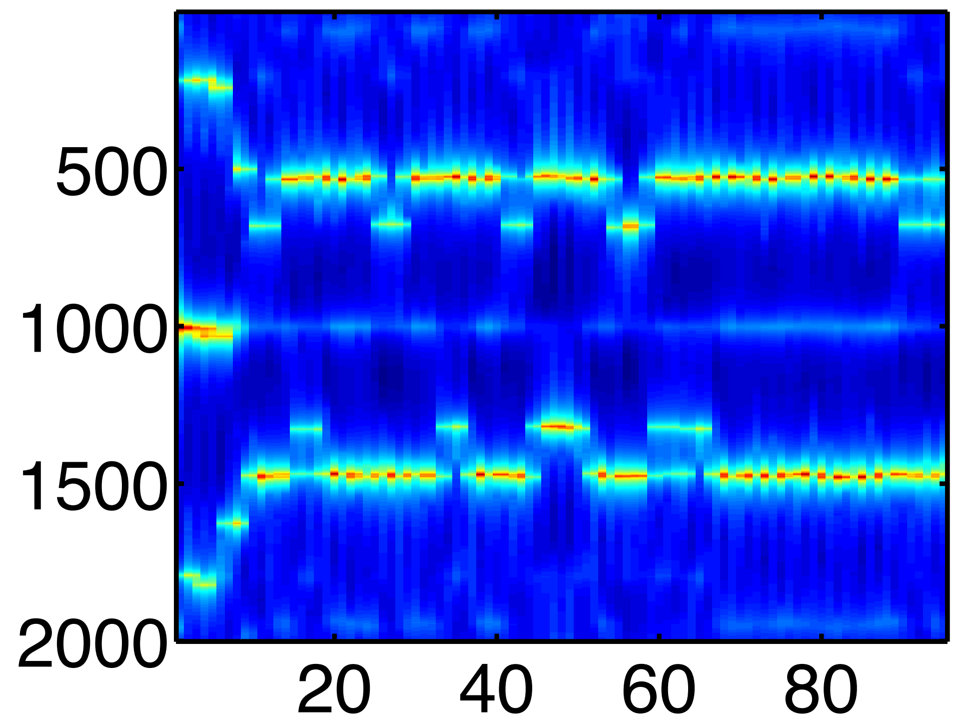


Stochastic synapses: Sashi Implementation

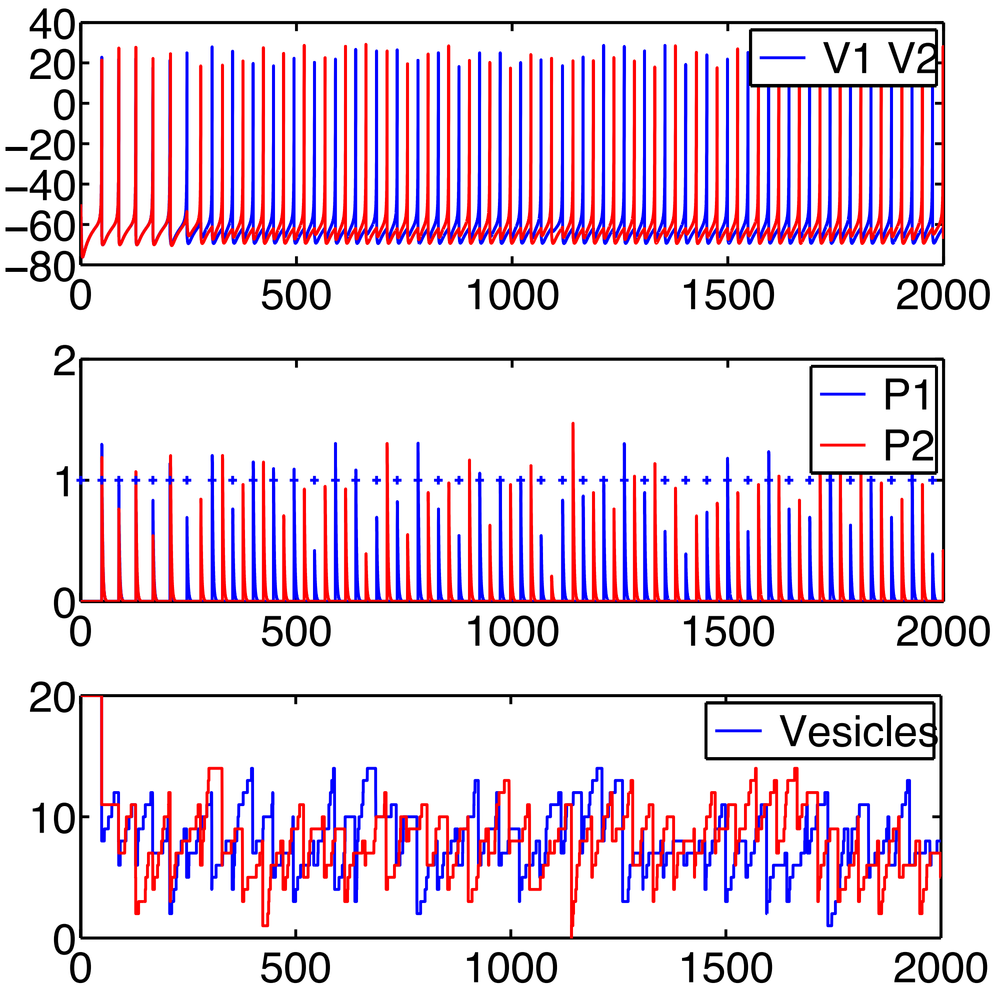


Hermann: I=4, pool = 5





I=4, pool = 20


40
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1000
1500
2000
V1 V2
2
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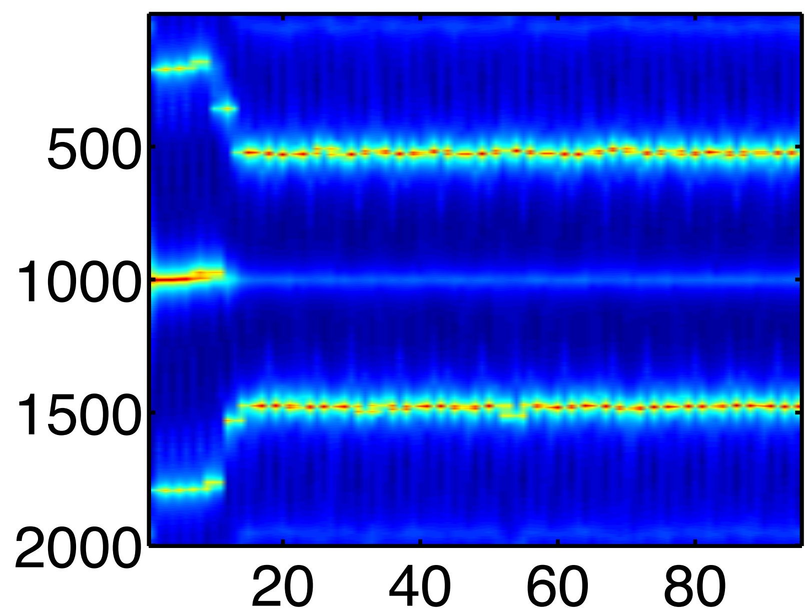
P1
P2
20
10
Vesicles


500
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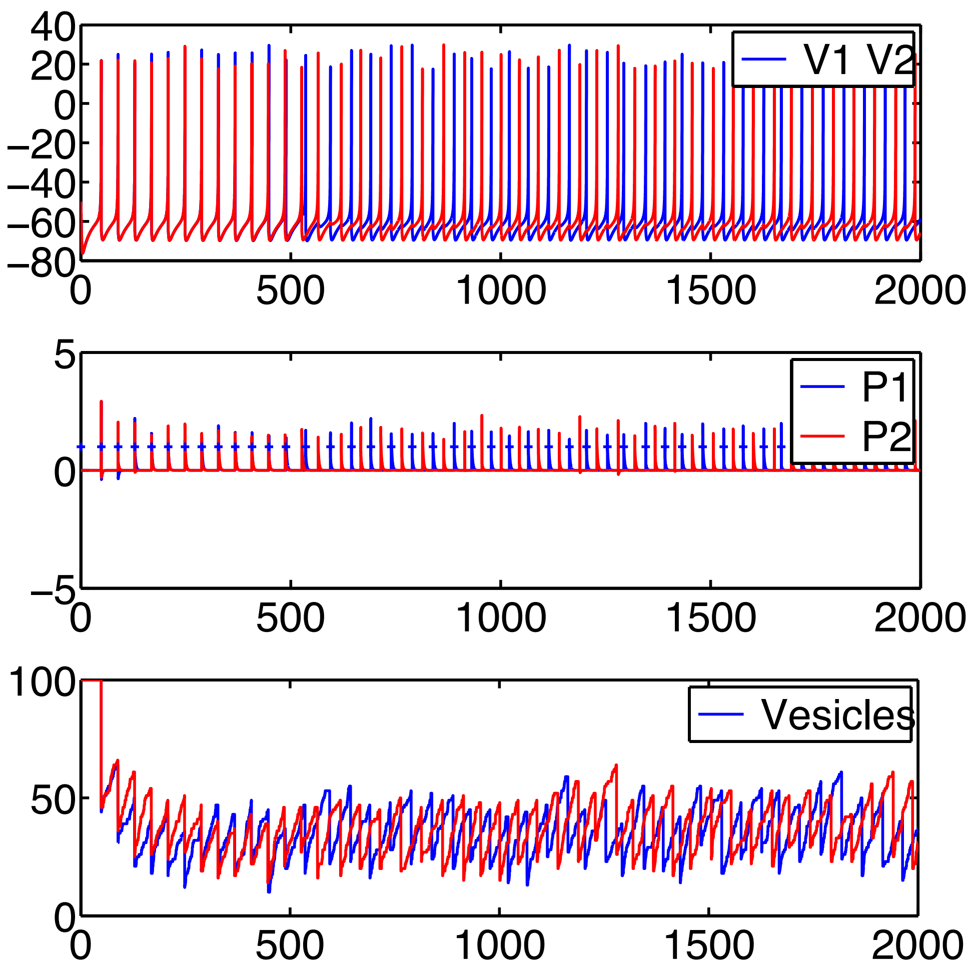
I=4, pool=100


V1 V2
P1
P2
Vesicles
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−20
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−5
100
50
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500
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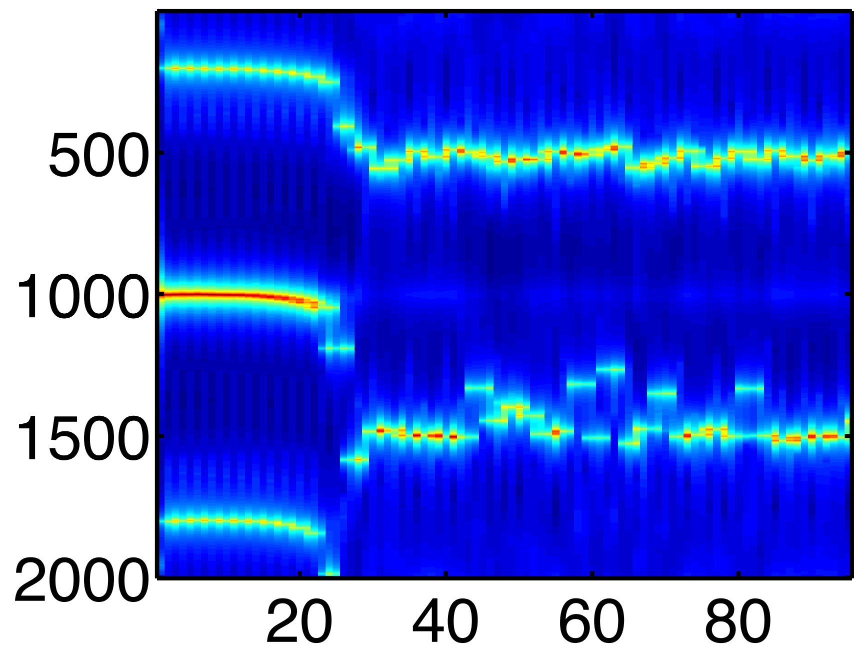
1500
2000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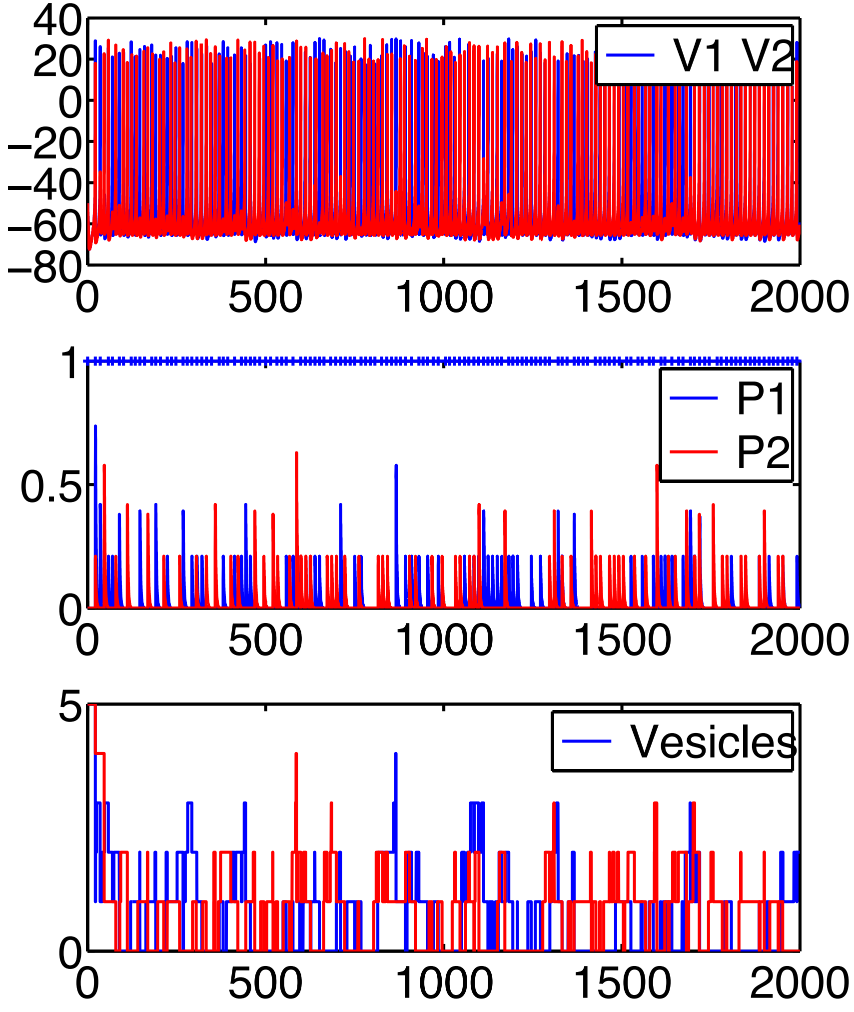
I=7, pool=5



V1 V2
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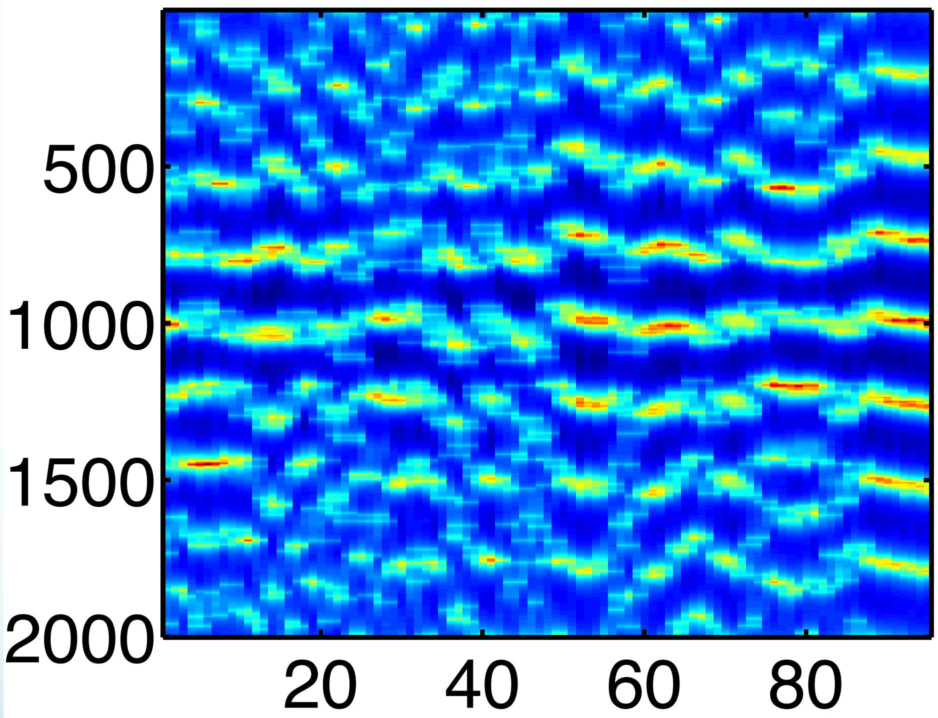
Vesicles



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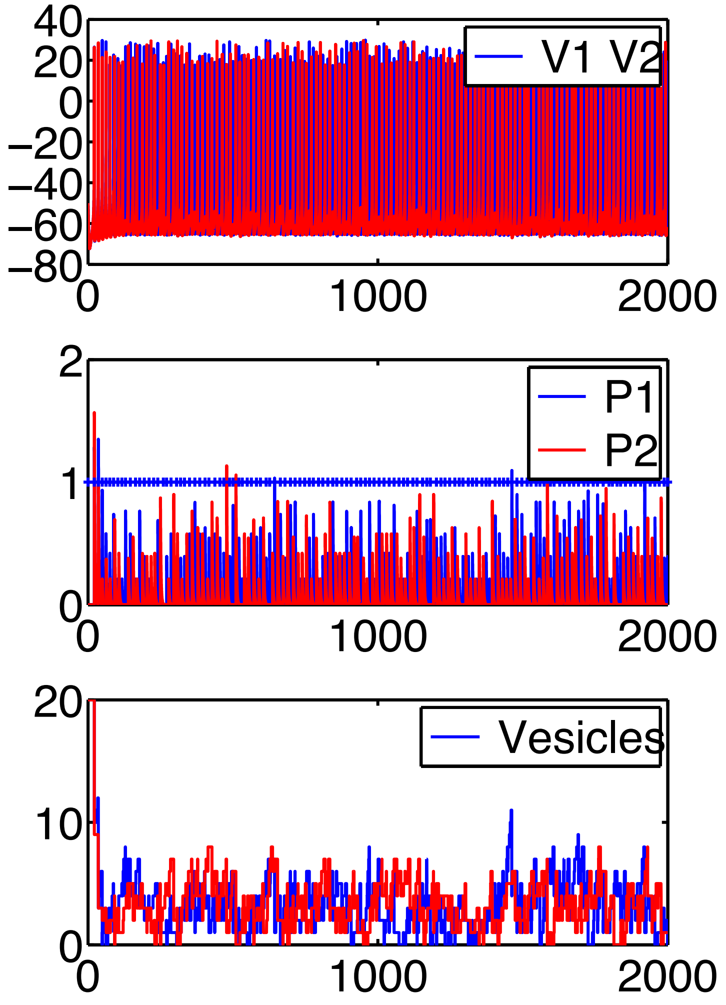
I=7, pool=20



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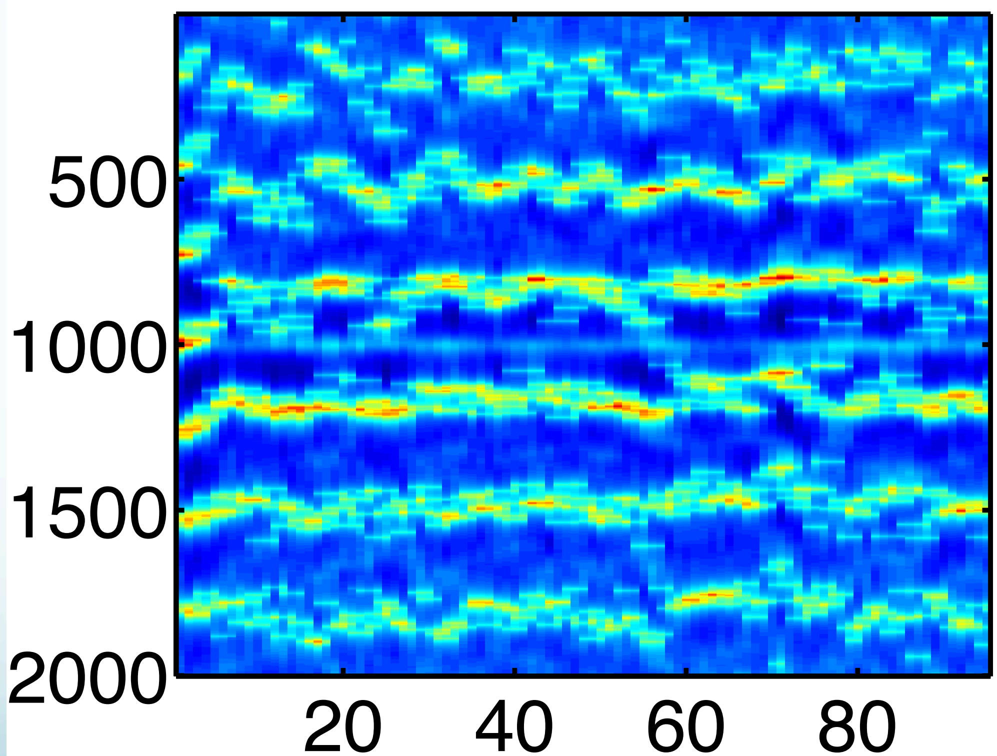

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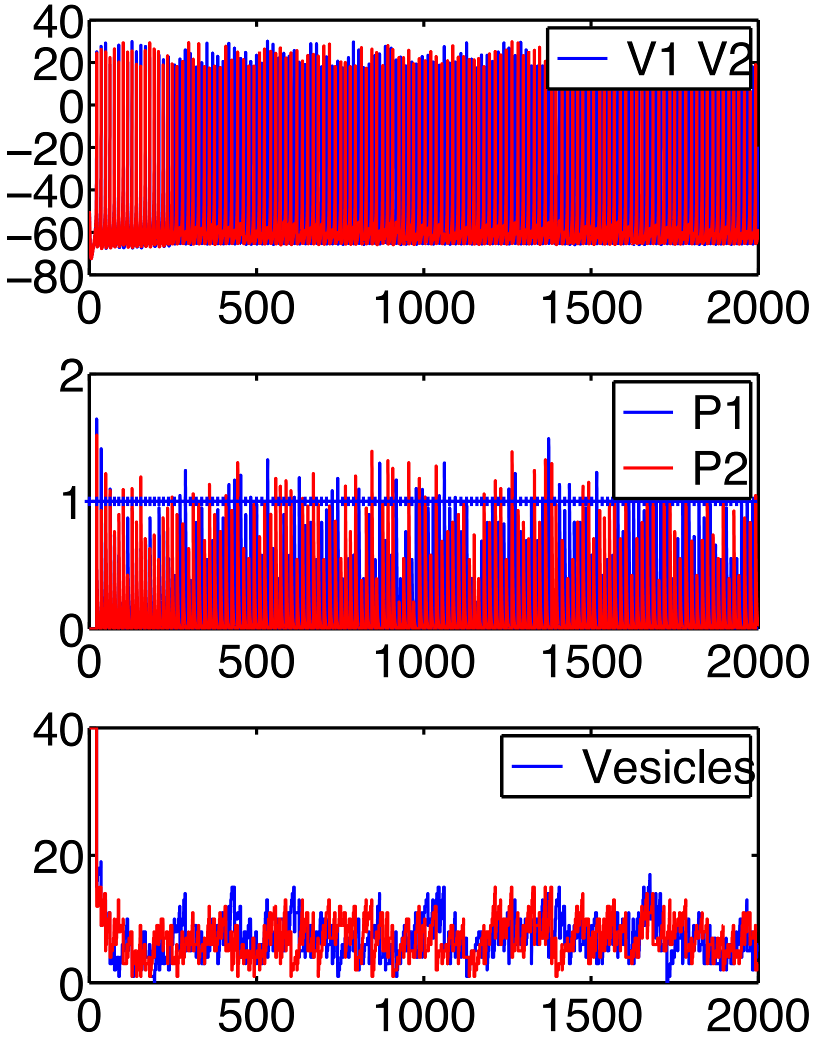
I=7, pool=40



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Vesicles
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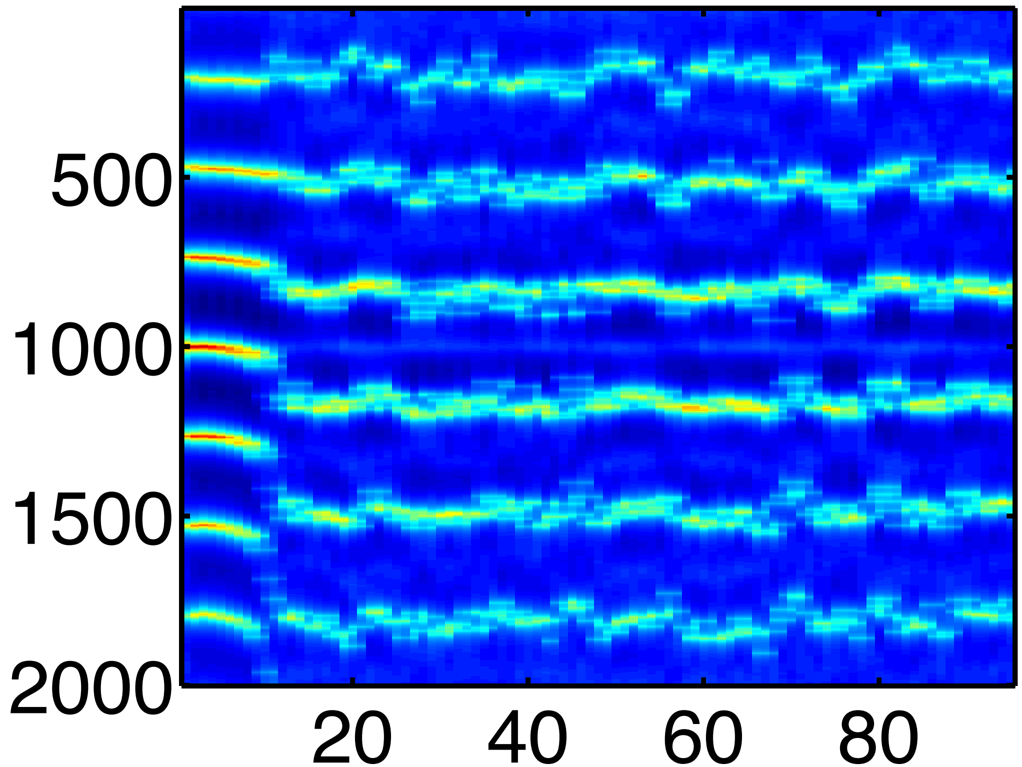

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