Report of Integrate and Fire Neuronal Network Simulation

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This week, I mainly focused on replanting my codes for IF neuronal network simulation as well as data analysis program for time delayed mutual information from Windows platform to Linux. After I polished my coding, my new codes generate different results compared with old ones based on identical inputs and inital conditions. To find out more details for this strange cases, I ran a few test and find some clues about it. Though I haven't come up with the final conclusion about this problem, I would like to present some of my findings.

At the begining, I would mention that I didn't change any logical functions as well as algorithm in my codes. And to verify the correctness of it, its numerical convergence must be calculated as usual. Here, I tried same operations on both of my old and new codes to compare their different outputs.

For single neuronal simulating and data recording, new codes and old codes present idential results according to same inputs, including their numerical convergence. However, for network simulaiton, things go differently. In Figure 1 and 2, the numerical convergence of network simulation is presented. The number of neurons in the net is 20, and each neuron is conected with its 4 closest neurons. The mean Poisson driven rate of 1500 Hz.

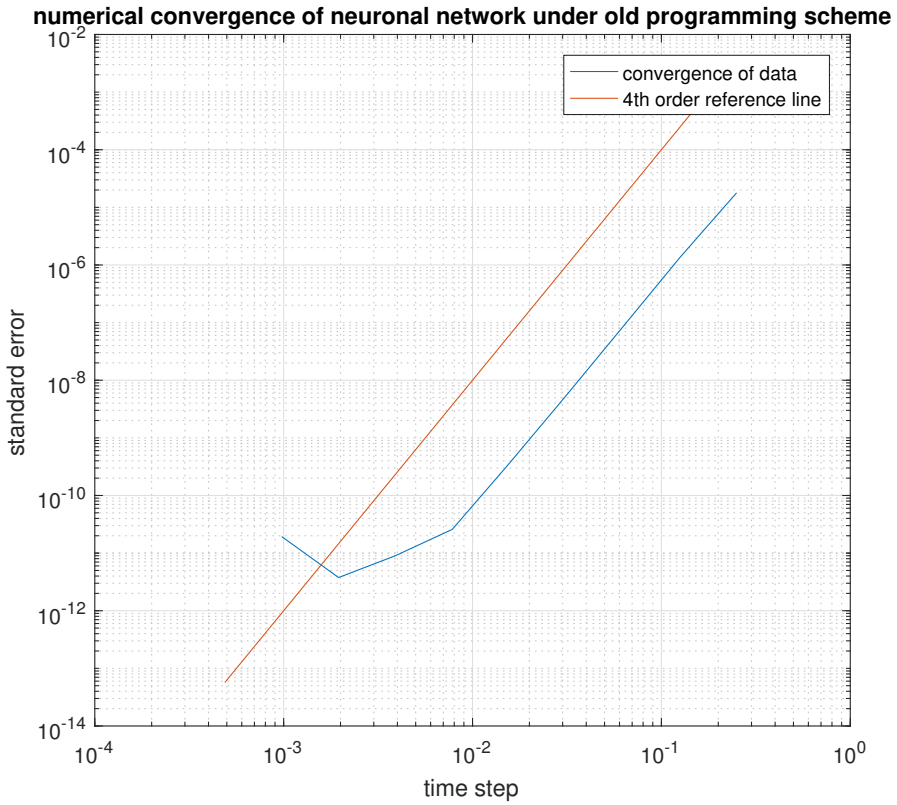

Figure 1: Numerical convergence of group dynamics based on old version codes. 20 neurons in total, and each neuron connects with 4 other neurons. The network is arranged in a regular loop lattice. The feedforward Poisson driving rate is 1.5/ms. In this case, the average firing rate among neurons is around 8.5 Hz.

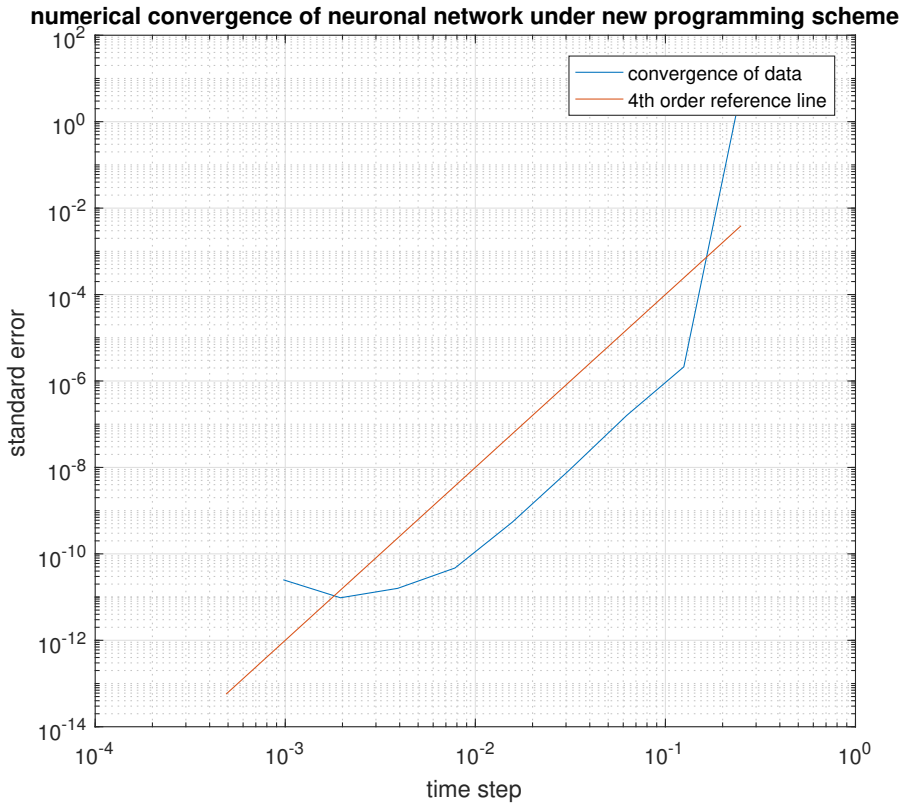

Figure 2: Numerical convergence of group dynamics based on new version codes. Its network setups are identical to the case in Figure 1. In this case, the average firing rate among neurons is around 9 Hz.

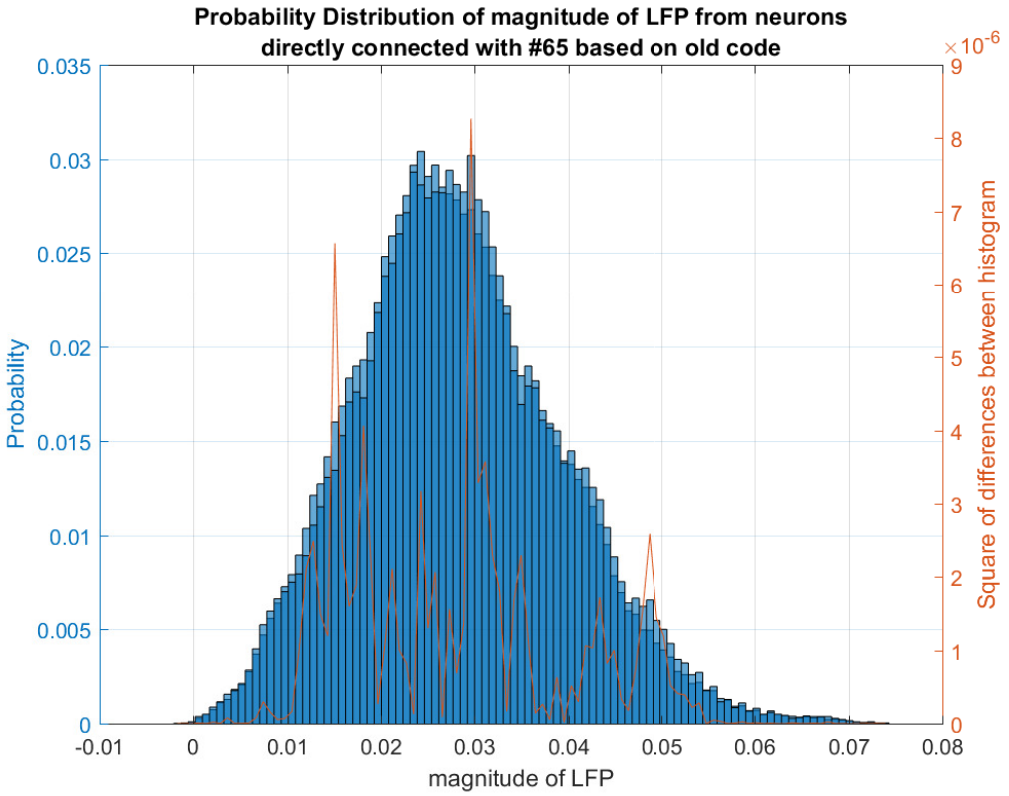

Figure 3: Probability distribution of magnitude of local field potential by neurons in post-loop that directly connected to #65 neuron in pre-loop. The network is arranged as a regular loop lattice, which contains 100 neurons. 80% neurons are excitatory, 20% are inhibitory. Networks are driven by 1500 Hz feedforward Poisson process. And the total time range of LFP is 1000 ms. The data is generated by old coding scheme.

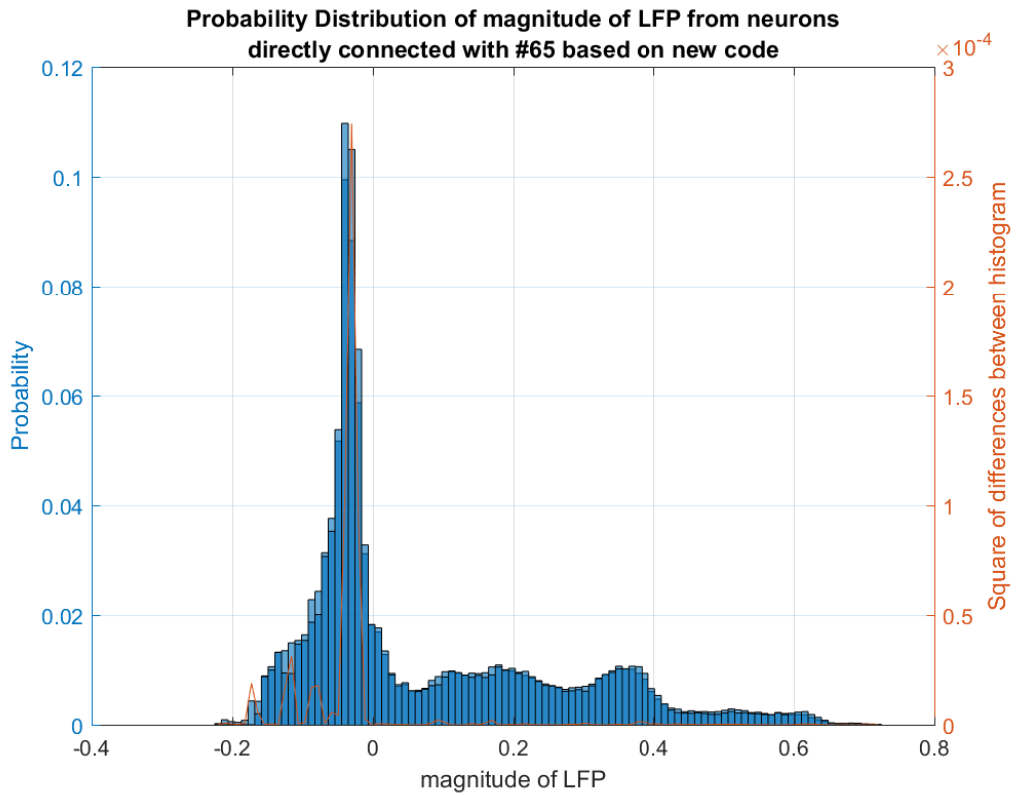

Figure 4: Probability distribution of magnitude of local field potential, which is generated by neurons in post-loop that directly connected to #65 neuron in pre-loop. The setups of network are identical to previous case. The data is generated by new coding scheme.

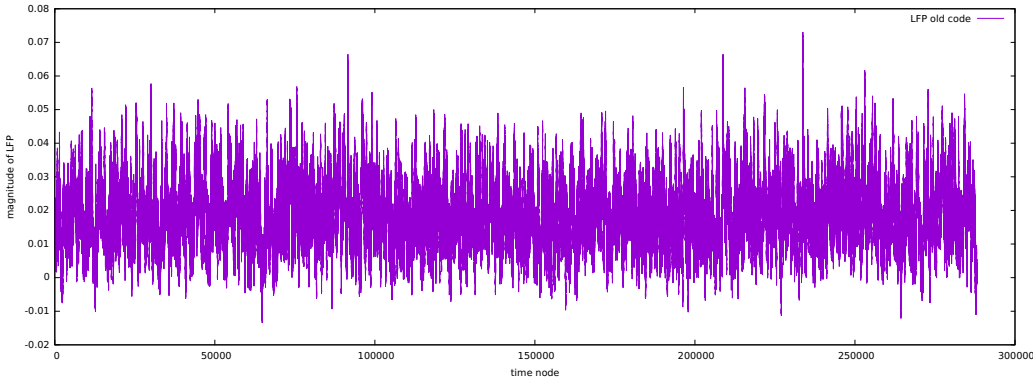

Figure 5: Local field potential of neurons directly connected with #65 neuron, based on old coding scheme.

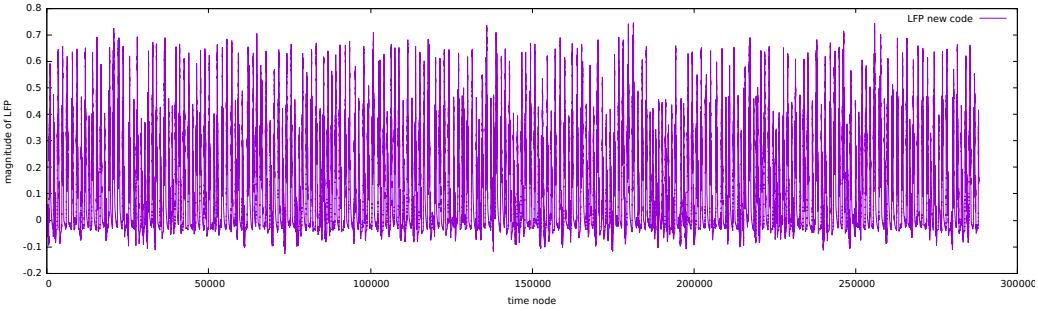

Figure 6: Local field potential of neurons directly connected with #65 neuron, based on new coding scheme.

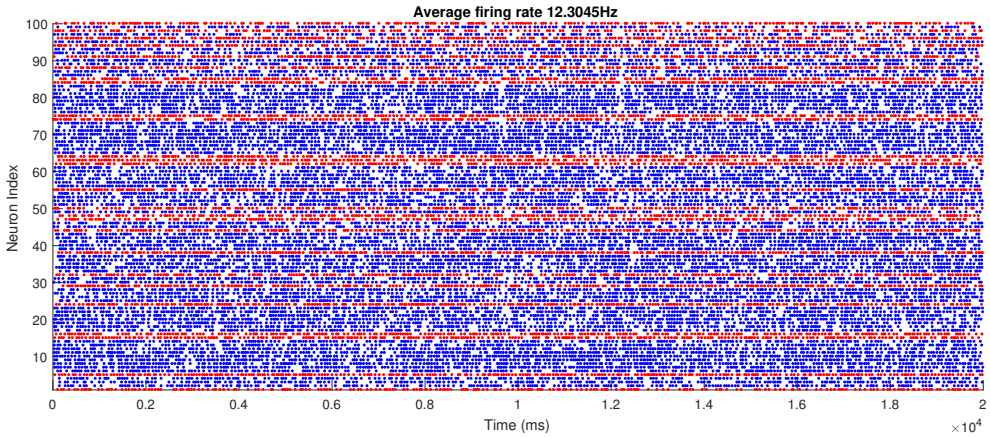

Figure 7: Raster plot of loop 1, based on old coding scheme. Network is driven by 1500 Hz Poisson process.

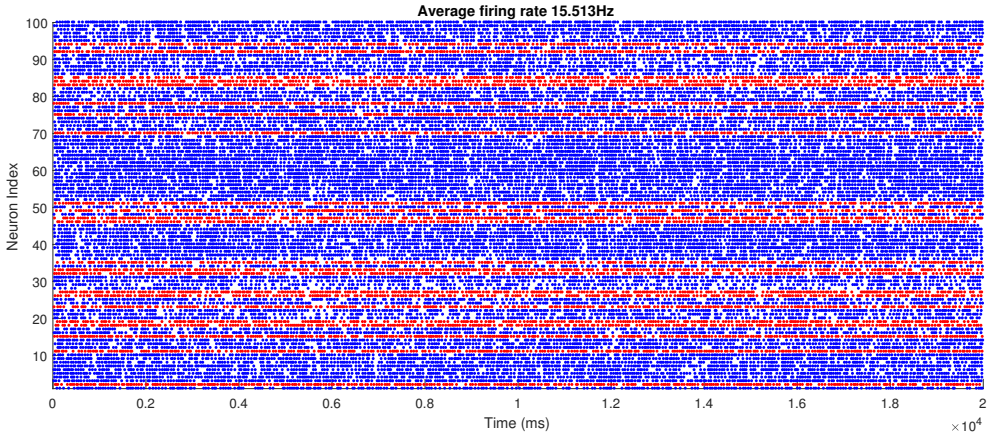

Figure 8: Raster plot of loop 2, based on old coding scheme. Network is driven by 1500 Hz Poisson process as well as neural input from loop 1.

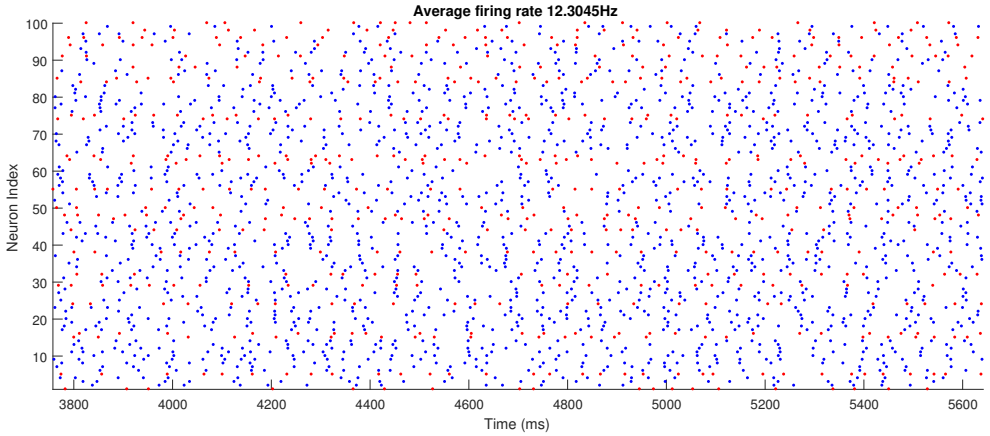

Figure 9: Raster plot of loop 1, based on old coding scheme. Network is driven by 1500 Hz Poisson process.

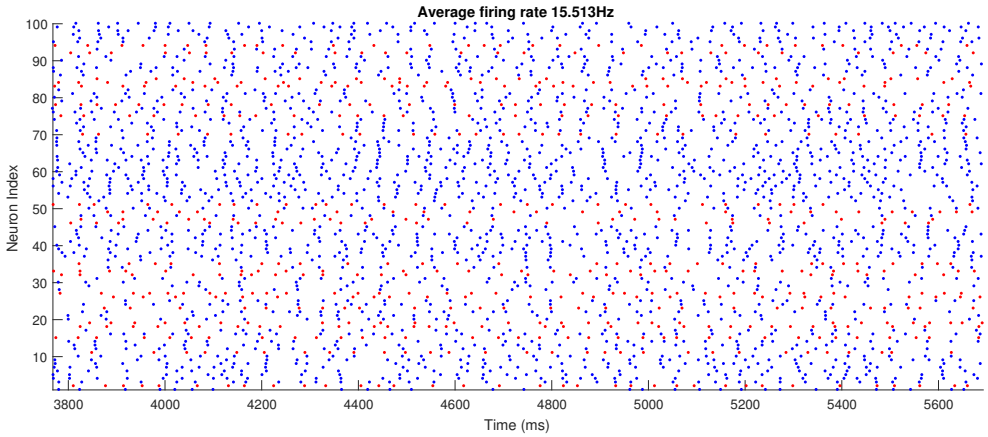

Figure 10: Raster plot of loop 2, based on old coding scheme. Network is driven by 1500 Hz Poisson process as well as neural input from loop 1.

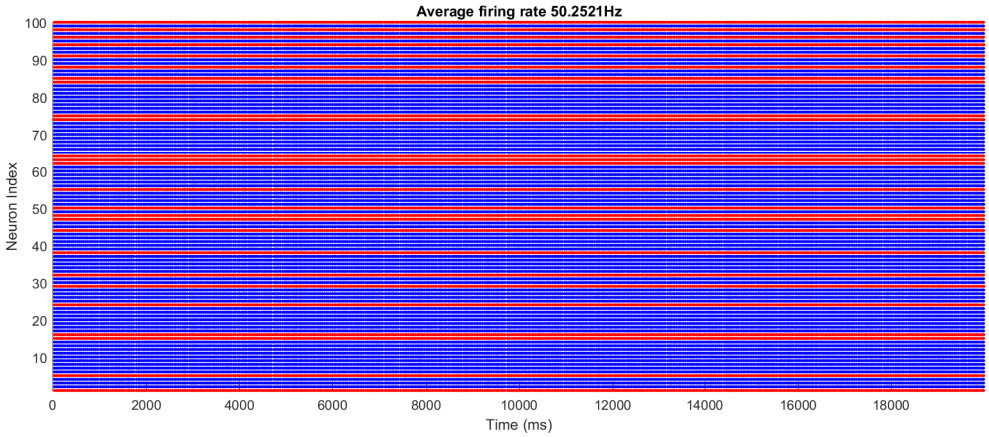

Figure 11: Raster plot of loop 1, based on new coding scheme. Network is driven by 1500 Hz Poisson process.

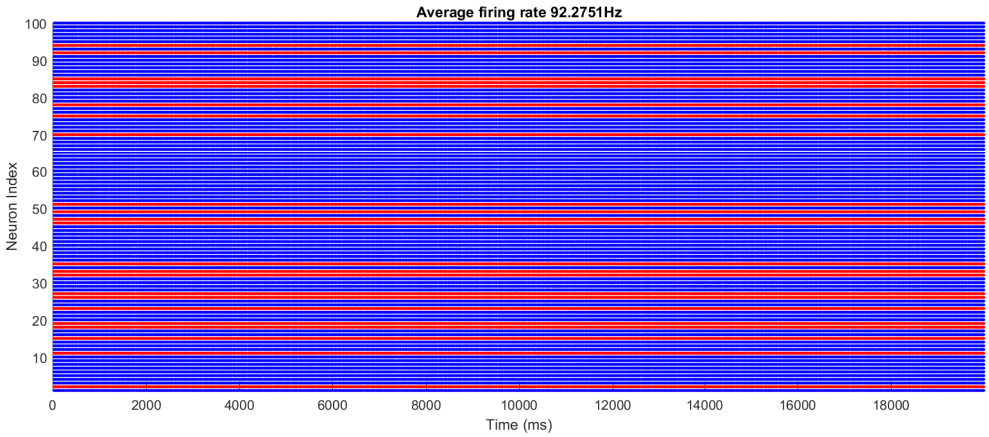

Figure 12: Raster plot of loop 2, based on new coding scheme. Network is driven by 1500 Hz Poisson process as well as neural input from loop 1.

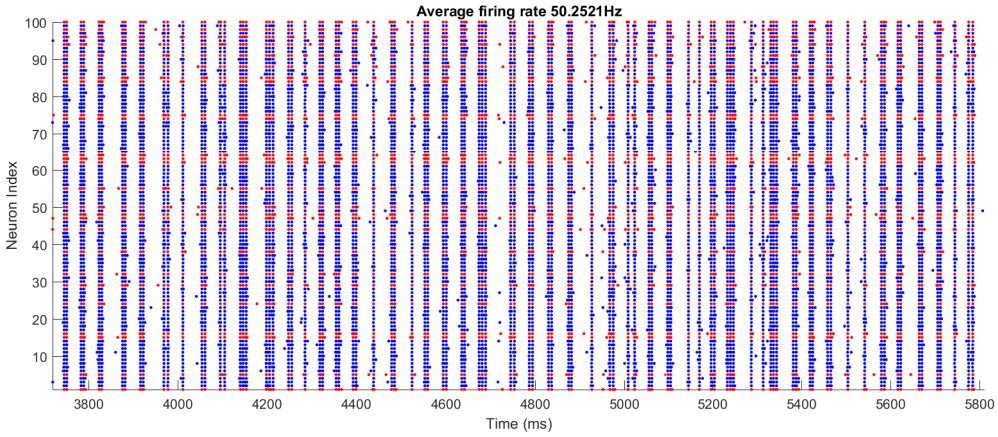

Figure 13: Raster plot of loop 1, based on new coding scheme. Network is driven by 1500 Hz Poisson process.

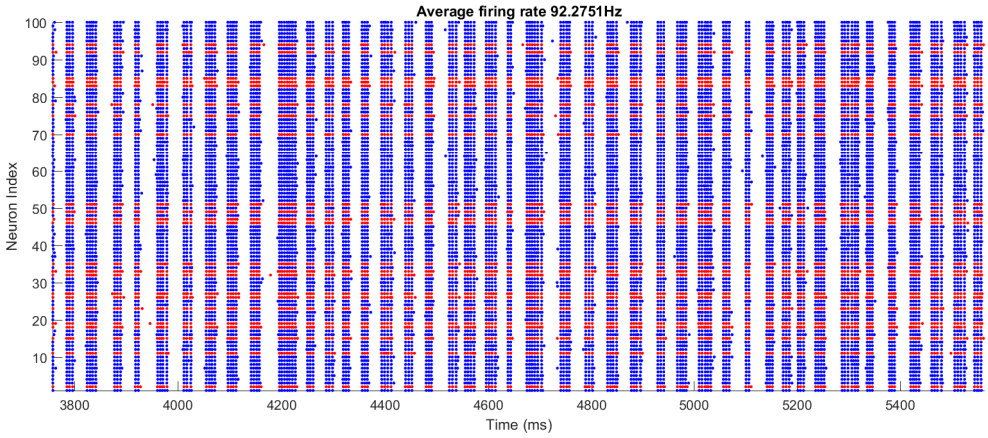

Figure 14: Raster plot of loop 2, based on new coding scheme. Network is driven by 1500 Hz Poisson process as well as neural input from loop 1.

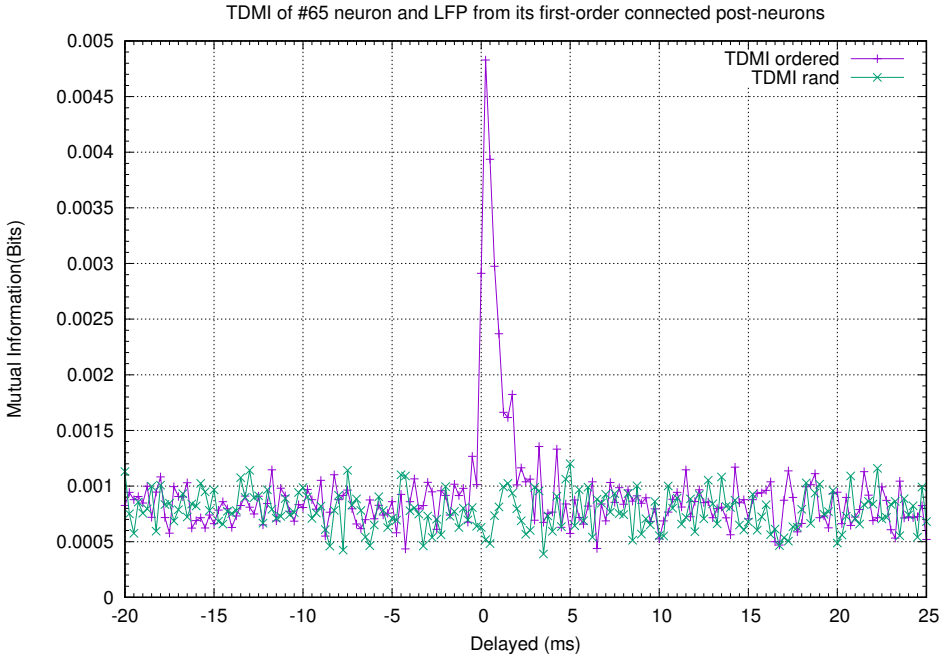

Figure 15: TDMI of #65 neuron's spike train and its first order connected LFP, based on old coding scheme. The timing-step for LFP is 0.25ms. Network is driven by 1500 Hz Poisson process.

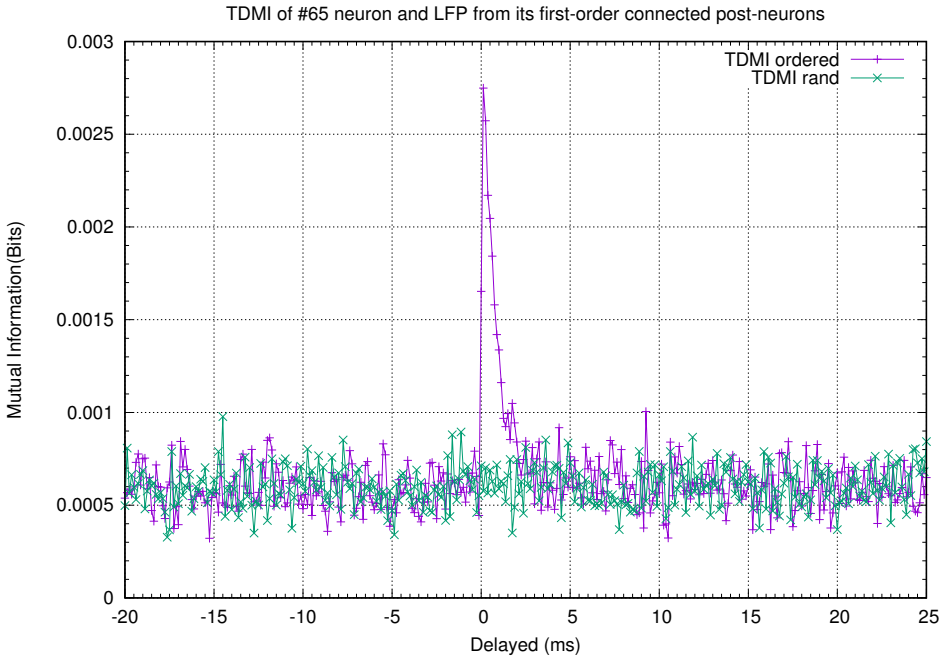

Figure 16: TDMI of #65 neuron's spike train and its first order connected LFP, based on old coding scheme. The timing-step for LFP is 0.125ms. Network is driven by 1500 Hz Poisson process.

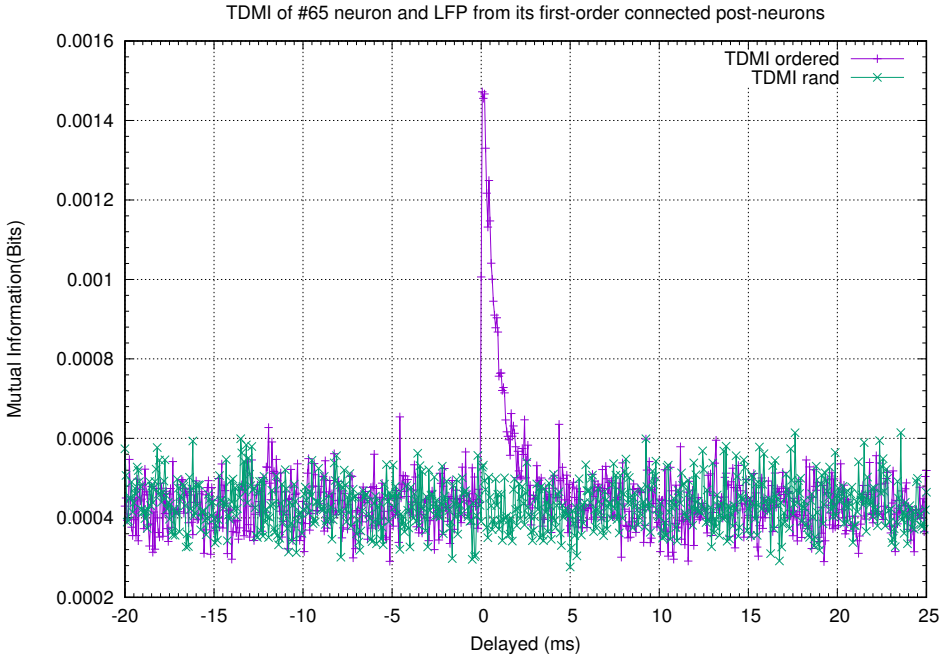

Figure 17: TDMI of #65 neuron's spike train and its first order connected LFP, based on old coding scheme. The timing-step for LFP is 0.0625ms. Network is driven by 1500 Hz Poisson process.

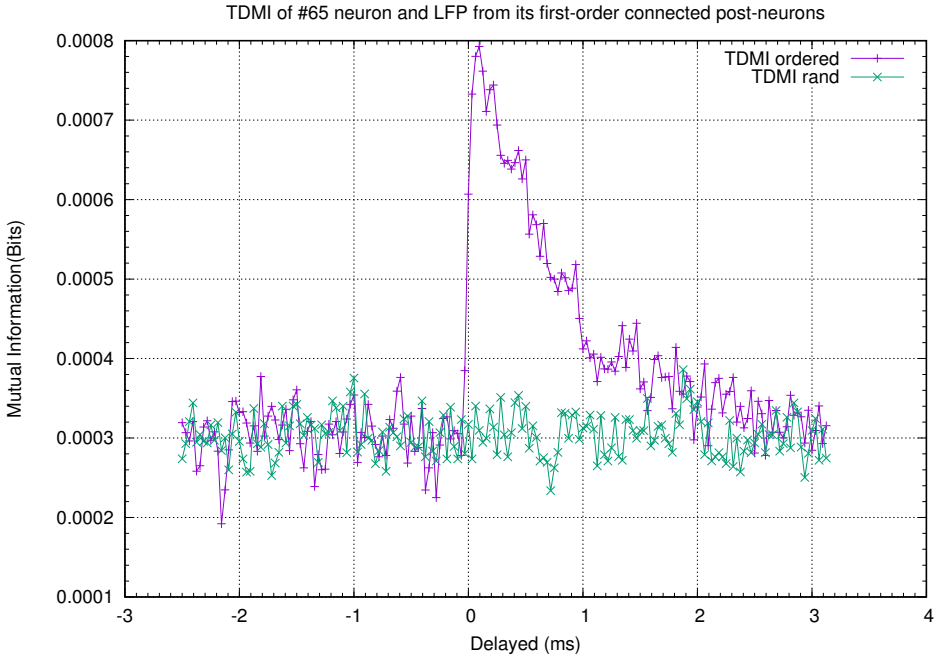

Figure 18: TDMI of #65 neuron's spike train and its first order connected LFP, based on old coding scheme. The timing-step for LFP is 0.03125ms. Network is driven by 1500 Hz Poisson process.

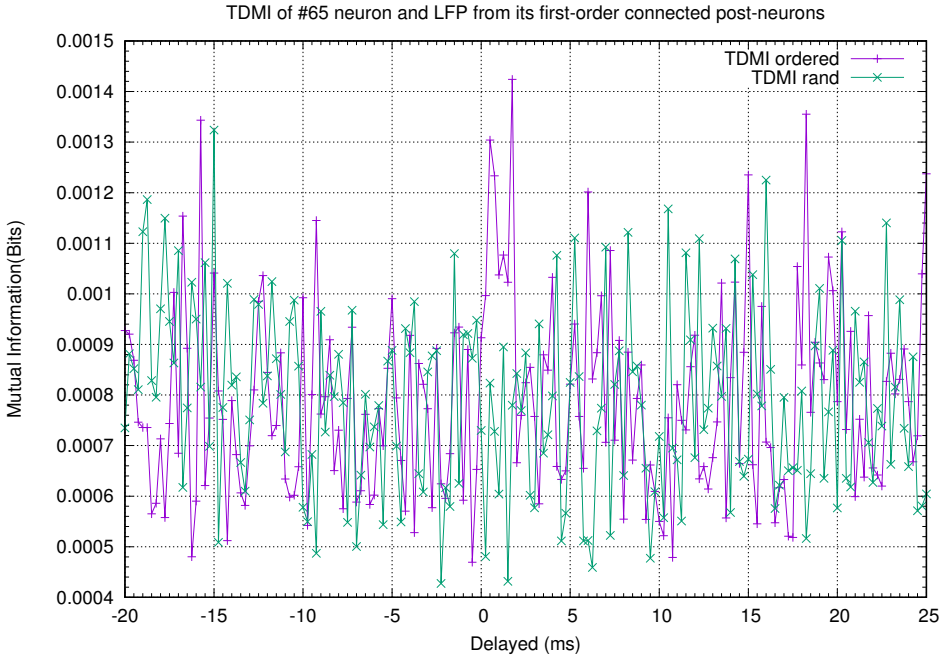

Figure 19: TDMI of #65 neuron's spike train and its first order connected LFP, based on old coding scheme. The timing-step for LFP is 0.25ms. Network is driven by 1500 Hz Poisson process.

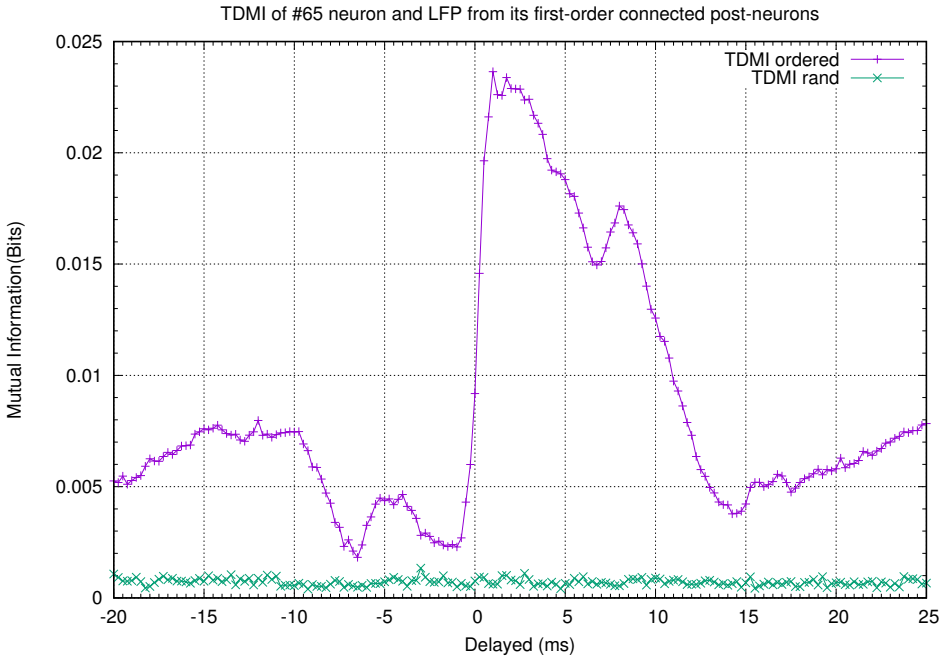

Figure 20: TDMI of #65 neuron's spike train and its first order connected LFP, based on new coding scheme. The timing-step for LFP is 0.25ms. Network is driven by 1500 Hz Poisson process.

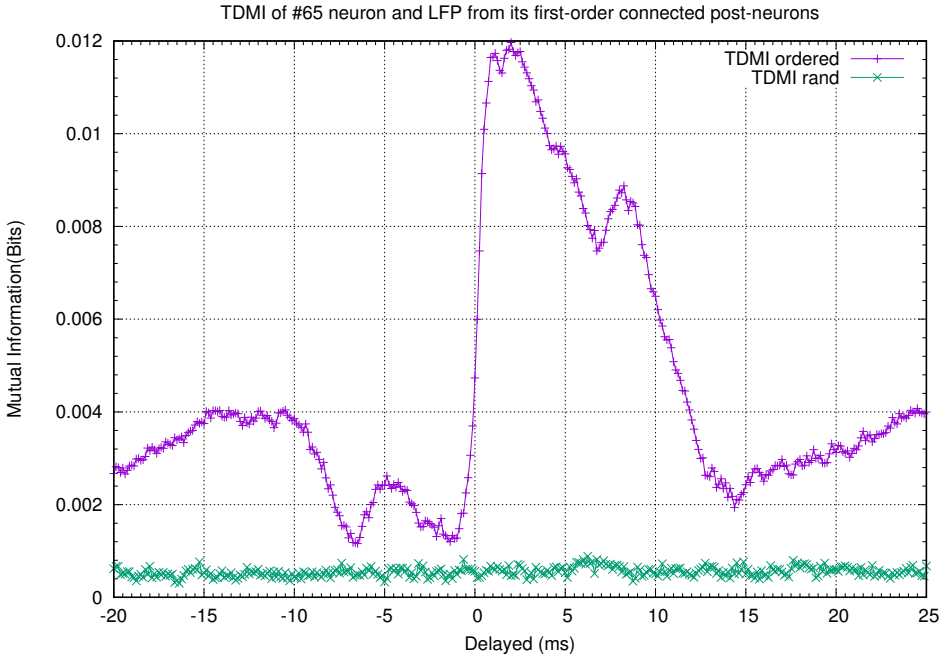

Figure 21: TDMI of #65 neuron's spike train and its first order connected LFP, based on new coding scheme. The timing-step for LFP is 0.125ms. Network is driven by 1500 Hz Poisson process.

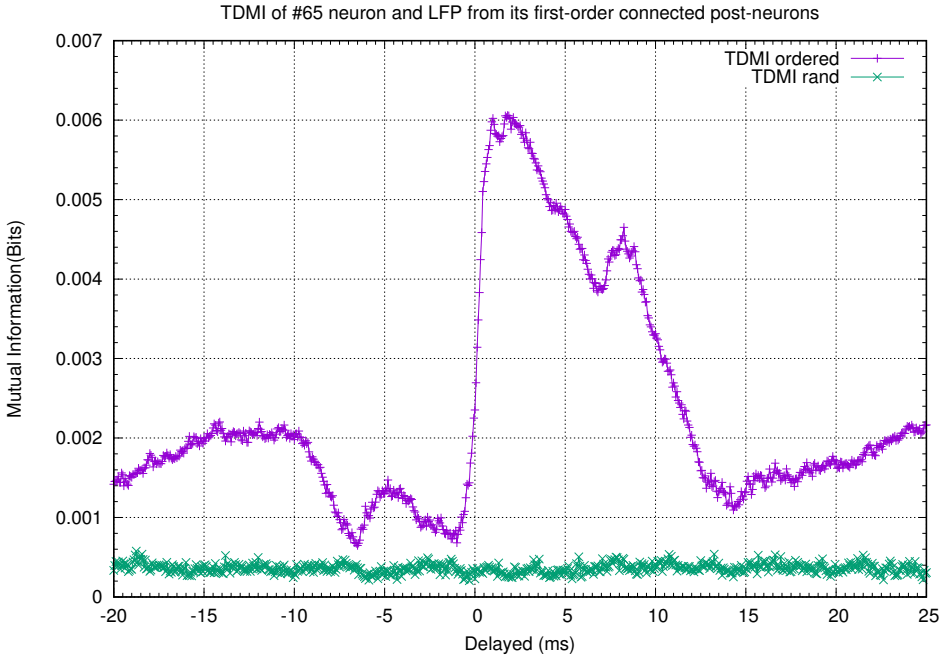

Figure 22: TDMI of #65 neuron's spike train and its first order connected LFP, based on new coding scheme. The timing-step for LFP is 0.0625ms. Network is driven by 1500 Hz Poisson process.

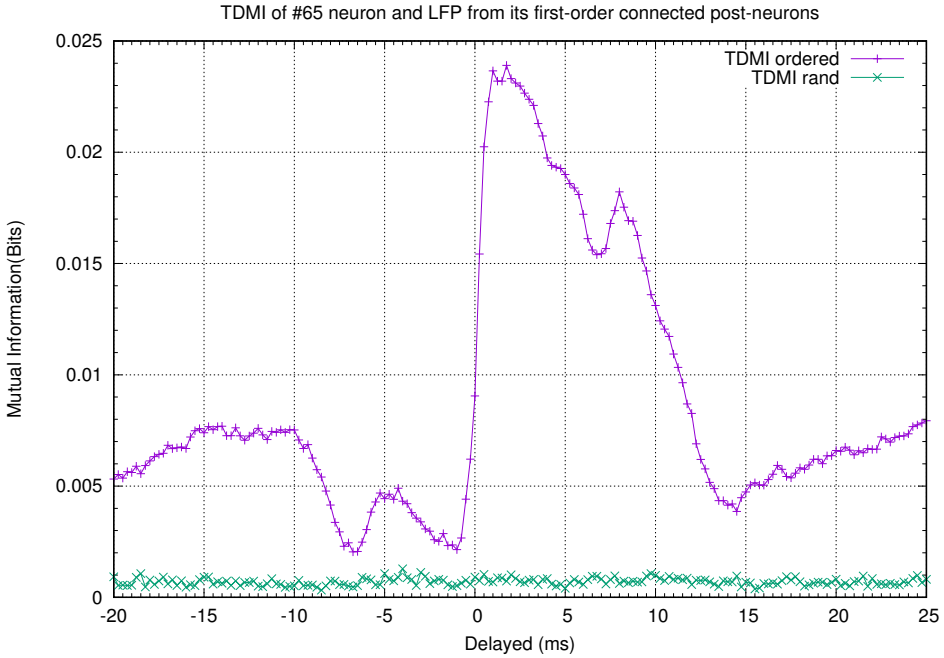

Figure 23: TDMI of #65 neuron's spike train and its first order connected LFP, based on new coding scheme. The timing-step for LFP is 0.25ms. Network is driven by 1500 Hz Poisson process.

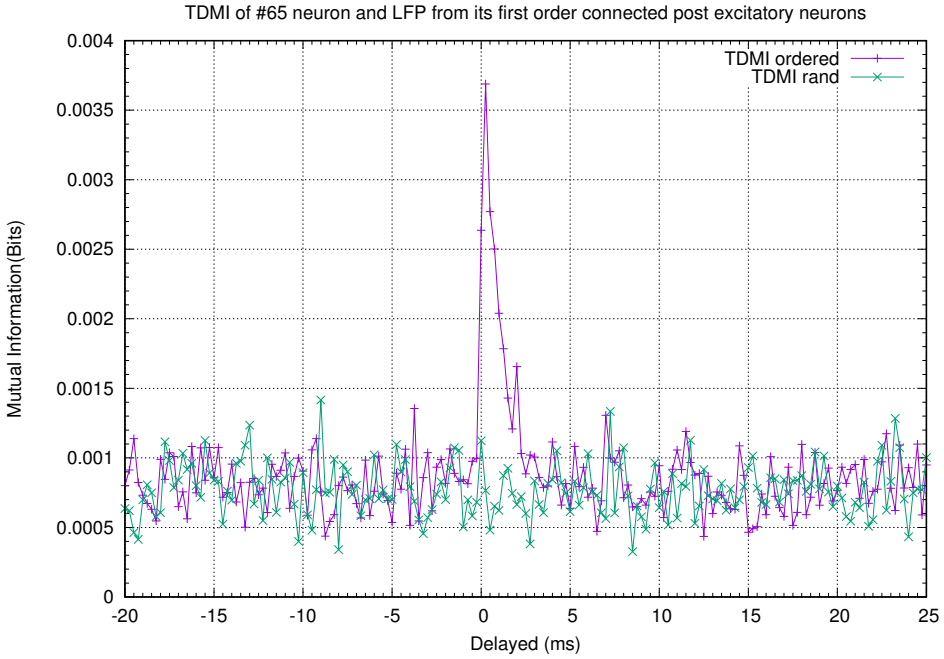

Figure 24: TDMI of #65 neuron's spike train and its first order connected excitatory neurons, based on old coding scheme. The timing-step for LFP is 0.25ms. Network is driven by 1500 Hz Poisson process.

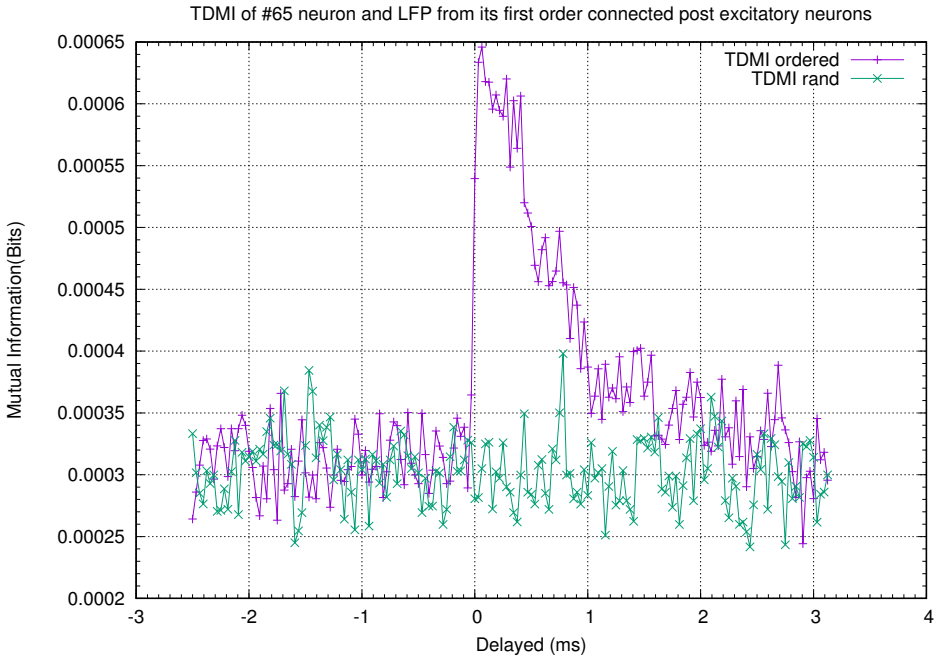

Figure 25: TDMI of #65 neuron's spike train and its first order connected excitatory neurons, based on old coding scheme. The timing-step for LFP is 0.03125ms. Network is driven by 1500 Hz Poisson process.

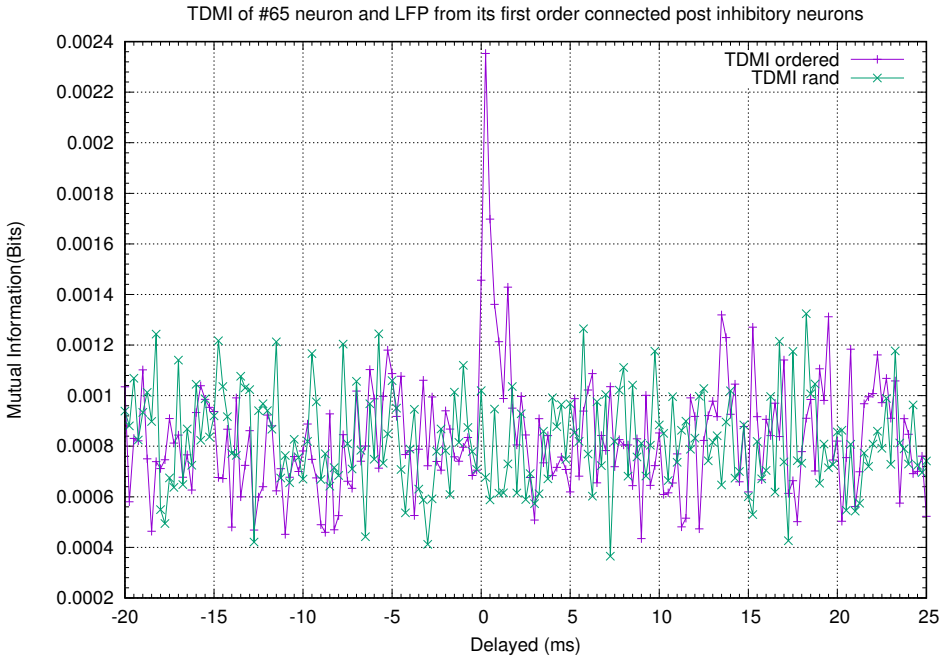

Figure 26: TDMI of #65 neuron's spike train and its first order connected inhibitory neurons, based on old coding scheme. The timing-step for LFP is 0.25ms. Network is driven by 1500 Hz Poisson process.

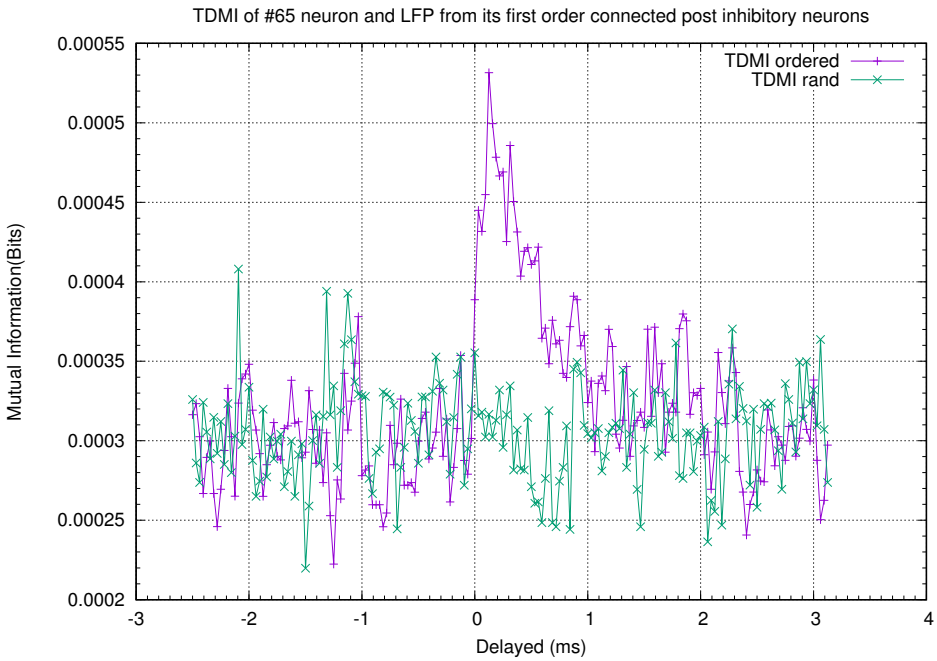

Figure 27: TDMI of #65 neuron's spike train and its first order connected inhibitory neurons, based on old coding scheme. The timing-step for LFP is 0.03125ms. Network is driven by 1500 Hz Poisson process.

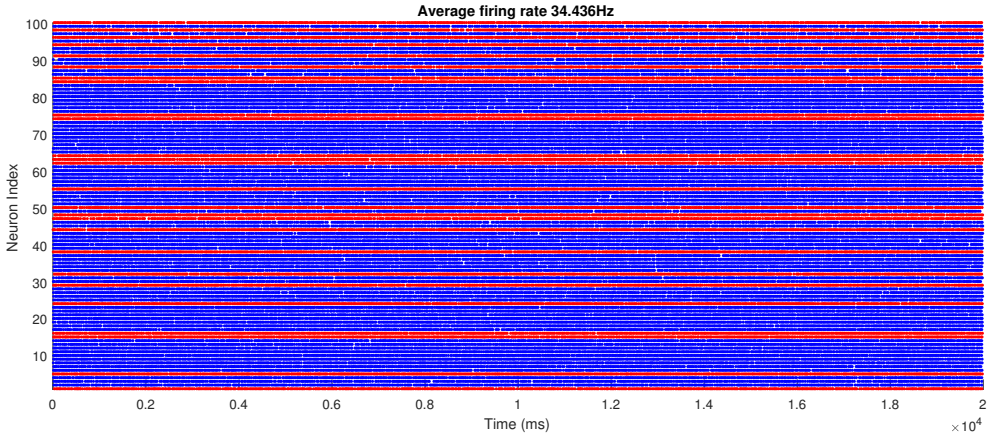

Figure 28: Raster plot of loop 1, based on old coding scheme. Network is driven by 2000 Hz Poisson process.

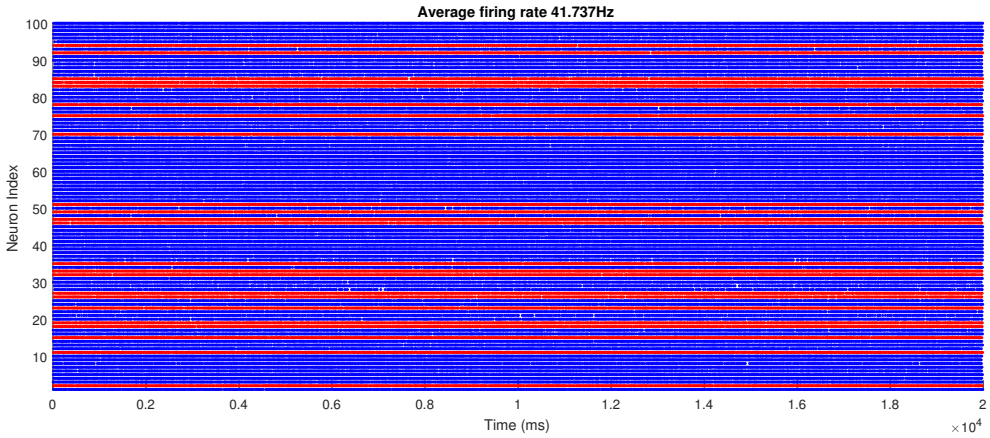

Figure 29: Raster plot of loop 2, based on old coding scheme. Network is driven by 2000 Hz Poisson process.

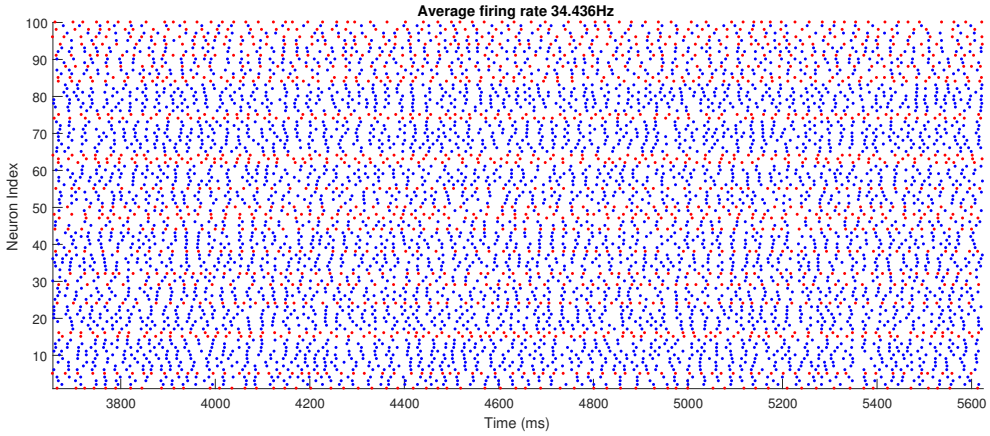

Figure 30: Raster plot of loop 1, based on old coding scheme. Network is driven by 2000 Hz Poisson process.

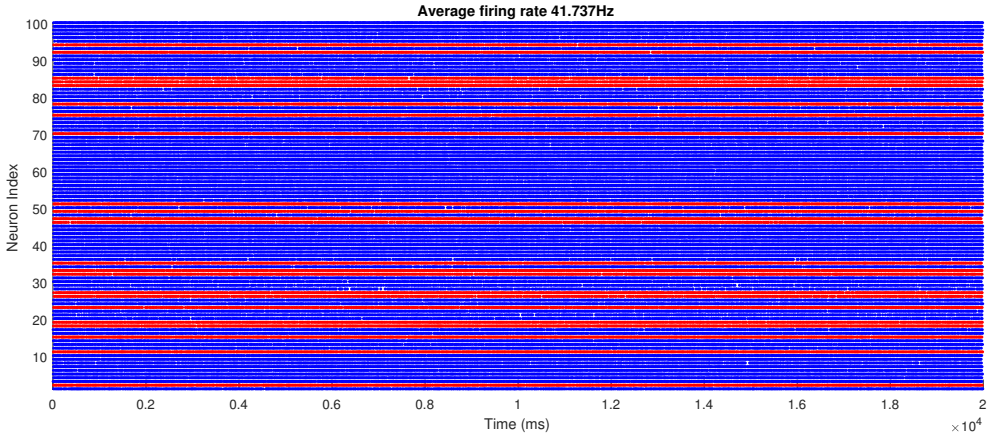

Figure 31: Raster plot of loop 2, based on old coding scheme. Network is driven by 2000 Hz Poisson process.

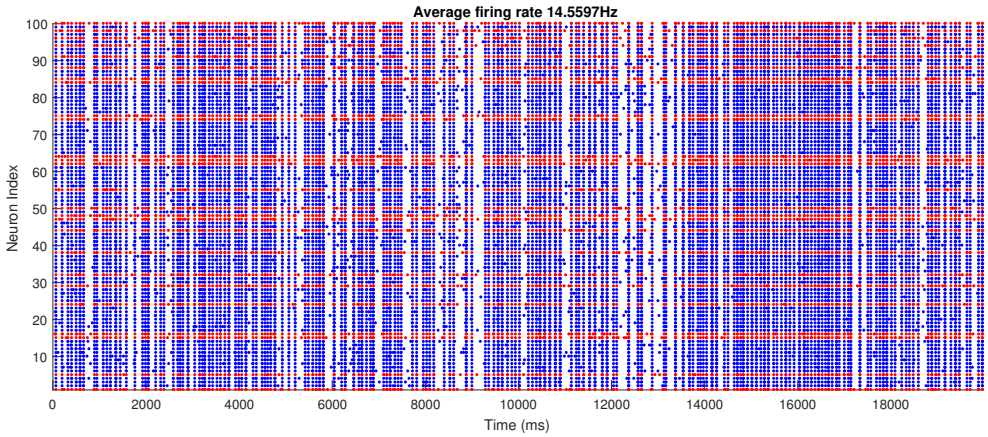

Figure 32: Raster plot of loop 1, based on new coding scheme. Network is driven by 1200 Hz Poisson process.

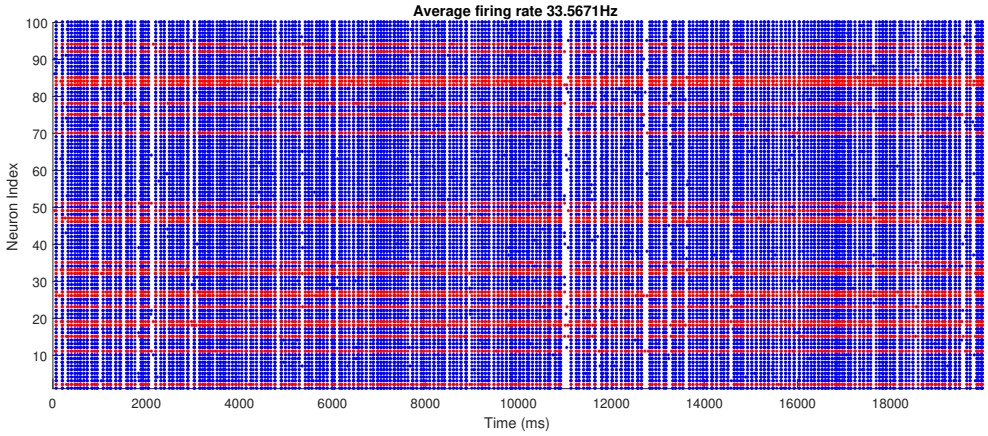

Figure 33: Raster plot of loop 2, based on new coding scheme. Network is driven by 1200 Hz Poisson process.

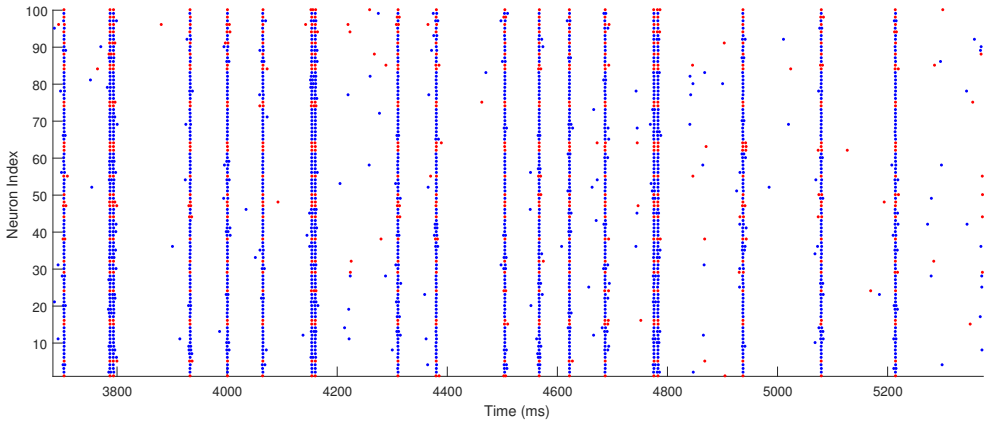

Figure 34: Raster plot of loop 1, based on new coding scheme. Network is driven by 1200 Hz Poisson process.

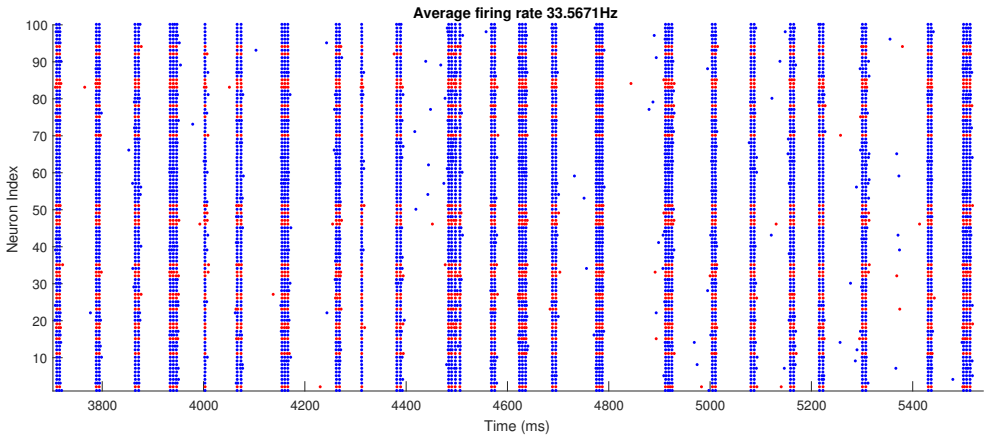

Figure 35: Raster plot of loop 2, based on new coding scheme. Network is driven by 1200 Hz Poisson process.

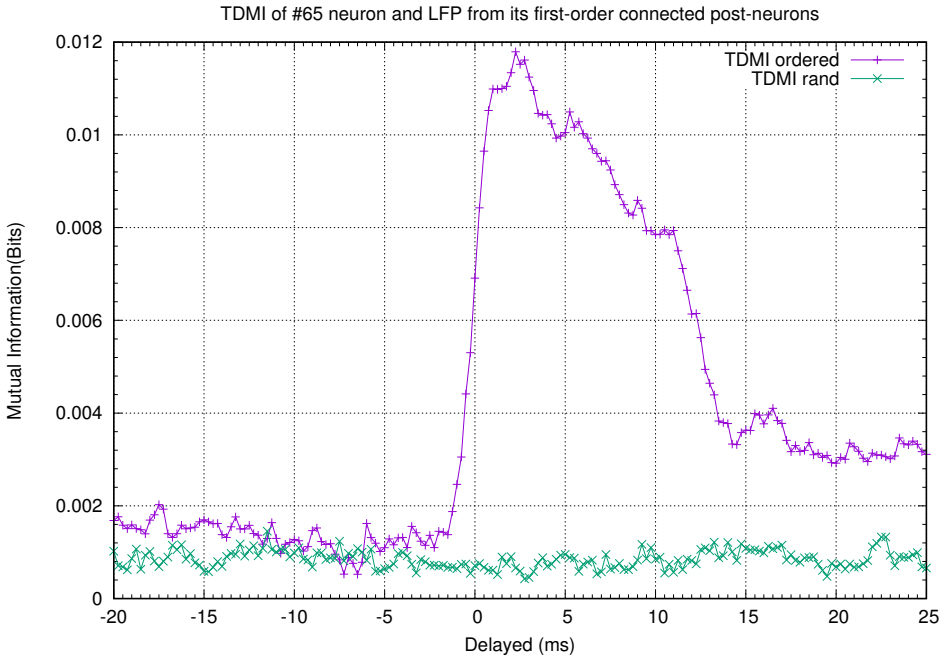

Figure 36: TDMI of #65 neuron and its first order LFP, based on new coding scheme. Network is driven by 1200 Hz Poisson process. Timing-step is 0.25ms.

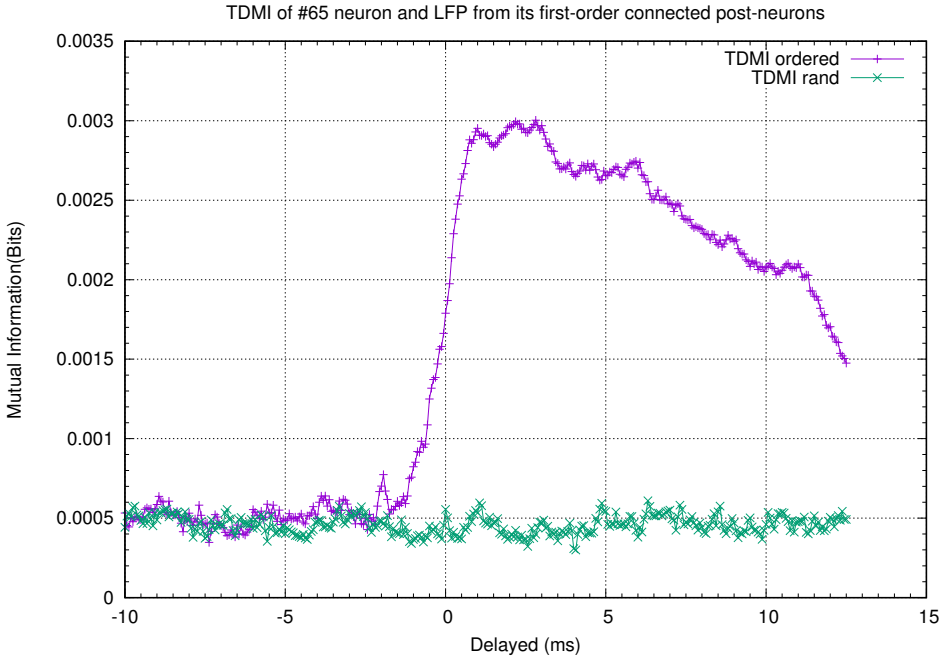

Figure 37: TDMI of #65 neuron and its first order LFP, based on new coding scheme. Network is driven by 1200 Hz Poisson process. Timing-step is 0.0625ms.