Erratum: Equalization of Synaptic Efficacy by Synchronous Neural Activity [Phys. Rev. Lett. 99, 208102 (2007)]

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(Received 30 December 2007; published 5 June 2008)

DOI: 10.1103/PhysRevLett.100.229901 PACS numbers: 87.18.Sn, 05.45.Gg, 89.75.Fb, 99.10.Cd

There is a numerical error, which has led to a large magnification of some of the synchronization effects on equilibrium conditions in Fig. 3. In numerical programming, we set the spike-timing window function to be $F(\delta) = A\exp(-\delta/\tau)$ for $\delta \geq 0$ rather than for $\delta > 0$; this was expected not to give an appreciable difference since in the ideal sense the case $\delta = 0$ has measure zero and the corresponding probability should vanish. In practice, however, such events of perfect synchronization turn out to happen frequently in simulations due to the discrete evolution time step ($\Delta t = 0.02$ ms). We have thus corrected this to obtain the accurate results shown in Fig. 1 below. It is observed that both mechanisms suggested are still effective in inducing unimodal synaptic strength through synchronous neural activity, although they do not achieve sharply equalized synaptic strengths under the employed simulation conditions: The data plotted by the dashed line, related to the first mechanism, show that C_V first decreases with the network size N but increases again for large N. There appears to be little difference for the data plotted by the dotted line, related to the second mechanism, because synchronization is not so sharp in neural firing. For the data represented by the solid line, the synaptic currents are observed to fall off too quickly to fire neurons repeatedly, so C_V remains close to unity. Instead, the validity of the second mechanism is shown by the data represented by the solid gray line, obtained under the new condition of an additional external direct current injected into the neurons. This additional current, which may be associated with the background noise in the real neural system, lowers the firing threshold of the neurons and facilitates repeated firing even with the rapid decrease of synaptic current. We expect that under optimized conditions substantially more equalized synaptic efficacy should be achieved. It would thus be of interest to probe how to maximize the effects of both mechanisms, which is left for further study.

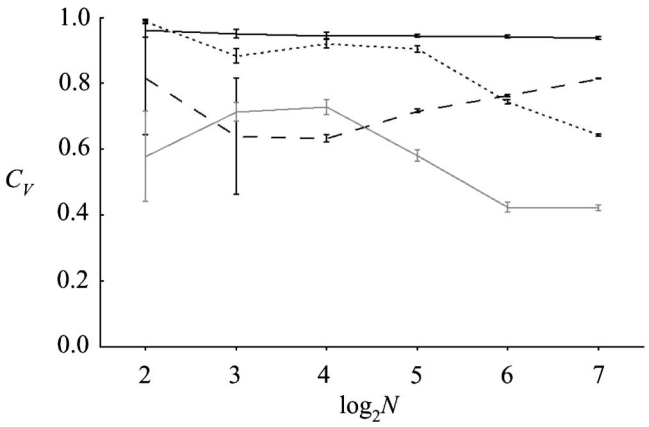

FIG. 1. Coefficient deviation C_V versus network size N. The time delay and the characteristic time are given by $(\tau_d, \tau_a) = (0, 2)$ (in milliseconds) for the data plotted by the solid line, (6, 2) by the dashed line, (2, 8) by the dotted line, and (4, 200) by the solid gray line. In the latter case, external direct current $I_{\mathrm{dc}} = 6.1\ \mu\mathrm{A/cm}^2$ is also applied.

