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References:

- [1] L. F. Abbott and C. van Vreeswijk, \textit{Asynchronous states in networks of pulse-coupled oscillators}, Phys. Rev. E, 48 (1993), pp. 1483–1490.
- [2] F. Pfaltzer, C. Ly, and D. Tranchina, \textit{Population density methods for stochastic neurons with realistic synaptic kinetics: Firing rate dynamics and fast computational methods}, Network, 17 (2006), pp. 373–418.
- [3] M. Augustin, J. Ladenbauer, and K. Obermayer, \textit{How adaptation shapes spike rate oscillations in recurrent neuronal networks}, Front. Comput. Neurosci., 7 (2013), 9.
- [4] C. M. Bender and S. A. Orszag, \textit{Advanced Mathematical Methods for Scientists and Engineers. I. Asymptotic Methods and Perturbation Theory}, Springer-Verlag, New York, 1999. · [Zbl 0938.34001](#)
- [5] P. C. Bressloff, \textit{Stochastic neural field theory and the system-size expansion}, SIAM J. Appl. Math., 70 (2009), pp. 1488–1521. · [Zbl 1198.92007](#)
- [6] R. Brette and W. Gerstner, \textit{Adaptive exponential integrate-and-fire model as an effective description of neuronal activity}, J. Neurophysiol., 94 (2005), pp. 3637–3642.
- [7] N. Brunel and V. Hakim, \textit{Fast global oscillations in networks of integrate-and-fire neurons with low firing rates}, Neural Comput., 11 (1999), pp. 1621–1671.
- [8] N. Brunel and P. E. Latham, \textit{Firing rate of the noisy quadratic integrate-and-fire neuron}, Neural Comput., 15 (2003), pp. 2281–2306. · [Zbl 1085.68617](#)
- [9] M. A. Buice, J. D. Cowan, and C. C. Chow, \textit{Systematic fluctuation expansion for neural network activity equations}, Neural Comput., 22 (2010), pp. 377–426. · [Zbl 1183.92013](#)
- [10] A. Dhooge, W. Govaerts, and Y. A. Kuznetsov, \textit{MATCONT: A MATLAB package for numerical bifurcation analysis of ODEs}, ACM Trans. Math. Software, 29 (2003), pp. 141–164. · [Zbl 1070.65574](#)
- [11] E. Doedel and J. P. Kernevez, \textit{AUTO, Software for Continuation and Bifurcation Problems in Ordinary Differential Equations}, California Institute of Technology, Pasadena, CA, 1986; available online at <http://indy.cs.concordia.ca/auto/>.
- [12] M. Dur-e Ahmad, W. Nicola, S. A. Campbell, and F. K. Skinner, \textit{Network bursting using experimentally constrained single compartment CA3 hippocampal neuron models with adaptation}, J. Comput. Neurosci., 33 (2012), pp. 21–40.
- [13] K. A. Ferguson, C. Y. L. Huh, B. Amilhon, S. Williams, and F. K. Skinner, \textit{Simple, biologically-constrained CA1 pyramidal cell models using an intact, whole hippocampus context}, F1000Res., 3 (2014), 104.
- [14] N. Fourcaud and N. Brunel, \textit{Dynamics of the firing probability of noisy integrate-and-fire neurons}, Neural Comput., 14 (2002), pp. 2057–2110. · [Zbl 1009.92007](#)
- [15] D. Hansel and G. Mato, \textit{Existence and stability of persistent states in large neuronal networks}, Phys. Rev. Lett., 86 (2001), pp. 4175–4178.
- [16] D. Hansel and G. Mato, \textit{Asynchronous states and the emergence of synchrony in large networks of interacting excitatory and inhibitory neurons}, Neural Comput., 15 (2003), pp. 1–56. · [Zbl 1031.68098](#)
- [17] L. Hertäg, D. Durstewitz, and N. Brunel, \textit{Analytical approximations of the firing rate of an adaptive exponential integrate-and-fire neuron in the presence of synaptic noise}, Front. Comput. Neurosci., 8 (2014), 116.
- [18] E. M. Izhikevich, \textit{Simple model of spiking neurons}, IEEE Trans. Neural Netw., 14 (2003), pp. 1569–1572.

- [19] E. M. Izhikevich, *Dynamical Systems in Neuroscience: The Geometry of Excitability and Bursting*, MIT Press, Cambridge, MA, 2007.
- [20] B. W. Knight, *Dynamics of encoding in neuron populations: Some general mathematical features*, *Neural Comput.*, 12 (2000), pp. 473–518.
- [21] C. Y. Liu and D. Q. Nykamp, *A kinetic theory approach to capturing interneuronal correlation: The feed-forward case*, *J. Comput. Neurosci.*, 26 (2009), pp. 339–368.
- [22] C. Ly, *A principled dimension-reduction method for the population density approach to modeling networks of neurons with synaptic dynamics*, *Neural Comput.*, 25 (2013), pp. 2682–2708.
- [23] C. Ly and D. Tranchina, *Critical analysis of dimension reduction by a moment closure method in a population density approach to neural network modeling*, *Neural Comput.*, 19 (2007), pp. 2032–2092. · [Zbl 1131.92016](#)
- [24] J. Modolo, A. Garenne, J. Henry, and A. Beuter, *Development and validation of a neural population model based on the dynamics of a discontinuous membrane potential neuron model*, *J. Integr. Neurosci.*, 6 (2007), pp. 625–655.
- [25] R. Moreno-Bote and N. Parga, *Role of synaptic filtering on the firing response of simple model neurons*, *Phys. Rev. Lett.*, 92 (2004), 028102.
- [26] R. Moreno-Bote, A. Renart, and N. Parga, *Theory of input spike auto- and cross-correlations and their effect on the response of spiking neurons*, *Neural Comput.*, 20 (2008), pp. 1651–1705. · [Zbl 1138.92014](#)
- [27] W. H. Nesse, A. Borisjuk, and P. C. Bressloff, *Fluctuation-driven rhythmogenesis in an excitatory neuronal network with slow adaptation*, *J. Comput. Neurosci.*, 25 (2008), pp. 317–333.
- [28] W. Nicola and S. A. Campbell, *Bifurcations of large networks of two-dimensional integrate and fire neurons*, *J. Comput. Neurosci.*, 35 (2013), pp. 87–108. · [Zbl 1276.92018](#)
- [29] W. Nicola and S. A. Campbell, *Mean-field models for heterogeneous networks of two-dimensional integrate and fire neurons*, *Front. Comput. Neurosci.*, 7 (2013), 184.
- [30] W. Nicola and S. A. Campbell, *Non-smooth Bifurcations of Mean Field Systems of Two-Dimensional Integrate and Fire Neurons*, preprint, <http://arxiv.org/abs/1408.4767> arXiv:1408.4767v1 [math.DS], 2014. · [Zbl 1335.34073](#)
- [31] D. Q. Nykamp and D. Tranchina, *A population density approach that facilitates large-scale modeling of neural networks: Analysis and an application to orientation tuning*, *J. Comput. Neurosci.*, 8 (2000), pp. 19–50. · [Zbl 0999.92008](#)
- [32] A. V. Rangan, *Diagrammatic expansion of pulse-coupled network dynamics*, *Phys. Rev. Lett.*, 102 (2009), 158101.
- [33] M. J. Richardson, *Firing-rate response of linear and nonlinear integrate-and-fire neurons to modulated current-based and conductance-based synaptic drive*, *Phys. Rev. E*, 76 (2007), 021919.
- [34] M. J. Richardson, *Spike-train spectra and network response functions for non-linear integrate-and-fire neurons*, *Biol. Cybern.*, 99 (2008), pp. 381–392. · [Zbl 1161.92014](#)
- [35] M. J. Richardson, *Dynamics of populations and networks of neurons with voltage-activated and calcium-activated currents*, *Phys. Rev. E*, 80 (2009), 021928.
- [36] S. H. Strogatz and R. E. Mirollo, *Stability of incoherence in a population of coupled oscillators*, *J. Statist. Phys.*, 63 (1991), pp. 613–635.
- [37] J. Touboul, *Bifurcation analysis of a general class of nonlinear integrate-and-fire neurons*, *SIAM J. Appl. Math.*, 68 (2008), pp. 1045–1079. · [Zbl 1149.34027](#)

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