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► **To cite this version:**

Bruno Cessac, Thierry Viéville. Revisiting time discretisation of spiking network models. BMC Neuroscience, BioMed Central, 2007, 8 (Suppl 2), pp.P76. <hal-00784465>

HAL Id: hal-00784465

<https://hal.inria.fr/hal-00784465>

Submitted on 4 Feb 2013

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Poster presentation

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Revisiting time discretisation of spiking network models

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from Sixteenth Annual Computational Neuroscience Meeting: CNS*2007
Toronto, Canada. 7–12 July 2007

Published: 6 July 2007

BMC Neuroscience 2007, **8**(Suppl 2):P76 doi:10.1186/1471-2202-8-S2-P76

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A link is built between a biologically plausible generalized integrate and fire (GIF) neuron model with conductance-based dynamics [1] and a discrete time neural network model with spiking neurons [2], for which rigorous results on the spontaneous dynamics has been obtained. More precisely the following has been shown.

i) Occurrence of periodic orbits is the generic regime of activity, with a bounded period in the presence of spike-time dependence plasticity, and arbitrary large periods at the edge of chaos (such regime is indistinguishable from

chaos in numerical experiments, explaining what is obtained in [2]),

ii) the dynamics of membrane potential has a one to one correspondence with sequences of spikes patterns ("raster plots").

This allows a better insight into the possible neural coding in such a network and provides a deep understanding, at the network level, of the system behavior. Moreover, though the dynamics is generically periodic, it has a weak form of initial conditions sensitivity due to the presence



Figure 1

A view of the numerical experiments software platform raster-plot output, considering either a generic fully connected network or, here, a retinotopic network related to visual functions (top-left: 2D instantaneous spiking activity).

of the sharp spiking threshold [3]. A step further, constructive conditions are derived, allowing to properly implement visual functions on such networks [4].

The time discretisation has been carefully conducted avoiding usual bias induced by e.g. Euler methods and taking into account a rather complex GIF model for which the usual arbitrary discontinuities are discussed in detail. The effects of the discretisation approximation have been analytically and experimentally analyzed, in detail.

Acknowledgements

This work was partially supported by the EC IP project FP6-015879, FAC-ETS.

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