How interaction delays control spiking patterns in pulse-coupled networks

Serhiy Yanchuk[1]

[1] *Technische Universität Berlin, Institute of Mathematics, Straße des 17. Juni 136 10623 Berlin, Germany (e-mail: yanchuk@math.tu-berlin.de)*

Delayed interactions are a common property of coupled natural systems and therefore arise in a variety of different applications. Such systems are often modeled by delay differential equations with discrete delays. In realistic situations, these delays are not identical on different connections. Using a componentwise timeshift transformation it is possible to reduce the number of different delays and simplify the models without loss of information.

We apply this approach to recurrent pulse-coupled networks of excitable elements with delayed connections, which are inspired by the neural networks. If the delays are tuned appropriately, the network can either stay in the steady resting state, or alternatively, exhibit a desired spiking pattern. We point out the relation of the considered systems with cyclic polychronous groups and show how the assumed delay configurations may arise in a self-organized manner. Moreover, the system is implemented experimentally on a Field-Programmable Gate Array.