Msc thesis
Mathematical Modelling and Computation

The dynamics of adaptive neuronal networks: influence of topology on synchronisation

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Contents

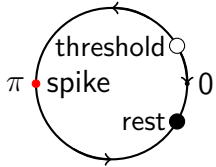
Neuronal activity

- Neurons receive neurotransmitters
- Stimuli control the neurons' membrane potential
- Action potential = explosion of electrical activity
- Synapse releases the neurons' neurotransmitter

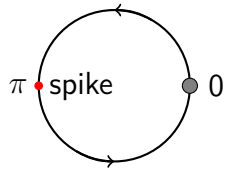
Model formulation

$$\dot{\theta} = (1 - \cos\theta) + (1 + \cos\theta) \cdot I \qquad \theta \in \mathbb{T} \tag{1}$$

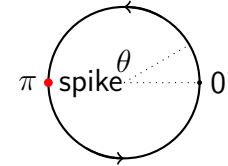
- SNIC bifurcation



Excitable regime: $I < 0$

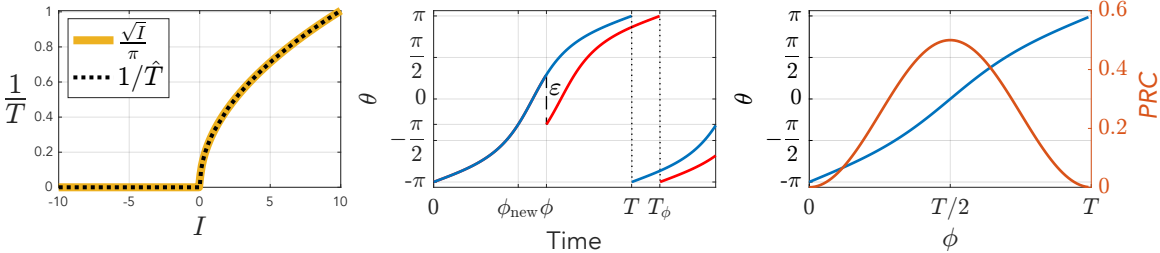


Bifurcation: $I = 0$



Periodic regime: $I > 0$

The Theta Neuron Model



Network Topologies

Mean Field Reductions

Investigation: Mean Field Reductions for undirected graphs

Hebbian Learning and Synaptic Plasticity

Investigation: Emerging Network Topologies

Conclusion and Discussion