$\label{eq:Msc} \text{Msc thesis} \\ \text{Mathematical Modelling and Computation} \\$

The dynamics of adaptive neuronal networks: influence of topology on synchronisation Simon Aertssen, s181603

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DTU Compute

Department of Applied Mathematics and Computer Science



Contents

- 1. Introduction
- 2. The Theta Neuron Model
- 3. Network Topologies
- 4. Mean Field Reductions
- 5. Investigation: Mean Field Reductions for undirected graphs
- 6. Hebbian Learning and Synaptic Plasticity
- 7. Investigation: Emerging Network Topologies
- 8. Conclusion and Discussion

Introduction

Neuronal activity

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

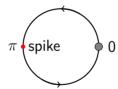
Model formulation

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

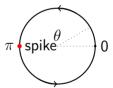
SNIC bifurcation



Excitable regime: I < 0

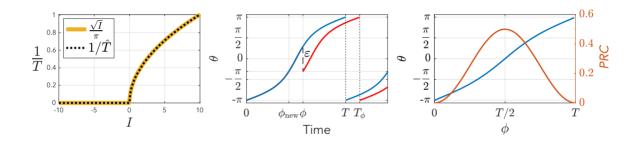


Bifurcation: I=0



Periodic regime: I > 0

The Theta Neuron Model



Network Topologies Network Topologies

Mean Field Reductions Mean Field Reductions

Investigation: Mean Field Reductions for undirected graphs Investigation: Mean Field Reductions for undirected graphs

Hebbian Learning and Synaptic Plasticity Hebbian Learning and Synaptic Plasticity

Investigation: Emerging Network Topologies
Investigation: Emerging Network Topologies

Conclusion and Discussion

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