DTU Compute

Department of Applied Mathematics and Computer Science

Dynamics of adaptive neuronal networks
A trip to topology and back

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Abstract

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Acknowledgements

thankyou thankyou

1 Nomenclature

N	Network degree. Number of neurons in the network.
A_{ij}	Adjacency matrix. Models which neuron i is connected to neuron j and vice-ersa.
P	Network degree distribution.
$k, \langle k \rangle$	Node degree, average node degree
γ	Degree exponent of a scale-free network
$\dot{\theta}, \theta$	Phase variable of the theta model
$\eta_i, I(t)_i$	Excitability and input current of neuron i
$g(\eta \vert \eta_0, \Delta)$	Excitability distribution
κ	Coupling strength
$Z(t), \bar{Z}(t)$	Order parameter, discrete and continuous.

2 Network Topologies

2.1 Fixed-degree networks

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2.2 Random / Erdös-Rény networks

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2.3 Scale-free networks

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3 The Theta Neuron Model

3.1 Model description

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3.2 Solutions for static currents

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3.3 Networks of theta neurons

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4 Mean Field Reductions

4.1 The Ott-Antonsen manifold for fully connected networks

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4.2 Extension to arbitrary network topologies

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5 Mean Field Reductions

5.1 Directed graphs as permutations

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5.2 Results

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6 Hebbian Learning

6.1 Fire and Wire

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6.2 Anti-hebbian learning

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7 Plasticity

7.1 Intrinsic plasticity

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7.2 Spike-timing dependant plasticity

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8 Emerging Network Topologies

8.1 Redefinition of the network

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8.2 Results

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8.3 Discussion

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9 Conclusion and discussion

Test citations: In [1]

10 References

[1] C. Bick, M. Goodfellow, C. Laing, and E. Martens, *Understanding the dynamics of biological and neural oscillator networks through exact mean-field reductions: a review.* *Journal of Mathematical Neuroscience* **10** no. 1, (Dec., 2020) .

11 Appendix

11.1 Solution to the theta neuron model

11.2 Jacobian of the Ott-Antonsen manifold

11.3 Jacobian of the Ott-Antonsen extended manifold