Mathematical Neuroscience Edinburgh 2011
Tutorials, Sunday April 10

12.30 - 12.45 Introduction by Steve Coombes and Mark van Rossum
12.45 - 13.45 Alex Roxin
13.45 - 14.45 Eric Shea-Brown
14.45 - 15.15 (break)
15.15 - 16.15 John White
16.15 - 17.15 Bard Ermentrout
17.15 Beer and pizza

Note that Tutorials are in a **different** place from the main meeting.
Location: Rm. 4.31 Informatics Forum, Crichton Street, EH8 9AB (marked on map with circle).
It is a 15 min walk from the Edinburgh Waverley train station, which is also the last stop of the airport bus.

Sponsored by the EPSRC Doctoral Training Centre for Neuroinformatics and Computational Neuroscience

From networks to normal forms: using reduced models to understand network dynamics

Alex Roxin

My goal in this tutorial is to convince you that one can use relatively simple models to understand the collective behavior of large numbers of recurrently connected neurons. I will start from the premise that networks represent a "best" description of neuronal dynamics given that they incorporate single-cell dynamics and chemical synapses which are the hallmarks of neurons. Therefore we should be interested in the dynamics of networks. I will furthermore focus on networks in which connections are sparse and random and spontaneous activity is highly irregular. In this case it is possible to capture the qualitative features of the dynamical states observed in the network with simplified firing rate models.

In some cases reduced dynamical equations can be derived directly from the network equations themselves. I will discuss two such cases: 1- fast oscillations in inhibitory networks, 2 - probabilistic two-choice forced alternative decision making. For both cases I will present the network model, discuss a phenomenological firing rate description and finally outline the derivation of normal form equations for the relevant bifurcations.

References Fast oscillations:
- Brunel and Hakim, Neural Comp. 1999.
- Roxin et al., PRL 2005.

References Decision Making:
- Wang, X.-J., Neuron, 2002.
- Wong and Wang, J. Neurosci. 2006.
- Roxin and Ledberg, PLoS Comp. Biol. 2008.

Introduction to correlations in neural coding and dynamics

Eric Shea-Brown

I'll give an overview of the literature on correlated neural activity, in which firing probabilities of different cells violate the independence assumption of the most classical population codes. We will cover both dynamical aspects of this problem – efforts to understand the underlying circuit mechanisms – and the impact on levels of encoded information.

Techniques in neurophysiology

John White

I will review some of the techniques used in experimental cellular neurophysiology. I will emphasize some opportunities and challenges for meaningful interaction between theorists and experimentalists. Examples will include the effects of noise, bias, limited access, and limited spatiotemporal resolution in measurements.

Readings:

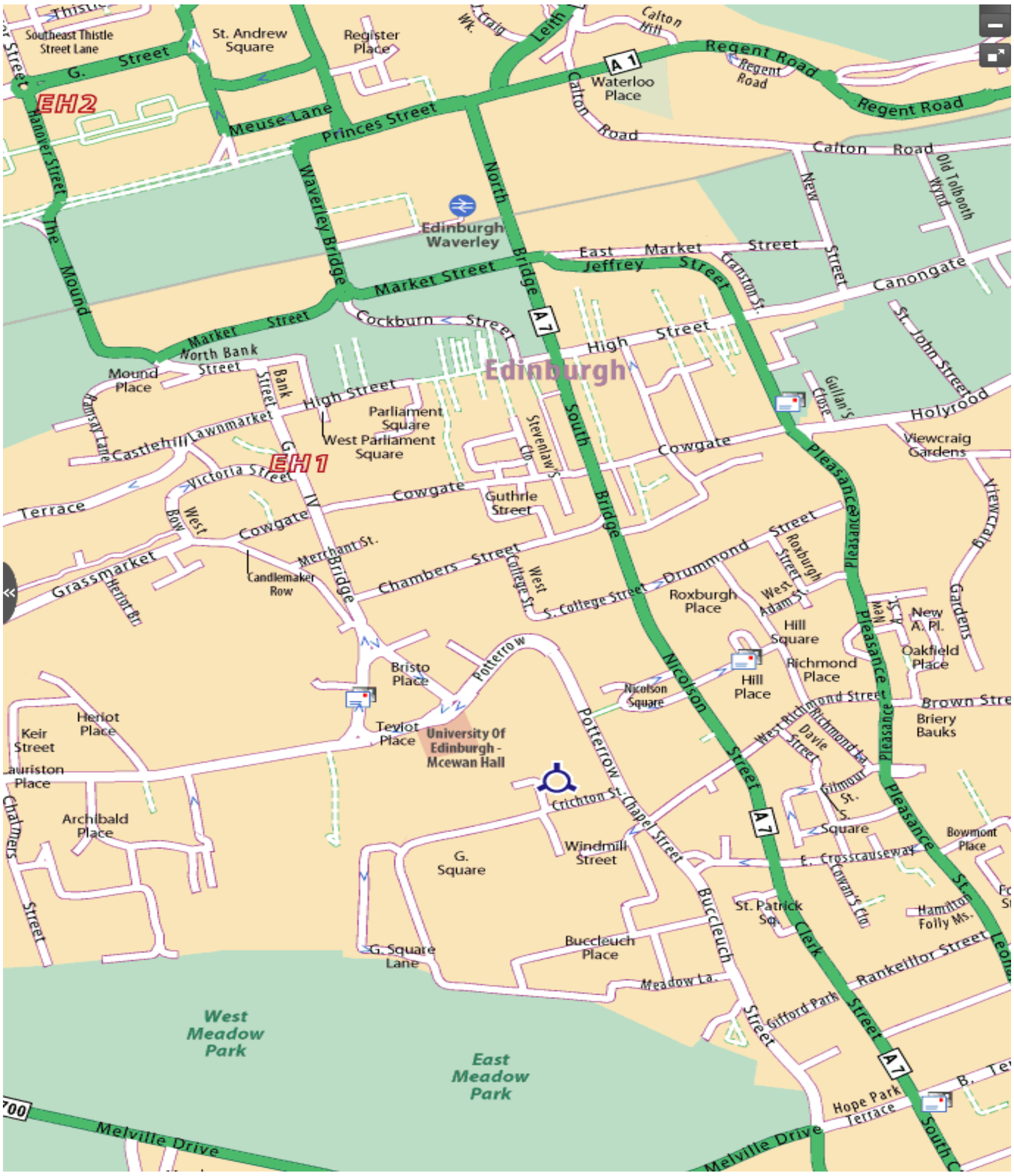
1. Economo MN, Fernandez FR, and White JA (2010) Dynamic clamp: Alteration of response properties and creation of virtual realities in neurophysiology. Journal of Neuroscience 30: 2407-2413.

2. Smeal RM, Ermentrout GB, and White JA (2010) Phase response curves and synchronized neural networks. Philosophical Transactions of the Royal Society B 365; 2407-2422.

Introduction to neural oscillators

Bard Ermentrout

I will discuss the notion of limit cycles, and how they respond to inputs. I will describe the relationship between bifurcations and phase resetting and how these define the collective dynamics of oscillators in the presence of inputs and coupling. It will be a chalk talk.



EH2
EH1
Edinburgh
Edinburgh Waverley
Princes Street
North Bridge
South Bridge
Nicolson Street
Clerk Street
Pleasance
Market Street
Cowgate
Chambers Street
Grassmarket
Lawnmarket
Castlehill
High Street
Regent Road
Calton Road
Canongate
Holyrood
The Mound
Waverley Bridge
Victoria Street
Potterrow
Bristo Place
Teviot Place
University Of Edinburgh - Mcewan Hall
Buccleuch Street
Melville Drive
West Meadow Park
East Meadow Park
A 1
A 7