Dynamic Networks

Nick Jones

Oxford Physics

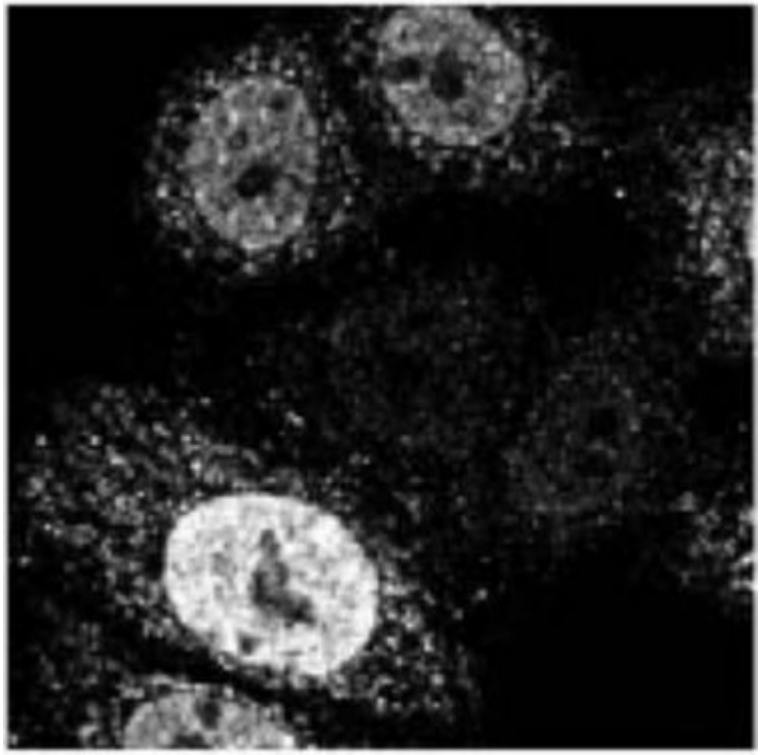
Soon

Imperial Maths

To come...

- What I do (networks and signals)
- Vascular networks.
- Comparing networks and signals.
- Network inference (dynamic...).
- Speculations.

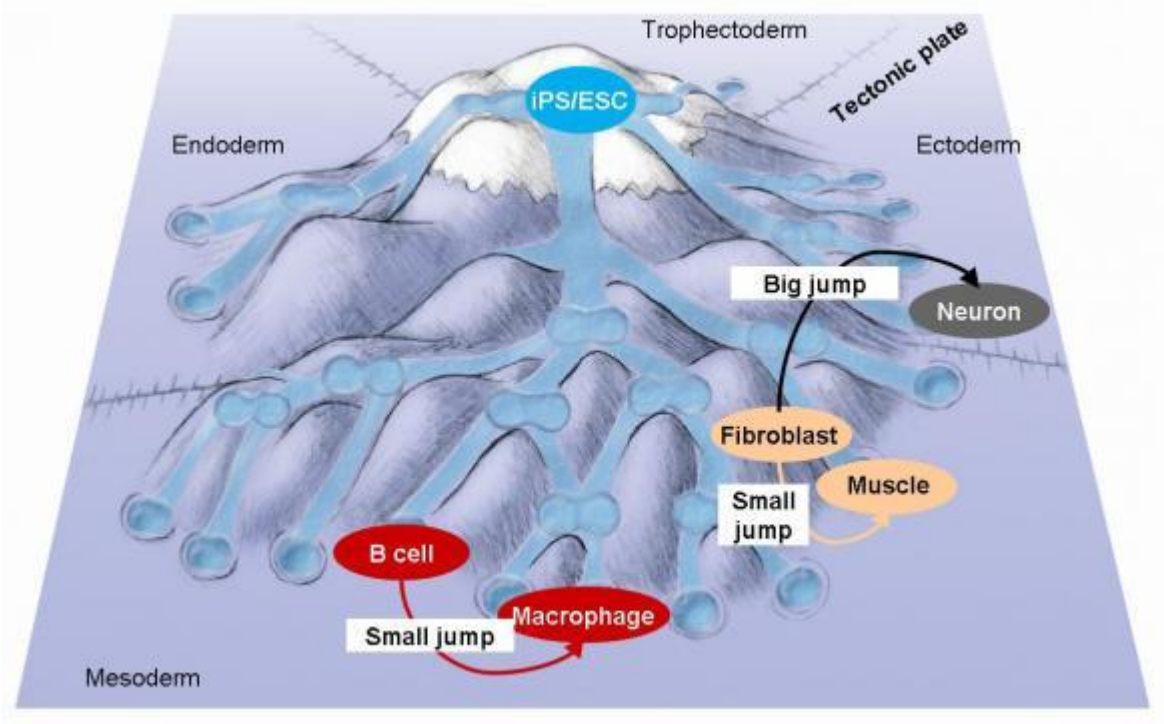
Mitochondrial Variability



Iain Johnston

- Why are genetically identical cells phenotypically different? Is the modulated by (time varying) networks of mitochondria?

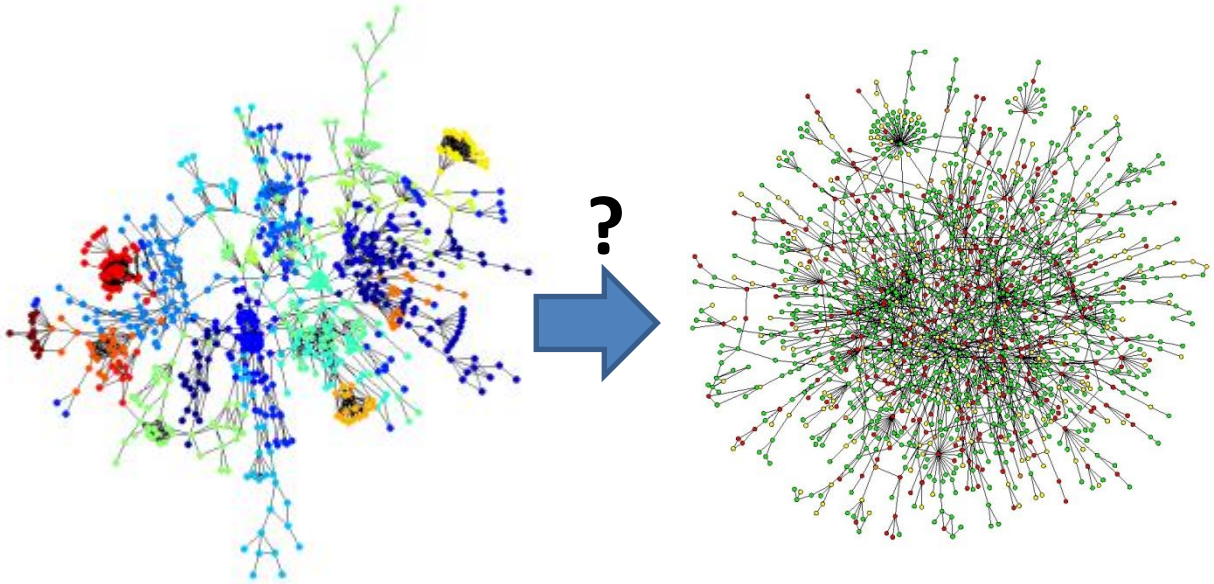
Stem cell differentiation landscapes and mitochondrial noise



Bernadett Gaal

- What is the source of noise that leads to cell fate decisions?

Inter-species network inference

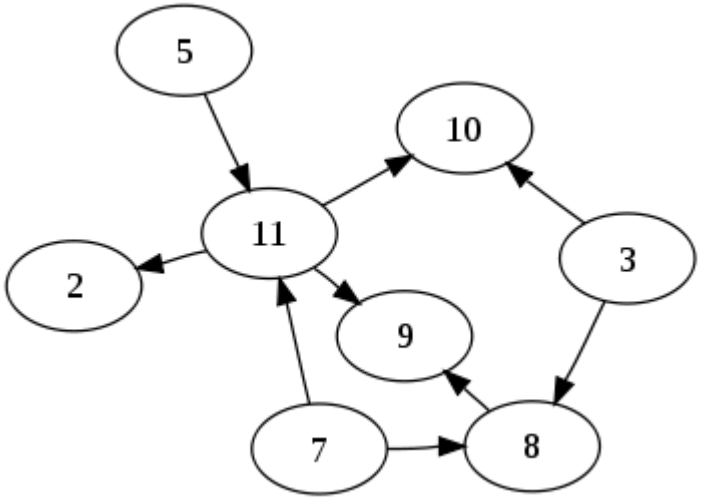


yeast human

Anna Lewis

- Using one protein interaction network to guess the protein interaction network of another species. With Mason Porter and Charlotte Deane.

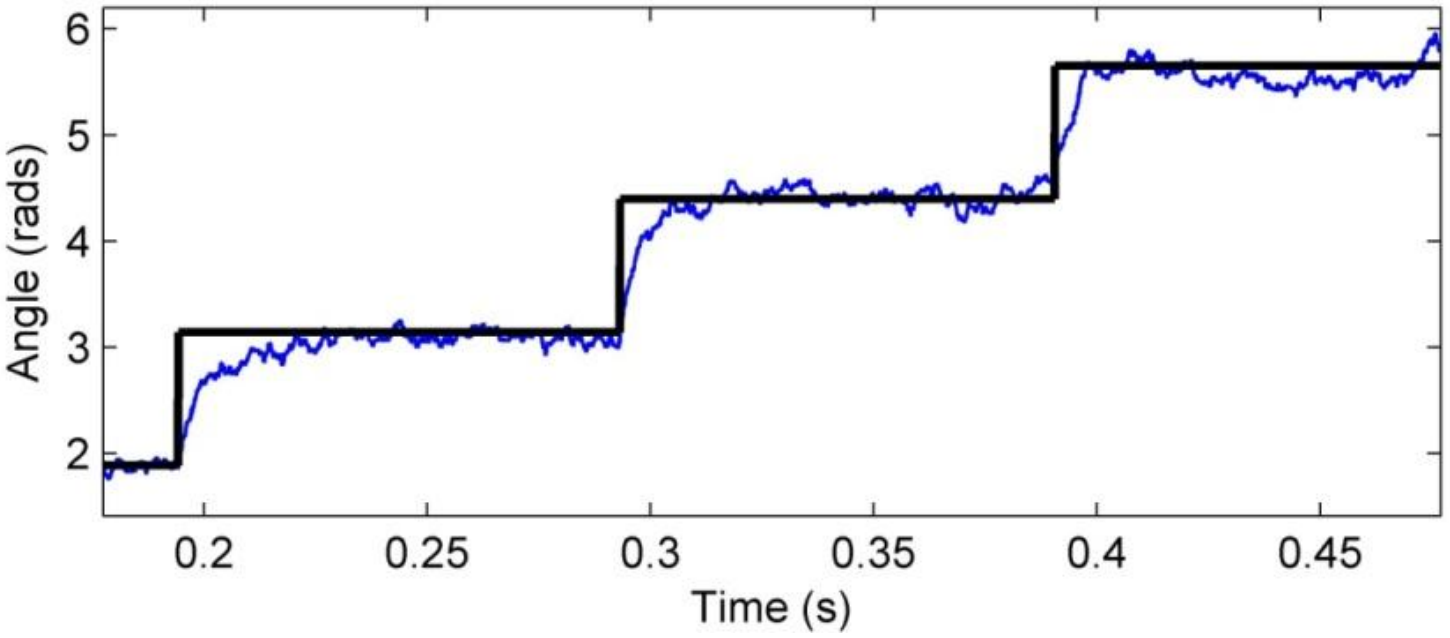
Processing by noisy cells



Sam Johnson

- How do noisy cells process both as individuals and as coupled ensembles?
- How do they perform inference, decisions and control their relationships?

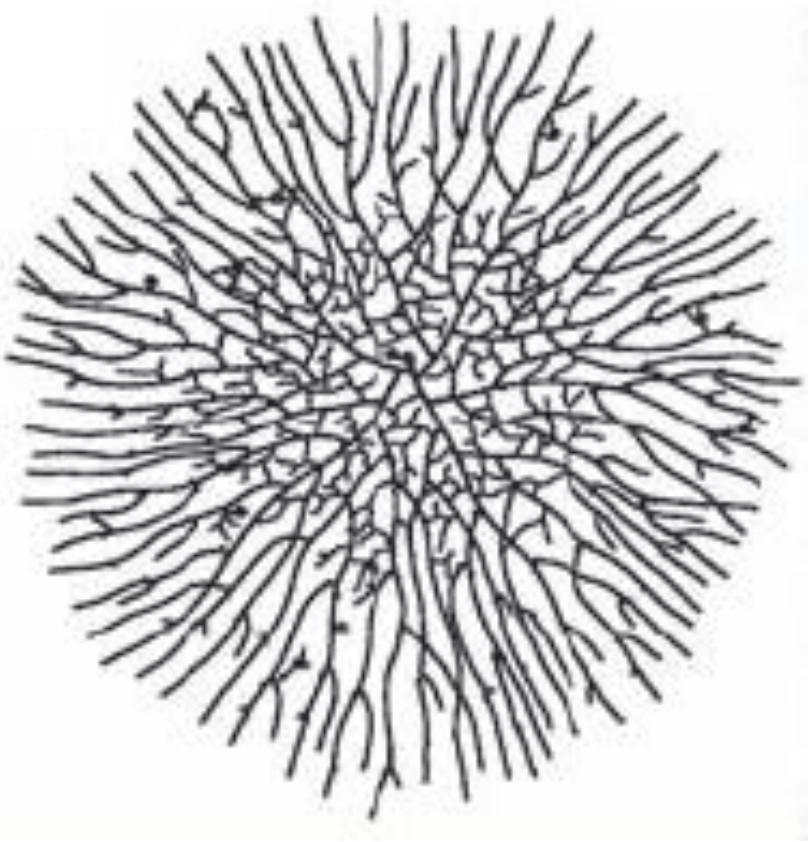
Steppy Signal Processing



Max Little (now MIT and Oxford)

- Generalized Methods and Solvers for Noise Removal from Piecewise Constant Signals Parts I and II: Proceedings of the Royal Society A (2011)
- Steps and bumps: precision extraction of discrete states of molecular machines using physically-based, high-throughput time series analysis. Biophysical Journal (2011) to appear.

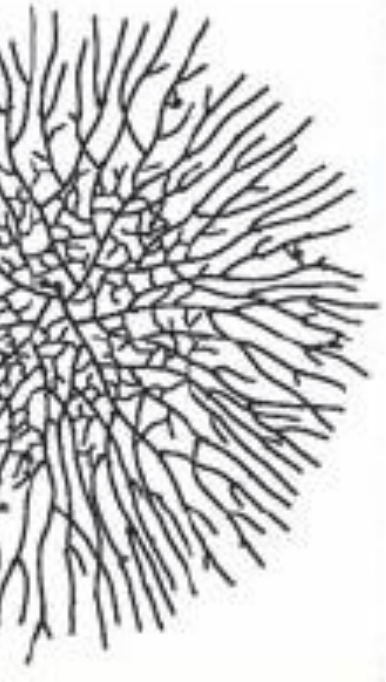
Transport in vascular networks



Luke Heaton

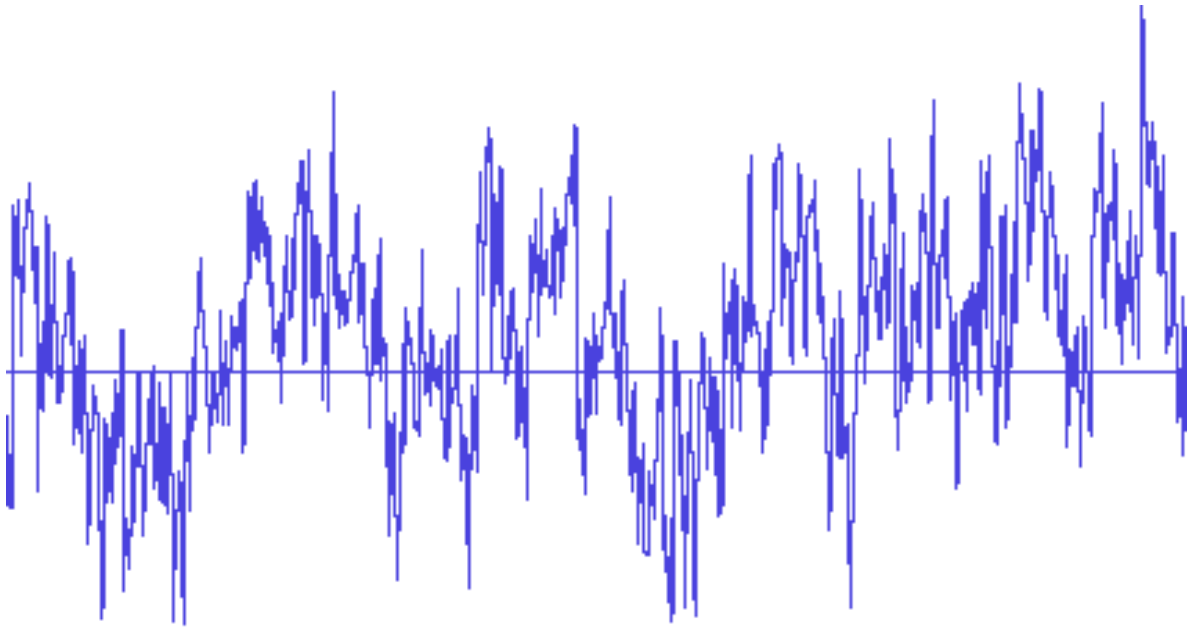
- How do networks of fluid filled tubes transport nutrients? Still unclear in the 3rd Major multicellular kingdom.

Transport in vascular networks



- Advection, diffusion and delivery in networks arXiv:1105.1647

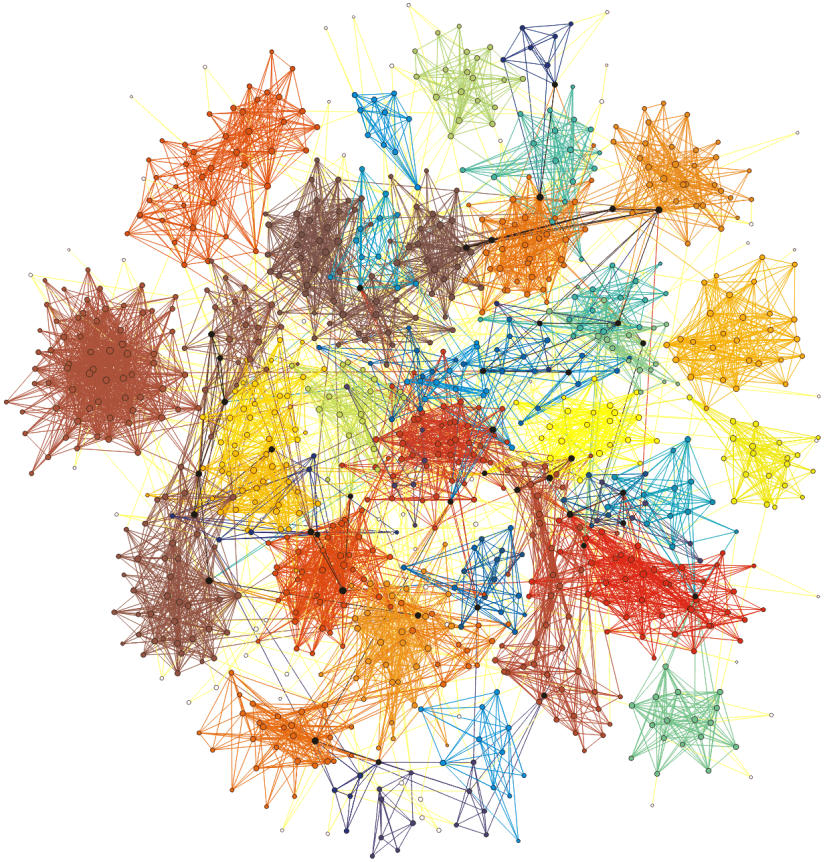
Highly Comparative Analysis of Signals



Ben Fulcher

- What is the empirical structure of our signals and our methods?

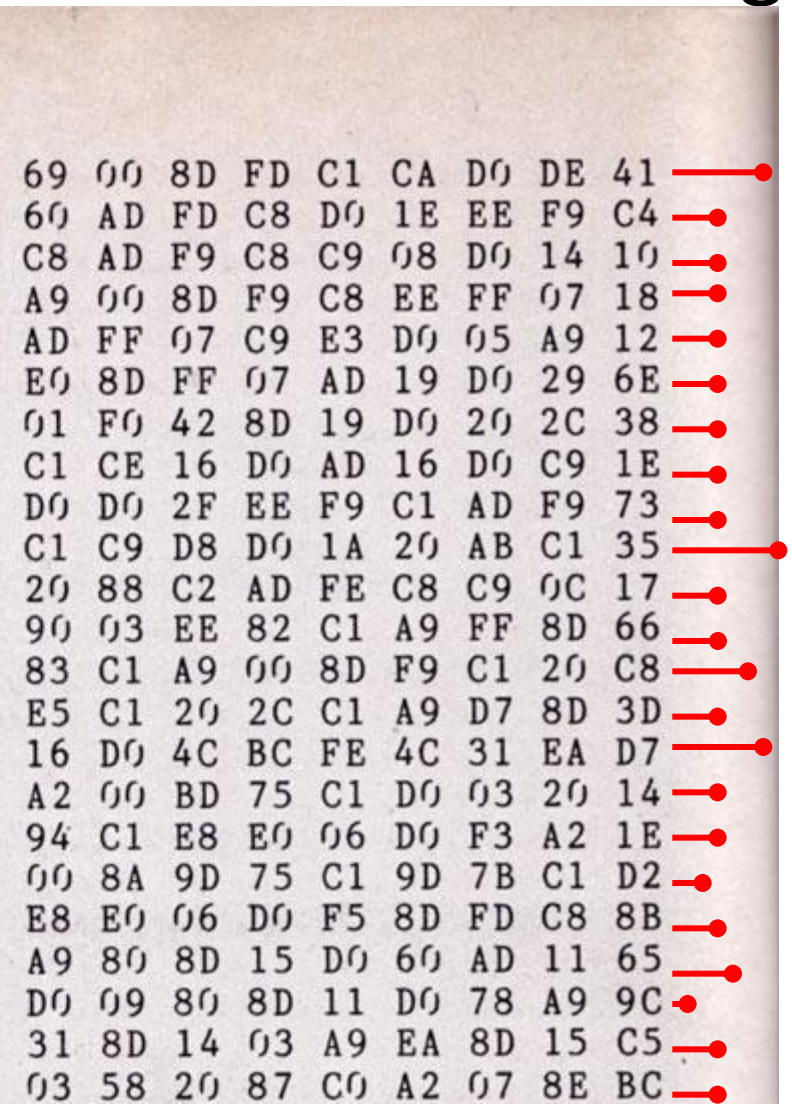
Highly Comparative Analysis of Networks

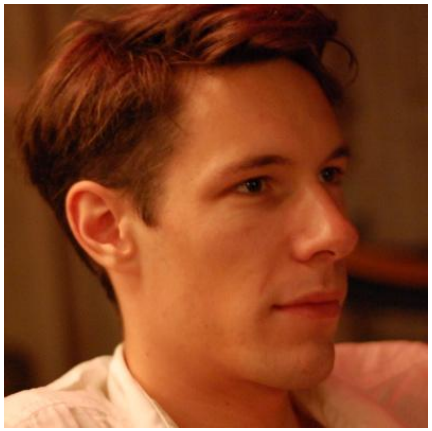


Sumeet Agarwal

What is the empirical structure of our networks and our methods?

Highly Comparative Analysis of Fitness landscapes [Functions on (Discrete) Configuration Spaces]

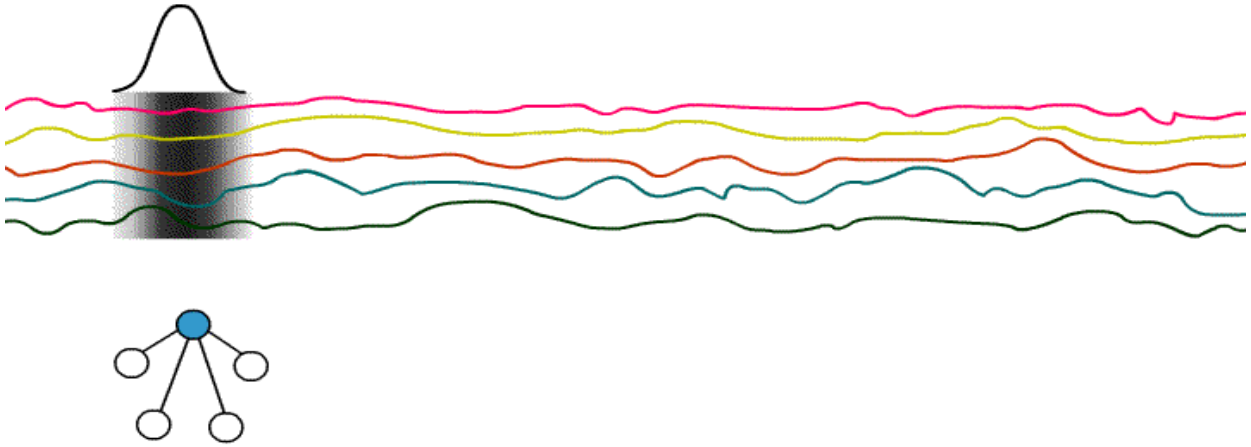




Jamie King

What is the empirical structure of our landscapes and our methods?

Dynamic network inference from multivariate signals



Umer Ijaz

- How to go from a set of signals to a sequence of time evolving networks?

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Network modelling methods for FMRI

Stephen M. Smith [a,*], Karla L. Miller [a], Gholamreza Salimi-Khorshidi [a], Matthew Webster [a], Christian F. Beckmann [a,b], Thomas E. Nichols [a,c], Joseph D. Ramsey [d], Mark W. Woolrich [a,e]

[a] FMRIB (Oxford University Centre for Functional MRI of the Brain), Dept. Clinical Neurology, University of Oxford, UK
[b] Department of Clinical Neuroscience, Imperial College London, UK
[c] Departments of Statistics and Manufacturing, Warwick University, UK
[d] Department of Philosophy, Carnegie Mellon University, Pittsburgh, PA, USA
[e] OHBA (Oxford University Centre for Human Brain Activity), Dept. Psychiatry, University of Oxford, UK

Abstraction?

- Paul's highest levels are also the most interesting? What is the relationship between this and brain architecture?
- Is this too hard to even discuss?

A theorist in a contingent world

A theorist in a contingent world

- Like many I thought that a theorist performed the following operation:
- Maths -> More Maths

A theorist in a contingent world

- When I left quantum mechanics people called me a modeller.
- Data -> Maths (-> Data -> ...)

A theorist in a contingent world

Method:
Methods can sometimes be transferred across systems

A theorist in a contingent world

Method:
Methods can sometimes be transferred across systems

Principles:
Evolution
Optimality
Design
The contingent is a detailed consequence of principles

A theorist in a contingent world

Method:
Methods can sometimes be transferred across systems

Commitment to the contingent:
Specific models for specific systems

Principles:
Evolution
Optimality
Design

A theorist in a contingent world

Method:
Methods can be transferred across Systems

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- Eg. One's attitude to choices of probabilistic model -> cost functions.
- Remark – we want to design models of the world for which the data we obtain is somehow likely or low energy. Often invoke structure in data we don't have. I.e. somehow we pick good probabilistic models.

A theorist in a contingent world

Method:
Methods can be transferred across Systems

Commitment:
Specific models for specific systems

Principles:
Evolution
Optimality
Design

- Stats and machine learning can help us work out the right model from a set we specify.
- Methods are much less good at giving us the models in the first place. There is activity in this direction.

A theorist in a contingent world

Method:
Methods can be transferred across Systems

Commitment:
Specific models
for specific systems

Principles:
Evolution
Optimality
Design
PAUL

- So designing models (broad sense) abstraction, is what we're good for.
- How can we abstract from our data automatically? How can we automatically design models instead of merely discriminating between a pre-specified set?
- Abstraction in the context of continuous data acquisition which can be interactive and rewarded.

Thanks!