Data Analytics of Large Coupled Structures

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Research Groups:

Complex Systems & Networks

Dynamical Systems and Statistical Physics

Probability and Applications

Statistics and Data Science

Funding: For September 2021 entry: Funding from QMUL mini-CDT Principal's Postgraduate Research Studentships has been assigned to this project.

Studentships will cover Home tuition fees, and a stipend at standard rates for 3-3.5 years.

We welcome applications for self-funded applicants year-round, for a January, April or September start.

Project description:

Possible Topics from Mathematical Data Analysis:

- **Emulating sounds with deep learning**
  The focus is on solving sophisticated machine learning problems and understanding convergence properties and their error estimates in a functional analytic setup. The project aims at creating synthetic sounds, which play a vital role in music production.

- **Reliable and efficient analysis of financial data for risk management**
  The focus is on the development of new complexity reduction tools for high dimensional non-linear parametric partial differential equations that arise in pricing and risk management. Ultimately, the methods will lead to better risk assessment in financial institutions.

- **Modelling stochastic processes in human population genetics**
  The focus is on understanding and identifying the growth of non-healthy human tissues such as tumours by using experimental and clinical data of genetic information. We will use stochastic models as well as data analysis tools to explain observed patterns in human cells, finally predicting the possible dynamics of disease development.

- **Generalisations of Submodular Functions for Algorithmic Game Theory**
  Recently, relaxations of the notion of "diminishing returns," or submodularity, have been proposed that enable optimisation over general classes of objectives in machine learning and operational research. This project will explore whether the same can be done in strategic or online settings that involve multiple agents or incomplete information.

- **Graph-based discretisation of geographical data**
  The availability of fine-grained geographical data calls for more refined methods to quantify and compare the heterogeneity of spatial distributions across urban, regional, national, and continental scales. In this project we aim at exploring graph-based representations of spatial data. This framework will allow us to use a wide corpus of results from network science and will provide non-parametric ways to analyse and comparie spatial distributions of categorical and real-valued geo-referenced data. We will use both synthetic and real-world spatial data sets, which are made available as OpenData by several governments, and we will also explore generative models of heterogeneous spatial distributions. Possible applications include the quantification of spatial segregation and socio-economic inequality, and the definition of policies for resource re-distribution and focused interventions.

Further information:

How to apply

Entry requirements

Fees and funding