Interdisciplinary Masters by Research

The York Centre for Complex Systems Analysis (YCCSA) at the University of York focuses on using interdisciplinary research approaches to tackle complex real-world problems. Our interdisciplinary Masters by Research programme brings together teams of students and supervisors to address specific research problems from an interdisciplinary perspective. Each student is registered in their home discipline department, but the student and supervisor team works together in YCCSA, jointly tackling a real research problem, whilst learning interdisciplinary research skills. Successful students will graduate with a Masters by Research degree from their department.

In addition to project-specific requirements (see below), successful applicants will have

- a demonstrable track record in project working, for example, a first class undergraduate project
- a strong interest in pursuing interdisciplinary research
- strong team working skills and experience
- your own source of funding for the degree programme

Cancer Systems Biology

start date: October 2017

Departments involved:

**Biology, Physics, Computer Science**

Our interdisciplinary group of biologists, physicists, and computer scientists are investigating processes in cellular systems biology, through wet-lab experiments, novel Raman spectroscopy techniques, and novel computational simulations.

We are recruiting a team of up to three Masters research students to further progress this work. The students will work in an interdisciplinary team to progress this research.

Disclaimer: While we will attempt to recruit a project cohort of three students, we cannot guarantee that this will be possible. Nevertheless, a smaller project team will still be able to complete a version of the proposed research, using data from other sources as required.

**Supervisor team**

Please contact the supervisor in your chosen discipline in the first instance:
Biology Masters by Research

Traditional approaches to determining cancer cell behaviour and fate at the molecular level have relied upon extraction of biomolecules from large numbers of cells or archival, fixed tissues. Our approach has been to enrich for specific cell populations from human (prostate) tissues which has revealed many of the shortcomings of previous analyses. To promote this small cell number/single cell approach, requires the means to not only distinguish individual cell types in normal and cancer tissues (currently limited by available cell surface antigenic markers), but also the methods to analyse cell fate in a dynamic system of cell growth and differentiation. You will apply our established techniques to generate multicellular laboratory reconstructions of the normal and malignant prostate, and will map the effects of established treatments on individual cell types in the prostate. Your data on cell material and growth/death kinetics will feed into the collaborative project, with Raman Spectroscopy used to generate novel signatures for normal and malignant cells, which in turn will be used to provide input for the computational modelling. The project will therefore generate the first dynamic model of differentiation changes between normal and malignant human prostate epithelial cells, and may reveal new cancer-specific therapeutic targets.

Essential requirements

• You will have an appreciation of cellular differentiation and the importance of the process in cancer and development
• You will have prior experience of mammalian cell culture techniques
• You will have demonstrated an attention to detail and an ability to interpret complex data sets
• You will be keen to read broadly in the scientific literature and have good time-management skills
Desirable requirements

- You will have a basic (degree level) knowledge of human cancer biology

**Physics Masters by Research**

Raman spectroscopy is a non-destructive and label-free method to study biological cells providing a detailed molecular-fingerprint of their biomolecular composition. You will be trained in using Raman spectroscopy to study prostate cancer cells, specifically in the generation of experimental data, and in using in-house codes as well as other statistical methods for data analyses. These studies will be used to characterise and distinguish different types of prostate cells (normal and cancer), and to determine the biomolecular effects of treatment on diseased cells. Full training in experiment and data analysis will be provided.

Essential requirements

- You will be keen to learn new experimental skills and be patient in performing the lab work needed to collect sufficient amounts of data for this project
- You will be interested in detailed data analysis and the interpretation of complex data sets
- You will be keen to read scientific literature and have good time-management skills to complete tasks and balance time spent on lab-work, data analysis, data interpretation and reporting

**Computer Science Masters by Research**

You will be working in this team to develop a new abstract computational model and agent-based simulation, using our well-defined development approach: CoSMoS. You will work with the domain scientists to elicit and develop an abstract model of their cellular level system and spectroscopy data. You will then use this model to implement a demonstrably fit-for-purpose prototype simulation of the system, calibrate it against experimental data, and then use it with the team to investigate various biological hypotheses.

Essential requirements

- You will be a skilled software engineer, with strong abstraction and modelling skills.
- You will be able to validate a simulation against its requirements, and have an appreciation of software quality assurance.
- You will be a skilled programmer, in a language such as Python, Java, or C++.

Desirable requirements

- Experience in agent based modelling and simulation
- Experience in cell systems biology