

Calcium signalling and travelling wave response to oocyte fertilisation

University of Adelaide-University of Nottingham Joint PhD in Mathematics

Supervisors

This project is offered jointly by the University of Adelaide and the University of Nottingham and will be supervised by four researchers:

- Yvonne Stokes, School of Mathematical Sciences, The University of Adelaide,
- Ruediger Thul, School of Mathematical Sciences, University of Nottingham,
- Stephen Coombes, School of Mathematical Sciences, University of Nottingham,
- Jeremy Thompson, School of Medicine, The University of Adelaide.

Project Information

The successful fertilisation of oocytes (eggs) is a major event in the reproduction of many species including humans. There is now compelling evidence that so called cumulus cells, which surround the mature oocyte, play a crucial role in this process. Recent experimental work by Thompson and others in the Robinson Institute, The University of Adelaide, showed that upon fertilisation cumulus cells move away from the oocyte in a travelling wave-like fashion. These travelling waves have been observed in bovine and amphibian embryos and are known to be a result of cellular calcium signalling. Importantly, these calcium signals are triggered in the first instance by oocyte fertilisation and thus provide a causal link between fertilisation and the wave-like motion of cumulus cells. In this project, we will investigate the connection between cell movement and cellular calcium signalling in the cumulus-oocyte complex (COC).

The new COC model that we will develop will amalgamate ordinary and partial differential equations with an agent-based framework. Using tools from applied nonlinear dynamical systems and scientific computation we will explore how this model integrates intra- and intercellular signals to create movement. A main question that we wish to investigate is how the information that the oocyte is fertilised is transmitted through the COC. Is the oocyte solely responsible for the calcium signal that then diffuses through the surrounding cells and into the medium surrounding the COC, or do the cumulus cells contribute to the signalling? By answering this question, we will gain a deeper understanding of the cellular calcium signalling cascades involved in fertilisation and the physical organisation of the cumulus cell network. Existing experimental data as well as new experiments will be used to determine model parameters and for model validation.

Joint PhD Arrangements

Applications are invited to this Joint PhD project in Mathematics between The Universities of Adelaide and Nottingham. The scholarship provides fully funded 3-year PhD studentships. Students will be co-supervised by staff at both universities and will undertake a minimum period of research of 18 months at

each institution. The Adelaide-Nottingham Doctoral Scholars will be primarily based on the North Terrace Campus in Adelaide and on the University Park campus in Nottingham. Both campuses are renowned for their world-leading research and their outstanding facilities for research and teaching.

PhD graduates will obtain a jointly awarded degree from the University of Adelaide and the University of Nottingham. The studentships will cover PhD tuition fees, plus a stipend corresponding to the standard research council rate in the UK or the APA rate in Australia. Subject to satisfactory progress, the duration of the stipend will be 3 years including time spent at the partner overseas campus.

Eligibility

Applicants should hold or be about to complete a degree in Mathematics or a closely related subject area. Those with UK qualifications should have, or expect to obtain, a first-class Honours degree and/or a distinction or high merit at MSc level. Under exceptional circumstances a good 2:1 or Merit degree can be considered. Applicants with Australian qualifications should have an Honours degree (Class 1 or 2A) or a Masters degree with a significant research component. Equivalent international qualifications can be considered.

Applicants should have UK or EU status for PhD fees or, alternatively, should be Australian Permanent Residents/ Citizens. Full international applicants can be considered provided they have an alternative means to cover the difference in tuition fees.

The project is available to begin either immediately or in the 2017/2018 academic year.

This studentship is open until filled. Early application is strongly encouraged.

Applications

UK or EU applicants should apply online at: <http://www.nottingham.ac.uk/pgstudy/how-to-apply/apply-online.aspx>

Please include in your application, a covering letter to indicate your interests and why you are applying to the "Joint Nottingham-Adelaide PhD", and indicate the specific project(s) that you wish to apply for.

Informal enquiries may be addressed to the individual project supervisors or PM-pg-admissions@exmail.nottingham.ac.uk

Australian Permanent Residents/ Citizens should apply online at: <http://www.adelaide.edu.au/graduatecentre/admission/>

using the domestic or international application as appropriate; please upload a covering letter indicating the specific project that you wish to apply for, your interests and why you are applying together with your CV. Informal enquiries may be addressed to the individual project supervisors or the Postgraduate Coordinator, School of Mathematical Sciences: pgc.maths@adelaide.edu.au.