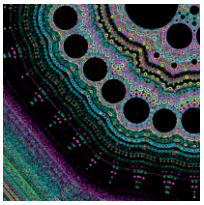
UNIVERSITY OF EXETER

POSTGRADUATE FACTFILE 2009

Computational Science and Modelling



"I studied here for my undergraduate degree in Mathematics, coming to Exeter for its excellent academic reputation and its great position in the South West close to the sea. Having enjoyed the applied maths modules I opted to stay on for a Masters. Exeter is an excellent place to live and work. Dartmoor, the beaches, countryside and range of pubs and bars always give you plenty to see and do.

My main interest is the use of numerical methods for weather prediction. My dissertation is entitled 'The Relevance of Orders of Accuracy for Numerical Modelling of Atmospheric Flows'. When using a numerical method there is inevitably some error in the approximation; the idea of the project is to build a way to classify the spectrum of errors involved with various numerical methods to understand when a given scheme should be used.

I received funding for this research from the Met Office. As part of my dissertation I visited the Met Office every six to eight weeks to discuss the work undertaken and give them an informal progress report.

I have continued to work in meteorology and am now undertaking a PhD in the School."

DAN HOLDAWAY

WHY STUDY FINANCIAL MATHEMATICS AT EXETER?

- **Strong links with the Met Office in Exeter, including three joint professorships researching weather and climate system modelling**
- **Diverse range of research topics in applied and pure mathematics, statistics and cross-disciplinary areas**
- **Multidisciplinary research institutes in mathematics, informatics and advanced technologies**
- **Opportunities for collaborative training awards to gain teaching experience**
- **Generous scholarships**

Computational modelling techniques and algorithms continue to be important tools for a wide range of established and emerging technologies and applications. The ever increasing power of computers means that computational modelling is now used for design and development in most science and engineering based industries. Numerical simulation is also making a big impact in many areas of modern scientific research. Well-known examples are in climate change prediction and weather-forecasting, but computational modelling is now entering into almost every sphere of scientific activity.

This MSc draws on both the expertise within the Mathematical Sciences at Exeter, and on the broader applications-oriented expertise in Computer Science, to create an exciting MSc which will be of interest to graduates in Mathematics, Engineering, Computational and Physical Sciences.

The particular research themes you can follow include:

- Climate and Weather Systems
- Computational Engineering
- Dynamical Systems and Control
- Geophysical and Astrophysical Fluid Dynamics

The University plans to invest £80 million in science by 2012, which includes £30 million of University funds and an anticipated £50 million external funding. This investment will support interdisciplinary research within five theme areas; the School plays a central role in four of these including the climate change and sustainable futures theme.

The University of Exeter is a major player in global warming research, with unprecedented links to the Met Office and Hadley Centre for Climate Prediction and Research through three jointly-funded professorships. The University of Exeter is uniquely well-placed to contribute to improved predictions of climate change and its impacts. There will be an extensive research programme involving the mathematics and physics of Extra-solar Planets supported by the University Science Strategy Funding.

Computational Science and Modelling

KEY FACTS

Computational Science and Modelling

Duration 12 months full-time, 24 months part-time

Start-date October

Entry requirements All applications are considered individually on merit. Normally a Second Class Honours degree or above (or equivalent) in an engineering or science subject is required. All international students whose first language is not English will need to satisfy our English Language requirements; for further information see the Postgraduate Prospectus at: *www.exeter.ac.uk/postgraduate*

Fees (2009/10) UK/EU students: £4,500; International students: £10,000

Funding opportunities Generous international scholarships are available from the School; visit *www.exeter.ac.uk/secam/scholarships* for full details. There are also University Scholarships including Full Fee Masters Scholarships, British Council Fellowships and Awards and Foreign and Commonwealth Scholarships. Visit *www.exeter.ac.uk/scholarships* for further information.

Programme aims

- To provide you with the knowledge and skills to build successful mathematical models for a wide range of applications and develop computer implementations of those models;
- To generate an enthusiasm for the application of mathematics and an understanding of its role in modelling industrial, commercial and environmental problems;
- To develop research skills, personal skills and core academic skills to prepare you for a wide range of employment opportunities;
- To prepare you for further research in the physical sciences and engineering.

Programme outcomes

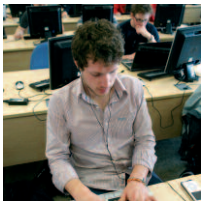
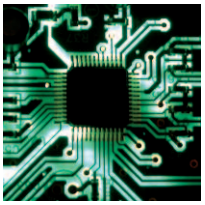
As a successful graduate of the programme you will be able to:

- Identify relevant research problems in science, particularly in the areas of applied mathematics and physics;
- Demonstrate a theoretical understanding of how to formulate physical and mathematical problems of practical importance;
- Apply the theoretical understanding of numerical formulation and modelling to physical, mathematical and industrial problems;
- Express yourself clearly in writing scientific publications for research journals;
- Design and perform numerical modelling for scientific problems and analyse and interpret the output of numerical modelling.

Programme overview

This programme is practically oriented and will provide you with a strong working knowledge of modern mathematical and computational modelling methods and algorithms, as well as the option to study areas such as pattern recognition, neural networks and computational signal processing. You will acquire the skills required to develop computer-based models and extract useful information from them, and consider the application of mathematics to modelling industrial, commercial and environmental problems.

The programme forms a good basis for careers in applied science requiring a balance of mathematical and computational skills; for example, in weather forecasting, environmental science or bioinformatics. It will be particularly valuable for progression into industrial research and development employment, or into scientific research at the PhD level or beyond.


Programme structure

The taught element of the programme takes place between October and May and is arranged into two 12-week teaching semesters. These are followed by a research project undertaken from June for submission in mid-September. Part-time study is also possible, over a two year period.

The programmes are modular and flexible, carrying 180 credits in total. You will take 150 credits of core modules, including the 60-credit research project, plus two 15-credit options to be chosen from a list of advanced modules. Alongside your choice of research project, the option modules give you the opportunity to tailor your MSc to meet your individual training needs.

Programme modules

CORE MODULES

Computation and Numerical Analysis
This module introduces the popular computer package Matlab and other relevant software. Topics from linear algebra, differential equations, statistical modelling, optimisation and dynamical systems are used to demonstrate the versatility and capabilities of such packages in the application of modern numerical modelling techniques.

Computational Science and Modelling Dissertation
You will carry out an in-depth study of a chosen topic under the supervision of a member of staff. The project will involve a critical review of the topic and/or some original research, and will lead to an extended dissertation.

Methods and Algorithms
This module explores a diverse range of mathematical topics, emphasising their practical aspects. The topics covered will range from matrix algebra to differential systems and optimisation and provide a theoretical grounding in many of the tools used in mathematical modelling.

Modelling Applications and Case Studies
This module aims to develop modelling skills through applications to active areas of modern research in the mathematical sciences. It will illustrate how mathematical and computational techniques can be used to solve key problems in areas of practical scientific (both physical and life science) and engineering importance.

Research Methodology
Good investigative research is a difficult skill involving the framing of research goals and investigative plans as well as critical evaluation of previously published results. This module explicitly addresses research planning and critical assessment in the context of your own research project, and introduces you to undertaking independent, but supervised, research at postgraduate level.

Research Project
This module aims to develop independent research skills through working on a scientific research project in the areas of mathematical and physical sciences. It will demonstrate how scientists employ modern mathematical and computational techniques to solve important problems and will teach you how to write a scientific publication.

OPTION MODULES

Differential Equations and Chaos
On this module you will explore qualitative and asymptotic methods for solving nonlinear ordinary differential equations. The phenomena studied occur in many physical systems of interest.

Hydroinformatics Tools
Hydroinformatics is the integration of information technology (computing and software tools) with knowledge and understanding of water quantity and quality to enhance our understanding and resolve problems related to the aquatic environment. On this module you will gain an understanding of tools in hydroinformatics for the practising engineer. We will discuss the theoretical and practical aspects of hydroinformatics tools such as geographical information systems (GIS), optimisation tools, data mining methods and decision support tools, as applied to urban water systems.

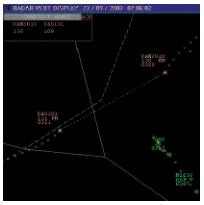
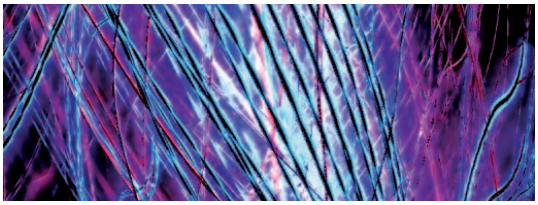
Nature-Inspired Computation
This module introduces a range of computational and information processing techniques based on, or inspired by, processes in nature and discusses their application to a range of artificial intelligence problems. Examples include evolutionary algorithms, swarm intelligence techniques and immune system methods.

Neural Networks
Neural networks have found a wide range of applications beyond their original motivation as a model of computation in the brain. The aim of this module is to introduce the field of connectionism, including its theory, implementation, application, and how it relates to other models of computation and learning.

Pattern Recognition
This module provides a thorough grounding in the theory and application of pattern recognition, classification, categorisation, and concept acquisition. Neural networks and graphical models are flexible tools for modelling data which can be employed, in a principled statistical way, in pattern recognition schemes. This module aims to use neural networks, graphical models and related methods to analyse and solve real problems. Symbolic algorithms are also introduced for extracting knowledge from large data sets of patterns (data mining techniques, Hidden Markov Models) where it is important to have explicit rules governing pattern recognition. Problems of coping with noisy and/or missing data as well as temporal and sequential patterns are addressed.

As the programme continues to develop, module options may change. This is only an indicative list; please visit our website for the latest information.



Learning methods and academic support

Teaching is by lectures, example classes, computer classes, tutorials, set work, project work, reading and self-study. The exact form and number of lectures and tutorials varies from module to module and reflects the material to be covered.

The programme actively encourages the development of transferable skills including management skills, communication skills, computational techniques, data handling and analysis, problem solving, decision making and research methodology.

You will be allocated a Personal Tutor who is available for advice and support throughout your studies, along with support and mentoring from graduates who are now placed in industry. There is also a Postgraduate Tutor available to help with further guidance and advice.

Research

Research within the School is organised into three Research Institutes; the Advanced Technologies Institute, Informatics Research Institute and Mathematics Research Institute. Each Institute has its own Research Centre, providing the focus for significant multidisciplinary research activity, transferring technology between academia and industry. The research undertaken in the Mathematics and Informatics Research Institutes is of particular relevant to this Masters programme.

The **Informatics Research Institute** builds on Exeter's international reputation for informatics activities and concentrates on the increasingly important areas of hydroinformatics (water systems), bioinformatics and biomedical informatics, together with computational statistics and information systems research. Our computer science and informatics research outputs were recognised as having both industrial and social importance in the 2008 RAE with the institute's Centre for Water Systems noted as a clear area of strength.

The **Mathematics Research Institute** brings together our international quality research in various areas of pure and applied mathematics, in particular climate and environmental modelling, geophysical and astrophysical fluid dynamics, dynamical systems and control, and number theory. This Institute also forms the core of our increasingly close collaborations with the UK Met Office, who jointly fund three professorships in mathematics (Professors Cox, Stephenson and Thuburn). In the 2008 RAE the fluids, dynamical systems and climate groups were singled out as being very strong, with our partnership with the Met Office considered a particular strength.

Postgraduate facilities and resources

The School provides a warm, friendly and supportive atmosphere. The close personal contact between staff and students contributes to a highly productive and well-organised research environment.

The School has excellent teaching and research resources and has recently invested £2.8 million into providing new academic and social facilities. You will have access to the School's fully-equipped research centres, comprehensive laboratories and workshops and computer facilities including wireless networking in most areas. The School has a brand new study area with core texts for courses, individual rooms for study groups to meet, and wireless connection for laptops and LCD TVs to display presentations.

Our Research Institutes offer weekly seminars which provide invaluable insights into current research and related work as well as a place to meet staff and other students. There are also a range of extra-curricular activities organised by students, student societies and the Research Institutes that provide an opportunity to meet students and staff in more informal settings.

International students

We pride ourselves on making our international students feel welcome and at home, with tutors offering guidance and support. International students appreciate Exeter's safe location and friendly atmosphere.

There is a thriving international student community of some 2,000 students from over 100 countries. There is a full-time International Student Adviser to help with welfare and visa issues. The INTO University of Exeter Centre provides courses for students who need to improve their English before starting a degree and free tuition during term-time. For further information visit *www.exeter.ac.uk/international*

Under the Post Study Work Scheme, international students who have graduated from one of our postgraduate programmes may be able to remain and work in the UK for up to 24 months after notification of their results. Students who wish to take advantage of the Scheme are encouraged to contact the University's Careers and Employment Service after they arrive at Exeter to discuss employment possibilities.

International students should note that they will not be permitted to study a programme part-time under the terms of a student visa.

Employment

Our technology-based society is increasingly dependent on mathematical modelling, from engineering to finance, environmental prediction to forecasting commercial supply and demand. There is therefore considerable demand in the workplace for graduates with the appropriate mix of mathematical and computational modelling skills. Our graduates take up employment in a variety of sectors, from large companies to small and medium-sized enterprises. The programmes also prepare you for undertaking further research, and a significant proportion of our graduates go on to study for PhDs.

The career and training destinations of a sample of recent graduates include:

- Research Assistant, University of Cambridge
- Software Developer, Portrait Software, Henley-On-Thames
- PhD Mathematics and Meteorology, University of Exeter
- PhD Applied Mathematics, University of Exeter
- MSc Bioinformatics and Systems Biology, Imperial College London

Why choose Exeter?

A top 15 research-led university

- The University of Exeter is ranked 13th in the *Times* and 14th in the *Guardian* and *Sunday Times* 2008 league tables. Nearly 90 per cent of Exeter's research was rated as being at internationally recognised levels in the 2008 Research Assessment Exercise. Sixteen of our 31 subjects are ranked in their respective top 10, with 27 in their respective top 20. Every subject was assessed as including world-leading (4*) research.*
- In the last year, £51 million was invested in research and the value of new research grants and contracts rose by 49 per cent.
- We are planning investment of £80 million in science, medicine and engineering over the next three years. £30 million of existing University funds and an anticipated £50 million from external sources will be spent on new appointments and infrastructure to boost research and teaching.

Dedicated support and training

- We invest £4.5 million per year in scholarships and financial support for postgraduates.
- Our employment rates for postgraduates are above the national average;** 97 per cent of postgraduates who graduated in 2006/7 entered employment or further study.***
- The Postgraduate Centre on the Streatham Campus offers purpose-built study and leisure facilities, including a 24-hour computer room, lounges, seminar room, bar and dining room.
- The Postgraduate Union (PGU) represents postgraduates across the University, organising the Postgraduate Forum which gives students the opportunity to provide feedback, as well as social events. Postgraduates are well represented on the Guild's award-winning media and wide range of clubs and societies. Each October, there is a Welcome Week specifically designed for new postgraduates.

Investment in student and research facilities

- We are near to completing a £140 million investment programme in new buildings and facilities, ranging from dedicated postgraduate study facilities and new research centres to the Students' Guild building and nightclub.
- The University is now looking to the future with a planned £450 million investment in campus facilities by the end of the next decade. This will include a £40 million redevelopment of the centre of the Streatham Campus and a new £45 million INTO Centre for international students.
- Exeter's expenditure on library books, journals and electronic resources is 35 per cent above the national average in terms of spend per full-time student.****
- An £8 million development programme has given Exeter some of the best sports facilities in the country. New indoor tennis facilities to LTA standards opened in 2004 on the Streatham Campus, making Exeter one of only nine UK universities to have such facilities. A new £2 million cricket centre will open in spring 2009.

An exceptional location

- The Streatham Campus in Exeter is one of the most beautiful in the country.
- A safe, student-friendly city within walking distance of both campuses, Exeter is consistently rated one of the best places to live in the UK for the quality of its facilities and low crime rate. For those looking to escape city life, sandy beaches, moorland and some of the most stunning countryside in Britain are all just a short journey away.
- No longer the 'sleepy cathedral town', Exeter is booming economically and culturally but without losing its human scale and relaxed ambience. Large companies like the Met Office are choosing to relocate and there are major developments in shopping, leisure and nightlife in the city centre, including a £200 million new retail centre. Exeter ranks joint 8th (just behind Brisbane, Shanghai, Sydney and London) in a worldwide study of promotion of inward investment and was voted 2nd best place for retail therapy in the UK outside London (Yellow Pages survey, 2007).

** based on percentage of research categorised as 3* and 4* (internationally excellent or world leading)*
*** HESA 2005/6*
**** Figures at Jan 2008 as a percentage of Home Full-time graduates available for employment or further study*
***** LISU/SCONUL figures, 2006/7*




Application procedure

You can apply online via the programme page on our website at **www.exeter.ac.uk/postgraduate**

Further information on application procedures can be found at **www.exeter.ac.uk/postgraduate/admissions**

UNIVERSITY OF EXETER

Useful contacts

School of Engineering, Computing and Mathematics
Telephone: +44 (0)1392 263624
Email: t.albutt@exeter.ac.uk
www.exeter.ac.uk/secam

Postgraduate admissions
Telephone: +44 (0)1392 263316
Email: pg-ad@exeter.ac.uk

Information for international students
Telephone: +44 (0)1392 263405
Email: intoff@exeter.ac.uk
www.exeter.ac.uk/international

University accommodation
www.exeter.ac.uk/postgraduate/accommodation

Fees and finance
www.exeter.ac.uk/postgraduate/money

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