



Bioengineering at Warwick University

Introduction to Warwick University

The **University of Warwick** is one of the top 5 universities in the UK. It is a university with about 20,000 students located on the outskirts of , Midlands, . It was established in 1965 as part of a government initiative to expand access to higher education, and in 2000 Medical School was opened as part of an initiative to train more doctors in Britain. The University is a research led institution and in the last Assessment Exercise the University was the 7th highest-ranked research institution in the UK. For further details see the university website: [.warwick.ac](http://warwick.ac).

Bioengineering at Warwick University

The University of Warwick has been engaged in bioengineering research almost since its creation. The research takes place both within research groups with university departments and in a number of different research centres. Here is a list of the different research groups and research centres related to the topic of bioengineering along with the leader or director who may be contacted for more details, such as recent publications.

Research Centres:

Centre for Cognitive and Neural Systems [.go.warwick.ac.uk/](http://go.warwick.ac.uk/)

CCNS was established in 2007, following a joint initiative between the Department of Psychology and the School of Engineering. The Centre provides a focal point for interdisciplinary research in Cognitive Science and Cognitive Systems, bringing together researchers from a range of disciplines. Its aim is to provide a home for research of the highest quality, and to provide support for projects that make a significant contribution to our understanding of cognition and cognitive systems.

Research in CCNS is organised around five major research themes:

- sensory & perceptual processing;
- high-level human perception;
- human action & motor control;
- communication & education;
- learning and memory.

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Centre for Systems Biology [://www2.warwick.ac.uk/fac/sci/systemsbiology/](http://www2.warwick.ac.uk/fac/sci/systemsbiology/)

The University of Warwick has created a new centre in the scientifically exciting and strategically important area of Systems Biology. This will build on the University's current strengths in the area and involves a substantial investment that includes 12 new posts, a number of secondments, sizeable infrastructure and dedicated accommodation. This initiative is being led by the Department of Biological Sciences, the Mathematics Institute, the Medical School and Warwick HRI

Systems biology involves developing the understanding of a biological system through the mathematical and computational modelling of the interactions of components of the system, leading to the expression of this understanding in qualitative and quantitative terms. A key feature that distinguishes the modern approach to Systems Biology is the aim of linking modelling with the huge volume and diversity of contemporary cellular and molecular data such as that coming from high-throughput, genome-wide and imaging technologies. Understanding of complex biological processes will allow us to tackle many important problems and will be crucial in addressing an enormously broad range of biological and medical priorities such as disease mechanisms, pharmaceutical drug discovery, drug target validation, and horticulture and agriculture.

Warwick Systems Biology (WSB) is an autonomous research centre led by its director Professor David Rand. It has its own staff, some of who have a joint appointment with another department, and its own dedicated accommodation. Professor Liz Wellington leads the Centre's microbiology activities and directs the 4m euro SYSMO grant led by the Centre. Staff seconded from within Warwick include Nigel Burroughs and Hugo van den Berg. Staff appointed from outside Warwick include David Wild, Jim Beynon, Paul Thornalley, Till Bretschneider, Katherine Denby, Magnus Richardson and Sasha Ott.

The University already has a thriving programme at the interface between the life sciences and the mathematical and physical sciences which has been led by the Interdisciplinary Programme for Cellular Regulation (IPCR) and the doctoral training centre MOAC (Molecular Organisation & Assembly in Cells). MOAC is funded by the Life Sciences Programme of the EPSRC. Over an 8-year period it will produce a minimum of 50 PhD postgraduate students with a uniquely broad interdisciplinary training in biology, chemistry, mathematics and computing. Further funding over a 3-year period will fund approximately another 10 studentships per year in our new Systems Biology Doctoral Training Centre. The two DTCs are co-located with WSB.

Further information about the Centre can be obtained from Professor David Rand (d.a.rand@warwick.ac.uk).

Centre for Scientific Computing [://www2.warwick.ac.uk/fac/sci/](http://www2.warwick.ac.uk/fac/sci/)

The Centre has a broad research base and is inherently interdisciplinary in its research agenda. The following themes identify its 6 main research areas.

Fundamentals



Computational work in the natural sciences relies on advances in numerical mathematics, algorithms and computer science. Examples of such "fundamental" research are partial differential equations (PDEs), new strategies for parallel computation, algorithmic approaches to high-performance computing and many more which arise throughout science and engineering.

Molecular Dynamics and Modelling



In the broadest sense, molecular dynamics is concerned with particle motion which is inherent to many natural processes. Examples are simple molecular vibrations, like bond stretching and angle bending.



Computational Engineering and Fluids

Computational engineering nowadays supports almost all branches of traditional engineering. For example, predicting what will happen, quantitatively, when fluids and gases flow, often with the complications of, e.g., simultaneous flow of heat, mass transfer, chemical reaction (eg combustion, rusting), mechanical movement (eg of pistons, fans, rudders), stresses, etc.



Monte Carlo and Stochastic Simulation

Monte Carlo methods provide approximate solutions to quantitative problems by inferring from samples produced through stochastic simulation. While the method itself is based on statistical simulation the problems solved can be both deterministic or probabilistic.



Quantum Simulations

Ultimately, quantum mechanics governs how the world around us evolves. Thus we study how quantum effects at the microscopic level manifest themselves in macroscopic behavior.



Computation of Living Systems

Biology as a quantitative science is more and more relying on large-scale computational approaches to understand the complex behaviour of living systems. This starts with investigations at the molecular level, continues to models of proteins, bio-polymers and their dynamics and culminates in the simulation of whole habitats.

Further information about the Centre for Scientific Computing can be obtained from its Director, Professor Mark Rodger (p.m.rodger@warwick.ac.uk)

Research Groups within Departments:

School of Engineering [://www2.warwick.ac.uk/fac/sci/eng](http://www2.warwick.ac.uk/fac/sci/eng)

The School of Engineering is large with approaching 1000 undergraduates and 1600 postgraduates supported by 300 academic, teaching and research staff. The great strength of the School is its combination of world-class fundamental research with the strong wealth creation that results from its exceptionally close involvement with industry. Its activities range widely over all aspects of engineering involving international industry and business. Apart from research and development, it provides a wide range of services to both local and worldwide companies, aimed at improving their performance.

Electronics, Power and Microsystems: semiconductor devices, **artificial olfaction and biological sensors**, advanced power management systems, **ultrasonic sensor techniques and electrical machines**.

[://www2.warwick.ac.uk/fac/sci/eng/research/epm/](http://www2.warwick.ac.uk/fac/sci/eng/research/epm/)

Fluid Dynamics: computational methods, flow control, cavitation, **medical engineering**, flow diagnostics.

[://www2.warwick.ac.uk/fac/sci/eng/research/fluids/](http://www2.warwick.ac.uk/fac/sci/eng/research/fluids/)



Information & Communication Technologies: optical wireless, optical fibre access, wireless comms, **intelligent systems**, image processing. [://www2.warwick.ac.uk/fac/sci/eng/research/ict/](http://www2.warwick.ac.uk/fac/sci/eng/research/ict/)

Systems, Measurement and Modelling: measurement, **modelling and analysis of: biomedical and biological systems**; precision engineering and surfaces; and stochastic and complex systems. [://www2.warwick.ac.uk/fac/sci/eng/research/smm/](http://www2.warwick.ac.uk/fac/sci/eng/research/smm/)

Warwick Manufacturing Group: digital health, neural engineering and e-health.

Department of Psychology [://www2.warwick.ac.uk/fac/sci/psych](http://www2.warwick.ac.uk/fac/sci/psych)

Three main research groups in the department are:

- Cognitive Psychology
- Developmental Psychology
- Attention, action and motor control

The Centre for Cognitive & Neural Systems is located within the Department of Psychology. The department has a strong record in the experimental study of behaviour and in the mathematical modelling of processes in perception, cognition and action. The department is equipped with state-of-the art laboratories, including EEG labs and vision and motor laboratories.

Department of Chemistry [://www2.warwick.ac.uk/fac/sci/chemistry/research/](http://www2.warwick.ac.uk/fac/sci/chemistry/research/)

Warwick Chemistry is one of the top UK Chemistry Departments and is at the core of the science faculty at Warwick with education and research spanning across all scientific disciplines. Warwick Chemistry is continuously investing heavily in its infrastructure to guarantee and nurture a world-class quality in education, cutting-edge research, and university life. This drive for excellence is intensively becoming a magnet for the best scientists in the world reflected in recent academics staff attracted by Warwick Chemistry from Edinburgh, London Imperial, Cambridge, the Max Planck Institute in Germany, and Boston University in the US, to name a few.

Warwick Chemistry has 5 research clusters: **chemical biology, materials chemistry, physical chemistry & chemical physics, synthetic chemistry** and **theory & computational chemistry**. They currently hold one of the UK Chemistry Departments' largest [EPSRC](#) research grant portfolios.

Warwick Chemistry is organised into three sections: **Inorganic and Materials (IM), Organic and Bioorganic (OB), and Physical and Theoretical (PT)**.

Department of Computer Science [://www2.warwick.ac.uk/fac/sci/dcs/research/](http://www2.warwick.ac.uk/fac/sci/dcs/research/)

Research in the department encompasses a variety of topics, ranging from advancing the foundations of computing to exploring novel, interdisciplinary applications. The activity is strengthened by a range of collaborations, including within the University, nationally, and internationally. Recent large-scale funding has resulted in the establishment of cross-faculty centres of research which bring together emergent technologies and target disciplines. The Department is consistently ranked amongst the top Computer Science Departments in the UK in independent surveys.

Information on **applying for a research postgraduate degree** is available on the [postgraduate admissions pages](#). Visit also our research-related taught MSc courses, the [MSc in Cognitive Systems](#) and the [MSc in Computer Science and Applications](#), which can be your entry point for a research degree at CS Warwick.

Information for **current postgraduate research students** is available as the [Research Degrees Handbook](#).

Information for **staff** is available from the Academic Office, Graduate School, on [Guiding Research Work](#) and on [Research Examinations](#).

The department's research is conducted within groups of staff and students with common interests. The research groups are indicated below, along with some keywords illustrating the range of expertise within each group.

| | |
|--|--|
| Algorithms and Complexity | combinatorial algorithms; randomised algorithms; approximation algorithms; game theory; parallel computation |
| Computational Biology | neuroscience; biological networks; systems biology |
| Formal Methods | logics and automata; formal verification and synthesis; probabilistic, real-time, and hybrid systems; quantum information processing; fault tolerance and security |
| High-Performance Systems | high-performance computing; eBusiness systems; fault tolerant computing; peer-to-peer systems; distributed sensor networks |
| Intelligent and Adaptive Systems | adaptive hypermedia; pedagogic architectures; relational and temporal data mining; web personalization; agent-based systems; educational technology; history of computing; empirical modelling; interactive environments |
| Signal and Image Processing | multiresolution signal representations; image analysis; multimedia standards; watermarking |

Department of Physics [://www2.warwick.ac.uk/fac/sci/physics/research/](http://www2.warwick.ac.uk/fac/sci/physics/research/)

The Department was rated as an internationally-prominent department in the 2008 Research Assessment Exercise. Its research is well supported by a wide range of funding bodies and it has many collaborations worldwide. Since 2001 it has almost doubled in size and research grant income has more than doubled. The Physics Department at Warwick currently has over 50 research active academic staff together with a similar number of Research Assistants and strong technical support. The Postgraduate research student population has also increased significantly to ~130 in 2009, as a consequence of Research Council grant awards.

There are five research themes:

- [Condensed Matter Physics](#)
- [Theoretical Physics](#)
- [Elementary Particle Physics](#)
- [Astronomy and Astrophysics](#)
- [Centre for Fusion, Space and Astrophysics](#)

School of Life Sciences [://www2.warwick.ac.uk/fac/sci/bio](http://www2.warwick.ac.uk/fac/sci/bio)

The Department of Biological Sciences is an acknowledged leader in biomedical education and research. We offer degrees of the highest quality at the undergraduate and postgraduate levels, together with an exciting research environment that is among the very best in the UK. The Department specialises in fundamental and applied research in molecular, biochemical, and cellular biology, with opportunities to carry out multidisciplinary research with a range of other centres of excellence at Warwick.

From 1 October 2010 the Department of Biological Sciences and Warwick HRI will amalgamate to form the new School of Life Sciences. This exciting initiative brings together the renowned research and teaching excellence in the two departments, and will form a platform to further enhance multidisciplinary Life Sciences activity in the University.

Key research themes are:

[Biology in a Changing Climate](#)

[Biophysics](#)

[Cell Signalling](#)

[Physiological Mechanisms](#)

[Genes and Development](#)

[Membranes and Transport](#)

[Microbiology](#)

[Neurosciences](#)

[Plant Cell and Molecular Biology](#)

[Populations and Disease](#)

[Structural Biology](#)

[Virology](#)

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