PhD Opportunities – Faculty of Engineering

This PDF document is an indicative list of PhD research opportunities available to students within the University of Sheffield’s Faculty of Engineering. The list was compiled in May 2013, and is subject to change as vacancies are filled.

Many more PhD opportunities exist within the University’s four other faculties. Information on each of these can be found on the web pages for Arts & Humanities, Medicine, Dentistry & Health, Science, and Social Sciences.

Automatic Control & Systems Engineering  Pages 2-5
Chemical & Biological Engineering  Pages 6-7
Civil & Structural Engineering  Pages 8-9
Computer Science  Page 10
Electronic & Electrical Engineering  Pages 11-17
Materials Science & Engineering  Page 18
Mechanical Engineering  (including Aerospace & Biomedical opportunities)  Pages 19-30

For further information on each opportunity please refer to the links provided to the vacancy (where available) and the department.

Additional information on specific opportunities can be obtained by contacting the International Office, via Danielle.Bertrand@sheffield.ac.uk, or by emailing departments directly.

Thank you for your interest in the University of Sheffield.

Gosia Wells
Head of International Office

www.sheffield.ac.uk/engineering
Automatic Control and Systems Engineering at Sheffield ranks in the UK’s Top 5, and is funded by more than £15m of public and private contracts.

Current opportunities:

- **Robotics, Biomechatronics and Control**
- **FPGA acceleration of computationally-intensive algorithms**
- **Modelling and analysis of the dynamics of global gene expression for diagnosis, prognosis, molecular classification of diseases and new drug development**
- **Real-time Fluorescence Molecular Tomography**
- **Analysis and Modelling of Stem Cell Dynamics**
- **Boundary stabilization of fluid flows**
- **Control theoretical approaches to modelling, analysis and design of gene regulatory networks**
- **Nonlinear System Identification and Biophysical Modelling of Neural Activity based on Electrophysiological Data**
- **Tracking, modelling, simulation and control of evolving interfaces**
- **Robotics and Autonomous Systems**
- **Modular reconfigurable robotic systems**
- **Evolutionary robotics and artificial life**
• Advances in swarm robotics (and multi-robot systems)
• Novel swarm systems
• Random vibration in ground vehicles
• Data modelling and machine learning
• Enhancing virtual screening in the search for new pharmaceuticals
• Optimal control of disease dynamics
• Modelling and Control of Turbulent Flows
• Road vehicle drag reduction via feedback flow control
• Optimal placement of sensors and actuators for feedback control of fluid flows
• Wind turbine gust prediction
• Frequency analysis and design of nonlinear systems: theories, methods and their applications
• Decision, dynamics and control in networked multi-agent systems
• Modelling, analysis, and control of hybrid dynamical systems and their applications
• Temporal logic-based formal synthesis of control systems
• Temporal logic-based correct, reactive robot control
• Analysis and design of systems with time delay
• Intelligent Systems Modelling and Decision Support in Biomedicine
• Advanced Systems-Modelling and Optimisation in Materials Science and Engineering
• Health Monitoring for Rolls-Royce Power Systems
• Computing With Words – Modelling and Optimisation of Industrial Processes
• Perpetual Modelling and Decision Making for Biomedical Systems
• Elastic and Acoustic Metamaterials
• Analysis and control of complex vibrating systems
- Design and development of smart acoustic devices: Cloaks and Lenses
- Integrated Sensing, Monitoring and Healing for Complex Autonomous Systems
- Space Systems
- Predictive control of non-linear and/or robust systems
- Computational efficiency in predictive control
- Application of predictive control to fast systems
- Multi-rate and/or non square systems and/or decentralised control
- Applications of control
- Smart materials for fluid flow control
- Poker: decision making under uncertainty
- Active control of noise and vibration
- Control of flexible manoeuvring systems
- Swarm intelligence optimisation techniques
- Adaptive/intelligent computing and control
- Assistive robotics
- Mobile service robotics
- High-performance real-time computing
- Distributed model predictive control
- Optimization and control for power networks
- Reliable Response and Behaviour of Autonomous Robots
- Cooperative Behaviour of Autonomous Unmanned Vehicles
- Portable Agent Software Architecture for Robot Control
• **Signal Processing, System Identification and Data Modelling for Complex Nonlinear and Nonstationary Systems: Methods, Algorithms and Applications**

• **Nonlinear Model Construction and Parameter Estimation for Complex Systems from Large Datasets**

• **Nonlinear Sparse Model Identification**

• **Detection and Development of Robust Biomarkers for Severe Brain Diseases from Neurophysiological Signals**

• **Data Mining and Modelling from Public Data Resources for Healthcare Applications**

• **Traction power systems for high-speed trains**

• **Advanced control and energy management of DC microgrids**

• **Advanced control and management of aircraft power systems**

• **Advanced control and energy management of hybrid electric vehicles**

• **Advanced control and management of ship power systems**
Four principal research groups produce internationally recognised output, placing the department at No. 7 in the UK. Heavily funded by UK and international industry, the department is also home to the new ChELSI institute, complete with exceptional postgraduate study and lab facilities.

- Liquefaction of fat-bound particle agglomerates [pdf (60KB)]
- Reversible thermo-responsive polymers for inherently safer lithium battery electrolytes [pdf (136KB)]
- Improving sustainability in heterogeneous catalysis through understanding the role of carbon [pdf (63KB)]
- Regenerated silk fibroin peptides as high valued functional biomaterials [pdf (59.6KB)]
- Mechanistic study of molecular assembly for gene and drug delivery [pdf (60.6KB)]
- Plasma Reactors for converting CO2 into Fuels [pdf (67KB)]
- Adsorbents for converting Carbon Dioxide into Fuels [pdf (67KB)]
- Processes for Converting Carbon Dioxide into Fuel (CCU) [pdf (66KB)]
- Mixing Engineering and Ecology to Fix Broken Ecosystems [pdf (96KB)]
- Tablet disintegration - Can we use disintegrants in a fat based system? [pdf (130kb)]
- Twin Screw Granulation: Improved granule quality via on-line monitoring, simulation and modelling [pdf (130kb)]
- Roller Compaction –Improving efficiency and particle characteristics [pdf (130kb)]
- Chemical modification of microbubble generating membranes for improved wetting behaviour and microbubble generation efficiencies. pdf (192kb)

- Protein engineering, design and selection – Carbonic anhydrase for carbon dioxide capture and sequestration pdf (<200kb)

- Protein engineering, design and selection – Carbonyl reductase coupled with cofactor regeneration system for chiral alcohol production pdf (95kb)

- Protein engineering, design and selection – Eukaryotic cytochrome P450s for ecdysteroid syntheses pdf (95kb)

- Formation of odour in wastewater collection systems pdf (285kb)

- Biofilms in urban water systems: fundamentals to application pdf (185kb)
All of the department’s research is recognised internationally, with the majority rated excellent or world-leading. This puts Civil & Structural Engineering at Sheffield firmly in the UK Top 10. The Department is ranked in the top 5 by both the Times and the Guardian 2012 university guides.

- Design rules for thin-walled structural elements subject to coupled instabilities
- Understanding rate effects in geomaterials
- Advanced composites as reinforcement for concrete
- Advanced composites for structural strengthening
- Construction innovation
- Earthquake resistant design of reinforced concrete structures
- FRC - fiber reinforced concrete
- Novel punching shear reinforcement
- The behaviour and design of reinforced concrete structures
- Use of recycled materials in concrete
- Earthquake risk assessment and management
- Seismic strengthening of rc using external lateral post-tensioning
- Mechanical behaviour and durability of steel fibre-reinforced rcc concrete made with recycled materials.
- **Structural analysis and design of steel fibre reinforced concrete pavements for surface transport.**
- **Post-cracking modelling of fibre reinforced concrete.**
- **Testing and modelling of freeze-thaw and corrosion resistance of steel fibre reinforced concrete pavements.**
- **Design and safety philosophy for reinforced concrete.**
- **Precast concrete connections**
- **Green roofs: hydrological performance**
- **Computational fluid dynamics (cfd) applications in urban drainage**
- **Flow patterns and pollutant retention in vegetated suds ponds**
- **Beyond drainage: the impact of suds on urban microclimates**
- **Enhanced runoff detention in green roofs or stormwater planters**
Computer Science at Sheffield ranks in the Top 15 nationally, and two-thirds of its research output is rated internationally excellent or better.

Current research groups (more information via links):

- Computational Systems Biology
- Computer Graphics
- Machine Learning
- Natural Language Processing (NLP)
- Organisations, Information and Knowledge (OAK)
- Speech Technology and Computational Hearing
- Software Verification and Testing
- Neurocomputing and Robotics
The Times of London ranks Sheffield's EEE Department in the UK Top 5, and 95% of its research output is internationally recognised. Exceptional facilities include a clean-room complex for semiconductor research, several anechoic chambers, and the Sheffield-Siemens Wind Power Research Centre.

**Subgroup: Electrical Machines and Drives:**

**Automotive**
- Electromechanical Valve Actuation
- Exhaust Gas Energy Recovery
- Electrical Torque Booster for Down-Sized Engine
- Free-Piston Energy Converter

**Hybrid Vehicles**
- Mild Hybrid/Integrated Starter-Alternator System
- Model Predictive Control Applied to Energy Management
- 36V VRLA Battery Module (Based on 2V Spiral-Wound Cells)
- Installation and Safety Optimised Battery for 42V Application
- Integrated Modular Drive for Parallel Hybrid Vehicle
Electric Vehicles

- Intelligent State-of-Charge and State-of-Health battery monitoring
- Zero-Emissions Down-Sized Vehicle
- Auxiliary Power Unit
- Flywheel Peak Power Buffer
- Supercapacitor Peak Power Buffer
- Anti-Lock Braking/Traction Control
- Electric Vehicles for Media/Leisure Events
- POLLUX - Embedded-Systems for Electric Vehicles

Thematic Networks

- FABIAN
- ELEDRIVE

Active Vehicle Suspension

- Linear Electromagnetic Actuation System

Healthcare

- Reciprocating Air-Compressors
- Electromagnetic Air-Flow Control Systems
- Semi-Active Vibrating Isolation of Reciprocating Air-Compressor
Aerospace

- Electrohydrostatic Flight Control Surface Actuation
- Electromechanical Flight Control Surface Actuation
- ‘More-Electric’ Aircraft Engines
- Fault tolerant drives

Industrial

- Induction heating
- Pulsed field magneto-polariscope
- Sensorless high-speed brushless DC motors
- Direct force control of a novel two-phase tubular motor
- Acoustic emissions from direct torque controlled induction machine drives
- EMC, measurements and modelling of power electronics/drive systems
- Silicon carbide power electronic devices

Marine

- Sensorless control of matrix converters for thrusters on deep-sea ROV’s
- High speed permanent magnet generator

Consumer Products

- Multi-Degree of Freedom Actuators
- Observer based feedback control of 3rd order LCC resonant converters
- Low cost energy efficient compressors for refrigeration
- Optimal sensorless control of PM traction machines for advanced wheelchair applications
- Modelling of Fluorescent Lamps for Circuit Simulation
Subgroup: Semiconductor Materials and Devices (Current areas of research):

Semiconductor Devices

- **AlGaN HFETs for High Power/ High Temperature Operation**
- **InP Travelling-Wave HPTs for Ultra High Frequency Photonic Systems**
- **Analytical Charge Control Modelling of HPT and PIN-diode Photoreceivers**
- **Quantum Dot lasers for GaAs-based telecommunications**
- **Broadband Quantum Dot Superluminescent Diodes for Optical Coherence Tomography**
- **Ultra Violet Light Emitting Diodes**
- **Semiconductor Lasers**

Electron Microscopy, Analysis and Modelling

- **Advanced Electron Microscopy of Semiconducting Materials**
- **Ultimate Microscopy**
- **Atomistic Modelling of Nanostructures**

III-V Semiconductor Materials & Processing

- **Molecular Beam Epitaxy**
- **Metalorganic Vapour Phase Epitaxy (Nitride)**
- **Metalorganic Vapour Phase Epitaxy (Phosphides and Arsenides)**
- Device Processing
- Focused Ion Beam Nanoprocessing
- Electron Beam Lithography

Packaging of Electronics and Microsystems
- Non Planar Photolithography ('Ffestiniog')
- Three Dimensional Interconnect (3DI)
- Three Dimensional Maskless Photolithography (3DML)
Department of Electronic and Electrical Engineering (cont.)

Subgroup: Communications (Current areas of research):

- Textile antennas
- Miniaturised periodic structures
- Miniature Antennas
- Elastic Antennas
- Reconfigurable antennas
- Tunable metamaterials
- Simulation of electromagnetic field exposure in resonant environments (SEFERE)
- Stealth Technology for Wind Turbines
- Electromagnetic Band-Gap Structures
- Hidden Antennas on Vehicles
- Base station antennas for next generation mobile communication networks
- Low Profile Street Furniture
- Phase modulating microwave structures
- Smart microwave materials and structures
- Biological effects of Electromagnetic Radiation from Cellular Phones and PMR apparatus
- Robust Watermarking for Scalable Coded Video Streaming
- Segmentation of Vascular Networks from X-ray Angiograms
- Feature Extraction by Multiobjective Genetic Programming
All of Materials Science & Engineering’s research output is considered to be of international importance. It is the only university department in the UK to be a member of the World Materials Research Institutes Forum (WMRIF), and conducts research in collaboration with more than 120 companies and governments.

- Advanced Characterisation
- Advanced Metallic Materials
- Biomaterials and Tissue Engineering
- Multifunctional Materials and Devices (Ceramics, Magnetics, Polymers and Nanomaterials)
- Multiscale Materials Modelling
- Nuclear Materials
- Structural Materials
- Surface Engineering and Tribology
The Department of Mechanical Engineering is rated No. 2 in the UK for the quality of its research output. Active research sponsors include Rolls Royce, Airbus, and BAE Systems.

**Biomedical Engineering:**

- Development of finite element models for real-time surgical simulation
- Development of mesh-free simulation methods for real-time surgical simulation
- Simulation and modelling of needle insertion
- Model-based registration of medical images
- Biomechanical modelling for image-guided surgery
- Modelling and experimental investigation of cutting of soft tissues
- Human grip of hand-held objects
- Developing a microfluidic chip for mechanobioengineering
- Mechanics of cellular co-culture
- Mechanical stimulation of stem cells in a composite scaffold sheet for tissue engineering
- Image-based elastography using non-rigid medical image registration
- In-vivo estimation of physical properties in right ventricular mechanics
- Computational models for virtual cerebral aneurysm stenting
- Computational models for virtual cerebral aneurysm coiling Computational models for virtual coronary artery stenting
- Dynamic anatomical modelling of arterial coronary trees from CTA and CCA imagery
- Morphological and hemodynamic determinants of cerebral aneurysms rupture: A computational study - Focus on morphology
- Morphological and hemodynamic determinants of cerebral aneurysms rupture: A computational study - Focus on hemodynamics
- Image-based computational haemodynamics of the aorta: Respecting the physics
- Maximising long-term treatment outcome through computational haemodynamics: The Fontan operation
- Intracranial aneurysms: Are we treating a disease, or trying to interfere with nature’s defence mechanism? Preserving dignity in catheterized patients
- A virtual model of the human lower urinary tract
- Predicting soft tissue balance and post-operative function after total knee replacement
- Individualised computer models to investigate neuromuscular variability over repeated tasks
- A stochastic model of femoral strength changes over time
- Finite element modelling of vertebral fracture in osteoporotic patients
- Effect of bone lamellae heterogeneity on the biomechanics of cancellous bone tissue
- Individualised multiscale modelling to predict the risk of bone fracture in elderly osteoporotic patients Development of a damage-based predictive model for bone tissue adaptation
- Bringing further insight in thermal processes into the area of fracture healing and joint life cycle

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Department of Mechanical Engineering (cont.)

Combustion:

- Emissions from blending various biomass fuels with coal in a fluidised bed combustor
- Rates of corrosion for different biomass cofired with coal in a fluidised bed combustor
- Development of a modifiable effective area fuel injector for use with variable calorific value fuel injectors
- High pressure flame instabilities
- Acoustic disruption of diffusion flames
- Airport primary NO2 from engines
- Flame dynamics at elevated pressure
- Experimental investigation of impinging flames
- Flame and acoustic wave interactions
- High speed stereo imaging techniques for flame studies
- Understanding the transient behaviour of gas turbine fuel injectors
- Fluidically controlled fuel injector for use with variable calorific value fuel
- Engine noise and emissions measurement system
- Aviation fuel thermal stability
- Measuring gas turbine engine oil degradation
- The effect of biofuel blends on the thermal stability of diesel in gas turbines
- The use of O2/CO2 closed cycle gas turbines for power generation
- Development of pulse detonation engines
- Development of a rapid compression machine for screening alternative fuels for gas turbines

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- Design optimisation of galvanising baths
- Evaluating the performance of elastomeric materials using a Hanson solubility parameter
- The effect of switching fuel supplies on the performance of elastomeric materials Linking the chemical composition of fuels to the elastomeric material performance in gas turbines
- Using spectroscopy to evaluate the decay in o-ring performance in gas turbines Aviation gas turbine ignition - linking fuel composition to performance
Design and Manufacturing:

- Improving the experience of using electronic hand-held devices
- Designing hand-held equipment for more effective human interaction
- Metal rolling - A new kind of sensor
- Economics of designing out terrorism
- Improved o-ring materials for use in gas turbines
- Cryogenic processing of automotive components
- Cryogenic processing of industrial tooling for manufacturing
- Manipulation modelling
- Designing with uncertainty
- Opening up the range of thermoplastic polymers for additive manufacturing
- Microstructural evolution and control of aerospace and automotive alloys using selective laser melting and electron beam melting
Dynamics:

- Damping technologies applied to sports equipment Uncertainty modelling in active vibration control
- Air film dampers for panel vibrations
- Application of MR dampers to vibration control problems
- Auto-balancing using linear inchworm motors
- Uncertain finite element modelling
- Validating methods for non-linear systems
- Experimental scale model testing of motorised momentum exchange space space tethers
- Dynamics of very large scale space webs for space based solar power
- Fundamental theoretical and experimental studies of non-stationary combination resonances in parametrically excited nonlinear structures
- Aerodynamic flutter drive for a stochastically resonant energy harvester
- Power flow through parametrically resonant oscillators
- Mutually interactive adaptative boundary conditions for speed rotors
- Modelling the dynamics of hybrid electric vehicle power-split systems
- Smart automotive structural dynamics
Fluid Mechanics:

- Numerical simulation of wind borne pollutants dispersion
- Effect of rotation and stratification on particle dispersion and sedimentation
- Wall effect on surface development in pipe flows
- DES of fractally forced turbulence
- Low reynolds number MAV aerodynamics
- Natural laminar flow wing design and optimisation
- Hybrid RANS/LES simulation of wind turbine
- High fidelity pore-scale modelling for CO2 trapping mechanisms in support of carbon storage
- Fundamental study of heat transfer to supercritical fluids in support of the development of novel inherently safe nuclear reactors
- Fundamental study of turbulence in unsteady flows
- Control of wall turbulence for drag reduction
- Control of boundary layer transition to turbulence
- Control of the pressure wave induced by a high-speed train running through a tunnel
Mechanics of Materials:

- Multi-scale modelling of machining
- Obtaining 3D stress fields using non-destructive photoelastic methods
- Load measurement and life modelling in wind turbine bearings
- Design and testing of a physical model to investigate Shaken Baby Syndrome
- Experimental determination of the 3D stress tensor in engineering components
- Using additive layer manufacturing to produce scaled structural models
- Modelling of a living tissue (multi-scale technique)
- Modelling of a living tissue (RVE analysis)
- Damage detection in fibre metal laminates using novel experimental techniques
- Wrinkling failure modelling in conventional metal spinning
- Finite element analysis of a new concept of asymmetric tube spinning
- Contact surface fatigue failures of wind turbine gearbox bearings
- Effects of extreme events on wind turbine bearing failures
- Probabilistic analysis of wind turbine gear micro-pitting
- Fracture of automotive advanced high strength steels
- Modelling of friction stir welding
- Multi-scale modelling of the fatigue and fracture of aerospace alloys
- Fatigue and fracture of fibre composites
- Machining of fibre composites
- Computational mechanics of fracture on advanced composite aerospace structures
- Fatigue and fracture of mechanical components and aerospace hybrid laminates: Computational analysis and prediction

- Local deformation and damage mechanisms and mechanical properties of spot welds in advanced automotive steels
Department of Mechanical Engineering (cont.)

Structural Health Monitoring:

- Ideas for non-stationarity in structural health monitoring
- Self-assembly of structural health monitoring diagnostic systems
- Pattern recognition in healthcare diagnosis
- Robust structural health monitoring
- Disease surveillance methods for structural health monitoring
- Verification and validation of damage models
- Corrosion fatigue
Tribology:

- Development of an ultrasonic tool for determining contact pressure
- Monitoring prosthetic hip joint lubrication
- Tribology and the causes of pedestrian slips
- Pin joints for aircraft landing gear
- Piezo-electric coatings to measure contact and wear
- Lubrication monitoring in bearings
- Railway track condition monitoring
- Wear of railway train pantograph and overhead wire
- Effect of soot on wear of engine components
- Ultrasonic arrays for real-time dynamic contact measurement
- Engine chain drive friction and wear
- Coolant performance during chip machining
- Surface finishing solutions in medical engineering applications
- Wind turbine bearing lubrication
- Bio-lubrication of contacts in the automotive powertrain
- Monitoring lubrication in automotive engines
- Analysis of strain in human tissue using dynamic OCT
- Testing and optimisation of medical examination and surgical gloves
- Tribology of the human foot - Avoiding slips and falls
- Assessment of slip potential on safety flooring
• Oil film measurement in auto engine piston rings
• Ultrasonic machining and the generation of textured surfaces
• Friction modifiers for the wheel/rail contact
• Railway sensors