Unit and programme catalogues University of Bristol

Programme specification: Robotics and Autonomous Systems (PhD) in 2020/21

Programme organisation

Programme code	4AERO010R
Programme type	Postgraduate Research Degree
Programme director(s)	Helmut Hauser
Faculty	Faculty of Engineering
School/department	Department of Aerospace Engineering
Teaching institution	Universities of Bristol and the West of England
Awarding institution	University of Bristol
Mode of study	Full Time
Programme length	1 years (full time)

Programme aims

this programme aims to develop the student's interest in and knowledge and understanding of robotics and autonomous systems (RAS), in order to prepare them for PhD research in that area through the FARSCOPE-TU Centre for Doctoral Training (CDT). The theme of the programme is ubiquity or robots everywhere enabling students to think beyond a robot's technology and about its environment. This looks to address the 4S challenges: requiring future robots to be: **Social**, able to interact naturally with humans; **Safe**, trusted on a technical and societal level to operate in unsegregated spaces; **Smart**, matching robust hardware with intelligent software to be effective in unstructured settings; and, **Scalable**, designed for large scale deployments and evolution of roles. The programme seeks to provide students with the breadth of technical knowledge and context awareness needed to go on and complete PhD research in RAS. The MRes year contains a wide range of detailed technical tools and topics designed to accommodate a variety of academic backgrounds, as well as cohort-based training activities.

Students will learn about industrial context through a dedicated mentoring programme run by the CDT and an Industrial Project in TB2. Research-led teaching in TB1 and TB2, including bespoke research preparation training, specialist options and a series of seminars on research topics, will prepare students to co-create their exploratory projects, which they will undertake over the summer of their first years, providing the full grounding and experience to finalize a PhD topic and supervisory team at the start of Year 2.

All students will have pastoral support from the outset from an individual personal tutor assigned from one of the CDT CoIs, with the CDT Director in the role of Senior Tutor. Once they begin the Exploratory Project, their supervisor becomes their personal tutor. Students will meet regularly with their personal tutors throughout, and with the senior tutor through research preparation group meetings and cohort events.

Programme outcomes

Knowledge and Understanding

Programme Intended Learning Outcomes	Learning and Teaching Methods
1. The fundamental chain of components in a robotic system: perception; cognition; action. 2. Theory and implementation of multi-degree of freedom robotic mechanisms and their control. 3. Algorithmic and operational principles of perception, with an emphasis computer vision. 4. Foundational and mathematical aspects of computer decision making and autonomous systems. 5. Integration of software and hardware to design and realise autonomous robotic solution to meet requirements. 6. Application of a selection of advanced methods in robotics and autonomous systems 7. Research topics and challenges within robotics and autonomous systems. 8. Applications and implications of robotics and autonomous systems, including societal and industrial context.	Technical concepts and methods will be taught through short courses at induction followed by ‘traditional’ lecture courses (1,2,3,4,6). Skills will be taught through intensive short courses and project work (4,5). Applications and research topics (7,8) will be taught through small group (cohort) seminars. Context (7,8) will be taught through case study work and seminars by external speakers. Additional multidisciplinary context (8) covered through option Bristol Futures optional units. **Methods of Assessment** Lecture material will be assessed by examinations and coursework. (Note that most of the lecture material in the course is in options drawn from existing provision.) Projects and short courses will be assessed through reflective accounts, presentations and in-class exercises to enable fast efficient assessment and feedback. Seminar material will be assessed by participation monitoring and reflective accounts.

Intellectual Skills and Attributes

Programme Intended Learning Outcomes	Learning and Teaching Methods
1. Conduct research in the field of robotics and autonomous systems 2. Analyse a problem to derive requirements and design of an autonomous robotic solution, if applicable. 3. Critically evaluate developments in robotics and autonomous systems. 4. Critically evaluate the potential for robotics and autonomous systems across a range of potential applications.	Research preparation (9) and evaluation (11,12) will be taught through a mixture of lectures, seminars and reading groups (“journal clubs”). Problem solving (10) will be covered in group project work. **Methods of Assessment** Reflective accounts; presentations; assessment of technical project work; monitoring of participation in seminars and reading group, including in a journal club wiki.

Other Skills and Attributes

Programme Intended Learning Outcomes	Learning and Teaching Methods
1. Identify, access and interpret state-of-the-art research literature. 2. Communicate research findings, orally and in written form, to both specialist and general audiences. 3. Plan, execute and manage an extended individual research project. 4. Work effectively in a multidisciplinary team.	Literature skills (14) will be introduced in research methods lectures and reinforced in the reading group. Communication (15) will be taught in an externally-delivered short course. Individual and team working (16, 17) will be taught experientially through the group, industry and individual projects. Bristol Futures online courses will be exploited to support study skills development. **Methods of Assessment** Journal club participation; presentations; assessment of technical work.

Intellectual Development

Statement of expectations from the students at each level of the programme as it/they develop year on year.

Level M/7 - Postgraduate Certificate	60 credits to be completed in the taught modules, to include at least one of the two “Robotics Research Preparation” modules. Students will have the initial foundations needed to perform individual research in robotics and autonomous systems (RAS), including fundamental mechanical and computational skills and selected specialist knowledge. They will be able to state common applications, challenges, and contextual issues appropriate to RAS and to study and evaluate related research.
Level M/7 - Postgraduate Diploma	120 credits to be completed in the taught modules, to include at least one of the two “Robotics Research Preparation” modules and at least one of “Robotic Systems” and “FARSCOPE Group Project”. Students will have the initial foundations needed to perform individual research in robotics and autonomous systems (RAS), including fundamental mechanical and computational skills and in selected specialist topics related to RAS. They will be able to state common applications, challenges, and contextual issues appropriate to RAS and to study and evaluate related research. They will also be able to combine their skills to deliver an integrated robotic solution to a problem.
Level M/7 - Postgraduate Masters	180 credits from the taught modules plus the dissertation. Note that the MRes degree will only be awarded to students electing to exit the CDT programme early, before completion of their PhD. Students will now be able to perform their own research at an internationally publishable standard. They will also be able to document and communicate their

	findings to peers and expert practitioners in the field. Their individual capabilities will be enhanced by teamwork and system integration skills.

Intended Learning Outcome Mapping

FARSCOPE-TU ILO Mapping Document.pdf

The intended learning outcome mapping document shows which mandatory units contribute towards each programme intended learning outcome.

Other information

Admissions Information

For information on the admissions requirements for this programme please see details in the undergraduate prospectus at http://www.bristol.ac.uk/prospectus/undergraduate/ or contact the relevant academic department.

Additional Information

Programme is delivered jointly by the University of Bristol and the University of the West of England. Units Robotics Research Preparation, Technology and Context of Robotics and Autonomous Systems, FARSCOPE Group Project, and FARSCOPE First Dissertation will all be delivered at the Bristol Robotics Lab.

Description of Distinctive Features and Support

This academic programme is tailored to provide initial training for students in the EPSRC Centre for Doctoral Training in Futurue Autonomous and Robotic Systems (FARSCOPE). It is delivered jointly by UWE and the University of Bristol through their existing partnership embodied in the Bristol Robotics Laboratory (BRL). The goal of the programme is to prepare students for independent, PhD-level research in multidisciplinary robotics. This is achieved by a mixture of formal instruction in fundamental subjects, introduction to the range of research topics and state-of-the-art, and individual experience of research through an extended dissertation. It is not required that a student's dissertation should for the beginning of their PhD project, although some may choose to follow that course. Rather, the entire one-year programme is intended to prepare students to make an informed decision and a good start on their subsequent PhD, which may or may not be in the same specialization as their preceding dissertation.

Although the MRes programme is only followed by students registered on the CDT PhD programme, it provides flexible exit qualifications, consisting of a Postgraduate Certificate and a Masters Degree. The programme is suited to engineers and scientists with a variety of backgrounds and who are interested in being part of the development of robots with greater levels of autonomy than currently seen. This is captured in the core theme of FARSCOPE; adaptability of robotic systems. The programme is not geared to any particular application or technical aspect of robotics: instead, students are encouraged to embrace a multi-disciplinary view of robotics. This is enhanced by the cohort-based nature of the programme, with regular contact and activities to bring the students together. This is aimed at maintaining a broad view of robotics technology and applications even while specializing in individual topics.

The programme has induction events that introduce the programme and its organisational context and provide training workshops. A key role of the induction programme is to build cohort spirit. Training workshops at induction will cover the use of all appropriate facilities at both UWE and UoB, for example the virtual learning resources and communications and administrative and training support structures. Induction training events and other workshops are also designed to provide a common foundation in key topics, including computing and control. The workshop format adopted enables greater flexibility than a weekly lecture programme, to account for diverse backgrounds within the cohort.

Student learning for each module is structured as appropriate to the module and will include, for example, study preparation, workshop or practical sessions, lectures, seminar discussions, reading group, group and individual project work, case studies, independent learning and assessment.

Source For Further Information

http://www.brl.ac.uk/cdt

http://farscope.bris.ac.uk

Programme structure by entry cohort

Year 1 (2020/21 entry cohort)

Unit Name	Unit Code	Credit Points	Status
Robotics Research Technology and Methods	EMATM0058	20	Mandatory
FARSCOPE Group Project	EMATM0019	20	Mandatory
Industry Project	AENGM0038	20	Mandatory
Robotics Systems	EMATM0054	20	Mandatory
Robotics Research Training Workshops	AENGM0072	15	Mandatory
Select from:			
Take one UWE and one UoB unit from the following list, totalling 25 credit points:			
Transport and Mobility Modelling	EMATM0021	10	Optional
Bio-Inspired Artificial Intelligence	EMATM0029	10	Optional
Advanced Control & Dynamics (UWE, UFME7F-15-M)	EMATM0031	15	Optional
Robotic Fundamentals (UWE, UFMF4X-15-M)	EMATM0033	15	Optional
Intelligent Information Systems	EMATM0042	10	Optional
Human-Robot Interaction (UWE, UFMFHP-15-M)	EMATM0043	15	Optional
MRes Robotics and Autonomous Systems		**180**	

Unit Name	Unit Code	Credit Points	Status
Introduction to Artificial Intelligence	EMATM0044	10	Optional
Machine Vision (UWE, UFMFRR-15-M)	EMATM0056	15	Optional
Soft Robotics	EMATM0057	10	Optional
Assistive Robotics (UWE UFMFSR-15-M)	EMATM0059	15	Optional
Uncertainty Modelling for Intelligent Systems	EMATM1120	10	Optional
Advanced Techniques in Multi-Disciplinary Design	AENGM2005	10	Optional
Mobile Communication Systems	EENG30010	10	Optional
Advanced DSP & FPGA Implementation	EENGM4120	10	Optional
The Dissertation Unit (UWE, UFMED4-60-M) is only taken by those exiting with an MRes award in order to gain the necessary credit.			
Dissertation	EMATM0055	60	Optional
MRes Robotics and Autonomous Systems		**180**	

Progression/award requirements

The assessment of the taught component of a doctoral degree is governed by the Regulations and Code of Practice for Taught Programmes and is assessed separately from the research project. Progression to the research project may be dependent on the successful completion of the taught component - please refer to the relevant handbook for the structure of the particular programme.

The pass mark set by the University for any level 7(M) unit is 50 out of 100.

Exit awards

It may be possible to exit the programme with a taught award. For detailed rules on progression please see the Regulations and Code of Practice for Research Programmes and the relevant faculty handbook.

Additional progress information

To be awarded a postgraduate certificate, students must have successfully completed 60 credit points of taught units, to include at least one of 'Robotics Fundamentals' and 'Robotic Systems'. There is no Postgraduate Diploma exit award.

To be awarded the MRes, students must have successfully completed 180 credit points from the taught units, including the dissertation unit. Note that the MRes degree will only be awarded to students electing to exit the CDT programme after one year.

The dissertation unit is must pass at the first attempt for students on the PhD. The dissertation unit may only be retaken by students who intend to exit with the MRes.

Please note: This specification provides a concise summary of the main features of the programme and the learning outcomes that a typical student might reasonably be expected to achieve and demonstrate if he/she takes full advantage of the learning opportunities that are provided. More detailed information on the learning outcomes, content and teaching, learning and assessment methods of each module can be found in the course handbook or on-line at http://www.bris.ac.uk. The accuracy of the information contained in this document is reviewed by the University and may be checked by the Quality Assurance Agency for Higher Education.

Related links

What's running in 2020/21
Structure by entry cohort
Programmes available in the Department of Aerospace Engineering

Print full programme specification