Call for Industry Partner Project Proposals

(For PhD Research Studentships commencing in October 2021)

This is a UK Government Research Council funded initiative to support robotics or agri-food sector businesses in their advancement of robotics-related projects benefitting the UK agri-food industry. The initiative is aimed at solving particular technology challenges and thereby securing sector advancement. The opportunity is for your organisation to engage in a PhD studentship focused on your specific robotics challenges. For agri / food related businesses these could include the design of applications which advance process productivity, increase efficiency, or solve labour challenges; and for robotics related technology providers the focus could be on unlocking the next generation of your product offering to best meet the needs of the agri-food sector.

Examples of some of the benefits that could be derived:

- Improved sales and price
- Fewer distress promotions
- Reduce imports
- Improved reliability and confidence in supply
- Improved matching of supply and demand,
- Improved scheduling of labour
- Reduced on farm and retail (higher shelf life) food waste

The AgriFoRwArdS Centre for Doctorial Training (CDT) is a collaboration between the Universities of Lincoln, Cambridge and East Anglia, providing your business with the opportunity to work with experts leading in their fields and their extensive R&D facilities. AgriFoRwArdS brings together a unique collaboration between the 3 partner Universities, PhD studentships and industry, by creating a unique community that identifies agri-food specific issues, and finds solutions using Robotics and Autonomous System (RAS) technologies.

The PhD project outputs will feed directly from your business interests. Your return on investment will be derived from the benefits that your organisation will draw from the selected project and wider engagement with the CDT. You, and the PhD student, will benefit from leading University research supervision provided by the consortium, working alongside and complementing the expertise present within your own organisation.

The project will be largely funded by the UK government via their Engineering and Physical Sciences Research Council (EPSRC www.epsrc.ukri.org/about), together with a smaller financial contribution from your organisation.

Benefits of engaging with the CDT:

• Advance your business and sector position - Research completed by the CDT will be inspired by your project proposal.

• The research will be heavily supplemented by EPSRC funding, reducing any financial commitment hurdles, de-risking your investment, and significantly amplifying your return on investment.

• The studentship could be used as the first stage of a long-term employment / R&D engagement with the individual who will be trained by the CDT.

• Projects will have supervisors from across the consortium providing high levels of expertise tailored to the project.

• Your organisation will be invited to AgriFoRwArdS events, providing the opportunity to network/collaborate with leading stakeholders from across industry, academia and government.

Project timeline:

Students will undertake a 4-year research initiative. Firstly they will complete an MSc programme in Robotics and Autonomous Systems, which includes a preliminary MSc project designed to feed directly into the PhD study. Having prepared the foundations in Year 1, Years 2-4 will advance full-time PhD research focussed on addressing your business-related challenges in robotics and autonomous systems.

Financial Contributions:

The initiative involves significant funding support from government, and Industry Partners are asked to make a smaller commitment towards the funding of their business-focused studentships.

The total cost of a 4-year studentship equates to more than £98,605, including a grant to defray living expenses, research travel costs, and MSc and PhD fees. We request Industry Partners to contribute £32,000 towards the total cost of the studentship, with the remaining 66% of the funding being provided by EPSRC. Businesses are not restricted to one PhD studentship – multiple projects can be supported if this is a preferred approach – and the EPSRC support will remain at the very high level.

For further details on the required financial contribution, please contact the AgriFoRwArdS Delivery Team.

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Once your business has decided to commit to this initiative the next step will be for the proposed Project Lead (from within the organisation) to complete the Project Proposal Form (included below) and return it to the AgriFoRwArdS Delivery Team.

Deadline: 1st September 2020

Email address for completed Project Proposal Form: agriforwards.cdt@lincoln.ac.uk

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FAQ.

Who can submit a proposal?

Authorised personnel, from within your organisation, can propose a PhD project, ideally the "Project Lead" (although this role can be allocated at a later date, if beneficial).

On what topic?

AgriFoRwArdS addresses fundamental challenges in Robotics and Autonomous Systems (RAS) technologies for both agriculture and food production. The project should be based upon a business need and focus on one of the following RAS component technology areas, including but not limited to (see also Figure 1):

1) Mobile autonomy: Agri-Food robots need to move in challenging dynamic, often GPS-denied and semi-structured environments with high precision. Autonomous mobility entails the integration of technologies for mapping, self-localisation and understanding of challenging farm and factory environments, dynamic path planning, precise motor control and locomotion, including safe operation in the presence of human workers.

2) Manipulation and soft robotics: Manipulators are needed for a range of tasks, replacing dexterous human labour, reducing costs and increasing quality. Handling of delicate, unstructured objects such as food products requires new approaches to compliant and flexible manipulation. Example PhD topics might include vision- and tactile-guided handling and grasping tasks, and advanced functional materials for soft sensing and actuation.

3) Sensing and perception: Machine vision and other modalities are needed for analysis of food products and sensor-guided control of robotic systems. Objectives might include classification of crops and weeds; phenotyping; quality analysis of food products; yield prediction; state estimation and modelling of farm or factory environments; detection, identification and tracking of human workers; etc.

4) Fleet management: The true potential of robotics in agriculture and food production will be realised when different types of robots and autonomous systems are brought together in a systemic approach. Holistic approaches to fleet management are required, which fully integrate component methods for goal allocation, joint motion planning, coordination and control, as well as research on their integration and scaling to applications in agri-food.

5) Human-robot collaboration: Many robotic applications will augment rather than replace human workers. Research may be needed into collaborative robotic systems or 'co-bots' that can work alongside human workers, for example, robots for fruit transportation working alongside human pickers, and to improve the safety of human-robot interactions in food production environments.
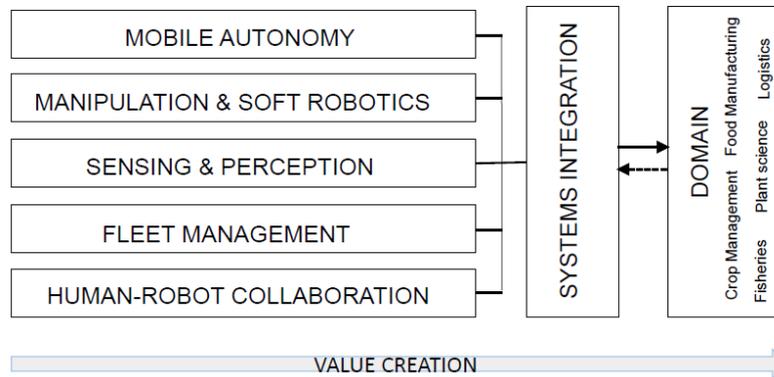
Figure 1: Research areas addressed by the CDT.

These technologies will be integrated together in robotic systems, and brought to bear in solving the unique challenges of the agri-food industry, as per this call.

Please contact the AgriFoRwArdS Delivery Team to see how research areas can be matched with your specific industry challenge. Further information on potential research areas can also be found in the UK-RAS White Paper on the Future of Robotic Agriculture [1]

Proposal Content

Proposals should demonstrate that whilst meeting the business objectives the student will be engaged on a rewarding and relevant research project that will provide them with a first-class research experience.

- The proposal should have clearly articulated aims, objectives and focus.

- The project should clearly enable the student to demonstrate a level of independence and originality, to test ideas and hypotheses, and to make a contribution to learning that would be potentially worthy of publication, subject to consultation with the industry partner on any IP arising.

- The proposal should detail the industrial challenge / participation, including agreed financial contributions.

Suitability & Feasibility

The project should be well-suited to a PhD. It will have clear aims that provide opportunities for intellectual challenge whilst having a reasonable element of "security" in that due progress can be made within the time constraints.

- The project is feasible within the given resource limitations (including financial constraints).

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[1] https://www.ukras.org/wp-content/uploads/2018/10/UK_RAS_wp_Agri_web-res_single.pdf

- The project is achievable within the given time frame.

- Risks to the completion of the project are identified, and robust contingency plans described that would allow the student to successfully conclude a programme of doctoral level research in the event of delays to, or failure of, the original work plan.

Supervisor Collaboration

You are actively encouraged to have engaged with a supervisor, from one of the partner universities, prior to submitting the project proposal. However, this is not a prerequisite and the AgriFoRwArdS Delivery Team will work with you, either pre or post submission, to facilitate communications between yourselves and supervisors. A list of supervisors, and their research areas, has been provided as part of this call out document. If you would like to discuss what supervisory skills will be ideal for the study, please email the AgriFoRwArdS Delivery Team, so that a call can be arranged. Similarly, if you would like to speak to a specific supervisor, please email the AgriFoRwArdS Delivery Team so that contact can be arranged, with the relevant supervisor/s on your behalf.

Email: agriforwards.cdt@lincoln.ac.uk

How to apply

By sending the Project Proposal Form electronically to: agriforwards.cdt@lincoln.ac.uk.

Please download the current Project Proposal Form from the above link, or via the AgriFoRwArdS website.

Selection of projects

The incorporation of a PhD project into the AgriFoRwArdS Programme involves two separate steps: 1) Selection of the PhD project, 2) Selection of the PhD student for the selected project.

1- Project selection

PhD projects should align with at least one of the above Robotics and Autonomous Systems (RAS) component technology areas, and be based on a real-world challenge, as defined by you, the industry partner. As there is a finite amount of government support available project selection will be subject to evaluation by the CDT Executive Team and approval by the CDT Industrial Advisory Board. Selection criteria will include alignment with the CDT objectives, scientific quality (originality, significance and rigour of the proposed research), industry partnership, and the ability to match the project to the expertise of an ideal supervisory team.

2 – Student Selection

Successful Studentship Proposals will be advertised on the AgriFoRwArdS website (agriforwards-cdt.ac.uk), from October 2020 onwards, for students applying for September 2021 entry. Applicants will apply online, for a specific studentship proposal, by completing an application form, and providing a CV and transcript.

All applications are anonymised prior to the shortlisting process. Shortlisting is the responsibility of the AgriFoRwArdS Project Lead at the relevant University.

The industry Project Lead, and the primary supervisors, will be invited to serve on the interview panel, together with other AgriFoRwArdS members as selected by the CDT Project Lead at the respective university.

Potential Supervisors and Their Research Interests

Name	Title	Partner Institution	Research Interests
Dr Alexander Jones	Research Group Leader	University of Cambridge	Investigation into how plant hormones serve as signal integrators and master regulators of physiology and development. Development of new technologies for high-resolution sensing and perturbation of plant hormones in vivo.
Dr Alexandra Brintrup	Lecturer in Digital Manufacturing	University of Cambridge	Predictive Data Analytics and Machine Learning in Manufacturing. Development of automated and scalable optimisation and distributed decision making technologies. Identification of emergent patterns in manufacturing and industrial systems
Dr Amanda Prorok	Assistant Professor in Computer Science and Technology	University of Cambridge	Algorithms for coordinating systems composed of multiple autonomous robots. This research brings in methods from planning, control, estimation, and learning, and has numerous applications, including automated transport and logistics, environmental monitoring, surveillance, and search.
Dr Amir Ghalamzan Esfahani	Senior Lecturer in Computer Science	University of Lincoln	Robotic grasping and manipulation, agri-food robotics, teleoperation, shared control, variable autonomy, robot learning from demonstration.
Dr Andrea Paoli	Associate Professor in Food Robotics and Process Automation / Programme Lead	University of Lincoln	Cyber-physical systems, discrete-event systems, fault diagnosis, fault tolerant control systems, functional safety systems, robotics and automation, traffic networks analysis and control.
Dr Beatriz De La Iglesia	Senior Lecturer in Computing Sciences	University of East Anglia	The area of data mining algorithm development and application of data mining techniques ranging from financial data to biological and medical data and including some health informatic themes.
Dr Charles Fox	Programme Leader / Senior Lecturer in Computer Science	University of Lincoln	Agricultural robotics (CEO IBEX Automation Ltd.), autonomous vehicles, pattern recognition and data.
Prof Elizabeth Sklar	Professor in Agri-Robotics	University of Lincoln	Interaction in Multi-Robot and/or Human-Robot systems, including multi-robot team (fleet) coordination, human-robot interaction
Dr Fulvio Forni	Lecturer in Control Engineering	University of Cambridge	Differential methods for system analysis (oscillators, multistable systems). Nonlinear control and hybrid control (electro-mechanical systems, systems with saturations, robotics)

Name	Title	Partner Institution	Research Interests
Dr Fumiya Iida	Reader in Robotics	University of Cambridge	Robotics, Mechatronics, Machine Intelligence, Soft Robotics, Human-robot interactions, Embodies artificial intelligence
Dr Gautham Das	Lecturer in Agri-Robotics	University of Lincoln	Multi-robot systems, Agri-robotics, Machine learning, Computational modelling & Optimisation techniques
Prof Graham Finlayson	Professor of Computing Science	University of East Anglia	Colour imaging, computer vision, colour science, artificial intelligence, computational geometry
Dr Grzegorz Cielniak	Associate Professor in Robotics	University of Lincoln	Mobile robotics, machine perception, AI, agri-robotics, food technology.
Dr Hatice Gunes	Reader in Affective Intelligence & Robotics	University of Cambridge	Artificial Emotional Intelligence, Affective Computing, Human-like Computing, Personality Computing, Social Signal Processing, Human Behaviour Understanding, Social Robotics, Human-Robot Interaction, Intelligent User Interfaces, Human Sensing in Virtual Reality, Assistive Technologies.
Dr Heriberto Cuayahuitl	Senior Lecturer in Computer Science	University of Lincoln	Machine intelligence including (spoken) dialogue systems, (deep) machine learning, and (multimodal) robotics
Dr Iain Gould	Senior Lecturer in Soil Science	University of Lincoln	Soil science, plant-soil interactions.
Dr Ignas Budvytis	Lectureship in Computer Vision and Robotics	University of Cambridge	Structured deep learning. Semantic and instance segmentation. Video analysis. Autonomous driving. Localisation. Robotics and computer vision applications.
Dr Isobel Wright	Senior Lecturer in Agriculture	University of Lincoln	Agricultural Environmental Science, Sustainable Resource Management.
Dr Jenny Zhang	Fellow in Chemistry	University of Cambridge	Semi-artificial photosynthesis, bio-photoelectrochemistry, chemical sensors, electrode design, biofilm biotechnology
Prof Joan Lasenby	Professor of Image and Signal Analysis	University of Cambridge	3D reconstruction (multiple RGB camera, depth cameras); point cloud analysis (registration, object recognition); geometric algebra (computer vision, graphics, CAD); image and video processing for medical applications; machine learning)
Dr Julia Davies	Teaching Coordinator Department of Plant Sciences	University of Cambridge	Plasma membrane (PM) calcium channels involved in root signal transduction, nutrition and growth
Dr Khaled Elgeneidy	Senior Lecturer in Engineering	University of Lincoln	Manipulation of delicate targets, primarily within the agri-food sector, using innovative soft actuators and flexible sensors.
Dr Letizia Mortara	Lecturer in Technology Management	University of Cambridge	Technological Decision-Making in response to fast-changing contexts. Managing and exploiting Emerging Technologies, Technology Intelligence, Open Innovation, Business Model Innovation

Name	Title	Partner Institution	Research Interests
Prof Marc Hanheide	Professor of Intelligent Robotics & Interactive Systems	University of Lincoln	Long-term robotic behaviour, AI, human-robot interaction, agri-robotics.
Mr Mark Swainson	Professor of Industrial Food Technology	University of Lincoln	Advanced Food Processing Technologies, Robotics & Automation, Product Safety and Quality Control Systems, HACCP Design and Implementation, Food Industry Legislation, Factory and Production Line Design, Environmental Management, Audit Systems/Skills, Microbiological Assessment and Control, Packaging Technology, Raw Materials and Supplier Control, New Product and Process Development
Dr Michal Mackiewicz	Associate Professor in Computing Sciences	University of East Anglia	physics based vision, colour science, environmental monitoring, machine and deep learning, medical imaging
Prof Mini C. Saaj	Global Chair in Robotic Engineering	University of Lincoln	Precision farming and Agri-Robotics: Design of locomotion system and control of mobile robotic platforms for weeding and harvesting; Fleet robotics; Control of high precision robotic manipulators for dispensing fertilizers, pesticides and herbicides; Design of soft robotic grippers for fruit picking; In-situ soil sensing devices for terrain monitoring.
Dr Mukesh Kumar	Lecturer in Manufacturing Engineering/Operations Management	University of Cambridge	Understanding of Industrial chain resilience and sustainability. Issues of food supply chains linked with food security. Differences between emerging and mature industrial systems. Distributed Manufacturing
Dr Nicola Bellotto	Associate Professor in Computer Science	University of Lincoln	Mobile robotics, machine perception, AI, sensor fusion, active vision, qualitative spatial reasoning.
Dr Nik Cuniffe	Senior Lecturer in Mathematical Biology	University of Cambridge	Mathematical modelling of the spread, detection, evolution and control of plant and tree diseases
Prof Ottoline Leyser	Research Group Leader, Sainsbury Laboratory	University of Cambridge	The role of plant hormones in plant developmental plasticity, using the regulation of shoot branching as a model
Prof Pål From	Professor in Agri-Robotics	University of Lincoln	Agricultural robotics (CEO SAGA Robotics Ltd.), control, motion planning.
Dr Paul Baxter	Senior Lecturer in Computer Science (Autonomous Systems)	University of Lincoln	Social human-robot interaction, cognitive/developmental robotics.
Dr Petra Bosilj	Lecturer in Agri-Robotics	University of Lincoln	Image Processing; Computer Vision; Mathematical Morphology
Prof Richard Harvey	Professor of Computing Sciences	University of East Anglia	Computer vision, colour vision, artificial intelligence, computer graphics
Prof Roberto Cipolla	Professor of Information Engineering	University of Cambridge	Computer vision. Robotics. Computer vision for human-computer interaction. Visually guided robotics. Applications of computer vision.

Name	Title	Partner Institution	Research Interests
Dr Sarah Taylor	Research Fellow in the School of Computing Science	University of East Anglia	Analysis and synthesis of faces and bodies during speech. Computer lip-reading, automatic redubbing of video and speech-driven facial animation.
Dr Shaun Coutts	Lecturer in the Lincoln Institute for Agri Food Technology	University of Lincoln	Optimal weed management in the face of evolving resistance. Integrated weed management. The scales at which population dynamics vary and the implications for population performance over a landscape. Rapid mapping of weed populations.
Prof Shigang Yue	Professor of Computer Science	University of Lincoln	Problem solving with inspiration from computer vision, AI, biology, neuroscience and psychology.
Prof Simon Pearson	Director of the Lincoln Institute for Agri Food Technology / Professor of Agri-Food Technology	University of Lincoln	Agri technology applications including robotic systems, automation, energy control and management, food safety systems, novel crop development.
Dr Tahmina Zebin	Lecturer in Computing Sciences	University of East Anglia	Advanced image and signal processing, Risk prediction modelling from Electronic Health Records using various statistical and deep learning techniques.
Dr Thomas Bohné	Senior Research Associate in Strategic Technology & Innovation Management	University of Cambridge	
Prof Tim Minshall	Head of Manufacturing and Management	University of Cambridge	Open innovation, digital manufacturing, manufacturing skills
Prof Tom Duckett	Professor of Robotics & Autonomous Systems / Programme Leader	University of Lincoln	Autonomous mobile robots, AI, machine perception, robotic mapping, long-term autonomy, agri-robotics.
Dr Wenjia Wang	Associate Professor in the School of Computing Sciences	University of East Anglia	Data mining/knowledge discovery, ensemble approach and artificial intelligence

Please email the AgriFoRwArdS Delivery Team so that contact can be arranged, with the relevant supervisor(s) on your behalf

Email: **agriforwards.cdt@lincoln.ac.uk**