NEXUSS CDT Research Experience Placement Supervisor Proforma 2018

Lead Supervisor: Co-supervisor	Dr. Sharif Ahmed Pierre Thibault
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University/Research Organisation:	University of Southampton
Department:	FEE
Project Title:	Autonomous measurement of sub-surface soil conditions for precision agriculture

Total Student Support Costs: £	£2500 (£200 for 10 weeks plus £500 research and training support grant)
Based on a minimum of £200/week full time for a minimum of 8 weeks and maximum of 10 weeks and a £500 Research and Training Support Grant.	

Proposed Start Date: **Monday, 04 June 2018 (please update)**	Proposed End Date: **Friday, 10 August 2018 (please update)**
Projects should run over the summer vacation and we recommend that projects will have terminated by 21 September 2018.	

Brief Summary – please provide a brief summary (maximum 300 words) of the project.

This should include:

- *Project outline;*
- *Links to staff/School/Centre activity as appropriate;*
- *Supervisory arrangement;*
- *How space/equipment/supporting resource demands will be met;*
- *Elements of the project that will incorporate elements other than computer/modelling e.g. fieldwork and data collection;*
- *How the project will enhance the skills of the appointed student;*
- *Any intellectual property rights concerns that may arise from the work.*

Access to low-cost unmanned aerial vehicles (UAVs) has accelerated developments in the field of precision agriculture. UAVs are being used to approximate soil conditions and crop health through remote sensing techniques and computer vision. This information is then used to apply focused remedial measures, applying watering, fertiliser or insecticide where needed.

Currently, agricultural UAVs use hyperspectral, multispectral, and thermal sensors. Data from these sensors allow approximation of field soil moisture (SM) and once the crop is growing calculate the vegetation index - a measure of the relative density and health of the crop based on amounts of green/NIR light emitted by the plants.

While measurement of plant health using these sensors' is robust, they are unable to measure actual sub-surface soil condition (SM, nutrient (NPK) availability and compaction). Current surface measurement of soil conditions can be highly depend on environmental variables such as wind speed/direction, cloud cover and plant matter cover.

The objective of this project will be to design, build and test an innovative combined moisture and electrochemical sensor capable of subsurface soil condition measurements with the aim of deploying on an existing multi-rotor UAV.
Initially, the student will carry out a desk study to identify suitable sensor modules in collaboration with Southampton's Crop Systems Engineering Group. The student will then integrate the sensor into a UAVs on-board computer (Intel Edison) using Python programming language and build a geostatistical model using the sensor data as input. Finally, field tests of the sensor will be need to be performed before commissioning on the UAV.
It is expected that by the end of the internship, the student will have experience of working in a multidisciplinary research environment, hardware/software integration of sensors and further develop Python programming skills with a focus on analytics.
Access to lab space and computing will be provided and support will be given through weekly supervisory meetings.

Please give an indicative timescale for the student's work over the length of the project: (maximum 150 words).

This should include:

- *The broad tasks the student will undertake;*
- *An indicative timescale for these tasks.*

1. Desk study on soil moisture and nitrogen sensors (1 Week)
2. Design and fabricate a damage resistant sensor enclosure that is connectable to a hexacoptor fuselage. (2 weeks)
3. Integrate sensor with on-board Intel Edison using Python (3)
4. Write simple geostatistical analysis tool in Python (2 weeks)
5. Test and debug the hardware and software (2 weeks)

Proposed procedure for appointing students, including selection criteria:

Please identify specific criteria that should be considered for the selection of placement students e.g. specific quantitative skills that may be required, subject knowledge etc. If a student has been pre-selected, or the research area has been led by the student, please provide the student's contact details, and a summary of their suitability for the NEXUSS CDT REP programme.

Required:
Excellent Python programming skills
Experience with development boards such as Raspberry Pi and Arduino