2015 YCCSA SUMMER SCHOLARSHIP PROJECT SUBMISSION

This form is for prospective project supervisors to submit their projects to be included in the YCCSA Summer Scholarships Programme for 2015.

It is the purpose of the Summer School that any projects submitted are interdisciplinary in nature.

Date	*9th January 2015*
Main Supervisor's Name	*Dr Martin A Trefzer* *https://www.elec.york.ac.uk/staff/mt540.html*
Main Supervisor's Department	*Electronics*
Co-supervisors' name(s) and Departments	*Dr Dimitris Lagos* *CII/HYMS/Biology* *http://www.york.ac.uk/cii/staff/academic/dimitrislagos/*
Project Title	*The Sensor Organism*
Project Description	*Large-scale, distributed sensor networks are the projected weapon of choice for future pervasive computing applications such as, for example, environment monitoring, surveillance, (big) data mining and patient monitoring. However, state-of-the-art approaches are facing major challenges: specialist sensors are expensive and require careful calibration. Hardware sensors operating in uncertain, harsh environments eventually suffer from stress, ageing and physical damage, which leads to unforeseen effects that can render the device and the data recorded useless. Highly tuned data processing algorithms are often not scalable and are not robust against faulty sensors delivering wrong data, and conventional communication consumes too much power. Generally, systems can only adapt, if at all, in some predefined limited ways and are not capable of autonomously "inventing" new ways of adapting to unexpected changes in their internal and external environment.* *This project follows a different approach to building and using sensor networks drawing inspiration from Nature, where biological organisms and nervous systems (e.g. the brain) self-construct, self-organise, self-heal, sense, process information and react, emerging from evolutionary and developmental processes exploiting the bio-chemistry and structure of singular diverse cells. Within this project sensor networks are perceived as spatially distributed multicellular organisms where each sensor node represents a cell. It is hypothesised that incorporating artificial biochemistry, gene regulatory networks and cellular structure within each sensor node enable the same emerging properties in a sensor network. The aim of the project is to implement a simplified model of cellular processes and signalling on a small sensor network based on Arduino and ZigBee in order to investigate how the aforementioned biological metaphors can be usefully ported to a distributed hardware system.*

Required skills	*The project would generally suit a student with any science and/or engineering background with a keen interest in interdisciplinary work between biology and computing/engineering. However, basic knowledge of how microprocessors and sensors work as well as good programming skills in C/C++ would be desirable.*
Project dates	*The project would run for 9 weeks, starting on Monday, 13 July 2015 and finishing on Friday, 11 September 2015.*
Other information	*Most of the work in this area has been previously applied to computational benchmark problems and robotics. Targeting sensor networks therefore brings in a degree of novelty.*
References	*Homeostatic control for a mobile robot: Dynamic replanning in hazardous environments. Arkin, R. C. (1992). Journal of Robotic Systems, 9(2), 197–214.* *An Investigation of the Importance of Mechanisms and Parameters in a Multi-cellular Developmental System.* *Tüze Kuyucu, Martin A. Trefzer, Julian F. Miller and Andy M. Tyrrell. IEEE Transactions on Evolutionary Computation, Vol. 15, No. 3 pp 313-345, June 2011.* *Evolution and Analysis of a Robot Controller Based on a Gene Regulatory Network. Martin A. Trefzer, Tüze Kuyucu, Julian F. Miller and Andy M. Tyrrell. Proceedings of the International Conference on Evolvable Systems (ICES 2010), York, United Kingdom, 6-8 September 2010.*

When complete, please email the form to sarah.christmas@york.ac.uk