2018 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 2018.

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

Date	*10th January 2018*
Supervisors' Names and Departments / Affiliation and Contact Email	*Prof. Susan Stepney* *Computer Science* *https://www-users.cs.york.ac.uk/susan* *Dr. Martin A. Trefzer* *Electronic Engineering* *https://www.elec.york.ac.uk/staff/mt540.html*
Project Title	*Evolving Computation in Materials (Evolution-in-Materio). Or How Smart is a Lump of Matter?*
Project Description	*As we approach the miniaturisation limits of conventional electronics, alternatives to silicon transistors – the building blocks of the multitude of electronic devices we've come to rely on – are being hotly pursued. Inspired by the way living organisms have evolved in nature to perform complex tasks with remarkable ease, in particular the way the brain outperforms classical computing paradigms, we are exploring a combination of "evolution" as the design tool and nano materials as the substrates to create novel information processing devices. Instead of creating computing devices from predefined discrete components, we utilise the physical properties of electrically active random disordered materials and "evolve" them to produce a desired behaviour.* *This emerging field of research is known as "evolution-in-materio," (EiM) a term coined by Julian Miller at the University of York [1]. This interdisciplinary field combines knowledge and methods from materials science, engineering and computer science. The concept of "evolution-in-materio" has already been shown to allow training of certain materials similar to natural evolution, so that they solve computational tasks (e.g. logic gates, classification problems or travelling salesman problem) without the need to specifically design or structure the material [2]. We have previously developed computational models (direct evolution and reservoir computing) and EiM hardware systems looking at a range of different materials including liquid crystal, carbon nanotubes and graphene flakes [3].* *This project is focussed around one of the most challenging research questions in EiM, which is the choice and evaluation of materials that exhibit the desired properties and behaviours to make them good computers. To achieve this, you will work with a selection of novel materials and investigate and characterise their properties with respect to their evolvability and computational performance.*

Required Skills	*The project would generally suit a student with any science and/or engineering background with a keen interest in interdisciplinary work between environment, biology and computing/engineering. Basic knowledge of electronics and programming would be beneficial.*
Supervision and Collaboration Arrangements	*The student will be co-supervised by Prof. Stepney and Dr. Trefzer. We will liaise with contacts in other departments or universities to procure materials samples.*
Project Dates	*The summer school runs for 9 weeks, starting on Monday, 09 July 2018 and finishing on Friday, 07 September 2018.*
Other Information	
References	*[1] Evolution-in-materio: Evolving computation in materials. Miller, J.F., Harding, S.L. & Tufte, G. Evol. Intel. 2014 7: 49. https://doi.org/10.1007/s12065-014-0106-6.* *[2] Extendible Hardware Platform for Reservoir Computing in materio. Dale, M. N., Miller, J. F., Stepney, S. & Trefzer, M. A. 2017.* *[3] Evolving Carbon Nanotube Reservoir Computers. Dale, M. N., Miller, J. F., Stepney, S. & Trefzer, M. A., UCNC 2016, Springer, p. 49-61 13 p.*

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