The Real-time Simulation & Computational Imaging Group of the Institute for Digital Communications (IDCOM) at the School of Engineering invites applications for PhD positions on randomised numerical algebra for real-time scientific computing.

"Sketching for data-intensive health analytics"

The aim of the post is to pursue research in the field of randomised numerical algebra for processing streaming biomedical data, e.g. in the context of intensive care monitoring or assisted living. This capability is key to prompt decision and intervention by detecting randomly occurring events (health deterioration, domestic accidents), as well as predicting the likelihood of future events from data trends. From a computational perspective, these tasks translate to online regression and data-driven model learning. The research should produce results in the form of new sampling algorithms that can extract the "most informative" data and their associated analysis to be published in scientific journals and presented at flagship conferences on data science, machine learning and signal processing.

Background: This project seeks to investigate algorithms for real-time simulation and data mining in high-dimensional streaming data. In an intensive care unit environment biological signals at high temporal resolution are continuously streamed to a processing unit or display for medical diagnosis. To aid the process, the data must be analyzed and translated into actionable information in real-time, allowing: (i) to extract information about the patient's current state of health (diagnostic analysis), and (ii) to forecast the patient's future health state (predictive analysis) based on previously recorded data, e.g. to predict signs of deterioration or improvement. For example, to use the streaming data in order to infer cardiological or cerebral models by solving inverse problems in (i), while for (ii) one could construct a statistical model for the targeted condition using online model learning. To be able to tackle such computations in real time a prudent use of model order reduction is essential. In many relevant cases these high-dimensional data and models have a latent low-dimensional structure, knowledge of which allows to reduce these datasets without a significant compromise in their information content, or indeed worsening the predictive skill of their respective models. A particularly appealing approach in reducing their dimension is randomized sketching, that randomly samples a small subset of the data according to some non-uniform distributions to do computations with, effectively replacing the conventional algebraic operations with sample-based estimators of controlled variance.

Prerequisite: A scientifically oriented person with an above-average master's/diploma degree in mathematics, statistics or computer science with a focus on inverse problems, Monte Carlo methods and linear algebra. Strong programming skills are desirable but non-essential. The holder of the position should be willing to collaborate with our ACRC (Advanced Care Research Centre) associates and industrial partners. Opportunities to be involved in teaching activities will also be explored if aligned to the career development of the student.

Technical queries should be directed to Dr Nick Polydorides (n.polydorides@ed.ac.uk). Start date in April-Sept 2021.

Keywords: data sketching, randomised numerical linear algebra, real-time simulation.

Funding: We anticipate competitive opportunities for funding to arise in the near future via PhD scholarship schemes.

Further info on the group's interests and projects http://www.homepages.ed.ac.uk/npolydor/

Please apply by **January 15th, 2021** using this LINK