Department	School of Engineering and the Built Environment
Supervisors	Yuyang Zhou ;Goh Keng
Project Title	Novel stochastic control method for a class of complex networks

PROJECT DESCRIPTION

Complex systems, which contain large ensembles of elements interacting with each other and are affected by noises and uncertainties, have become one of the major research fields due to their presence in the real life. Systems such as electrical power grids, cryogenic propellant loading systems, and social, biological, economic systems can all be regarded as complex systems. The main characters of complex dynamical systems including,

• The complex systems are high dimensional, usually contains large numbers of mutually interacting quasi independents nodes;

• Their structures are complicated, usually nonlinear and inherent some complicated model such as the multiple modes switching, data loss, ext.

•The systems usually subjected to high uncertainties, such as external disturbance, structure randomness, and system noises, ext,

These characters of complex networks bring challenges in the systems analysis, estimation, and especially control.

The project aims to develop some novel frameworks for reliable, robust, and responsive control to overcome the aforementioned challenges of large-scale and complex dynamics. The framework will be based on a hybrid decentralised architecture of mutually-interacting quasi-independent subsystems which are subjected to a high level of randomness. Moreover, the proposed control frameworks will be demonstrated on power systems, formation control systems, robotic systems or other real-life-based control systems. This project is suitable for people who have basic control theory knowledge and probability theory knowledge. The applicants should have good mathematical skills and programming skills. The c programming skill is desirable but not essential.

Academic qualifications

A first degree (at least a 2.1) ideally in Control Systems, Electrical Electronic Engineering or Mathematics with a good fundamental knowledge of control theory, probability theory, and electrical engineering.

English language requirement

IELTS score must be at least 6.5 (with not less than 6.0 in each of the four components). Other, equivalent qualifications will be accepted. Full details of the University's policy are available online.

Essential attributes:

- Experience of fundamental control theory expercise, mathematical modelling of systems, matlab coding
- Competent in BEng or MSC
- Knowledge of probability theory and control theory

- Good written and oral communication skills
- Strong motivation, with evidence of independent research skills relevant to the project
- Good time management

Desirable attributes:

- Probabilistic modelling
- Control design of nonlinear systems.
- Design of consensus algorithms
- Neural network
- C programming
- Power system knowledge

Indicative Bibliography	[1] Zhou Y, Herzallah R. Probabilistic message passing control for complex stochastic switching systems[J]. Journal of the Franklin Institute, 2021. [2] Herzallah R, Zhou Y. An Efficient Message Passing Algorithm for Decentrally Controlling Complex Systems[J]. International Journal of Control, 2021 (just-accepted): [3]Herzallah R, Zhou Y. Probabilistic decentralised control and message passing framework for future grid[J]. International Journal of Electrical Power & Energy Systems, 2021, 131: 107114.
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Web page	https://www.napier.ac.uk/research-and-innovation/research-degrees/application-process