

Imperial College London
Department of Civil and Environmental Engineering
EPSRC CDT in Sustainable Civil Engineering

PhD Studentship:

**Design and Control of Intelligent Water Networks with Dynamically Configurable
Network Topologies**

Supervisor: [Dr Ivan Stoianov](#)

Industry Partner: [Welsh Water](#)

This project investigates the design and operation of intelligent water supply networks with dynamically configurable topologies. It is motivated by the increasing need for water companies to reduce leakage levels by actively managing pressure whilst at the same time providing higher quality of service to customers (e.g. a reduction in supply interruptions).

The benefits of optimally controlling the water supply systems pressure has already been demonstrated using a novel methodology and algorithms for the dynamic aggregation of water supply zones using self-powered control valves. The work has been pioneered by the InfraSense Labs (www.infrasense.net) and demonstrated on an operational water distribution network in the UK serving 8,000 properties.

This applied research on dynamic network topologies has also demonstrated the increase in resilience that comes from optimally aggregating pressure zones. The current project will build upon existing research; one of the project aims is to study various indices of resilience that can measure the system's ability to maintain sufficient levels of service under disruptive events. The integral design and operation of dynamic topologies will be studied by explicitly incorporating objectives to maximise resilience of urban water networks. Simulating tools and optimization algorithms for computing resilience indices for water distribution networks will be studied. Optimization and graph-theory tools will be used to investigate what kind of topologies benefit from dynamic optimal pressure management. This will be done in collaboration with a UK water utility.

The successful candidate will join a multidisciplinary team of researchers in the InfraSense Labs (www.infrasense.net) led by Dr Ivan Stoianov (Department of Civil and Environmental Engineering). The immediate research group is currently composed of 2 post-doctoral research associates and 9 PhD students working on various aspects of smart water systems modelling, optimization and control.

The successful candidate will develop their understanding of water distribution networks and appropriate numerical tools for large scale water distribution systems. There will also be an opportunity to develop relevant algorithms in Matlab, and other software. You will learn from the

technical expertise of our dynamic, multidisciplinary team of researchers and collaborators. You will also develop a number of mathematical optimization and optimal control problems to solve various objectives ranging from network pressure management to improved network resilience. New insights will also be developed by investigating various, possibly conflicting, control objectives and the trade-offs that have to be made.

The student will take part in an extensive field-based experimental programme.

Eligibility and Funding

Funding is available for applicants with settled UK status (see <https://www.epsrc.ac.uk/skills/students/help/eligibility/> for eligibility). The studentship offers a stipend of approximately £16,000 per annum (tax free) and covers fees at the UK/EU student rate for a period of four years.

Applicants for the studentship should have or expect to obtain a first or upper second class honours degree or equivalent, in a relevant aspect of Engineering (Mechanical Engineering, Civil Engineering) or other strongly quantitative engineering discipline. An MSc in these subjects would also be desirable. Good computing skills are also required.

It would also help if you have experience in the following areas, or have backgrounds indicating you can acquire skills in these areas would be a bonus.

- Numerical Methods for Solving Linear and nonlinear Equations, Optimization, Network systems.
- Matlab, Python or R.

Contact

For informal enquires and to request more information, contact Dr Ivan Stoianov (<http://www3.imperial.ac.uk/people/ivan.stoianov>)

This PhD studentship is co-funded by the EPSRC CDT in Sustainable Civil Engineering at Imperial College London:

(<http://www3.imperial.ac.uk/sustainablecivilengineering>)

Deadline

Review of application is now in progress and will continue until suitable candidate is identified. The starting date for this PhD Studentship is 1st of October, 2018.