(Project Proposal – Undergraduate Research & Leadership Scholarship)

**Generating modelling geometry from real-world hydraulic structures -using LIDAR and photogrammetry**

**Background**

Hydraulic CFD modelling is an important tool for understanding the behaviour of complex free-surface flows. There is enormous appetite from industry to be able to make use of these models more widely to support in the design of new (and extremely costly) hydraulic infrastructure -such as reservoir spillways, weirs and flood defence structures. Billions of pounds will be spent in the UK in coming years updating existing infrastructure. Current industry practice is to use scale-physical models; this is the well-established and trusted approach for such critical projects. For the free-surface CFD models to be adopted and accepted there are a number of key challenges to overcome. An industry linked project underway within IPHEE in Civil Engineering involves evaluating a wide range of free-surface hydraulic modelling approaches (mesh based and particle based). The aim being to identify guidance and information for industry as to the advantages and disadvantages of CFD and physical models for different types of hydraulic free-surface problem. Of particular interest are the predictions of location and shape of air-water free surfaces created at hydraulic jumps induced in rivers, spill ways weirs (and other open channel flows).

Three key challenges to realising the use CFD-free surface models are:

- A validated evidence base that demonstrates where CFD approaches predict reliably

- Evidence based guidance as to which CFD tools are appropriate where and when

- Establish work flows to efficiently simplify and convert ‘real-world’ geometry into suitable modelling domains

**Aim (for Laidlaw Scholar)**

To help develop a robust workflow that allows LIDAR and photogrammetry to be efficiently used to generate optimal modelling domain.

**Details**

The research project will involve designing and undertaking field work which involves terrestrial laser scanning and photogrammetry of full (and physical scale) hydraulic structures (for the purpose of modelling flow interacting with them). It will also involve analysis of these large datasets in order to help develop an optimal workflow. The student scholar will be part of multidisciplinary research team where they will be make an important contribution to an industry linked research project and will receive training in key research software. The candidate will take ownership of an aspect of the research and as such will gain valuable experience undertaking a study in an important area of research. There will be opportunities for the candidate to present their work both within the group and to wider audiences (including potentially to our industry partners, Yorkshire Water/Arup).

**During the studentship, the scholar will:**

1. Undertake analysis of large three-dimensional point cloud data to extract useful geometries of the hydraulic structures (and evaluate different approaches for doing this).

2. Work alongside a PhD student and other members of the larger project team to set-up and perform a free-surface modelling study (making use of one of the test geometries collected during field work)

3. Work with PhD students and iPHEE researchers to help evaluate different free-surface modelling approaches and their suitability for different hydraulic problems.

4. Meet with Industrial colleagues (as part of a team) and present information to other researchers and industry. As part of the larger project which involves industrial partner Arup, there will be opportunity to take part in research meetings and present findings (this has been agreed with the Dams and Reservoir team at Arup, Leeds).

**Research Environment**

The project will be hosted by IPHEE (Institute for Public Health and Environmental Engineering) within the School of Civil Engineering. The project will provide an opportunity to undertake both fieldwork and a modelling study alongside experienced researchers in a dynamic and supportive research environment.

The project involves working closely with industry. Industrial partner Arup and Yorkshire Water (who are a partner in the main project too) are very supportive of involving a student intern (Arup contacts: David Neeve & Rachel Sandham).

*Project supervision*

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Dr Andy Sleigh: [P.A.Sleigh@leeds.ac.uk](mailto:P.A.Sleigh@leeds.ac.uk) School of Civil Engineering

**Person Specification**

An inquisitive, creative mind and the initiative to work independently and to deadlines are essential attributes. A strong background in Engineering Mathematics important.

**Benefits and Outcomes**

*For candidate*

• Valuable experience developing their research and modelling expertise

• To undertake ‘on the job training’ in key scanning, measurement & modelling tools

• Ownership of their own project

• Opportunity to present work within the School of Civil Engineering/Arup

*For University/School*

• Providing an opportunity to a high calibre student to gain research experience, with the school supporting the training (who would perhaps not otherwise have opportunity to get this research environment exposure)

• Enables school to work with a high calibre student

• Supports further research in this area and potentially provides a platform to develop the research