Engineering and Innovation Research Studentship 2024/2025

Project title:	**Sustainable Power Generation using a Hydroelectric Siphon**
Discipline	Energy, Fluid Dynamics
Key words:	Hydraulics, Power Generation, Sustainability
Supervisory team:	Dr Salih Gungor, Dr James Bowen, Dylan Simpson (Longshore Engineering)
URL for lead supervisor's OU profile	https://www.open.ac.uk/people/jb36559

Project Highlights:

- High efficiency hydroelectric power generation
- Siphon effect lifts water against gravity
- Develop designs and explore scale-up effects
- Manufacture a working prototype

Overview:

The 21st Century is a turning point in the Earth's energy landscape. The ongoing revolution in how we live, work, and travel has implications for our energy demands. Fossil fuels are an unsustainable energy source and green energy solutions such as solar, wind, and battery storage are at a stage of intense development. However, unique solutions to the problem of rapid response, on-demand power generation continue to be sought.

Hero of Alexandria was a 1st Century mathematician, physicist, and inventor who studied the fundamentals of hydraulics and pneumatics. He developed devices which utilised the flow of fluids – air and water – turning them into useful mechanical action. One such device is called Heron's Fountain, represented in Figure 1, which operates seemingly continuously due to self-contained hydrostatic pressure and the siphon effect. Although the fountain eventually exhausts itself, the possibility of utilising gravity-driven flow for small-scale power generation is an intriguing engineering and design challenge.

The incorporation of a gravity-driven 'system reset', possibly using a rotating mechanism to invert the device, allowing the water to return to its start point, means that the system could be used to generate power almost indefinitely. An alternative design could be a dual-section 'sand timer' system, in which the upper section gradually refills the lower section, before inverting and restarting.

Depending on the mass flow rate of water, it should be possible to continuously generate milliwatts of power, using a closed system which does not require hazardous materials or environmental resources such as chemical elements which are increasingly considered scarce and precious.

Provided the materials of construction are suitable for long-term contact with water, this system offers an exciting possibility for reducing our over-reliance on electrochemical energy storage.

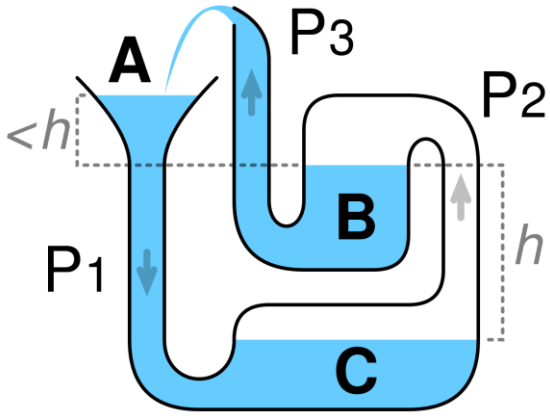

Figure 1. Heron's Fountain, which produces a seemingly continuous flow of water.

Using computational fluid dynamics and Multiphysics simulations, three-dimensional digital models of fountain designs will be developed. These will inform the construction of prototype devices whose efficiency and carbon-cost are understood, as well as supporting a detailed exploration of how designs fare when scaled-up. The objective of this project is to develop a viable prototype manufactured from modular sections, enabling easy construction by non-specialists. The long-term aim is to create a sustainable power generation solution which can be applied in a wide range of locations.

References & Further Reading:

The following list includes some of the critical literature associated with this project.

1. https://en.wikipedia.org/wiki/Heron%27s_fountain

2. https://www.youtube.com/watch?v=igMI0GxATUI

3. https://www.isu.edu/physics/facilities--research/physics-class-demos/thermodynamics/herons-fountain/

Further details:

We are looking for highly motivated individuals with a strong enthusiasm for innovation and design. Applicants should have a first-class or upper second-class Masters degree (or equivalent) in a relevant discipline, including Engineering, Physics, or Mathematics.

Applications should include:

- A 1,000-word cover letter outlining why the project is of interest to you and how your skills match those required
- An academic CV containing contact details of three academic references
- An Open University application form, downloadable from: http://www.open.ac.uk/postgraduate/research-degrees/how-to-apply/mphil-and-phd-application-process
- IELTS test scores where English is an additional language

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