Volume 2, Issue 3

December 2016

Inside this issue:

1. Introduction

A word from the new President

As the year draws to a close this issue is the final release of 2016 and details the activities within the YPN over the last few months. At the start of the current academic year the Hydro-environmental Research Centre (HRC) saw a large influx of new students from across the world. In my view one of the many benefits of studying for a PhD or perusing a career in academia is the international nature of the research community. It is always a pleasure to meet new staff or students from different backgrounds and cultures which in the melting pot that is university creates a vibrant and dynamic environment in which to work. I would like to take this opportunity to welcome all of the new students to and wish them the best for their time in Cardiff.

The past year has also seen many great achievements from the members of the YPN, detailed in previous issues. With a number of exiting opportunities in the pipeline for next year I am sure we will have many more success stories and achievements to share with you in the near future.

Amongst other events detailed in this issue one of the major changes we have seen was the election of a new committee in November. Made up of both new and existing members they will oversee the YPN and its activities for the remainder of the 2015/16 academic year. The newly elected committee is as follows:

President
Jonathan King — KingJA@Cardiff.ac.uk

Vice-President
Filipa Adzic — AdzicF@Cardiff.ac.uk

Secretary
Stephen Clee — CleeSA@Cardiff.ac.uk

Treasurer
Arthur Hajaali — HajaaliA@Cardiff.ac.uk

Digital Content Manager
Nejc Čož — CozN@Cardiff.ac.uk

Social Secretary
Joe Shuttleworth — ShuttleworthJD@Cardiff.ac.uk

Academic Representative
Alex Stubbs — StubbsA1@Cardiff.ac.uk

Industry Representative
Josephine Nelson — NelsonJ2@Cardiff.ac.uk

Finally this issue is the first to include a new section following the progress of YPN alumni in their careers. This will hopefully not only be beneficial to existing students to see what opportunities are available to them in the future but will strengthen ties between current and past students and the academic and industrial factions of YPN members. You will also find a hydraulics themed crossword which you might like to attempt.

On behalf of the new committee I warmly wish you all a merry Christmas and best of luck for the New Year.

-- JK

2. Events

YPN-WISE micro-presentation event

11/11/2016

School of Engineering, Cardiff University

The first collaborative event between the IAHR-YPN Cardiff and the WISE programme took place this

November. Held at Cardiff University this saw an afternoon presentations given by YPN members and students on the WISE programme.

Figure 1: In all we heard nine interesting talks from these nine presenters.

In keeping with and building on the success of previous events presentations were given in the 5-minute 'elevator pitch' format. These covered three main research areas; numerical modelling using the TELEMAC suite, experimental and numerical modelling of tidal turbines and hydrology.

Figure 2: IAHR Cardiff YPN and WISE CDT collaboration.

The event was a great success with a large turnout of students from the four WISE universities and professional members from industry. We hope to build on this success in the future and are looking at ways in which we can further collaborate with the WISE programme for whom we are very grateful for the support they provided in organising the event.

-- JK

The Water Informatics: Science and Engineering (WISE) Centre for Doctoral Training (CDT) is currently in its third year and sees students from each of the GW4 alliance universities (Bath, Bristol, Cardiff and Exeter) attend a year of taught courses at Exeter University on a diverse range of topics before returning to their home university to continue their PhD research. More details can be found here; http://wisecdt.org/.

3. Research progress

Low-Head Cross-Flow Turbine

By Filipa Adzic

With the rapid and constant development of technology, 21st century society has become tremendously dependent on energy production. Moreover, world population has been significantly increasing over last few decades, and with that, demand for energy has also amplified. Out of all available renewable energy sources, hydropower is responsible for, by far the largest part, of generated electricity. Large hydropower projects require significant financial investments and numerous amounts of environmental considerations and permissions. On the other hand, mini and micro hydropower schemes have shown great potential as they have a smaller environmental impact, are faster to set up and are more affordable. Small scale hydropower schemes can be installed in smaller rivers, or even pipe outlets with sufficient head and discharge. Cross-flow turbines are appropriate for small scale applications as very high system efficiencies can be achieved. Some researches focusing on this topic have observed efficiencies as high as 90 %.

A cross- flow turbine can be defined as an impulse turbine consisting of two main parts, the nozzle and the runner. These types of turbines always have a runner shaft horizontal to the ground which ensures radial flow over the turbine. Moreover, cross – flow turbines have two stages of power production. First stage occurs when the water jet interacts with the blade at the entrance. The water jet then goes through the hollow inside of the turbine towards the exit blades. Second stage of power production therefore occurs when the water jet hits the blades again from the inside of the turbine. Under the supervision of Professor Thorsten Stoesser, this project is focused on developing a low-head cross-flow turbine that will have higher efficiency than previous designs. Both experimental and computational analysis are planned for this project.

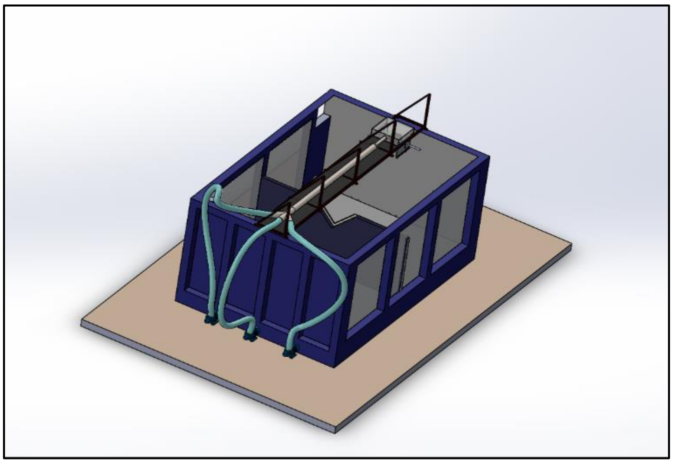

Figure 3: Experimental layout.

Firstly, the runner and the nozzle will be tested in the experimental setup shown in Figure 3. The experiment layout consists of 3 pumps with maximum discharge capacity of 13 l/s each. The pumps will feed the water to the stainless steel pipe, leading to the nozzle, and then finally, the runner. Flow meter and V-notch weir will be used to confirm discharge through the system.

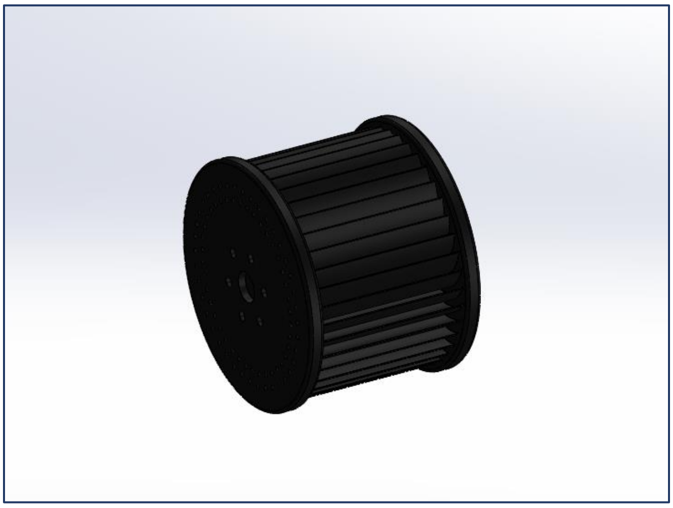

Figure 4: Initial runner design.

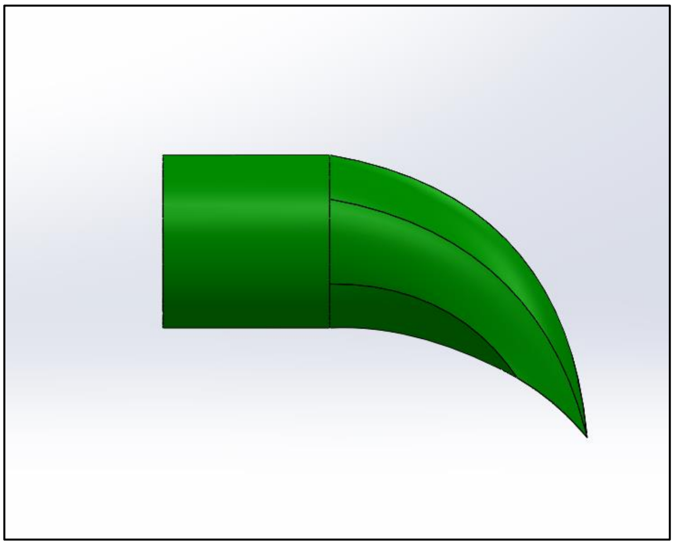

Figure 5: Initial nozzle design.

The power of turbine will be calculated through measuring turbine torque and rotational speed. Moreover, efficiency of the turbine can be defined as the ratio of power of flow going in and power of the turbine produced from it. Initial runner and nozzle design are shown in Figures 2 & 3 respectively. Nozzles will be 3D printed in university available printers which will allow faster production and avoidance of additional expenses.

After the first laboratory tests, Hydro3D code will be used to further analyse flow and forces in the nozzle and the rotor. Hydro3D (http://hydro3dproject.github.io/) is an in-house code that efficiently solves finite difference Navier-Stokes equations that allows accurate Large Eddy Simulation (LES) of turbulent flows. Simulating forces and flows in the system through LES will accelerate nozzle and runner re-design and optimisation process. Re-designed components will be experimentally tested to observe system efficiency.

For more information about this research, please contact Filipa Adzic, AdzicF@Cardiff.ac.uk

Modelling Hydrodynamic and Solute Transport Processes for Tidal Energy Structures

By Nejc Čož

The Hydroenvironmental Research Centre (HRC) at Cardiff University has a rich legacy of research on the topic of tidal energy. With the tidal range of the nearby Severn Estuary ranking third largest in the world there has been great interest into means of extracting this energy for electricity generation. Examples include studies on the impacts of proposed schemes such as the Severn barrage project and Swansea Bay Tidal Lagoon. With the aim of expanding the existing knowledge on tidal range structures (TRS) and their impact on the environment this projects focus is on correct representation of the objects in the hydrodynamic model.

To date numerical modelling has been carried out using the in-house hydrodynamic model DIVAST (Depth Integrated Velocity and Solute Transport) alongside the open source code EFDC (Environment Fluid Dynamics Code). However, for this project we have migrated to another open-sourced model, Delft3D-FLOW, developed by Deltares in the Netherlands. The advantage of using Delft3D is that it already includes a built in module for morphological changes and sediment transport which are pivotal for this research. It can be run either as a 2D or 3D model and is currently becoming more widely used within both academia and industry, thereby increasing the potential impact and application of this research.

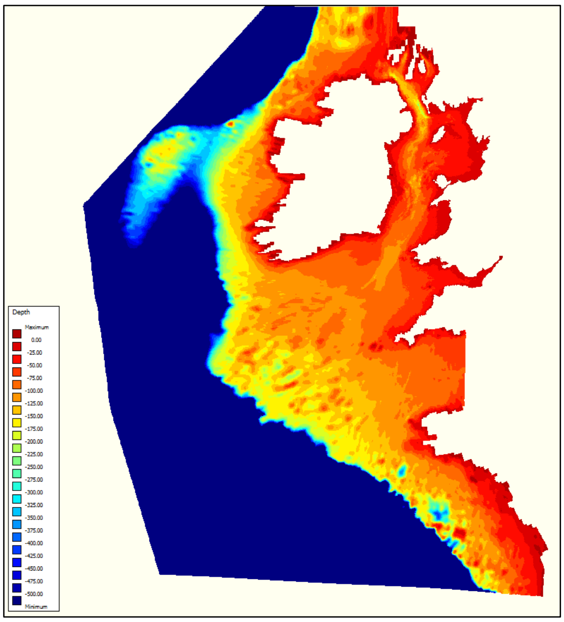

Figure 6: The CSM domain: curvilinear grid; cell size from 50 x 50 m, up to 5,000 x 5,000 m; open boundaries beyond the edge of Atlantic Continental shelf.

First the model was set up to run the so-called Continental Shelf Model (CSM). It is a model with a relatively coarse domain that covers a large area of British west coast and it stretches all the way out to the Atlantic continental shelf (Figure 6). This is necessary because such large impoundments in the basin result in a noticeable changes in hydrodynamics (extreme water levels) far beyond the usual open boundary. In the case of Severn barrage projects this effects were observed as far away as Irish Sea.

In order to simulate the action of turbines and sluice gates within the model it was necessary to modify existing subroutines within the Delft3D-FLOW source code. They are presented as culverts, but modified to correctly represent the mass and momentum transfer between intake and outfall. Because of the relatively long computational time a model for one of the Severn barrage layouts was set up to act as a development model on which the source code modifications were tested. Figure 7 illustrates the operation of the barrage with the ebb-only generation scenario. It is showing the water levels that are being recorded immediately upstream and downstream of the barrage during a typical spring tide cycle and different stages of operation are marked with black dots.

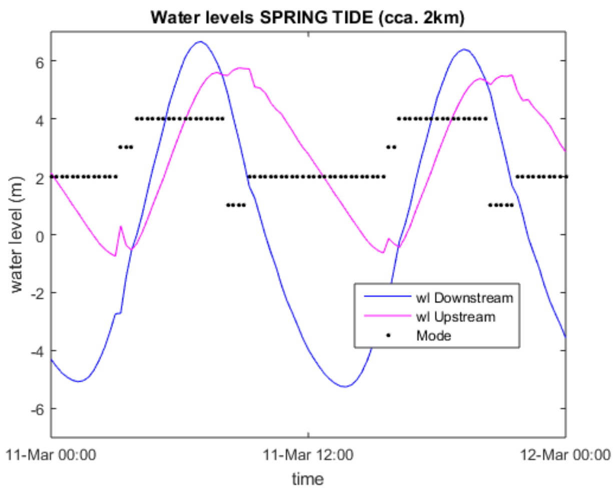

Figure 7: Operation of TRS - set up for ebb-only generation of power (modes of operation: 1 Holding HW, 2 Generating, 3 Holding LW, Filling.

Future work will focus on adapting the model for different proposed tidal range projects in the Severn Estuary (lagoons) and analysing the hydrodynamic impacts on the environment with special focus on morphology and sediment transport.

For more information about this research, please contact Nejc Čož, CozN@Cardiff.ac.uk.

4. Our members in industry

Fernando Alvarez

Intertek Energy & Water Consultancy Services, Cardiff

Fernando Alvarez has been a PhD student within the Hydro-Environmental Research Centre at Cardiff University since 2012 and will probably have completed his Viva by the time this newsletter is published. However, before submitting his thesis he stepped out of Academia to start a career in Industry. He started working for Arup as a Coastal Modeller for a short period. Later on, he moved to Intertek Energy & Water Consultancy Services where he currently works as a Senior Scientist.

His experience in Industry, and in particular in Intertek, has been great. He can apply many of the skills developed during his PhD studies. Although he does not carry out pure research, each of the projects requires a deep understanding of the environment he is working on: hydrodynamics, hydrology, sewage network or land uses among others. This forces him to be able to understand data from different sources, relate different processes together and being able to assess what is important and what is less relevant in the system for the purpose of their studies. This is a key factor as time and budget are two big constraints in their activity. Thanks to this dynamic and the experienced team within Intertek he is really enjoying his experience in Industry.

At the moment he is currently working on a couple of Water Quality Compliance Assessment projects. These projects involve hydrodynamic and water quality modelling, GIS, data analysis and some MATLAB scripting. The main objective is to determine whether the water quality standards dictated by the BWD are met or some action is needed. In addition, he recently joined a project concerning power cable decommissioning where he will be looking at the possible impacts produced by rock dumping during the decommissioning of a power cable.

-- Fernando Alvarez

5. Social Activities

Annual HRC Christmas Dinner

The Cricketers

14/12/2016

On December the 14th members of the YPN along with other members of the HRC met up for the much anticipated annual Christmas Party. Yet again it did not disappoint with the group choosing to go to The Cricketers in Pontcanna and it provided an excellent chance for everybody to let their hair down before everybody takes a break over Christmas.

Figure 8: HRC annual Christmas Dinner

In the New Year there are plans for socials to expand to include a weekly pub quiz and other activities.

-- JS

6. Publications

February 2016

1. Xia, J., Teo, F., Falconer, R. A., Chen, Q. and Deng, S. 2016. Hydrodynamic experiments on the impacts of vehicle blockages at bridges. Journal of Flood Risk Management. In Press Online. doi: 10.1111/jfr3.12228.

March 2016

2. Al-Enezi, E., Bockelmann-Evans, B. and Falconer, R. 2016. Phosphorous adsorption / desorption processes of estuarine

sediment: a case study – Loughor Estuary, U.K. Arabian Journal of Geosciences. 9(200), 1-9. doi: 10.1007/s12517-015-2014-1

August 2016

3. Angeloudis, A. and Falconer, R. A. 2016. Sensitivity of tidal lagoon and barrage hydrodynamic impacts and energy outputs to operational characteristics. Renewable Energy. In Press Online. Open Access doi: org/10.1016/j.renene.2016.08.033

4. Hejazi, K., Falconer, R. A. and Seifi, E. 2016. Denoising and despiking ADV velocity and salinity concentration data in turbulent stratified flows. Flow Measurement and Instrumentation. In Press. doi: org/10.1016/j.flowmeasinst.2016.09.010

5. Xia, J., Chen, Q., Falconer, R. A., Deng, S. and Guo, P. 2016. Stability criterion for people in floods for various slopes. Proceedings of the Institution of Civil Engineers, Water Management. 169(WM4), 180-189. doi: 10.1680/wama.14.00110

September 2016

6. Ahmadian, R., Falconer, R. A. and Wicks, J. 2016. Benchmarking of flood inundation extent using various dynamically linked 1D-2D approaches. Journal of Flood Risk Management. In Press Online. Open Access doi: 10.1111/jfr3.12208

December 2016

7. Angeloudis, A., Falconer, R. A., Bray, S. and Ahmadian, R. 2016. Representation and operation of tidal energy impoundments in a coastal hydrodynamic model. Renewable Energy. 99, December, 1103-1115. doi: org/10.1016/j.renene.2016.08.004

8. Kvocka, D., Falconer, R. A. and Bray, M. 2016. Flood hazard assessment for extreme flood events. Natural Hazards. In Press Online. Open Access doi: 10.1007/s11069-016-2501-z

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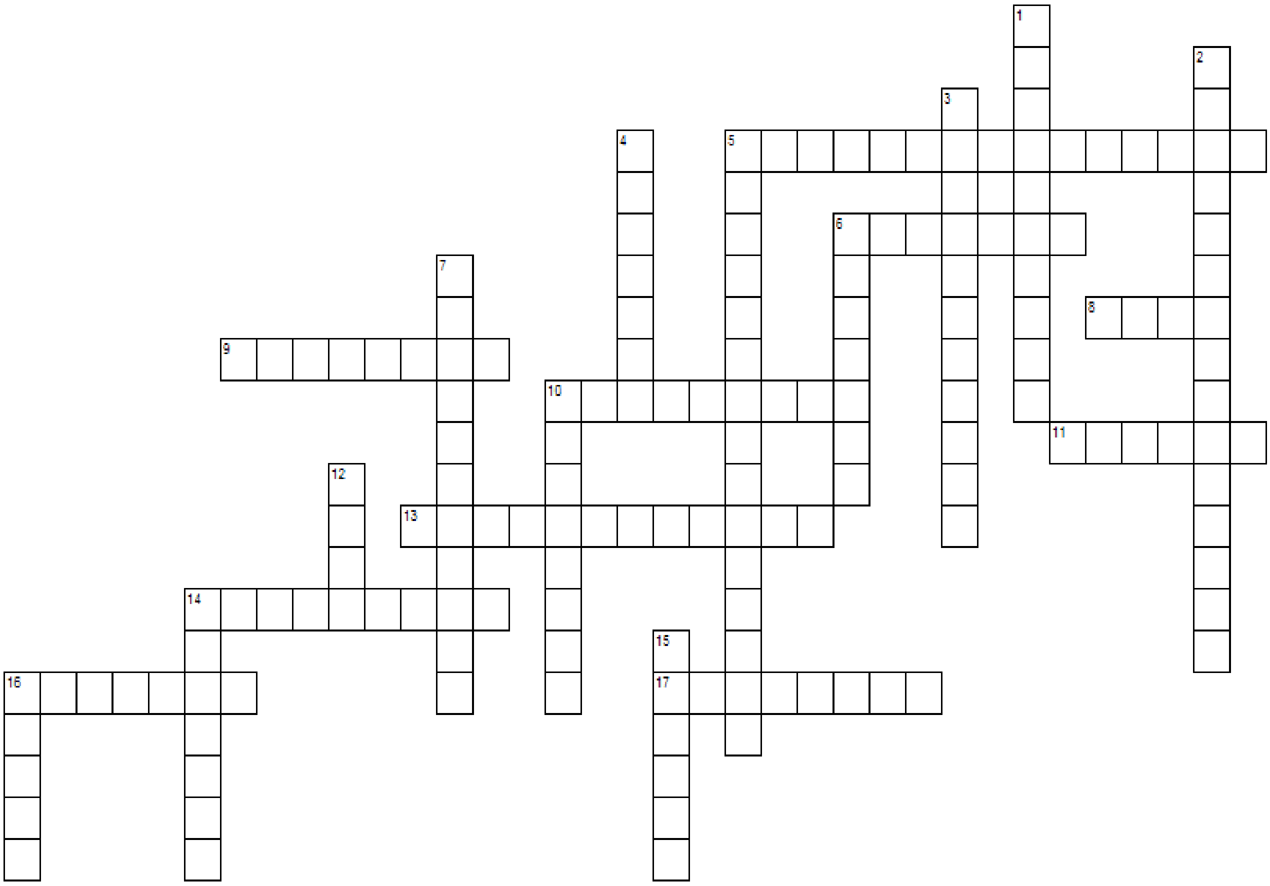
If you wish to request more information about the newsletter, please contact to:

- Jonathan King (President): KingJA@Cardiff.ac.uk
- Filipa Adzic (Vice president): AdzicF@Cardiff.ac.uk
- Stephen Clee (Secretary): CleeSA@Cardiff.ac.uk

Crossword



ACROSS

5 Parameter that shows the level of turbulence"
6 Tidal_______"
8 Integral of cos"
9 Plotting Software"
10 The volume of fluid passing a point in a given time"
11 Country that generates most electricity from hydropower”
13 City of next IAHR World Congress 2017"
14 Force of a fluid per unit area"
16 Type of impulse turbine”
17 Mass per unit volume”

DOWN

1 The measure of resistance of a fluid to flow"
2 Fluid obeying Newton's law of viscosity"
3 Bacteria found in stagnant water”
4 SI unit of pressure”
5 A group of viruses that infect bacterial cells"
6 Estuary with 2nd Highest Tidal Range in the World."
7 Country with the biggest tidal power plant”
10 Finite element hydrodynamic software developed by EDF"
12 Large Eddy Simulation (short)"
14 Three .... Dam, Largest Hydropower Dam in the World."
15 Fluid Dynamics phenomenon”
16 A mechanical device using suction or pressure to raise or move liquids