

Volume 3, Issue 2

September 2017

Inside this issue:

1. Introduction
2. Events
3. Research progress
4. YPN's alumni
5. Highlights - the 37th IAHR World Congress
6. Publications
7. Entertainment

1. Introduction

Cardiff's YPN has had an eventful summer this year. We saw our members participate in numerous events both here in Cardiff and internationally. In late June Nejc travelled back to his home country to present his work on tidal lagoons at the 10th International Conference on Sustainable Energy and Environmental Protection (SEEP), held in Bled Slovenia. A month later we had the pleasure to host Dr Karim Alizad from Louisiana State University. We were also highly involved in outreach as some of our members volunteered to deliver engineering activities to secondary schools in Cardiff.

Next you can read about the progress of Arthur's and Joe's research. Both are part of the WISE CDT programme and are just finishing their first year of research. We all know how frustrating the first year of PhD can be, so I am happy to say that both of their projects are very interesting and we look forward to seeing them develop over the next two years.

This issue is the second in a row where we hear back from one of our old members. This time we have a short chat with James Brammer who exchanged worn out desks at HRC with a shiny office at GE Renewable Energy in France. I am pleased to see our alumni still interested in our

cause and hopefully we can make this section a permanent feature of our newsletter.

The 37th IAHR World Congress deserves a special mention, as it is one of the more important events for the HRC and is always very well represented by Cardiff University. This year a large number of our members flew to Kuala Lumpur, Malaysia to present their work and expand their professional network.

By now you are probably already eager to just start reading, however before I let you do that I also need to mention that two of our members have just moved to Beijing. Jonathan and Nejc have been invited on a three-month research visit at Tsinghua University, where they are hosted by Prof Binliang Lin from the Department of Hydraulic Engineering. Jonathan was awarded a grant by the prestigious Newton Fund for this visit. Both will work on their respective experiments in a large flume. In November they will be joined by David Glover who is visiting Beijing to take part in a two-week workshop organised by University Consortium on Engineering Education and Research. More on this to follow in future newsletters.

Enjoy reading!

-- NC



IAHR Cardiff YPN team in Kuala Lumpur, Malaysia

2. Events

10th International Conference on Sustainable Energy & Environmental Protection

27-30 June 2017

Bled, Slovenia

This year [SEEP](#) conference was held in a lovely alpine town of Bled in Slovenia. It was organised jointly by University of Maribor from Slovenia and University of the West of Scotland from UK. We could see numerous papers from many different fields of research, from Chemical engineering to Civil Engineering, but all focusing on sustainable energy and environmental protection.



Figure 1: Nejc getting ready for his presentation.

Our Nejc Čož has travelled there to present his most recent work on Swansea Bay tidal lagoon. The title of his presentation was *High Resolution 3D Modelling of the Swansea Bay Tidal Lagoon* and the conference paper was published in conference proceedings that are available through open source licence via this [LINK](#).

-- NC

~~~

**Early Careers Seminar Series**

10/07/2017

School of Engineering, Cardiff University

On 10th July the YPN teamed up with the Cardiff University Water Research Institute Early-Career Group to hold a joint seminar delivered by Dr Karim Alizad from the Centre for Coastal Resiliency (CCR) at Louisiana State University (LSU):

[www.karimalizad.com](http://www.karimalizad.com)

Dr Alizad's presentation was titled '*Coastal wetland response to sea level rise in three different estuarine systems*'.

In his words; "This research applies the coupled Hydro-MEM model [Alizad et al., 2016] to study three different estuarine systems in the NGOM. The model incorporates both sea level rise rate and feedbacks between physics and biology by coupling a hydrodynamic (ADCIRC) and salt marsh (MEM) model. The results of the model provide tidal hydrodynamics and biomass density change under four sea level rise projections during a 100-year period. The results are used to investigate marsh migration path in the estuarine systems. In addition, this study shows how marsh migration and biomass density change can impact storm surge modelling. The results imply the broader impacts of sea level rise on the estuarine systems in the NGOM."

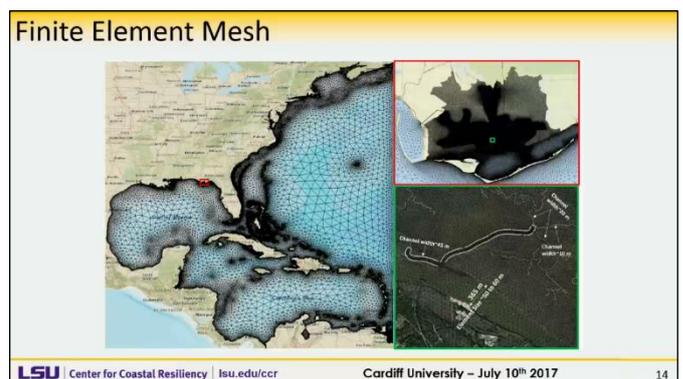


Figure 2: Finite element mash covering Gulf of Mexico, Caribbean Sea and Atlantic Ocean.

This is very relevant to much of the work ongoing at the Hydro-environmental Research Centre, Cardiff University and was well received by students and

staff alike. Dr Alizad has since presented his work at the IAHR World Congress 2017 in Kuala Lumpur, Malaysia.

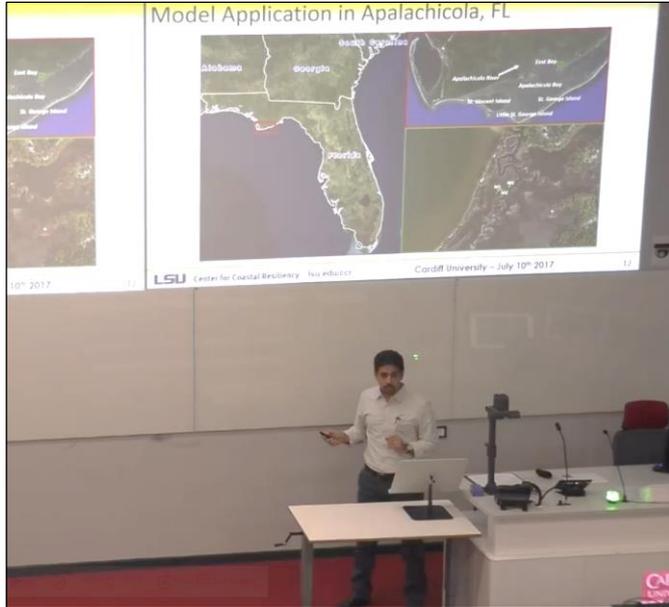


Figure 3: Snapshot - the presentation was broadcasted online.

A recording of the seminar is available using the following link:

<https://cardiff.cloud.panopto.eu/Panopto/Pages/Viewer.aspx?id=1e4ced33-7b21-435f-bc86-5859def7e783>

-- JK

~~~

Smallpiece Dare to Engineer Summer School

July 2017

School of Engineering, Cardiff University

YPN Cardiff took part in few outreach events in July. The team was focused on delivering several different activities to secondary school students that have interest in engineering and science.

Firstly, a short lecture type talk that gave an overview of what civil engineering is. The students were shown what different branches of civil engineering deal with and what kind of

responsibilities do engineers face when designing and analysing for different scenarios.

Secondly, the students were shown what a hydraulic jump is and how water energy is dissipated in the small hydraulic flume. Basic mathematics of hydraulic jump was demonstrated and explained. This sparked a large amount of questions about fluid mechanics and physics principles behind different types of flows.



Figure 4: Future engineers.

Finally, the students were shown the AR Sandbox. An initial demonstration was used to explain dam break scenarios. Following this the students created their own map of the South Wales valleys, including model towns, and were tasked with designing flood alleviation schemes. The students were very intrigued by this activity and found it extremely interesting and fun.

-- FA

~~~

### 3. Research progress

#### Assessment of the Bordas-Carnot Losses within the diffuser of tidal turbines using far-field and near-field CFD models

By Arthur Hajaali

Although bulb-turbine is a long-established technology installed in various tidal barrages including the two biggest La Rance (1964) and Lake Sihwa (2011), its low head versatile design still generates high interests within the marine renewable energy sector. Indeed, this turbine continues to appeal and was selected to figure into the potential tidal projects within the Severn Estuary.

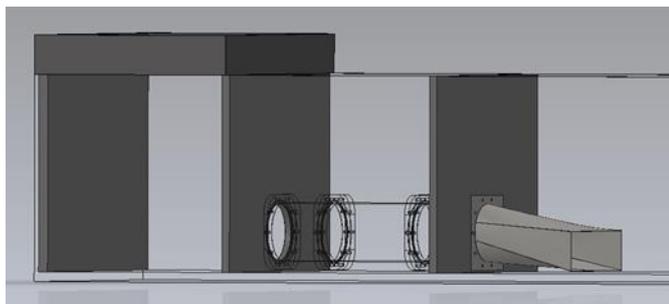


Figure 5: Diffuser Physical Model present in Cardiff University Hydraulic lab.

The bulb turbine technology has been the subject of many scientific papers most of them concentrating and narrowing their focus on the design of the rotor, blades and combiner. This project has for ambition to further the general understanding on the design of the diffuser by performing analysis on the development of eddies and the turbulences using computational fluid dynamic (CFD) models. These eddies affect the overall performance and efficiency of the bulb-turbines by reducing the pressure recovery. The purpose of the diffuser is not only to smooth out the turbulences and eddies past the turbine but also to reduce the overall velocity to avoid any scour and erosion of the estuary bed at the outlet of the diffuser. For the first part of this research Hydro3D, a Cardiff University in-house software developed by Professor T. Stoesser is used to perform these near-field analysis. The validation of the code requires the completion and comparison of a CFD model and physical model as

shown in Figure 5, crediting the future optimal design proposals.

The other part of this study consists of creating a far-field model to represent the marine environment such as cross-flow prior and after the structure and understand how it affects the overall efficiency in the diffuser. One of the main challenge and advancement of this research is to find a methodology and system to link the far-field and near-field modelling to produce an interacting and dynamic model.

For more information about this research, please contact Arthur Hajaali, [HajaaliA@cardiff.ac.uk](mailto:HajaaliA@cardiff.ac.uk)

~~~

Suitable modelling techniques for short steep catchments

By Joe Shuttleworth

Natural flood management (NFM) can be described as the alteration, restoration or use of landscape features to reduce flood risk. It is being promoted increasingly as a novel way to reduce flood risk.

In the UK NFM is often used in areas which fit into some, or all of the following categories; where previous land management has enhanced flood risk, areas with steep sloped catchments, areas prone to 'flash flooding' and perhaps most importantly, areas in which a cost benefit analysis shows 'hard engineered' solutions are not viable.

Computational modelling can be seen as an effective tool in the adoption of NFM as it is a low cost way of developing an evidence base to support NFM approaches. However, the downside is that modelling is only as trustworthy as the mathematical principles underpinning it.

In existing hydraulic models this difference can be attributed to a simplification strategy used. In an effort to minimize time and optimize resources it is common practice to remove governing terms, such as the advective acceleration or not include shock capturing features for trans/super critical flow. The removal of these features can lead to spurious

numerical oscillations which leads on to the inclusion of artificially high bed resistance or eddy diffusion terms. In these cases it is impossible to tell how much of this increased dissipation is being used in physically dissipating the energy of the flow and how much in dampening out the numerical oscillations. This strategy, although it saves time and computational resources in most cases, can therefore lead to misleading or incorrect prediction of flood elevations.

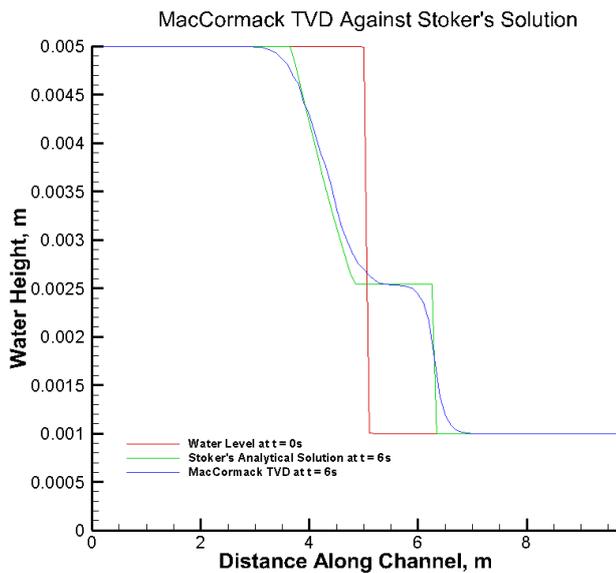


Figure 6: Comparison of the MacCormack solution to Stokers analytical solution for the classical dam break scenario.

In short steep catchments the use of a two dimensional model could be seen as unnecessary as the predominant flow will be in one direction. As such over the last few months my work has been focused on the development of a one dimensional model with shock capturing capabilities. This is based upon the MacCormack algorithm with a term added to account for spurious oscillations. Details of this model are available for discussion further upon request. Initial results are promising with Figure 6 showing a comparison of the MacCormack solution to Stokers analytical solution for the classical dam break scenario. This is used at is models a vertical step change in water height over a single grid regardless of the grid size.

For more information about this research, please contact Joe Shuttleworth,
ShuttleworthJD@cardiff.ac.uk

4. YPN's alumni

James Brammer, *GE Renewable Energy*

In this month's alumni section we catch up with James Brammer who left the HRC with a PhD in 2014 to see what he's been up to since then.

Firstly, thanks for talking to us today. Briefly, what have you been up to since you finished your PhD at Cardiff?

After the PhD my girlfriend and I decided that we wanted to try living in a new country, and both managed to find jobs in the French Alps after our PhD's. It is nearly four years now that we have been living near Grenoble. I work for GE Renewable



Energy in their technology department for hydro-electric turbines, where I mainly work on developing our CFD methodologies for complex phenomena, as well as turbine design. It is a great balance between academia and industry: I still participate in conferences and we have contact with universities etc., but all in an industrial environment. The Alps is an incredible place to live as well: skiing every weekend from January to May, and too many activities to list to do in the summer...

When you started at Cardiff, what were your career plans? How did they evolve over time?

Before my PhD I was already at Cardiff: I was a Civil Engineering undergraduate there. At the time I was sponsored by a contracting firm so always thought I would work for them after my degree, then at university I became more and more interested in the HRC and in particular tidal energy, so I applied for a PhD and spent three years studying the Severn Barrage and tidal stream turbines. Since then I have been living in France working in the hydropower industry. I guess now I try not to have a long term plan, as I know it can all change very quickly!

What made you choose to do a PhD and how do you feel it has prepared you for your career so far?

It was during my undergraduate degree that I realised I preferred the hydraulic aspects of civil engineering than the others, and therefore wanted to focus on that.

Professor Falconer's lectures were particularly good and that's why I applied for a PhD in the HRC. I think it has helped me a lot in my career also, there are a lot of skills that you learn (some without even realising it) that have definitely helped me adapt to my career abroad.

Is there any advice you'd give to anyone wanted to follow a similar path as yourself?

It sounds very cheesy, but go for it! It's amazing what we can achieve if we want something enough, and are willing to leave our comfort zones every now and then.

Finally, if you had to do it all again would you do anything differently?

PhD wise, I probably spread myself a bit too thinly as I was interested in so many things at the same time. I could have probably produced a better piece of research if I had been more focused on fewer areas. Having said that I loved my time at Cardiff and met some great people along the way.

-- JS

~~~~

**5. Highlights from the 37th IAHR World Congress**

*Kuala Lumpur, Malaysia, 13-18 August 2017*

IAHR World Congress is the biggest event organised by IAHR. It takes place every two years at a different location, this year it was hosted by Kuala Lumpur in Malaysia. Around 1200 experts from more than 60 countries were participating, covering numerous water related topics. Like always, HRC was strongly represented with 11 people involved with the conference.

It started off with an early morning keynote by Prof Roger Falconer, followed by talks from Prof Thorsten Stoesser and Dr Reza Ahmadian. Furthermore we saw presentations from two of our postdocs Richard McSherry and Pablo Ouro Barba. And finally, we had six presentations from our PhD students (listed alphabetically): Amyrhul Abu Bakar, David Glover, Jonathan King, Ken Vui Chua, Nejc Coz, Yan Liu (visiting PhD student from Tsinghua University).

Here is the photo gallery from the event:



*Keynote by Prof Roger Falconer – Modelling extreme flood events and associated processes.*



*Dr Reza Ahmadian – Hydro-environmental modelling of a Severn barrage with very low head turbines.*



*Ken Vui Chua – Free surface turbulent flow around single bottom mounted cube at low relative submergence.*



David Glover - Assessing the flood dynamics of the Somerset levels using telemac-2d.



Congress dinner. From left to right - Prof Dragan Savic (Exeter), Dr Reza Ahmadian, David Glover, Jonathan King and Nejc Coz.



Jonathan King - Modelling the impact of microbial sources on water quality: a study on the designated sampling point in Swansea Bay.



YPN night at Putra Jaya.



Nejc Coz - Modelling the impacts of tidal range energy structures in the Severn Estuary and Bristol Channel, UK.



Networking – traditional Chinese-Malaysian dinner with Prof Thorsten Stoesser and Prof Hongwei Fang of Tsinghua University.

## 6. Publications

1. Abu-Bakar, A., Ahmadian, R. and Falconer, R.A. (2017). Modelling the transport and decay processes of microbial tracers in a macro-tidal estuary. Water Research, In press, Accepted manuscript.  
doi: [10.1016/j.watres.2017.07.007](https://doi.org/10.1016/j.watres.2017.07.007)
2. Adebayo, I., Xie, Z., Che, Z., and Matar, O. K. Doubly-excited pulse waves on thin liquid films flowing down an inclined plane: An experimental and numerical study. Physical Review E, 96, 013118, 2017.  
doi: [10.1103/PhysRevE.96.013118](https://doi.org/10.1103/PhysRevE.96.013118)
3. Coz, N., Ahmadian, R., Falconer, R. A. High Resolution 3D Modelling of the Swansea Bay Tidal Lagoon. Conference: 10TH International Conference on Sustainable Energy and Environmental Protection.  
DOI: [10.18690/978-961-286-055-4.5](https://doi.org/10.18690/978-961-286-055-4.5)
4. Xie, Z. Numerical modelling of wind effects on breaking waves in the surf zone. Ocean Dynamics, in press, 2017.  
doi: [10.1007/s10236-017-1086-8](https://doi.org/10.1007/s10236-017-1086-8)
5. Xie, Z., Hewitt, G.F., Pavlidis, D., Salinas, P., Pain, C.C., and Matar, O.K. Numerical study of three-dimensional droplet impact on a flowing liquid film in annular two-phase flow. Chemical Engineering Science, 166:303–312, 2017.  
doi: [10.1016/j.ces.2017.04.015](https://doi.org/10.1016/j.ces.2017.04.015)

---

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

- Jonathan King (President):

[KingJA@Cardiff.ac.uk](mailto:KingJA@Cardiff.ac.uk)

- Filipa Adzic (Vice president):

[AdzicF@Cardiff.ac.uk](mailto:AdzicF@Cardiff.ac.uk)

- Stephen Clee (Secretary):

[CleeSA@Cardiff.ac.uk](mailto:CleeSA@Cardiff.ac.uk)

7. Sudoku challenge

|   |   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|---|
|   |   | 4 | 9 | 3 |   | 5 |   |   |
|   | 8 |   |   | 7 | 1 | 4 |   |   |
| 6 | 9 |   |   |   | 5 |   | 8 | 1 |
|   |   |   |   |   |   |   | 3 | 2 |
| 4 |   |   |   |   |   |   |   | 7 |
| 8 | 3 |   |   |   |   |   |   |   |
| 5 | 7 |   | 4 |   |   |   | 1 | 9 |
|   |   | 8 | 3 | 9 |   |   | 5 |   |
|   |   | 9 |   | 5 | 6 | 2 |   |   |

**EASY**

|   |   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|---|
|   |   | 5 |   |   |   | 3 |   |   |
| 2 |   |   | 4 | 9 |   |   |   | 7 |
| 1 | 8 |   | 6 | 2 |   |   |   |   |
|   |   |   |   |   |   |   | 5 | 1 |
| 5 |   |   |   |   |   |   |   | 9 |
| 7 | 9 | 2 |   |   |   |   |   | 8 |
|   |   |   |   | 3 | 9 |   | 8 | 4 |
|   | 1 |   |   | 5 | 6 |   |   | 3 |
|   |   |   | 1 |   |   |   | 6 |   |

**MEDIUM**

|   |   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|---|
| 2 |   |   |   |   |   | 5 | 3 |   |
|   |   |   |   | 9 |   |   |   | 7 |
| 8 |   | 5 |   |   |   |   | 9 | 4 |
|   | 2 |   | 4 |   |   |   |   |   |
|   |   | 1 | 2 |   | 3 | 9 |   |   |
|   |   |   |   |   | 5 |   | 2 |   |
| 1 | 7 |   |   |   |   | 8 |   | 6 |
| 6 |   |   |   | 7 |   |   |   |   |
|   | 3 | 4 |   |   |   |   |   | 2 |

**EVIL**