

Volume 3, Issue 1

May 2017

Inside this issue:

1. Introduction
2. Events
3. Research Progress
4. Our Alumni
5. Future events
6. Publications
7. Hydro Word Search

1. Introduction

The beginning of 2017 saw plenty of activity from our group members. With assistance from Cardiff University, School of Engineering our YPN became involved in STEM outreach. A number of our members volunteered to spend their afternoons at local primary schools promoting science and engineering. Our WISE CDT members spent an interesting day at HR Wallingford's state of the art facilities outside Oxford. We also organised another annual Micro-engineering presentation event at Cardiff University, with thanks to CIWEM, ICE and Institute of Water for their support which helped make it a fun and successful evening.

As always we feature a short update on research progress from a couple of our members. Alex Stubbs is finishing the first year of his PhD research and presents his involvement in the set-up of the school's novel Augmented Reality Sandbox. Jonathan King, just finishing his second year, gives us an insight into '*Hydro-epidemiological modelling of Swansea Bay U.K. using the TELEMAC model*'.

I am happy to see our group so engaged and I am looking forward to all future IAHR Cardiff YPN happenings. But for now, just enjoy reading!

-- NČ

2. Events

STEM outreach

17/03/2017

St Philip Evans R.C. Primary School

IAHR YPN together with Cardiff University School of Engineering participated in a local primary school STEM week event on the 17th of March 2017. The YPN team visited the school on the day awards were given out to teams with best projects. Some of the projects involved designing a straw bridge, designing an alien that can live in space, building wooden or Lego houses etc.



The students had opportunities to ask and be asked question about different types of engineering. Year 1 students were making straw bridges and were

asked how using different materials can make their structure stable and strong. Year 3 students were briefed on how dependent our society is on energy and how renewable energy sources can be used to meet our energy needs. The event was motivating and encouraging for both students and the YPN team and led us to organise and take part in more primary school outreach in the future.

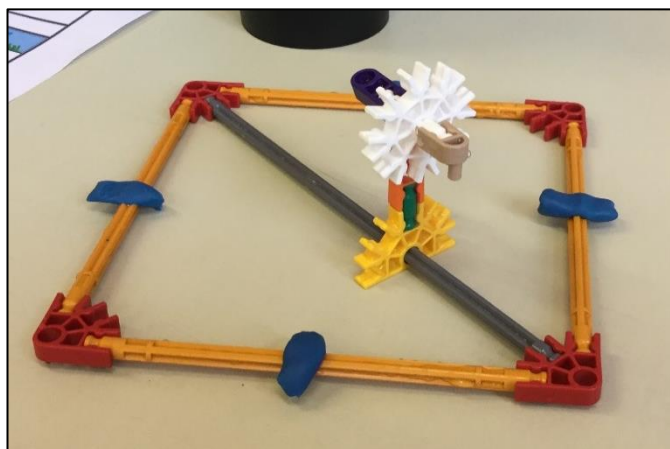
-- FA

~~~~~

28/04/2017

Radnor Primary School

On 28th April 2017 the YPN team went to Radnor Primary School, Cardiff with the Cardiff University School of Engineering STEM group to run the first of a 5 week outreach programme. Over the 5 weeks the students become engineers and will learn all about tidal energy, how it works, how turbines are designed and what the role of an engineer involves.



The first week was a hands on session to get the students to think about turbine design, material properties, structural stability and the forces a turbine will be subject to in its lifetime. Armed with K'NEX and plasticine they had to build a working turbine which was stable when placed in a test tank on a flat or irregular 'sea bed' and subject to wave forces.

The students all had a fantastic time and the day was a huge success. Future sessions the YPN will be involved in follow on from this to teach the students about tides and introduce them to flood

modelling with the School of Engineering's Augmented Reality Sandbox.



-- JK

~~~~~

Micro-engineering presentation evening

04/05/2017

Cardiff University, School of Engineering



CIWEM Chartered Institution of
Water and Environmental
Management
Welsh Branch

CIWEM Chartered Institution of
Water and Environmental
Management
Rivers and Coastal Group

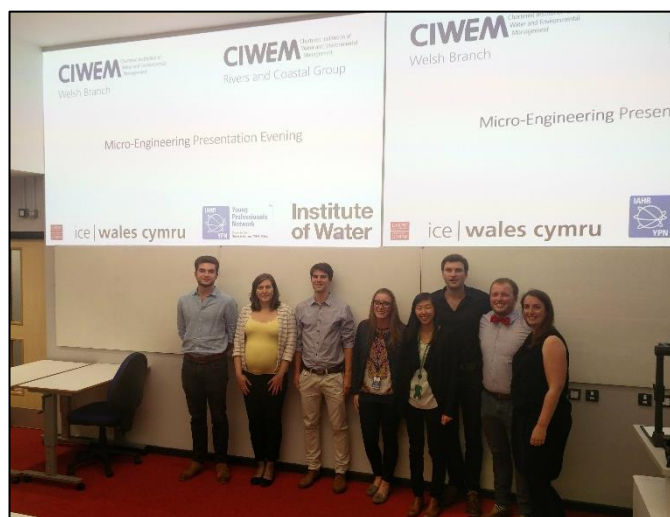
ice | wales cymru **Institute
of Water**

This year our annual micro-presentation evening took place in association with CIWEM Welsh Branch, CIWEM Rivers and Coastal Group, ICE Wales Graduates & Students and the Institute of Water.

The evening was a great success with around 30 attendees from both industry and academia. This year it was not only great to see a range of topics but also how a few of them crossed-over and interlinked. All presenters did a fantastic job at keeping presentations to the 5 minute 'elevator-

pitch' format which made for a dynamic and interesting evening.

We would like to thank Tracey Dunford (CIWEM) and Gillian Steele (ICE G&S) who helped organise the evening and without whom it would have not been such a success.



Presentations:

Victoria Collier - Welsh Water / Dwr Cymru
'DCWW graduate programme: Wastewater Treatment'

Ina Svilarova - Mott MacDonald
'Small Wastewater Treatment Works in North Wales'

Rachael Ng - Arup
'Surface water removal: DCWW RainScape'

Paul Bayle - University of Bath
'Coastal adaptation under sea level rise using soft engineering technique'

Cain Moylan - Bristol University
'Quantifying sensitivity in a global flood model'

Joanne Barlow - Mott MacDonald
'Weir removal - how to consider geomorphological changes'

David Glover - Cardiff University
'Assessing the Flood Dynamics of the Somerset Levels using TELEMAC-2D'

Jonathan King - Cardiff University

'Hydro-epidemiological modelling of Swansea Bay U.K. using the TELEMAC model'

The whole event was recorded and is available to watch online at ["VIDEO LINK"](#). Just make sure to select "Camera" tab in the lower-right corner of the screen to view presentation slides (instead of "Screen" tab that is selected by default).

-- JK

~~~

## WISE CDT Industry Day at HR Wallingford

17/03/2017

HR Wallingford, Oxfordshire

Our WISE CDT members took part the annual Industry Day, organised by WISE Centre for Doctoral Training. This time the event took place at marvellous facilities of HR Wallingford in Oxfordshire. The day was full of interesting presentations and discussions, with great opportunities for networking between students and industry.

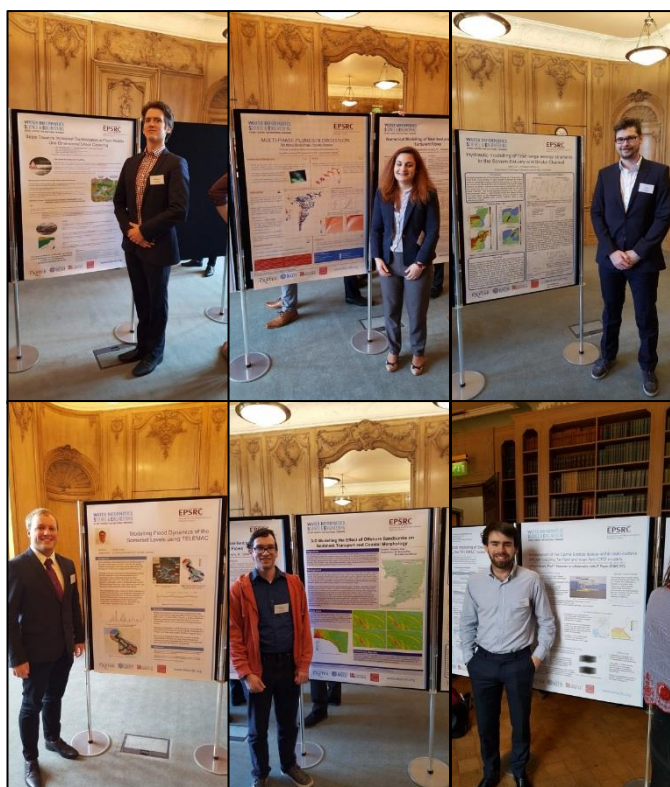


In the morning we listened to a number of presentations, covering a wide range of water related topics such as flood risk management, tidal energy, sea level rise, coastal protection and water quality modelling to name just a few. The format of presentations was similar to our Micro-engineering event, where each presenter was given 5 minutes to deliver a so called 'elevator pitch'. Two of our

YPN members, David Glover and Jonathan King, pitched their research on Flooding in Somerset and Water Quality in Swansea Bay respectively.



Presentations were followed by a poster session with buffet lunch. Currently there are eight YPN members who are part of the WISE CDT programme - Stephen Clee, Nejc Čož, David Glover, Arthur Hajalli, Jonathan King, Elli Mitrou, Joe Shuttleworth and Alex Stubbs. All eight of them created interesting posters that attracted much attention during the event.



The poster session was followed by a tour of HR Wallingford's excellent facilities. We took a walk through a giant warehouse (14,400 m<sup>2</sup>) that houses

one of the largest and most innovative physical hydraulic model in the world.



We finished our day at the state of the art ship simulator – some of us even got a chance to navigate a tug boat down the busy Thames river through London city (and definitely not crash it in to a bridge ☺).

-- NČ



### 3. Research Progress

#### Augmented Reality Sandbox (AR Sandbox) an Overview

By Alex Stubbs

Cardiff University has recently invested in an Augmented Reality Sandbox, or AR Sandbox. This equipment replicates that first conceived by Reed et al. (2014) by utilising open source software from the University of California.

The AR Sandbox equipment, as shown in Figure 1, augments, in real-time, computer generated visualisations with reality by monitoring changes in a bed of sand. Through use of an Xbox-360 Kinect sensing bar, the Sandbox's software obtains real-time distance measurements from the sensor to the sand surface. The software generates an elevation map using preset distance levels for different contours and colours, which is projected onto the surface of the sand, as shown in Figure 2. This topographic map can be changed in real-time by simply moving the sand, making this equipment both highly interactive and visual. However, this is not all the AR Sandbox can do.



Figure 1 - Example AR Sandbox equipment setup.

By tapping into the Kinect's gesture recognition capabilities, the Sandbox software can apply

precipitation to any area of the sand surface. The user simply opens and closes their fingers within the Kinect's field of view to achieve this. The Sandbox software utilises Navier-Stokes and Saint-Venant equations to calculate fluid routing across the sand surface, resulting in what looks like real water flow being projected onto the sand surface, all in real-time. Simply by modifying the fluid colour, surface attenuation and flow velocity, the fluid can be modified to replicate lava.

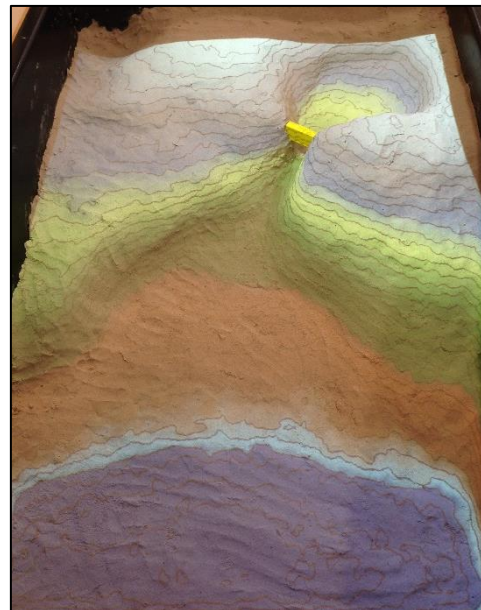


Figure 2 - Elevation map projected onto a sand surface replicating a dam-break scenario before the application of fluid.

Therefore, the AR Sandbox equipment lends itself to STEM outreach activities at all levels of the education system as well as engaging with prospective undergraduate students. Though currently being employed as an educational tool by Cardiff University and allowing many aspects of geography, physics and engineering to be explored, it is hoped that through further research the capabilities of the AR Sandbox software can be vastly extended allowing it to become a valuable tool for research.

Potential areas for further research include:

- Real-time measurement and calculation data capture for future analysis.
- The evaluation of real-life topography and catchment map.

- Increased control of fluid characteristics.
- Improved fluid routing accuracy through resolution changes.
- Adding facility to simulate continual fluid flow from a set location.

## Reference:

Reed, S. et al. *Shaping Watersheds Exhibit: An Interactive, Augmented Reality Sandbox for Advancing Earth Science Education*, American Geophysical Union (AGU) Fall Meeting 2014, Abstract no. ED34A-01

Funded by: Cardiff University, School of Engineering

For more information about this research, please contact Alex Stubbs, [StubbsA1@cardiff.ac.uk](mailto:StubbsA1@cardiff.ac.uk)

Website: <https://arsandbox.ucdavis.edu/>

## Hydro-epidemiological modelling of Swansea Bay U.K. using the TELEMAC model

By Jonathan King

The revised Bathing Water Directive (rBWD; 2006/7/EC) was introduced in 2006 by the European Union to improve the quality of recreational water resources within Europe that may be used for bathing. This requires the monitoring of two Faecal Indicator Organisms (FIOs); Intestinal Enterococci (I.Ent) and Escherichia coli (E.coli), the presence of which is indicative of faecal contamination which poses a human health risk; for example the contraction of gastroenteritis. Based on the compliance criteria specified in the rBWD this work looks at the case study of Swansea Bay in the Bristol Channel, UK, to determine the impact of faecal pollution on resulting FIO levels in the bay. Subsequently this enables prediction of non-compliance scenarios where concentration limits of I.Ent and E.coli in the rBWD are exceeded and the associated risk of bathers contracting gastroenteritis.

Two hydrodynamic models have been set up using the Finite Element software TELEMAC-2D and

TELEMAC-3D, based on the depth- and layer-averaged Navier-Stokes equations. The computational domain covers the Bristol Channel and Severn Estuary (see Figure 3) from the Celtic Sea at the Westward boundary to the tidal limit of the River Severn at Gloucester. Using an unstructured triangular grid the horizontal mesh consists of 331407 nodes and 660927 elements with a mesh size ranging from a maximum of 1000m, refined down to 5m in Swansea Bay. The 3D model consists of the same grid repeated over 5 sigma layers.

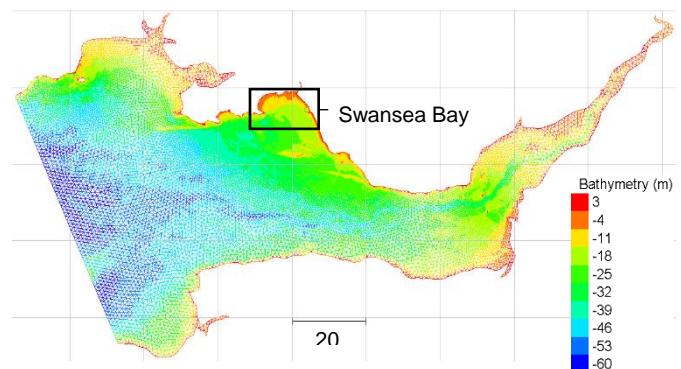


Figure 3- Computational domain of the Bristol Channel and Severn Estuary using an unstructured triangular grid.

Hydrodynamic validation has shown excellent agreement with British Oceanographic Data Centre tide gauge records, Admiralty Chart derived velocity records and data gathered during an Acoustic Doppler Current Profiler of Swansea Bay, (see Figure 4).

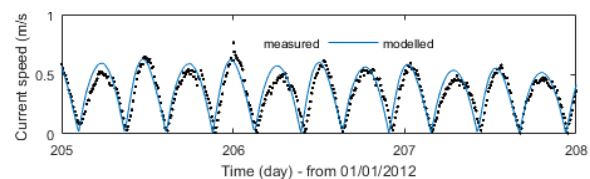


Figure 4 - ADP recorded and predicted current speed in Swansea Bay.

The existing method implemented within the TELEMAC suite to model bacterial kinetics uses a first order reaction, the decay rate governed by what is known as the T90 value. This represents the time taken for the population to decrease by 90% and is treated as a constant. Work is currently ongoing to refine the T90 value to include the effects of temperature, salinity, irradiance and sediment

interactions. This will allow more accurate calculations to be made of the spatially and temporally varying T90 values throughout the bay, providing a better understanding of sub-daily variations of bacterial concentrations and the subsequent compliance with the rBWD and risk to bathers.

*This research is ongoing under the supervision of Professor Roger Falconer and Dr Reza Ahmadian with funding from WISE EPSRC grant EP/L016214/1.*

For more information about this research, please contact Jonathan King, [KingJA@cardiff.ac.uk](mailto:KingJA@cardiff.ac.uk)

## 4. Our Alumni

### Luis Priegue Molinos

*Energy Analyst for Welsh Water*

Luis Priegue Molinos completed his PhD at the Hydro-environmental Research Centre, Cardiff University this year, under supervision from Professor Thorsten Stoesser. His thesis was titled Optimisation of a Vertical Axis Tidal Turbine and Testing of a Prototype in an Unblocked Environment. He now works as an Energy Analyst for Welsh Water.

"My PhD focused on one of the most innovative renewable sectors, tidal energy. Tidal turbines are at an early stage of development, with a lack of existing knowledge and ongoing research at many institutions around the world. In this particular case, the main aim of my work consisted of optimising the design of vertical axis tidal turbines. In order to do so, I carried out physical experiments at a small scale to analyse the influence of parameters associated with turbine performance. Once the physics behind each parameter and its influence on the hydrodynamics was assessed, the most efficient tidal turbine was designed, manufactured and assembled at Cardiff University. Following manufacture, tests at an intermediate scale were undertaken in a semi-natural environment. These tests confirmed that the design produced based on previous results were accurate, increasing confidence in the device to progress to research at larger scales.

After completing my PhD, with my experience working on renewable energy I joined the energy team at

Welsh Water in Newport. The company consumes and generates large amounts of electricity and many renewable energy assets have been installed to generate their own, clean energy. My role as an Energy Analyst is to help manage and report the performance of these assets."-- Author Name placeholder

[Luis.PriegueMolinos@dwrcymru.com](mailto:Luis.PriegueMolinos@dwrcymru.com)

-- Luis Priegue Molinos

## 5. Future Events

27-30 June  
2017

### SEEP 2017

10th International Conference on Sustainable Energy & Environmental Protection taking place in Bled, Slovenia.

13-18 August  
2017

### IAHR World Congress 2017

A number of our members had conference papers accepted and will be travelling to Kuala Lumpur, Malaysia to present their work

Autumn 2017

### Research visit to Tsinghua University, Beijing, China

Two of our PhD students will be visiting Tsinghua University as part of the WISE CDT programme.

## 6. Publications

1. 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](https://doi.org/10.1016/j.renene.2016.08.004)
2. Kvočka, D., Falconer, R. A. and Bray, M. 2016. Flood hazard assessment for extreme flood events. *Natural Hazards*. 84(3), 1569-1599. Open Access [doi: 10.1007/s11069-016-2501-z](https://doi.org/10.1007/s11069-016-2501-z)

3. Faghihirad, S., Lin, B. and Falconer, R. A. 2017. 3D layer-integrated modelling of morphodynamic processes near river regulated structures. *Water Resources Management*. 31(1), 443-460. Open Access. [doi: 10.1007/s11269-016-1537-4](https://doi.org/10.1007/s11269-016-1537-4)
4. Huang, G., Falconer, R. A. and Lin, B. 2017. Integrated hydro-bacterial modelling for predicting bathing water quality. *Estuarine, Coastal and Shelf Science*. 188, 145-155. Open Access. [doi: 10.1016/j.ecss.2017.01.018](https://doi.org/10.1016/j.ecss.2017.01.018)
5. Ouro P, Harrold M, Stoesser T, Bromley P. "Hydrodynamic loadings on a horizontal axis tidal turbine prototype". Accepted in Journal of Fluids and Structures.

---

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. Hydro Word Search

|   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I | W | Y | T | I | S | O | C | S | I | V | V | W | U |
| N | E | C | N | E | L | U | B | R | U | T | A | I | O |
| D | V | W | I | F | L | O | W | I | D | T | O | E | L |
| W | E | D | A | D | S | S | S | L | E | O | N | M | L |
| I | M | N | C | V | V | O | W | R | D | R | A | G | T |
| M | A | T | S | U | E | E | M | S | A | Q | O | E | R |
| N | C | E | E | I | U | U | T | R | D | M | R | Q | B |
| S | H | P | T | A | T | E | N | Y | R | U | C | G | O |
| W | N | I | O | O | A | Y | N | T | S | W | I | S | U |
| D | U | P | W | D | R | A | R | S | D | T | E | J | N |
| A | M | G | Y | E | M | Q | E | M | S | C | P | N | D |
| I | B | I | O | I | I | R | U | T | S | B | E | C | A |
| A | E | B | C | O | P | R | E | E | M | D | O | W | R |
| T | R | S | N | M | O | M | E | N | T | U | M | S | Y |

WATER  
PIPE  
PRESSURE  
STEADY  
BOUNDARY  
VISCOSITY  
DYNAMICS  
TORQUE  
MOMENTUM  
MACHNUMBER  
JET  
WAVE  
FLOW  
WEIR  
DRAG  
TURBULENCE  
DENSITY

Play this puzzle online at : <http://thewordsearch.com/puzzle/198349/>