

Volume 2, Issue 2

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1. Introduction

The second issue of the IAHR Cardiff Young Professional Network (YPN) newsletter provides updates of activities and work undertaken over the past few months. The highlights of the recent months covered within this newsletter include the Eighth international conference on fluvial Hydraulics that was held in St. Louis in July, at which several HRC members presented their updated research works and helped with the organisation of special YPN sessions. News of recent and future activities held by the YPN are also featured, including an Industry Awareness Event organised by ATKINS and WISE (Water Informatics Science and Engineering) and many social events organised by the YPN.

We would like to thank as well to the successful collaboration with the WISE program, where several postgraduates from universities of Bath, Bristol, Exeter and Cardiff are taking part in numerous events and bringing new ideas to the association.

2. Events

WISE CDT Industry Event at Atkins

02/03/2016

Atkins Plc, The Hub, Aztec West, 500 Park Ave, Almondsbury, Bristol BS32 4RZ

Earlier this year on 2nd March the first cohort of students from the EPSRC funded WISE CDT visited the Atkins office in Bristol for an Industry Awareness

Event. The evening comprised of the students giving five minute "elevator pitch" presentations on their research followed by an informal poster and networking session. Of the Cardiff YPN members, WISE students Nejc Čož, Jonathan King and Elli Mitrou attended.



Figure 1: Poster presentation session - Nejc Čož talking to one of the industry partners.

Nejc presented his research on modelling the impact of marine renewable energy structures and devices on flood risk and water quality. Jonathan discussed the challenges facing water quality modellers when simulating bacterial processes in estuarine and coastal waters. Elli presented her work on bubble plumes and jets in crossflow which has numerous applications in environmental and ocean engineering problems.



Figure 2: Jonathan King and his five minute "elevator pitch".

The event was aimed at promoting the students' research and demonstrating how this can be used to solve the existing challenges facing the water

industry. The event was a huge success with close to 50 attendees from Atkins, Arup, Welsh Water, Wessex Water and RSKW.

WISE CDT - Water Informatics Science & Engineering Centre for Doctoral Training, see <http://wisecdt.org>.

Social at City Mazes Escape Rooms

24/04/2016

City Mazes, Cardiff

A very different social event, City Mazes, was organised by the Cardiff YPN. It is a game where a group of people is locked in a game complex, the clock is set to an hour and the group must work together in a team to solve the puzzles and search for clues around the complex to ultimately work out a door code and escape within an hour. The Cardiff YPN group managed to escape the room in time and won the game. More brain-squeezing mazes ahead will be challenged.



Figure 3: Survivors of the "Fall-In", a real life escape game.

ICE Wales Cymru 5-A-Side Football Competition

05/06/2016

Gôl Football Centre, Lawrenny Avenue, Cardiff, CF11 8BR

A five-a-side football tournament organised by the ICE was held the in first week of June at the Gôl sport facilities in Cardiff. Two teams from the School

of Engineering and the Hydro-Environmental Research Centre competed against teams composed of engineers from companies that collaborate with the institution in Wales. This event has been run for several years, providing a comfortable way of networking between professionals while doing some exercise. The tournament champions of 2016 were the second year engineering students from Cardiff University, whose members will attempt to win the British ICE tournament on 6th of August in Belfast, Northern Ireland.



Figure 4: Hydro-Environmental Research Centre team.

Riverflow 2016, Eight International Conference on Fluvial Hydraulics

12 - 16 June 2016

St. Louis, United States

The biannual Riverflow conference was held in St. Louis, US last July. Three members of the Cardiff YPN attended the conference. They showcased their recent research topics with oral presentations, specifically in channel flow over a rough bed, turbulent flow in a compound channel and bubble simulation in cross flows.

The four main themes of this conference were; river flow and transport processes, sediment transport and river morphodynamics, river floods, and river management, ecology, and restoration. The conference was a huge success, attracting hundreds of researchers from all around the world. In addition to academic lecture sessions given by researchers, a Young Professionals meeting was held in the evening, 13th July. This event was joined

by international YPN members which included members from Cardiff YPN. Topics such as the role of young researchers in IAHR, how YPN members can be more active in IAHR and within their own chapters, and more were discussed during the meeting led by the IAHR President, Prof Peter Goodwin. The conference ended with a grand banquet held in the Chase Park Plaza, St. Louis.



Figure 5: Members of the YPN in front of the Riverflow 2016 venue.

3. Research progress

Large-eddy simulations of bubble plumes in crossflow

By Elli Mitrou

Bubble plumes have important practical applications in industrial, environmental and ocean engineering, such as destratification and aeration of lakes and reservoirs, injection of CO₂ in the deep ocean and/or the prediction of gas release from natural vents or from accidental well blow-outs.

Under the supervision of Prof Thorsten Stoesser, this study is focused on the numerical simulation of the flow and turbulence of bubble plumes in crossflow in order to understand the physical processes of the interaction between the gas and the liquid phases. The in-house code named Hydro3D (<http://hydro3dproject.github.io/>) is used to conduct these simulations. The Hydro3D code

solves the Navier-Stokes equations on a staggered grid for the liquid phase and predicts the dispersed phase using a Lagrangian Particle Tracking algorithm. The physical effect of the liquid-gas mixture is accounted through forcing terms. Bubbles are assumed to be rigid and spherical and there is no direct interaction between them.

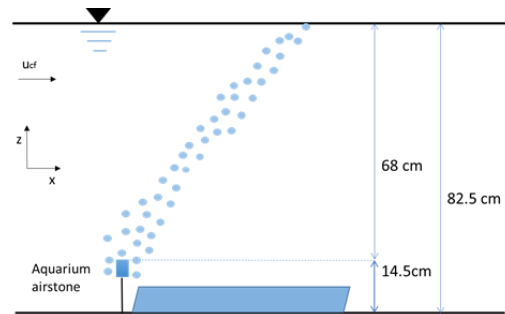


Figure 6: Experimental setup.

The bubble plume simulation reported here is an extension of a set of experiments conducted in the Fluid Dynamics Laboratory of Civil Engineering Department of Texas A&M University. The setup of the plume in crossflow is sketched in Figure 6. Compressed air is injected at constant gas flow rate through an aquarium air stone, 2.5 cm high, which is located 12 cm above the bottom of 1 m deep tank. The gas flow rate is set to $Q_g = 0.5$ l/min and the approach flow velocity to $u_{cf} = 0.04$ m/sec. The numerical simulation is carried under analogous geometrical conditions.

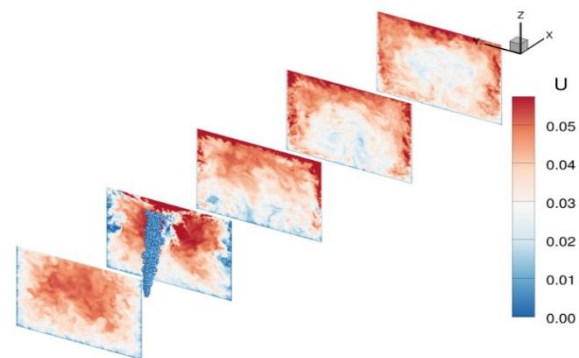


Figure 7: Instantaneous streamwise velocity contours and bubble plume.

In order to provide a realistic, fully-turbulent inflow, the computational domain is used initially for a precursor simulation of the approach flow only. Once the flow is well-developed in the precursor simulation, cross-sections of the velocity field are

recorded and provided at the upstream side of the domain (Figure 7).

Figure 8 provides a visualization of the experimental (a) and LES (b) vertical velocities 60 cm downstream the centre of the diffuser. In Figure 9, profiles of the time-averaged vertical velocity of the liquid at two locations downstream of the diffuser, i.e. 10 cm and 50 cm, are provided.

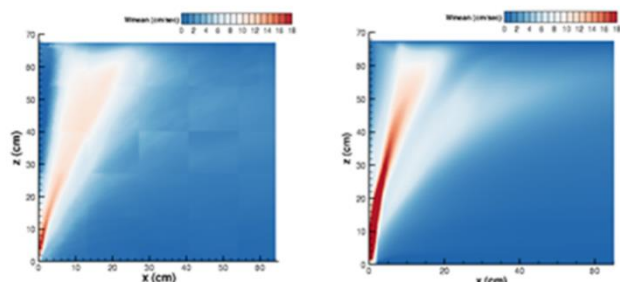


Figure 8: Contours of the time-averaged vertical velocity for (a) experimental and (b) LES results.

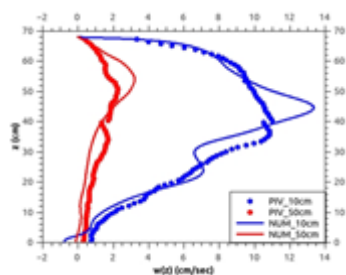


Figure 9: Vertical profiles of the mean vertical velocity for LES (solid lines) and experimental data (circles).

The agreement between the experimental and LES results is relatively good. However, discrepancies are noticed inside the bubble plume.

For more information about this research, please contact Elli Mitrou, MitrouE1@cardiff.ac.uk.

Design and optimisation of storm water constructed wetland systems

By Christopher Kiiza

High population and urbanisation increase demand for water, energy and food. These competing demands for water often accelerate water scarcity through abstraction and pollution. Minimising the effects of water pollution requires management interventions that are sustainable and holistic. Constructed Wetland systems (CWs) are globally

recognised for their ability to remove various environmental pollutants in wastewater. CWs are a relatively cheaper infrastructure requiring minimal energy and operational skills. However, various design criteria for CWs do not adequately account for influences of key design variables on performance of CWs. This research study aims at enhancing the current understanding of the effects of key design variables on long-term performance of CWs; so as to develop design codes for CWs.



Figure 10: Experimental Vertical flow CW Units.

Treatment processes in each novel CW design were simulated using multi-layer perceptron neural networks (executed in WinGamma software) to predict contaminant removal efficiency. The non-linear Broyden–Fletcher–Goldfarb–Shanno (BFGS) algorithm is the numerical optimisation technique used. It is assumed the biological, physical and chemical treatment processes involved contribute to the quality of effluents from each design.

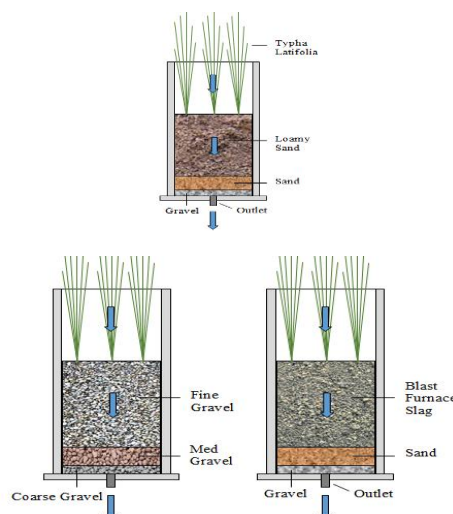


Figure 11: Cross-section of loamy sand, gravel and BFS CWs.

Modelled outputs for nitrogen (TN) removal using different bio filter media are shown below:

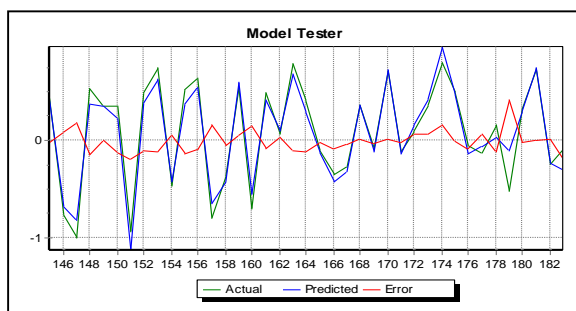


Figure 12: TN removal in blast furnace slag unit.

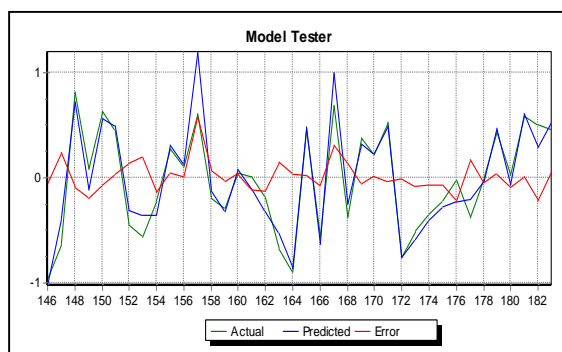


Figure 13: TN removal in loamy sand unit.

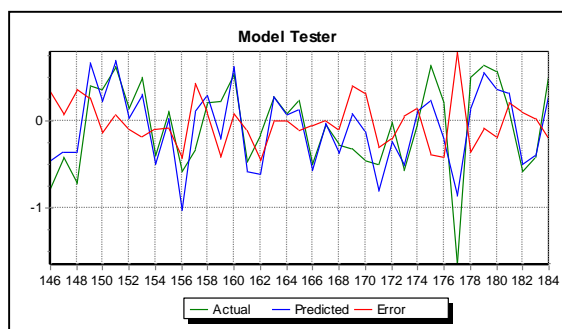


Figure 14: TN removal in gravel CW unit.

There are variations in the way each design CW units remove TN. Loamy sand is moderately consistent in its performance, achieving the fastest and highest TN removal rates (79 %). Although TN removal rates in BFS were less than those seen in loamy sand bio filters (77 %), BFS removed TN most consistently. Gravel bio filter achieved the least and slowest TN removal rates (62 %).

For more information about this research, please contact Christopher Kiiza, KiizaCJ@cardiff.ac.uk.

4. Future activities

WISE – YPN Presentation & Networking Event

21/10/2016

School of Engineering, Cardiff University

In collaboration with the WISE group, the Cardiff YPN is organising a presentation and networking event on the afternoon of Friday 21st October. The event will take place at the School of Engineering, Cardiff University, and will include presentations from members of both organisations on their research. The idea behind this activity is to allow future and current Ph.D. students from the Hydro-environmental Research Centre (HRC) and WISE to introduce themselves to the scientific community and present elements of their research. We would like to welcome all professionals from academia and industry to take part in this event and to join us for dinner in the evening. The venue will be chosen according to attendance. For more information, please contact our secretary:

MitrouE1@cardiff.ac.uk

37th IAHR World Congress

13 – 18 August 2017

Kuala Lumpur, Malaysia



The 37th IAHR World Congress will be held in Kuala Lumpur, Malaysia, from 13-18 August 2017. The congress will cover a number of research themes; river and sediment management, flood management, environmental hydraulics and industrial flows, coastal, estuaries and lakes management, water resources management and hydroinformatics. The 36th IAHR World Congress held in The Hague-Netherlands gathered more than 1300 participants from 72 countries, and the following Congress in Kuala Lumpur is expected to

see similar attendance. The Young Professional Network committee would like to encourage readers to take part in the conference. The abstract submission deadline is 1st October after which all papers will go through a strict double peer-review process with notification to be given on 1st November.

5. Publications

1. Fraga, B., and Stoesser, T. 2016. Influence of bubble size, diffuser width, and flow rate on the integral behavior of bubble plumes. *Journal of Geophysical Research Oceans*, 121, Open Access. doi: [10.1002/2015JC011381](https://doi.org/10.1002/2015JC011381).
2. Al-Tahmazi, T., and Babatunde, A. O. 2016. Mechanistic study of P retention by dewatered waterworks sludges. *Environmental Technology & Innovation*, Elsevier B.V., 6, 38–48. Open Access. doi: [10.1016/j.eti.2016.05.002](https://doi.org/10.1016/j.eti.2016.05.002).
3. Khajah, M., and Babatunde, A.O. 2016. Nitrogen removal in a Redox-stratified constructed wetland system. *Journal of Water Sustainability*, Vol. 6, Issue 1, 29-42. Open Access. doi: [10.11912/jws.2016.6.1.29-42](https://doi.org/10.11912/jws.2016.6.1.29-42).
4. Almatouq, A., and Babatunde A.O. 2016. Concurrent Phosphorus recovery and energy generation in mediator-less dual chamber microbial fuel cells: mechanisms and influencing factors. *Int. J. Environ. Res. Public Health*, 13 (4), 375, Open Access. doi: [10.3390/ijerph13040375](https://doi.org/10.3390/ijerph13040375).

6. Special announcement

YPN Committee Elections

28/10/2016 (*Venue TBA*)

Elections to select the new Cardiff YPN committee for the upcoming year (2016-17) will be held on Friday 28th October. We would like to encourage all members of the HRC to take part. Positions available are as follows; president, vice-president, secretary, treasurer, academic coordinator, research associate representative and social secretary.

In addition to the usual positions, the current committee would like to offer a new position, industry representative. The purpose of the role is to act as a figure to strengthen links with local companies who specialise in hydro- environmental engineering in order to broaden the network.

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

- Luis Priegue (President):
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