Cardiff IAHR Young Professionals Network: Report on 39th World Congress, Granada – June 2022

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SUMMARY

The 39th International Association for Hydro-Environment Engineering and Research (IAHR) World Congress was held in Granada, bringing together over 1000 researchers from across the globe to share work in the field of water-related research, under a variety of topics, with the over-arching theme of “From Snow to Sea”. As a long-established group within the community, the Cardiff Young Professionals Network (YPN) was well represented and was presented with an award recognising the level of activity in 2021. This report on activities collates the experiences of the members at the congress and provides an overview of the work being carried out by the members of the network. Full papers for the studies shown here are available in the congress proceedings and the authors welcome any discussion on their works to be directed to them.

1 INTRODUCTION

The IAHR Cardiff YPN aims to provide a community for water researchers based in and beyond Cardiff to come together and support each other in the early stages of their research careers. As one of the oldest YPNs within the IAHR, the Cardiff group has a membership of 20-30 researchers each year. A major part of this group’s aims is to facilitate membership of the IAHR and attendance at IAHR events. Members of this group have presented at European and Global congresses, as well as at the recently established IAHR Young Professionals congresses. For many young professionals, the 39th World Congress was the first opportunity to attend an international congress in person. The congress was hosted at the Palacio De Congresso in Granada over the course of six days, with 8 major themes, 4 high-level panels, multiple special sessions, and a variety of technical visits on offer. The days were capped with social events including the Young Professionals night, and cocktail gala.

2 INDIVIDUAL REPORTS

To provide a summary of the activities of the Cardiff YPN at the world congress, each member has compiled a personal retrospective, which is then followed by the title, authorship, and abstract of each of the works they contributed to at the congress. The reports are separated by author, ordered alphabetically, full papers are available in the conference proceedings.

2.1 Fawaz Alzabari

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The 39th IAHR World Congress was my first in-person international conference and the perfect opportunity to meet some of the best researchers in the water field. Also, I created connections with other research institutes and made great new friends.

Large-eddy simulation of the free-surface impact on the wake dynamics of a circular cylinder.
Fawaz Alzabari, Pablo Ouro and Catherine Wilson (presented by Fawaz Alzabari)

The wake structures generated downstream of a circular cylinder obtained from large-eddy simulations using a level-set method (LSM) and rigid-lid (RL) to represent the air-water interface are studied to assess how the flow dynamics change depending on the numerical treatment of the free-surface. A horizontal cylinder at a gap-to-diameter ratio of 0.5 is considered, with a bulk Froude number equal to 0.45, and Reynolds number based on the cylinder's diameter equal to 13,333. Spanwise vorticity contours show that the coherence of vortical structures is strongly impacted by the water-surface deformation when this is computed with LSM. The coherence of these turbulent structures in the cylinder wake are analysed using Proper Orthogonal Decomposition (POD) based on the instantaneous turbulent velocity fluctuations. The POD analysis indicates that the first two spatial modes contain most of the energy irrespective to the free-surface treatment, which correspond to von-Karman vortices. These have different spatial coherence depending on the air-water surface representation method, as when using the RL these two first modes account for about 67.7 % of the total energy, and are more coherent than in the LSM setup in which they account for 42 % of the total energy. The spectra computed from the temporal coefficients of the first two POD modes feature a dominant peak for both cases, while the energy content of the spectra diminish with increasing frequency for the LSM case. Our study outlines that adopting an accurate free-surface reconstruction method to correctly account for the water-surface deformation and turbulent structures in the flow.

Figure 1. Fawaz presenting his work to the congress.

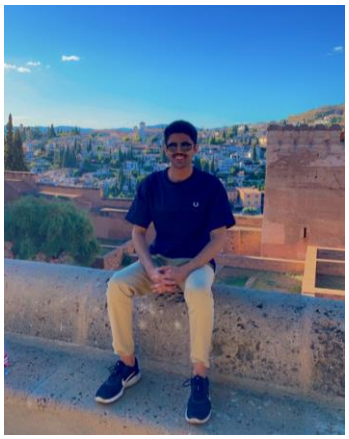

Figure 2. Taking in the sights at the historic Alhambra

2.2 Tommaso Attili

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The 39th IAHR World Congress has been a unique experience both from a scientific and social point of view. Several key note lectures and high level panels have been very inspiring. Among these I really enjoyed the talk by Dr. Steven Brunton about machine learning applied to CFD and the presentation by Prof. Nadia Pinardi about climate change. Along these, a numerous of regular sessions have been really interesting, especially the sessions of theme 6 (Computational and experimental methods).

Thanks to the sociable environment, I had the chance to meet and speak to several peers and mature researchers. It was interesting to discuss our projects and ideas at the congress, as well as have informal chats while enjoying tapas after a long day. Granada was the perfect framework for this conference. The beauty of the city made my stay even more pleasant!

Numerical Investigation of Impulse Waves Impacting Dams
Tommaso Attili, Valentin Heller and Savvas Triantafyllou (presented by Valentin Heller)

Impulse waves are generated by landslides, rockfalls and iceberg calving in water bodies such as lakes and reservoirs. These waves represent a persistent danger for dams, e.g. in the 1963 Vajont disaster an impulse wave impacted and overtopped the Vajont dam causing approximately 2000 causalities. Unfortunately, an accurate prediction of the effects of tsunamis on dams, e.g. pressures and forces, is still subject to large uncertainties and 3D effects are typically neglected. The present study relies on the numerical modelling of impulse waves impacting dams with the toolbox solids4foam. To this end, a total of 72 2D tests involving a range of wave conditions and dams of different inclinations have been conducted. A new empirical equation to predict the run-up height is suggested, showing a good agreement with available laboratory measurements. The resulting wave forces on dams agreed with an available empirical method, further extending its validation range. Novel insight in the 3D effects is given based on 4 simulations with straight and arch dams impacted normal or at an angle of 30°. Both the dam curvature and asymmetrical wave impact resulted in up to 32% larger run-up heights at the dam flanks than in the centre. Such findings may support tsunami hazard assessment in reservoirs and are also relevant for a range of coastal designs, e.g. oil and gas rigs, breakwaters and flood protection systems.

Numerical Investigation of Waves Interacting with Rigid and Flexible Plates
Tommaso Attili, Valentin Heller and Savvas Triantafyllou (presented by Tommaso Attili)

Coastal structures, such as oil and gas rigs, offshore wind turbine platforms, breakwaters, flood protection systems and wave energy converters, need to be appropriately designed to withstand wave loading. These structures experience stresses under wave loading and may significantly deform. A mutual interaction is triggered between the waves and structure, which may have significant effects and result in structural failures in extreme cases. Experimental and numerical investigations of wave-structure interaction (WSI) phenomena have been increasingly conducted in the last decade. However, an accurate understanding of WSI effects is still challenging. The present study focuses on the numerical modelling of waves impacting rigid and flexible plates with the toolbox solids4foam. The numerical model was validated with available laboratory experiments for a solitary wave impacting a flexible plate. A total of 117 tests with a range of linear and solitary waves impacting plates located offshore and onshore with different stiffnesses and inclinations have been conducted. In the onshore tests, the time series of the force on the plates confirm the previously observed double peak. The first peak was due to the initial impact of the surge, while the second peak was related to the collapse of the water column following the wave run-up. New semi-empirical correlations are proposed based on the offshore wave energy to predict the overland flow energy and force on the plate. These findings improve our understanding of WSI and may support the design of coastal structures.

Figure 3. Tommaso presents his work to a packed room.

Figure 4. Daniele Catucci (University of Nottingham), Joseph Hun-Wei Lee (IAHR President), and Tommaso.

2.3 Nicolas Hanousek

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Like most of the other PhD students I met at the congress, this was my first in-person conference. For me, it was a fantastic experience. My paper assessing the sensitivity of tidal range energy models was shortlisted for the John F Kennedy award for student papers. The opportunity to present among other exemplary speakers from diverse backgrounds and the additional attention this garnered all helped me in my time at the conference introducing me to a wide variety of people both young and experienced professionals. I eventually was awarded third place, behind the very impressive works of Acacia Markov and Antoine Villefer. Though I primarily attended the sessions on Topic 6 (Computational and Experimental methods), I also found the talks on AI, and the special session on diversity and inclusion to be a refreshingly honest discussion on the challenges faced in this world, and the avenues along which we can look to resolve them.

The conference experience was excellent, with the city of Granada offering vast amounts of scenery, good food, tapas, and culture. I am very glad to have gotten the opportunity to meet so many interesting and impressive people at the congress having made friends and connections I hope to hold on to going forward, perhaps we will all see each other next year in Vienna!

Assessing the Sensitivity of Tidal Range Energy Models to Water Level Accuracy
Nicolas Hanousek and Reza Ahmadian (Presented by Nicolas Hanousek)

Tidal range energy has long been considered for contribution to a low-carbon electricity mix, with schemes in operation for over half a century, generating dispatchable, predictable, energy. Proposed schemes are often modelled using simplified 0D models in the optimisation stages, taking a few key inputs to describe the operation of a tidal range scheme. Fundamental among these is the external water level, typically extracted from other models or harmonic extraction. To assess the possible variation in energy outputs that can be incurred from an erroneous water level, a set of base outputs for two tidal range schemes were determined using a combination of configurations. A set of error forms were identified, applied to the base water levels, and statistical parameters identified from the literature used to provide a set of erroneous water level sets within the reported accuracy. The tidal range schemes were then run using these mutated time series and the change in performance to the base condition was calculated. The models showed significant change in financial yield for the period with the error passing the criteria previously used, demonstrating the need for additional methods to assess the errors. The tests found that the tidal range schemes do not have a particular operating mode that is more resilient or susceptible to an inaccurate water level series, although, of the chosen schemes, one was more varied, indicating that future work may indicate a physical characteristic leading to a more consistent energy estimate.

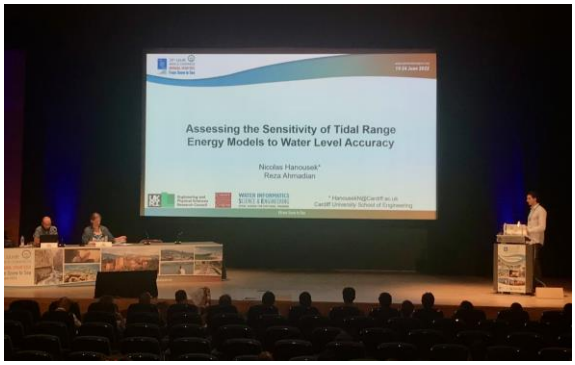

Figure 5. Presenting the paper as part of the competition.

Figure 6. Left to right: David Ferras (JFK Award Organiser), Nick, Antoine Villefer (1st Place), Acacia Markov (2nd Place), Joseph Hun-Wei Lee (IAHR President)

2.4 Juliette Mullineaux

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I had the pleasure to attend the 39th congress of International Association for Hydro-Environment Engineering and Research (IAHR) in Granada as part of my work at the Hydro-environmental Research Centre (HRC) of Cardiff University.

I had the opportunity to go on stage to report the discussion about Nature-based solutions on small streams with my colleague Samuel Rowley . Meeting peers from all around the world was very interesting and instructive!

Figure 7. Presenting work as part of the special session on nature based solutions.

Figure 8. Left to right: Leonardo Corredor Garcia (Sheffield University), Fawaz Alzabari, Samuel Rowley, Juliette Mullineaux

2.5 Samuel Rowley

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I had an amazing time at the IAHR 2022 World Congress in Granada last week. Particular highlights include presenting our work on leaky barrier modelling in 1D, as well as leading Natural Flood Management workshop groups and presenting the nature based solution discussion results on the main stage. Additionally, the weather and food in Granada was fantastic. All in all the conference was a big success for Cardiff University and it's IAHR YPN.

In-Channel Natural Flood Management Approach to Flood Risk Management: Modelling Applications on a Small Catchment in the UK.
Valentine Muhawenimana, Rhys Tucker, Samuel Rowley, Elizabeth Follett, Shunqi Pan, Catherine Wilson (presented by Samuel Rowley)

Leaky barriers, instream runoff and stream flow attenuation methods were modelled using a 1D HEC-RAS hydraulic model for a Natural Flood Management (NFM) monitoring test reach in the Corvedale catchment, UK. Indirect representations of leaky barriers used in the model included: a WINFAP- FARL (Flood Attenuation by Reservoirs and Lakes) index approach; a combined FARL and Manning's n increased roughness approach; and clusters of leaky barriers as culvert units. The computed discharges and water depths were compared against recorded monitoring data at the test reach. For two rainfall events which represent partial overbank and full overbank conditions, the model results indicated that the greatest time lag attenuation of the peak flow was achieved through the culvert approach for the partial overbank condition. The culvert approach was verified through a comparison of observed and modelled data for both water depths and storage volumes. The verification shows that the culvert modelling represents both the localized backwater effect of the leaky barriers and the temporary water storage response offered by the leaky barriers at the test reach. The global attenuation indexes of WINFAP- FARL and combined FARL- Manning's n adjustment emulated the cumulative effect of the enhanced ground infiltration of 86 leaky barriers and resulting reduction in streamflow by up to 24%. Further work is ongoing to test these approaches and alternative approaches for different observed rainfall and design flow events.

Figure 9. Sam presenting at the conference.

Figure 10. Juliette, Sam, and Ellis Penning (Deltares) during the Nature Based Solutions session.

3 YPN ACTIVITIES

The organizing committee included several activities throughout the week aimed at bringing together the young professionals at the event. The members of the Cardiff YPN appreciated the fantastic views over the city and in particular the Alhambra afforded at the gardens in which the Young Professionals night was hosted, an event run by the IAHR Spain YPN. The Cardiff YPN was also glad to accept an award for being one of the most active YPNs in recent years, alongside the IAHR Queensland YPN.

Figure 11. Subaru Moroi (IAHR Queensland YPN) and Sam enjoying the YPN night.

Figure 12. Nick and Subaru Moroi (IAHR Queensland YPN).

4 CONCLUSIONS

After a hiatus on in-person conferences in recent years due to Covid-19, the IAHR Cardiff YPN was well represented at the 39th IAHR World Congress, presenting in a variety of sessions over the course of the week, with participation in the special sessions, and winning of awards. The members would like to the IAHR and the local organizing committee, for their efforts undertaken to cater to young professionals and making this conference the experience it was we look forward to continued collaboration with the other YPNs we were able to meet during the conference and hope to see attendees at the up-coming IAHR Conferences. The current YPN committee would also like to thank the previous teams who built the Cardiff YPN into the group it is currently.

5 ACKNOWLEDGEMENTS

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