ARC Research Hub for Offshore Floating Facilities

eNewsletter

December 19, 2018

Welcome from Phil Watson, OFFshore ITRH Director

Christmas already – how did that happen?

If you are like me, 2018 has been passed in a blur. It's been a year filled with both challenge and opportunity, and we made great progress across the OFFshore Hub.

Recruitment of PhD students to the OFFshore Hub was largely completed this year, and the training programme is in full swing. We saw our first student graduate (Joe Tom), and a number have recently submitted (Dunja Stanisic, Xiantao Zhang, Hongchao Wang) – congratulations to them all! We have executed several large testing programmes, with others planned for 2019 – including significant field programmes from Project 1 and Project 4. We've engaged beyond the OFFshore Hub team, to increase our impact and ensure the research aligns with industry needs – following an earlier announcement that we had signed an agreement with the Alan Turing Institute, we've now signed agreements with the Norwegian Geotechnical Institute and BP to work on studies related to well conductors. The team has travelled widely, disseminating the key messages of the OFFshore Hub.

We recently held our annual workshop, attended by both the internal team and our industry partners – and it was a productive day. With the OFFshore Hub now half way through its cycle, the emerging themes centred on measuring impact from our activities, communicating the key research outcomes as widely as possible, and early planning for the future. These will all need attention in 2019, as we strive to deliver maximum value to the offshore sector.

Overall – it was a great year!

I wish you all a safe and enjoyable festive season, and look forward to more engagement in 2019!

Hub News

Success in the 2019 Pawsey supercomputer allocation scheme

The OFFshore ITRH was awarded 12 million core hours from the 2019 Pawsey supercomputer allocation scheme in order to crunch the numbers on the **"Further investigation on the hydrodynamics of offshore floating facilities using numerical modelling"** project. This project combines fluid mechanics, oceanography and statistics in order to focus on a range of areas within the field of offshore engineering. Applications were assessed against the following criteria: quality and innovation, investigators involved, benefit and impact of the work and its suitability and scalability of analysis.

This is a big win for the OFFshore ITRH as access to supercomputer hours is highly competitive. The awarded core hours for 2019 far exceeds our allocation in both 2017 and 2018.

This project is a key component of the OFFshore ITRH initiative with much of the high performance computing being led by two Early Career Researchers: Lifen Chen and Matt Rayson. Numerous other OFFshore ITRH members and industry participants will provide co-supervision of the five PhD students who will utilize the resource.

The awarded supercomputer hours will allow for further investigation of the interactions between ocean processes and floating facilities by using advanced numerical modelling. In particular, the team will look at the occurrence and consequence of potentially hazardous hydrodynamic loads on offshore floating facilities, resulting from extreme currents, surface and internal waves. Specific applications include predictions of peak ocean currents including the effect of internal solitons, the fatigue life of water intake risers, side by side vessel response, and the magnitide of greenwater loading on FPSOs during storm events.

Well done Lifen, Matt and the whole project team!

ARC Discovery Grant Winners

OFFshore ITRH Chief Investigators Mark Randolph and Yinghui Tian were both recently awarded ARC Discovery Grants for projects within the field of Geotechnical Engineering.

The ARC Discovery Grant scheme encourages high-quality research and training by individuals and teams. It aims to enhance international collaboration in research while expanding Australia's knowledge base and research capability.


Australian Government
Australian Research Council

Over the next three years, Mark Randolph and a team of UWA research members will be looking at solutions for rapid penetration into sand for offshore energy installations.

The aim of the project is to develop a fundamental understanding of the response of saturated sand in seabeds during rapid penetration by offshore site investigation tools and during foundation construction. Innovative physical and advanced numerical modelling techniques will be used to quantify the significant increase in sand resistance caused by rapid penetration, enabling reliable design and reducing the risk of material failure associated with the high impact forces.

Expected outcomes of the project include a conceptual framework and scientific-based design tool to predict the geotechnical performance of offshore installations. The research will provide the necessary scientific advances to install, moor and service offshore wind and wave energy devices more economically and efficiently.

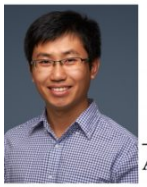
As lead investigator, Yinghui Tian's ARC Discovery grant will focus on investigating the process of lifting objects off the seabed. Understanding this process will provide the scientific basis for a variety of offshore applications such as oil and gas decommissioning, marine salvage, and securing foundations under extreme storms.

The project expects to advance the understanding of soil-fluid-structure interactions by using innovative high-speed photography observations and advanced numerical analyses.

Expected outcomes will include a numerical tool to predict the soil breakout process which is verified against a high quality experimental database. This will allow Australia's engineers to predict lift procedures more accurately which will contribute to safer operations in Australian waters and promote the economic harnessing of ocean resources.

Congratulations go out to Mark and Tian. 2019 will no doubt be a busy year!

Dr Wenhua Zhao awarded an ARC DECRA grant



Australian Government
Australian Research Council

Congratulations to OFFshore ITRH Chief Investigator Dr Wenhua Zhao who was recently awarded an ARC Discovery Early Career Researcher Award (DECRA) for his project entitled "*Unlocking lab to field scaling in design for floating offshore structures*".

The objectives of the DECRA scheme are to support excellent basic and applied research by early career researchers, advance promising early career researchers and promote enhanced opportunities for diverse career pathways, enable research and research training in high quality and supportive environments, expand Australia's knowledge base and research capability, and enhance the scale and focus of research in the Science and Research Priorities.

Over the next three years Wenhua will use his DECRA to develop rigorous, physics-based models to accurately predict the hydrodynamics of floating offshore structures at different scales. This project will address the key issue of laboratory-to-field scaling, which is a fundamental problem in fluid dynamics. This will be achieved through the

integration of numerical technology, with physical modelling and field data acquisition. The ultimate goal of this work is to reduce risk and improve the operability of existing offshore floating facilities, leading to more efficient design for future projects.

Wenhua's work will ultimately benefit the whole floating offshore structures community and cement Australia's place as a pioneer in both the offshore and emerging renewable energy sector.

Well done Wenhua!

The OFFshore ITRH delivers real Impact for Woodside

Floating Production Storage and Offloading facilities (FPSOs) offshore Western Australia are exposed to persistent Southern Ocean swells which may induce onerous roll motions. The topside operational processes of FPSOs, and personnel safety, can both be adversely affected by excessive roll motions. Accurate prediction of roll motions is therefore essential for efficient FPSO design in this region.

In comparison to the other motions of a ship (heave and pitch etc.), the roll response is much more difficult to predict as non-linear, viscous effects generally provide a significant contribution to the available damping.

Optimisation of a new build FPSO for Australia had initially shown that the use of a large bilge radius was beneficial for ship motions and mooring design. However, the bilge radius used was outside the usual experience range for accurately predicting roll damping. A concern was raised that separation off the bilge radius would result in a reduced effectiveness of the bilge keel.

Dr Ian Milne (UWA) of the OFFshore ITRH investigated this problem in collaboration with Woodside's naval architects, which involved the development and application of advanced computational fluid dynamics (CFD) models to simulate the flow around the hull and bilge keels for the various geometries of interest.

The CFD analyses provided critical new insights into the damping characteristics for the range of swell conditions likely to be experienced by the FPSO. In particular, the damping was found to be reduced by around 50 percent when compared to a conventional hull design, with the larger bilge radius resulting in weaker vortex shedding at the keel.

As a consequence of the smaller available damping, the roll motions for the large bilge radius hull would likely be excessive and hence significantly undermine the operational efficiency of the FPSO. This new work allowed a key risk for the project to be mitigated. The fundamental new insights on roll damping are also expected to assist the design of other FPSOs for years to come.

This collaborative work is a clear example of how the Offshore ITRH has provided high value outcomes for its research partners and had a significant impact on Australian operations.

Greg Ivey elected a Fellow of the Australasian Fluid Mechanics Society

Greg Ivey, who has recently been elected a Fellow of the Australasian Fluid Mechanics Society (AFMS).

AUSTRALASIAN FLUID MECHANICS SOCIETY

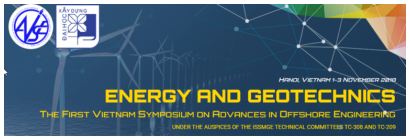
AFMS is an independent, non-profit society that supports and fosters interest in fluid mechanics and related disciplines in the Australasian region. AFMS provides a forum through publishing and promoting relevant material to Government, institutes and the public. The AFMS also oversees and supports the Australasian Fluid Mechanics Conference (AFMC) series.

The Fellowships are designed to recognize outstanding achievement, provide inspiration and mentoring to younger members of AFMS and to provide a resource of experienced fluid mechanicians. In Greg's instance, the panel recognised his "outstanding contribution to the cause of fluid mechanics domestically and internationally", with his work on ocean mixing, internal waves and currents in both the coastal and open ocean environments.

Greg will be awarded his Fellowship at the upcoming 21st Australasian Fluid Mechanics Conference (AFMC) in Adelaide on December 12th 2018.

Congratulations Greg!

The First Vietnam Symposium on Advances in Offshore Engineering



In early November, OFFshore Hub members headed to Hanoi, Vietnam for the first Vietnam Symposium on Advances in Offshore Engineering (VSOE) at the National University of Civil Engineering.

The VSOE, in conjunction with universities and research bodies in Vietnam, brought together researchers, practitioners, policymakers, and entrepreneurs to discuss and promote technology and policy changes affecting renewable energy.

The central theme of the symposium was "***Energy and Geotechnics***". The program was comprised of paper presentations, poster sessions, project demonstrations and keynote speakers. Topics included recent offshore engineering and technology innovations, cost-effective and safer foundations and structural solutions, environment protection, hazards, vulnerability and risk management.

The OFFshore Hub was well represented at the event. Director Phil Watson chaired a session on the *Design of Offshore foundations* and presented a paper on "Life cycle changes in p-y stiffness for a conductor pile installed in carbonate silt". Chief Investigator (CI) Christophe Gaudin chaired a session on the *Design of Offshore structures*, CIs Scott Draper and Fraser Bransby presented recent work, and CI Mark Randolph provided the closing address.

Phil Watson elected a Fellow of the Australian Academy of Technology and Engineering

It has been announced by the Australian Academy of Technology and Engineering (ATSE) that OFFshore ITRH Director, Phil Watson, has been chosen as one of 25 experts to be elected as an Academy Fellow.

By bringing together the brightest minds in technology, engineering and science, ATSE aims to ensure that Australia remains a world leading technology economy.

Fellows were chosen based on their impressive track records in leadership and creating impact. They include industry experts in infrastructure, mining and agriculture, leaders in federal government departments, and world-renowned researchers.

With over 30 years of engagement in offshore engineering, Phil brings vast experience in delivering and managing significant international geotechnical engineering projects.

Phil and the other 24 experts will be formally welcomed into ATSE at its Annual Meeting in Melbourne on the 23rd of November.

Congratulations Phil!

Hub Spotlight

Joe Tom is a Research Fellow in the Project 4: Novel Anchors and Subsea Foundation Systems project stream. Joe's research is focusing on mooring line trenching and its impact on anchor capacity. A multi-disciplinary approach is vital in defining this concept, and Joe is drawing on the expertise from across the OFFshore Industrial Transformation Research Hub for Offshore Floating Facilities (ITRH) to do so.

"I've broken the problem into fundamental components and performed both physical experiments and computational analyses. Computational fluid dynamics are used to predict how water flows around the oscillating mooring and this is validated by supporting experiments. Concepts from sediment transport are then applied to assess the rate and extent of seabed trenching."

In conjunction with Joe's work, industry partners are providing field data of instances where mooring line trenching has and hasn't occurred. This data will help to validate Joe's new analysis methods and enable him to create new prediction methods.

This, in turn, will allow for more accurate forecasting of mooring line trenching and will directly impact the development and design of more robust mooring systems, providing less down time and greater production.

Incremental publication of Joe's research is listed here, and further details are available on Joe's profile page.

Publications

Interested in learning more about our work? Below is a list of some of our more recent publications. A full list of our publications can be found here. To request a PDF version please contact us.

- Hou, Z., Saudi, F., Gaudin, C., Randolph, M. (2018) Evolution of Riser-Soil Stiffness in a Soil Crust Layer. Proceedings of the 1st Vietnam Symposium on Advances in Offshore Engineering
- Doherty, J., White, D., Watson, P., Grime, A. (2018) Life cycle changes in p-y stiffness for a conductor pile installed in carbonate silt. Proceedings of the 1st Vietnam Symposium on Advances in Offshore Engineering
- Rayson, M., Jones, N., Ivey, G. (2018) Observations of large-amplitude mode-2 nonlinear internal waves on the 2 Australian North West Shelf. American Meteorological Society (AMS) Journal of Physical Oceanography
- Astfalck, L., Cripps, E., Gosling, J.P., Milne, I. (2018) Emulation of vessel motion simulators for computationally efficient uncertainty quantification. Ocean Engineering December 2018.
- Feng, X., Gourvenec, S., White, D. (2019) Load capacity of caisson anchors exposed to seabed trenching. Ocean Engineering, Volume 171, 2019, pp. 181-192
- Chen, L., Taylor, P., Draper, S., Wolgamot, H. (2019) 3-D numerical modelling of greenwater loading on fixed ship-shaped FPSOs. Journal of Fluids and Structures, Volume 84, Pages 283-301

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