TETHYS ENGINEERING BLAST

23 September 2022

Tethys Engineering is an online knowledge hub that facilitates the exchange and dissemination of information on the technical and engineering aspects of marine energy. The bi-weekly *Tethys Engineering* Blast highlights new publications in the *Tethys Engineering* Knowledge Base; relevant announcements, opportunities, and upcoming events; and news articles of international interest. Email tethys@pnnl.gov to contribute!

Announcements

PRIMRE Highlight

The Marine Energy Projects Database is the newest Knowledge Hub on the Portal and Repository for Information on Marine Renewable Energy (PRIMRE). Learn more here.

ORISE Application Opens

The U.S. Department of Energy's (DOE) Water Power Technologies Office (WPTO) and Oak Ridge Institute for Science and Education (ORISE) recently opened applications for the next cohort of students for the Marine Energy Graduate Student Research Program. The program is accepting applications from master's and doctoral students with a marine energy-focused research thesis and/or dissertation at a U.S. institution. Applications are due 2 December 2022.

FOSTWIN Controller Competition

Sandia National Laboratories, in conjunction with Oregon State University and Evergreen Innovations, is hosting the FOSWEC Digital-Twin ("FOSTWIN") Control Competition to develop an effective power absorption controller for a digital twin of the Floating Oscillating Surge Wave Energy Device (FOSWEC). Try your hand at generating the most electrical power on a real-time digital-twin system for a chance to win reimbursement for travel to a control workshop at the Maneuvering and Sea Keeping Basin. Submissions are due 16 June 2023.

INORE BECS

The International Network on Offshore Renewable Energy (INORE) has announced a Call for Blue Energy Collaborative Scholarships (BECS) Proposals, targeted at INOREans from Latin America, Africa, and Asia. If you have a research project that can provide collaborative work with other INOREans, the grant can be used for travel expenses and accommodation at the institution where the work will take place or be presented. Applications are due 31 October 2022.

Calls for Abstracts

The Call for Abstracts for the 33rd International Ocean and Polar Engineering Conference (ISOPE) is now open through 20 October 2022. Manuscripts will be due for review by 20 January 2023. ISOPE 2023 will take place 19-23 June 2023 in Ottawa, Canada.

The Call for Abstracts for the 42nd International Conference on Ocean, Offshore and Arctic Engineering (OMAE 2023) is now open through 24 October 2022. OMAE will take place on 11-16 June 2023 in Melbourne, Australia.

Funding & Testing Opportunities

The U.S. Testing and Expertise for Marine Energy Research (TEAMER) program is now accepting Request For Technical Support (RFTS) 8 applications through 14 October 2022. Developers can apply for support in numerical modeling and analysis, bench/lab or tank/flume testing, and open water activities. Visit the TEAMER website for RFTS updates.

The European Commission has launched the LIFE Programme 2022 Calls for Project Proposals for nature conservation, environmental protection, climate action, and clean energy transition projects. Application deadlines vary, but most are due between September and November 2022.

WEAMEC (West Atlantic Marine Energy Community) has opened a Call for Projects to support eligible French researchers with writing and structuring marine energy projects that will be carried out by academic members of the community. Applications are due 30 November 2022.

Student & Employment Opportunities

Ghent University is looking for a Post-doctoral Assistant to conduct numerical modelling of wave-structure interactions with applications in the field of coastal engineering and offshore renewable energy. Applications are due 11 October 2022.

Oregon State University is seeking a Safety and Compliance Officer to join the PacWave team and ensure compliance with all safety and environmental regulations and requirements through the construction and operational phases of the project. Applications are due 31 October 2022.

HydroQuest is seeking an Engineer to assist with the development of tools and computational fluid dynamics calculations for tidal turbine arrays. Applicants must be fluent in French.

Boston Government Services is seeking a Marine Energy Data Scientist/Analyst who will help directly support the U.S. Department of Energy's (DOE) Office of Energy Efficiency and Renewable Energy Water Power Technologies Office (WPTO) in project management activities.

Upcoming Events

Upcoming Workshop

The National Renewable Energy Laboratory (NREL) and the Hydropower Foundation are hosting an International Workshop on Marine Energy Workforce Development and Education Efforts on 20 October 2022, as part of the International Conference on Ocean Energy in Donostia-San Sebastián. Email Arielle Cardinal with any questions and to RSVP.

Upcoming Webinars

PRIMRE is hosting a webinar, "Wave Hindcast Webinar: High-resolution regional hindcast datasets for wave energy resource characterization in US coastal waters", on 27 September 2022 from 8:00-9:00am PDT (3:00-4:00pm UTC). During this webinar, the Marine Energy Resource Characterization Team will discuss the overall effort and highlight some technical details and challenges. Register here.

Sandia National Laboratories is hosting a webinar on the Wave Energy Converter Design Optimization Toolbox (WecOptTool) on 27 September 2022 from 8:00-9:00am PDT (3:00-4:00pm UTC). WecOptTool is an open-source software for conducting optimization studies of wave energy converters and their control strategies. Register here.

The U.S. DOE WPTO is hosting a webinar, "WPTO R&D Deep Dive: Lessons Learned from Instrumenting and Deploying Composite Tidal Turbine Blades", on 27 September from 3:00-4:00pm EDT (7:00-8:00pm UTC). During the webinar, a team from NREL will share best practices, including what equipment, techniques, and tools worked for the project. Register here.

The U.S. DOE WPTO is also hosting a webinar, "WPTO R&D Deep Dive Webinar: Small WEC Analysis in the Palm of Your Hand", on 29 September 2022 from 1:00-2:00pm EDT (9:00-10:00am UTC). The webinar will highlight the Small WEC Analysis tool, a modeling tool that uses performance data from downscaled models of common wave energy converter (WEC) devices to compare power output for a variety of WECs and model sizes. Register here.

Upcoming Events

The Tidal Stream Industry Energiser (TIGER) project is hosting a TIGER Supply Chain Event on 26 September 2022 from 1:45pm-4:00pm CET (11:45am-2:00pm UTC) at the Sea Tech Week Conference in Brest, France. Register here by 23 September 2022.

The TIGER project will also be attending the European Sustainable Energy Week (EUSEW) on 26-30 September 2022 in Brussels, Belgium and online. Join TIGER partners at the European Commission Charlemagne building or through the online EUSEW Energy Fair. Register here.

New Documents on *Tethys Engineering*

Variability of wave power production of the M4 machine at two energetic open ocean locations: Off Albany, Western Australia and at EMEC, Orkney, UK – Orszaghova et al. 2022

> Since intermittent and highly variable power supply is undesirable, quantifying power yield fluctuations of wave energy converters (WECs) aids with assessment of potential deployment sites. This paper presents analysis of 3-hourly, monthly, seasonal, and inter-annual variability of power output of the M4 WEC. We compare expected performance from deployment at two wave energy hotspots: off Albany on the south-western coast of Australia and off the European Marine Energy Centre (EMEC) at Orkney, UK. We use multi-decadal wave hindcast data to predict the power that would have been generated by M4 WEC machines. The M4 machine, as a floating articulated device which extracts energy from flexing motion about a hinge, is sized according to a characteristic wavelength of the local wave climate.

A deep learning-based optimization framework of two-dimensional hydrofoils for tidal turbine rotor design – Wang et al. 2022

> Convolutional Neural Network (CNN) is a commonly used deep learning algorithm due to its excellent capability in identification of structural features and parameter predictions in many domains. In addition, it has incomparable advantages of high analysis efficiency and generalization performance. However, it has been questioned in the research community on whether CNN method can be applied to effectively predict hydrofoil performance for hydraulic machinery design. To this end, this paper demonstrates a novel optimization platform using CNN for hydrofoil performance prediction, which can effectively and accurately obtain the optimized hydrofoils results in aid of the structural design of tidal turbine. The prediction model uses signed distance function (SDF) to graphically represent the shape of the hydrofoil which is subsequently imported into CNN as the network input.

The investigation of optimum multi-component blends in organic Rankine cycle for ocean thermal energy conversion – Yang and Yeh 2022

> This study investigates the effects of working fluids on the performance of an organic Rankine cycle (ORC) used in an Ocean Thermal Energy Conversion (OTEC) power plant. Working fluids of R1123, R161, R32 and their mixtures are employed. Parameters of pinch points, temperatures of deep cold and surface warm seawater, and efficiencies of pumps and expander are taken into consideration. The objective functions are either net power output or economic performance parameter, respectively. A numerical approach,

gradient descent, is employed to solve the optimum mass fractions of mixture working fluids in the OTEC system. The results show that for pure working fluids, the net power output of the OTEC system using R1123 is 620.76 kW and is the highest, followed by R32 and R161, respectively.

Hybrid machine learning models for predicting short-term wave energy flux – Lu et al. 2022

Wave energy flux is a critical index of available wave energy in a region. The short-term wave energy flux prediction is conducive to implementing marine energy generation management. Due to the high degree of nonlinearity in the time series, it is challenging to achieve the accurate prediction of the short-term wave energy flux. The existing prediction models usually only focus on the prediction accuracy without considering the prediction stability. This paper presents hybrid support vector models combining a multi-objective optimizer and data denoising for short-term wave energy flux prediction. The proposed models are tested on the hourly wave energy flux data from November 2014 to January 2015 at the South Energy Test Site in the United States.

Performance and near-wake analysis of a vertical-axis hydrokinetic turbine under a turbulent inflow – Dhalwala et al. 2022

This study investigates the performance and near-wake characteristics of a full-scale vertical-axis hydrokinetic turbine under a uniform inflow and turbulent inflow with a 5% and 10% turbulence intensity. The governing equations of the flow field are the incompressible Navier–Stokes equations expressed within an arbitrary Lagrangian–Eulerian framework to account for mesh motion. To discretize the system of equations, the residual-based variational multiscale formulation, augmented with a weakly imposed Dirichlet boundary condition at no-slip surfaces, is used. Moreover, a turbulent inflow is prescribed using a synthetic turbulence generation method referred to as Smirnov's random flow generation and the near-wake characteristics are studied using a multi-domain method.

Composite Springs for Mooring Tensioners: A Systematic Review of Material Selection, Fatigue Performance, Manufacturing, and Applications – Cai et al. 2022

Ocean energy is an underutilized renewable energy source compared with hydropower and wind power. Therefore, the development of economical and efficient wave energy converters (WECs) is important and crucial for offshore power generation. The mooring tensioner is a critical device that can be used in point-absorber-type WECs, semisubmersible floats for oil and gas drilling, and floating wind turbines. A mooring tensioner is a system used to create, reduce, or maintain tension within the mooring lines by applying a force to the mooring line. This paper reviews in detail the fatigue performance, seawater durability, and manufacturing methods of different composite materials as well as the current and potential applications of composites springs. In addition, recommendations for future research and opportunities for composite mooring tensioners are presented.

News & Press Releases

First commercial scale UMACK anchor deployed offshore, Portugal. – CorPower Ocean

CorPower Ocean, Maersk Supply Service and Dieseko have successfully installed the first commercial-scale UMACK (Universal Mooring, Anchor & Connectivity Kit) anchor to support the HiWave-5 demonstration project. The novel anchor has been installed 4km off the coast of Aguçadoura, in northern Portugal, where it will be used to anchor the CorPower C4 Wave Energy Converter, as part of the flagship HiWave-5 project. Developed by a European consortium of experts led by CorPower Ocean, the UMACK technology provides a step-change improvement to the vertical holding capacity of pile-type anchors. It offers significant reductions to cost and carbon footprints compared to both monopiles and gravity foundations and can support offshore installations such as marine energy devices, floating wind and aquaculture.

Five wave energy projects to continue to next phase of EuropeWave – EuropeWave

Following the competitive Phase 1 of EuropeWave's Pre-Commercial Procurement programme, five wave energy projects have been selected to develop their concepts further in the next phase. The five successful wave energy projects are: Arrecife Energy Systems S.L. – Trimaran; AMOG Consulting Limited – Sea-Saw WEC; CETO Wave Energy Ireland Limited – ACHIEVE; IDOM Consulting, Engineering, Architecture S.A.U. – MARMOK Atlantic; and Mocean Energy Limited – Blue Horizon 250. These projects, progressing to the second phase in the innovative 'Phase Gate' process, will share a budget of €3.6 million over the next nine months to continue the development of their wave energy device concepts. This phase will focus on the front-end engineering design of a scale prototype device intended for open-water trials during Phase 3.

Patented Wave Energy Technology Gets Its Sea Legs: New Technology Could Generate Electricity From Ocean Waves or Even Clothing, Cars, and Buildings – NREL

Imagine this: Clothing that charges your smart watch as you walk, buildings that vibrate in the wind and power your lights, a road that extracts energy from the friction created by moving cars, and flexible structures that change shape in ocean waves to generate clean electricity for communities around the world. It is not science fiction. Someday, we could harness these naturally occurring energy sources thanks to a fledgling technology domain that just earned its first patent: distributed embedded energy converter technologies (or DEEC-Tec, pronounced deck-tech, for short). The invention's first patent is specifically for applications in marine renewable energy—clean power generated from ocean and river waves, currents, and tides. But DEEC-Tec could eventually transform sources of everyday energy, including almost all physical motions or dynamic shape changes, into electricity or other forms of usable energy.

Energy-Generating 'Artificial Blowhole' Completes 1-Year Test – CNET

> Could the ocean become a source of renewable energy? The company Wave Swell Energy is hoping for exactly that with its UniWave 200. The structure, with a large concrete base, has an opening for waves to enter through a hollow central chamber. As water rises and falls within the chamber, air gets pushed through a turbine, which spins and in turn generates electricity. This chamber is an artificial version of a naturally occurring phenomenon called a blowhole, in which rising waves compress air in a cave and send bursts of seawater outward. The device recently completed a one-year-long test run off the coast of King Island, Australia. Two of the primary metrics the Wave Swell Energy team measured during this time were efficiency and availability.

World's first offshore green hydrogen production platform inaugurated in France – Offshore Energy

> French green hydrogen technology developer Lhyfe, together with its partners, has inaugurated the world's first offshore renewable hydrogen platform in France. The world's first offshore hydrogen production platform, developed by Lhyfe in collaboration with Chantiers de l'Atlantique, will become operational at the SEM-REV site off the coast of Saint-Nazaire in France, later in 2022. The electrolyser, which will produce green hydrogen from marine renewable energy sources, has been installed on Geps Techno's hybrid floating renewable energy platform – which combines solar, wind and wave energy. The platform will be connected to various marine renewable energy sources, including floating offshore wind turbine Floatgen, to secure enough power for the production of green hydrogen.