TETHYS ENGINEERING BLAST

14 January 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

New Fact Sheets Available

France Énergies Marines recently published two new Fact Sheets on Foundations and Anchors and Moorings, which describe the different systems used for offshore renewable energy, and compare their advantages and limitations.

ETIPP Accepting Applications

The US Department of Energy (DOE) and National Renewable Energy Laboratory recently announced that the Energy Transitions Initiative Partnership Project (ETIPP) is accepting applications from remote, island, and islanded communities for technical assistance to transform their energy systems and increase energy resilience. Applications are due 15 April 2022.

OPIN Survey

The Ocean Power Innovation Network (OPIN), an international network headquartered in Europe, is conducting a survey on current practices for corrosion protection of offshore reinforced concrete structures. The results will be analyzed and compiled in an OPIN report on future paths to reduce corrosion costs for offshore renewables. Please consider submitting feedback by 17 January 2022.

Calls for Abstracts

The Call for Abstracts for the Frontiers in Hydrology Meeting is open through 26 January 2022. The meeting will take place online and in San Juan, Puerto Rico on 19-24 June 2022.

The Call for Abstracts for the 9th Partnership for Research in Marine Renewable Energy (PRIMaRE) Conference is open through 14 February 2022. The conference will take place in Cornwall, UK on 6-7 July 2022.

Calls for Papers

Energies is accepting submissions for several Special Issues, including "Advanced Development on Solar, Wind and Tidal Energy" (due 10 February 2022), "Innovation in Grid Connection and Control of Offshore Renewable Energy Systems" (due 25 February 2022), and "Technologies for Wave Energy Extraction" (due 25 February 2022).

Ocean Engineering is accepting submissions for Special Issues on "Hybrid Numerical Modelling in Wave-Structure Interactions" (due 15 February 2022) and "Safety, Reliability and Risk Analysis of Modern Marine Power and Energy Systems" (due 20 February 2022).

The *Journal of Marine Science and Engineering* is accepting submissions for several Special Issues, including "Advancements in Marine Renewable Energy and Renewable Powered Marine Vehicles" (due 20 February 2022), "Renewable Energy Applications: Wind turbines, Marine Current Turbines, Hybrid Generation Systems, and Smart Grids" (due 15 March 2022), and "Recent Advances in Wave Energy Resource Assessment" (due 20 March 2022).

Funding & Testing Opportunities

The Selkie project has teamed up with the Lir-National Ocean Test Facility in Ireland to provide a free tank testing opportunity to Irish and Welsh wave and tidal energy developers within the Selkie Network. Applications are available here and are due 31 January 2022.

The Horizon Europe Framework Programme has launched two funding opportunities titled, "Next generation of renewable energy technologies" and "Innovative foundations, floating substructures and connection systems for floating PV and ocean energy devices". Proposals for both are due 23 February 2022.

The Oceanic Platform of the Canary Islands (PLOCAN) recently announced the launch of its Winter Access Call for the use of its facilities and services by public research groups and by the private sector, both national and international communities. Applications are due 20 March 2022.

Student/Employment Opportunities

The University of Oxford is seeking a full-time Departmental Lecturer in Fluid Mechanics for Offshore Renewable Energy to join the Civil Engineering research group at the Department of Engineering Science. Applications are due 21 January 2022.

The European Marine Energy Centre (EMEC) is looking for a Project Manager to manage projects across EMEC's project portfolio, ranging from tidal, wave, hydrogen, offshore wind, and/or integrated energy systems. Applications are due 24 January 2022.

The University of the Highlands and Islands is seeking interdisciplinary candidates for a fully-funded PhD studentship focused on the impacts of floating offshore wind infrastructure on the distribution and behaviour of fish and marine mammals. Applications are due 31 January 2022.

IMDC is looking for an experienced Marine Engineer to lead its "Blue Energy" Product in the management, technical execution, training of junior engineers, and quality assurance of its growing project portfolio. Applications are due 5 February 2022.

Upcoming Events

Upcoming Webinar

Sandia National Laboratories' Water Power Program is hosting a webinar on the Wave Energy Converter Design Optimization Toolbox (WecOptTool) on 7 February 2022 from 11:00am-12:30pm EST (4:00-5:30pm UTC). WecOptTool is an open-source software for conducting optimization studies of wave energy converters and their control strategies. The webinar will cover basic concepts for WecOptTool and introduce the new Python package. Register here.

Upcoming Summit

The International Energy Agency Ocean Energy Systems (IEA-OES) is hosting a Funders' Summit: Adoption of the IEA-OES Evaluation and Guidance Framework for Ocean Energy Technology on 26 January 2022 at 7:30am UTC (register here) and 4:00pm UTC (register here).

Upcoming Conferences

The Supergen Offshore Renewable Energy (ORE) Hub is hosting the 4th Supergen ORE Hub Annual Assembly on 18-20 January 2022 in Plymouth, UK and online. To accompany the event, the Hub is also hosting an Early Career Researcher Forum on 18 January 2022. Register for free.

The American Geophysical Union, the Association for the Sciences of Limnology and Oceanography, and The Oceanography Society are co-hosting the 2022 Ocean Sciences Meeting from 27 February to 4 March 2022 online. Register here.

The Advanced Research Projects Agency–Energy (ARPA-E) is hosting the ARPA-E Energy Innovation Summit on 14-16 March 2022 in Denver, US. The Summit is an annual conference and technology showcase that brings together experts from different technical disciplines to think about America's energy challenges in new and innovative ways. Register here.

New Documents on *Tethys Engineering*

Mapping a blue energy future for British Columbia: Creating a holistic framework for tidal stream energy development in remote coastal communities – Richardson et al. 2022

> This study develops and implements an interdisciplinary framework to provide a holistic examination of the potential for tidal stream turbines (TST) to displace diesel generated electricity in remote coastal First Nations communities in British Columbia. In doing so it seeks to answer the following research questions: what is the distribution of practical tidal resources in the study region, for which communities is tidal energy a potentially viable electricity source, and what are the benefits and challenges of TST development. GIS Multi-Criteria Decision Analysis and interviews with high level marine spatial planning decision makers are used to identify practical resource sites, bridge knowledge gaps, assess views towards TST development, and understand the desired characteristics of community energy systems.

Evaluation of a few wave energy converters for the Indian shelf seas based on available wave power – Amrutha & Kumar 2022

> The energy resource assessment at a location is crucial for designing wave energy projects. However, there is a divergence in wave energy converter (WEC) design due to diversity in wave climate, energy availability, and conversion methodology. Optimizing devices for different wave climates is essential since low risk, low variability, and moderate energy resources are attractive. This paper examines the location-wise wave characteristics with energy resource evaluation and the performance of a few WECs in the Indian shelf sea using the WAVEWATCH III model output data for 26 years (1990–2015). The annual mean wave power at 25–30 m water depth at the 20 stations varies from 1.49 kW/m to 11.79 kW/m. From offshore to nearshore waters, a large reduction in wave power is observed at a few stations.

Development study of automatic control system for the demonstration plant of ocean thermal energy conversion (OTEC) using sequence controller – Lim et al. 2022

> Based on the success of the demonstration experiment of MW-class Ocean Thermal Energy Conversion (OTEC) in East Sea, Korea, OTEC technology is expected to spread in the future. In order for this to happen, technology improvement factors, such as minimizing human error and reducing operating costs through automatic start and stop for stable operation, are to be applied. In this paper, the operation performance of a 20 kW-class pilot model for the automated start and stop of the recently demonstrated MW-class OTEC served as the basis for the scenario. The scenario derived from the operation experiment of the 20 kW-class pilot plant established the starting conditions of the surface water and deep water seawater inflow conditions with maximum flow conditions of 1,864 kg/s and 1,507 kg/s, respectively, at the initial start-up of the MW-class OTEC.

Numerical Performance Model for Tensioned Mooring Tidal Turbine Operating in Combined Wave-Current Sea States – Fu & Johnstone 2021

This study proposes the design of a tidal turbine station keeping system based on the adoption of a tensioned mooring system. Damping is introduced to investigate its effect on the reduction in the peak load experienced by tidal turbines during their operational lives in high-energy wave–current environments. A neutrally buoyant turbine is supported using a tensioned cable-based mooring system, where tension is introduced using a buoy fully submersed in water. The loads on the turbine rotor blades and buoy are calculated using a wave and current-coupled model. A modelling algorithm is proposed based on inverted pendulums, which respond to various sea state conditions, to study the behaviour of the system as well as the loads on blades.

Optimal control of wave energy converters with non-integer order performance indices: A dynamic programming approach – Mahmoodi et al. 2021

In this paper, a fundamental theoretical framework of a control strategy is presented for wave energy converters (WECs) in a closed-loop configuration. The problem is translated to the optimal control, based on the Hamilton-Jacobi-Bellman (HJB) theory that some generalized semi-quadratic value functions are used as the stage cost within the performance index. The performance index is introduced as much as possible in the general quadratic form based on a non-integer order integral of the Riemann-Liouville form whose kernel plays as a tuning factor of the resultant optimal controller. Optimizing several compromising requirements in the presence of penalty on the final situation of the WEC is our main effort during which, based on the optimal control theory, a set of rigorous mathematical conditions have been derived for the optimal control law.

Nanoparticle enhanced salinity-gradient osmotic energy conversion under photothermal effect – Ren et al. 2022

Nanofluidic osmotic energy conversion is an attractive technique to directly convert salinity-gradient energy into electricity. However, the power density of osmotic energy conversion is still relatively low due to the insufficient ion selective transport in nanofluidic channel, limiting its development towards practical applications. We present a nanoparticle enhanced ion selective transport in nanofluidic channel due to the consolidated space charge density via electric double layer of nanoparticles. When a 10% volume fraction of nanoparticles are suspended inside nanofluidic channel, the theoretical osmotic output power under 50-fold salinity-gradient is improved by 43.1%. The current work paves a promising route for consolidating salinity-gradient osmotic energy conversion through suspending nanoparticles under photothermal effect.

News & Press Releases

EC-OG supplies Halo intelligent battery system for world-first autonomous offshore power trials in Hawaii – EC-OG

EC-OG, a specialist in intelligent energy management and storage technologies for the energy industry, has achieved a significant company milestone with the first commercial delivery of its Halo subsea battery storage system. The lithium-ion based device will be part of a world-first autonomous offshore power sea trial in Q1 2022 at the US Navy Wave Energy Test Site, off the coast of the Hawaiian island of Oahu. Aberdeen-based EC-OG's Halo system will be integrated into the sea trial in which Columbia Power Technologies, Inc. (C-Power), a leader in ocean energy systems, will demonstrate its Autonomous Offshore Power System in partnership with the US Department of Energy, as well as companies such as Saab, BioSonics and Franatech.

Eco Wave Power and Ocean Power Technologies Announce Collaboration to Propel Wave Energy to the Next Level – Eco Wave Power

Eco Wave Power and Ocean Power Technologies (OPT), two publicly traded wave energy companies, recently announced they are working to utilize their complementary technologies and skills to accelerate wave energy projects pursuant to an agreement previously signed. The companies will work together on several fronts, including knowledge sharing, joint grant submissions, and collaborative assistance in entry to new markets. In addition, joint solutions can be developed utilizing each company's respective offshore and onshore technologies and leveraging OPT's offshore engineering and newly acquired robotics capabilities in Eco Wave Power's applicable projects.

Sabella wraps tests on next-gen tidal turbine blades – Offshore Energy

French tidal energy company Sabella has performed 'successful' tests on the next generation tidal turbine blades as part of the RealTide project. Sabella has developed and tested a new design of the turbine blade which integrates optimised materials like fiberglass and carbon fiber mix, which allows a reduction in manufacturing costs by 10% while increasing the breaking load by 35%, the company said. Analysis of the tests carried out on a first prototype blade in early 2021 had made it possible to determine the sequence of damage that led to the failure. The researchers tested the blade's structural integrity by applying a force of up to 60 tonnes – equivalent to the weight of 60 cars.

Spotlight on VALID user cases: IDOM's Wave Energy Converter – VALID (Verification through Accelerated testing Leading to Improved wave energy Designs) Project

The cornerstone of the Horizon 2020 VALID project is its three user cases, against which the methodology and associated hybrid testing infrastructure will be validated. In this three-part series, VALID breaks down the different wave energy devices used and their role in the VALID project. Electric generator failure, a crucial issue of wave energy devices, is the focus of VALID User Case II. Using IDOM's floating device, the Mutriku fixed Oscillating Water Columns pilot plant and TECNALIA's test rig facilities, the VALID project aims to further understand and evaluate failures in generators and power electronics that operate about 20% of the time over nominal power.

New generation turns to tidal energy using high tech – Offshore Energy

An all-female team of ‘hackers’ was declared the winner of the national technology contest – set up by the University of Florida and IBM – for their work on tidal energy and its positive contribution to the fight against climate change. The team, Gator Gulf Energy – comprised of three current University of Florida students and a recent graduate – will be awarded a $30,000 grand prize. The team focused on tidal energy, and conducted a study that called for the installation of 10 tidal turbines off the coast of Jacksonville. They found that as many as 4,000 homes could be powered by tidal energy per year. Additionally, using the 10 turbines to power those homes could offset as much as 3,500 metric tons of carbon dioxide emissions per year, the team concluded.