TETHYS ENGINEERING BLAST

18 November 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

WPTO Projects Map

The U.S. Department of Energy's (DOE) Water Power Technologies Office (WPTO) supports marine energy innovation with strategic investments in early-stage research. To learn more about the WPTO research and development portfolio, visit the interactive WPTO Projects Map.

ORISE Applications

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

SULI & CCI Applications

The U.S. DOE Office of Science is now accepting applications for the Science Undergraduate Laboratory Internships (SULI) program and the Community College Internships (CCI) program. Interns will work directly with national laboratory scientists and engineers that support the DOE mission. The application deadline is 10 January 2023.

FOSTWIN Control 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.

Calls for Abstracts

The Call for Abstracts for OCEANS 2023 Limerick Conference & Exhibition is now open through 20 December 2022. The event will take place on 5-8 June 2023 in Limerick, Ireland.

The Call for Abstracts for the 15th European Wave and Tidal Energy Conference Series (EWTEC 2023) is now open through 28 January 2023. Full papers will be due 27 May 2023. EWTEC will take place on 3-7 September 2023 in Bilbao, Spain.

Funding & Testing Opportunities

The U.S. DOE'S WPTO has released a $10.3 million funding opportunity, "Marine Energy Systems Innovation at Sea", to accelerate the development and testing of marine energy technologies with a focus on wave and ocean current. Concept papers are due 2 December 2022.

ProtoAtlantic is now accepting applications for the ProtoAtlantic Customized Scale Start-Ups Support Program at the Lir-National Ocean Test Facility in Ireland. The program will provide free facilities access to marine technology (wave, wind, tidal, floating solar, biotechnology, robotics) developers across the Atlantic Area. Applications are due 23 December 2022.

The U.S. DOE has opened applications for the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) Program, which offers grants to small businesses to support technological innovation. WPTO is hosting an informational webinar from 2:00-3:00pm EST (7:00-8:00pm UTC) on 1 December 2022 to provide information on water-power-focused topics. Letters of intent are due 3 January and applications are due 21 February 2023.

The European Commission has launched two new Calls for Proposals under the European Maritime, Fisheries and Aquaculture Fund aimed at supporting careers and regional projects for a sustainable blue economy in European Union sea basins. Proposals are due 31 January 2023.

Student & Employment Opportunities

European Marine Energy Centre (EMEC) is seeking a Commercial Manager to identify, secure and manage new commercial opportunities to support the long term growth of the company. Applications are due 25 November 2022.

University of Southampton is offering a PhD opportunity to develop efficient deep water anchoring systems for floating offshore renewable energy infrastructure. Applications are due 9 December 2022.

The Institute for Cyber-Physical Infrastructure and Energy at Lehigh University is inviting applications for a tenure-track Assistant Professor in Coastal Infrastructure and Energy to begin August 2023. Applications are due 31 December 2022.

Upcoming Events

Upcoming Webinar

The U.S. DOE WPTO is hosting a webinar from 2:00-3:00pm EST (7:00-8:00pm UTC) on 1 December 2022 to provide information on the water-power-focused topics and subtopics in the SBIR/ STTR programs Phase I Release 2 for Fiscal Year 2023. Register here.

Upcoming Conferences

The Marine Renewables Canada 2022 Annual Conference will take place from 22-24 November 2022 in Halifax, Nova Scotia. Register here.

Offshore Energy Exhibition & Conference 2022 will take place 29-30 November 2022 in Amsterdam, The Netherlands. Register here.

New Documents on *Tethys Engineering*

An approach for evaluating the stochastic behaviour of wave energy converters – Avila et al. 2022

> Due to their random nature, obtaining reliable models that can describe the behaviour of waves is far from simple. This paper presents an approach for forecasting the capabilities of wave energy converters (WECs) for two points, one of them located offshore and the other nearshore. Bivariate Weibull distributions were fitted from spectral significant wave height and mean peak period data. Then, models relating the parameters of these distributions to the day of the year were obtained using mixture density networks, which give the distribution of the predicted variables instead of their expected value. Energy conversion capabilities were forecasted by generating a set of random values for the bivariate Weibull coefficients from the modelled distributions for the period in question.

A low-order wake interaction modeling framework for the performance of ocean current turbines under turbulent conditions – Razi et al. 2022

> Understanding the effects of ambient turbulence (expressed often in terms of the turbulence intensity I_t) is critical to the development of predictive models for the

performance of Ocean Current Turbine (OCTs). This paper describes a new, wake interaction modeling framework capable of capturing the detailed effects of turbulence on various performance parameters associated with OCTs that may be arranged in any arbitrary configuration. The model accounts for the effects of turbulence on the structure of the turbine wakes, specifically the extents of near- and far-wake regions, and the dependence of the transition point between the two regions on I_t. The analytical description for turbine wake is combined with an existing wake interaction model to predict the global power output from an array of OCTs.

Structural analysis of low pressure steam turbine rotor for Open Cycle Ocean Thermal Energy Conversion (OC-OTEC) based desalination plant – Majumdar et al. 2022

India being a tropical country, has a large ocean thermal gradient available throughout the year that can be utilized to extract energy. This energy can be used to power a Low-temperature thermal desalination plant using the Ocean Thermal Energy Conversion (OTEC) method. OTEC works at a very low pressure, and developing a low-pressure turbine for OTEC is very challenging. The turbine needs to be designed to produce maximum power while maintaining its structural integrity to make the system self-sustaining. Finite Element Analysis was carried out for a single rotor blade and the complete rotor in ANSYS Workbench to ascertain its strength. The paper presents the static analysis of a single turbine blade and static and modal analysis of rotor assembly.

Recent advances in ocean energy harvesting based on triboelectric nanogenerators – Song et al. 2022

Triboelectric nanogenerators (TENG) have emerged as a promising new source of ocean energy, and it has shown significant technical advantages in applying low-frequency ocean energy-efficient harvesting. The self-driven energy system based on TENG has been successfully used in the ocean Internet of Things and distributed sensor systems, and breakthroughs have been made in integrating research and development with traditional electromagnetic power generation systems. In this paper, we systematically review the latest developments in ocean energy harvesting with TENG and analyze and summarize the principle, structure, efficiency, and performance of various types of TENG ocean energy harvesting systems, and the present challenges and development trends of TENG in ocean energy collection and application are also pointed out.

Analysis and Design of Monopile Foundations for Offshore Wind and Tidal Turbine Structures – Nasab et al. 2022

This paper aims to design an integrated offshore structure capable of supporting a hybrid assembly of one wind plus two tidal turbines. The monopile has been found to be a suitable foundation type as the most inexpensive solution in water depths of less than 30 m. The Cook Strait in New Zealand is an ideal location for wind and tidal renewable energy sources due to its strong winds and tidal currents. Finite element analysis was performed to determine the displacement of the structure for different types of soils using OPTUM G3. After that, a macro-element model for soil was represented, considering the

monopile as a Euler–Bernoulli beam model. The results enable the finding of optimum dimensions of monopiles with allowable tilt and deflection.

Importance of nanochannels shape on blue energy generation in soft nanochannels – Dartoommi et al. 2022

Using water sources of different concentrations is one of the newest methods of energy production. Due to the energy of mixing fluids, two fluids of different concentrations on both sides of a nanochannel membrane can produce energy. Given the costs and restrictions of studying complex systems experimentally, simulation is required to investigate their behavior and determine the best states. As a result, using an energy production strategy, this work explores the effect of nanochannel shape on the ion transfer behavior. Asymmetric (bullet, trumpet, cigarette, hourglass, and hill) and symmetric (cylindrical) geometries were utilized. The effects of different geometries, soft layer density, and concentration ratio on energy production considering the effect of ion partitioning in soft surfaces was investigated.

News & Press Releases

Sin Mao Group and Wello to deploy 12 MW wave energy park in Taiwan – Wello

Wello and the Taiwanese Sin Mao Group have signed a contract on deploying a wave energy array of 12 MW in Taiwan. Furthermore, the two companies have signed an agreement for Sin Mao Group to act as a distributor of Wello's technology in Taiwan. Wello is the leading wave energy technology provider in the world presently working on several sites together with their customers and partners worldwide. Wello's unique wave energy technology is based on gyrating asymmetric floating device with the rotational power conversion unit safely constructed inside the steel hull. Wello is cooperating and partnering with established strong offshore technology providers to be able to respond efficiently to the rapidly growing demand at the global market.

SeaRAY autonomous offshore power system set for final journey to Hawaii – Offshore Energy

US-based marine energy company C-Power has prepared its SeaRAY autonomous offshore power system (AOPS) for shipping to Hawaii, where it will undergo a demonstration at US Navy's wave energy test site. C-Power's 2kW SeaRAY AOPS is currently en route from Oregon to San Diego, where it will be loaded into the Hawaii-bound ship for its final destination at US Navy's Wave Energy Test Site (WETS). Once in Hawaii, SeaRAY AOPS will be dropped in the water at the Navy's docks to undergo a few system checks and tests, after which it will be loaded onto a vessel and deployed at WETS. In Hawaii, project partners, including Saab, one of the world-leading companies in electric underwater robotics, the National Oceanic and Atmospheric Administration, and BioSonics, will pair the SeaRAY AOPS with their electronics, which collect data on methane and carbon levels, fish activity, and more.

Who Will Win the Race to Generate Electricity From Ocean Tides? – The New York Times

> The Bay of Fundy, off the Canadian provinces of Nova Scotia and New Brunswick, has long tantalized and frustrated engineers hoping to harness its record-setting 50-foot high tide to generate electricity. After more than a century of attempts, there has only been one small power-generating station, since closed, and countless broken dreams, abandoned plans and bankruptcies. Even so, a new coalition of entrepreneurs and scientists in Nova Scotia are trying again. One participant, a company called Sustainable Marine, has devised a new technology and successfully operated it for more than seven months, longer than any other similar system, producing enough electricity for about 250 homes. Sustainable Marine is one of five racing to produce a viable method of electrical generation in the Bay of Fundy and, it hopes, in dozens of tidal regions in the world.

Oscilla Power's Triton Wave Energy System Named a 2022 TIME Best Invention – GlobeNewswire

> Oscilla Power has had their 'Triton' grid-scale ocean wave energy converter named as one of TIME's Best Inventions for 2022. The company is aiming to make its Triton wave energy converter (WEC) the first ocean wave energy system ever to produce power at a levelized cost that is on par with other forms of clean power generation. Oscilla Power's wave energy systems are highly efficient and based upon an approach known as a "multi-mode point absorber." This consists of a geometrically optimized surface float connected to a submerged ring-shaped, reaction structure that hangs beneath on three tendons. This innovative design moves in all six degrees of freedom when moved by waves (heave, pitch, surge, roll and yaw) enabling it to continuously generate energy.

QED Naval collects over €1.7 million as tidal power picks up pace – Offshore Energy

> QED Naval, a Scotland-based tidal energy company, has secured over €1.7 million of funding with 1,152 investors taking part in its Seedrs crowdfunding campaign. Further investment was provided by Kelvin Capital, whose members have supported the business from an early stage. Scottish Enterprise awarded match funding via its Scottish Co-investment Fund. The injection of capital will enable QED Naval to complete the deployment of its 'pioneering' Subhub tidal platform at its Yarmouth Tidal Test Centre, showcase its yield benefits to the sector, and build towards commercial sales of the platform. Subhub is a patented platform that is said to reduce deployment and maintenance costs by up to 60%, and improves yields by 48%. Using the Subhub platform, tidal energy can be deployed over large distances, installed quickly, cost-effectively, in a single operation, across a wide range of weather conditions.