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Guest Editorial

Special Section on Sustainable and Innovative Use of Emerging Ocean Structural Systems

Near-shore and open-ocean areas offer abundant energy resources. There is an ever-increasing demand to harness these resources in a safe, cost-effective, and sustainable manner. Innovative ocean structural systems can play an important role to meet this demand. Along with advances in engineering design methods and computational power, the development of such structural systems appears to be more efficient than ever before. Still, the design process is nontrivial and often requires physical insights combined with practical considerations. On the one hand, the structural system can be highly complex and may consist of multiple components, some of which require active control. On the other hand, the system can be subjected to extreme environmental loads from wind, waves, and ocean currents, and the structural integrity of the system then becomes a great concern. This Special Section aims to highlight recent efforts in addressing the challenges of next-generation ocean structural systems.

There is a wide range of papers included in this Special Section. One study by Li and co-authors proposes a modular floating structure (MFS) that consists of inner hexagonal tension leg platform modules and outer floating artificial reef modules. Relative motions between adjacent modules of the MFS are utilized by wave energy converters (WECs) in the form of ball connectors. Through dynamic response analysis of this novel modular system, the authors demonstrate its technical feasibility in operational and extreme sea states.

The subject of WECs is further pursued by Husain and co-authors. In their work, important design parameters are studied of a variable-geometry oscillating WEC. This system resembles a paddle pitching about a fixed hinge, and its geometry variation is achieved by opening controllable flaps on the paddle. By numerical simulations in the time domain, the authors gain insights into structural loads and dynamics, power generation, and the design of such systems.

Another study by Ma and co-authors deals with the station-keeping control of an interesting subsea shuttle tanker concept. This tanker was originally proposed for efficient underwater transport of liquid carbon dioxide; ocean currents pose maneuvering challenges during the offloading process. The authors propose and develop a comprehensive maneuvering model and a linear quadratic controller for hovering the tanker in stochastic currents.

Additionally in this Special Section, the concept of using a spar floating wind turbine to power a floating production storage and offloading unit is addressed by Schnepf and co-authors. Through numerical simulations and by comparing the dynamics of the structural systems, insights are provided into the design of suspended power cables. In another study, an improved actuator line method was developed by Fan and co-authors and then used to study the wake characteristics and power performance of two wind turbines in tandem.

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