Wind Energy with Integrated Servo-Control

Floating offshore wind turbines, innovative renewable energy systems

Floating offshore wind turbines are a relatively new technology designed to harness wind energy in deep-water regions where conventional fixed-foundation turbines are impractical. They offer several advantages over fixed foundation counterparts, including access to higher wind speeds and more expansive offshore areas with reduced visual impact on coastal landscapes. These innovative renewable energy systems consist of a floating platform that supports the turbine structures, providing them with a stable foundation against the dynamic forces of wind, waves, and currents. However, despite significant progress, numerous challenges persist due to the inherent complexity of this technology, necessitating the development of new engineering design principles to address them effectively.

Dr. Yong Hoon Lee, assistant professor in Mechanical Engineering, teamed with the National Renewable Energy Laboratory (NREL) and other university collaborators, has initiated work on the development of an open-source toolset named Wind Energy with Integrated Servo-control (WEIS). This project is sponsored by the U.S. Department of Energy Advanced Research Projects Agency-Energy (ARPA-E). Through this research, he aims to provide floating wind turbine designers with a system design toolset incorporating the novel control co-design (CCD) principles and design coupling analysis methodologies he is developing. Unlike the conventional approach that takes the sequential design principle, CCD concurrently tackles physical and control subsystems to achieve radically new optimal designs. However, efficiently formulating correct mathematical design problems remained challenging for large-scale systems, such as floating wind turbines. The system design toolset will aid design engineers in formulating effective CCD problems that allow a more straightforward exploration of design trade-offs and strength of couplings between groups of design variables.

The development of the WEIS toolset holds immense promise for the future of renewable energy. By integrating novel design principles and advanced design coupling analysis methodologies, this toolset has the potential to revolutionize the design processes of floating wind turbine systems. Beyond the value it will provide in solving existing challenges more efficiently, the toolset will open doors to innovation with new design paradigms. With the support of ARPA-E and collaboration across multiple institutes, professor Lee signifies a crucial step towards achieving sustainable and economically viable green energy solutions from abundant offshore wind potentials. As the WEIS toolset becomes readily available to industry professionals, it promises to accelerate the transition toward a sustainable, carbon-free energy future.

For more information on this project, contact Lee at **yhlee@memphis.edu**.

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