

Nov 18, 2021

Controls of Wind Energy Systems: from Turbine, Farm to Offshore Floating



Yaoyu Li

*Professor,
Department of Mechanical
Engineering,
University of Texas at Dallas,
Dallas, Texas*

ABSTRACT:

Wind energy has become a major renewable resource of power generation, for which successful deployment of cost-effective control system development is critical for reducing its levelized cost of energy (LCOE). Primary objectives of wind energy controls include enhancing the efficiency of energy capture and reducing the structural loads. This talk introduces two efforts we have made in wind energy controls: i) model-free control of energy capture for turbine and farm operation, and ii) controls of floating offshore wind turbines with novel actuation devices. For below rated wind speed operation, the primary goal is to enhance energy capture, however, model-based control strategies can be expensive due to the difficulties in model acquisition and wind measurement. Extremum seeking control (ESC) has been explored as a model-free control strategy for such circumstance. We have developed ESC based control strategies for both turbine and farm level operation, with significant improvement in energy capture observed from the turbine-level validation testing on the NREL's CART facility. At the farm level, a nested-loop ESC strategy with delay compensation is developed. For controlling floating offshore wind turbines, a major line of efforts has been development of additional control authorities to meet the challenge of under-actuation due to increased number of degrees of freedom. In the past we have developed the concepts of active vane control, dynamic vibration absorber and active mooring line control with artificial muscle actuations, and simulation-based studies have revealed their promises.

BIOGRAPHY:

Dr. Yaoyu Li is a professor in the Department of Mechanical Engineering at The University of Texas at Dallas (UTD). His primary research interests lie in controls, optimization, modeling and monitoring for renewable energy and energy efficiency, including building HVAC, wind and solar, energy and thermal managements of electrified vehicle, demand response and building/vehicle-to-grid interactions. He has authored and co-authored about 150 journal and conference papers, and eight patents. He received his Ph.D. degree in mechanical engineering from Purdue University in 2004. He was assistant and associate professor in mechanical engineering at University of Wisconsin – Milwaukee from 2004 to 2011, and has been with UTD since 2011. Dr. Li was an associate editor for IEEE/ASME Transactions on Mechatronics, and is now an associate editor for IFAC Mechatronics.