Fusing Simulation Results From Multifidelity Aero-servo-elastic Simulators - Application To Extreme Loads On Wind Turbine

Fusing predictions from multiple simulators in the early stages of the conceptual design of a wind turbine results in reduction in model uncertainty and risk mitigation. Aero-servo-elastic is a term that refers to the coupling of wind inflow, aerodynamics, structural dynamics and controls. Fusing the response data from multiple aero-servo-elastic simulators could provide better predictive ability than using any single simulator. The co-Kriging approach to fuse information from multifidelity aero-servo-elastic simulators is presented. We illustrate the co-Kriging approach to fuse the extreme flapwise bending moment at the blade root of a large wind turbine as a function of wind speed, turbulence and shear exponent in the presence of model uncertainty and non-stationary noise in the output. The extreme responses are obtained by two widely accepted numerical aero-servo-elastic simulators, FAST and BLADED. With limited high-fidelity response samples, the co-Kriging model produced notably accurate prediction of validation data.