Constructing a Reduced Order Model for Wind Turbine Wake Development from Lidar Measurements

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Abstract

The focus of our research is the real-time characterization of the wake behind wind turbines in the setting of a wind farm. We accomplish this through work based on a reduced-order model (ROM). The ROM we use does not require the velocity field to be discretely divergent-free in the discretization of the Navier-Stokes Equation, and it incorporate modes for the pressure fields. The ROM is derived from a snapshot matrix that is generated from a library of simulations that encompass a range of values for certain parameters. These simulations are solved using a fully coupled, fully implicit, second-order accurate method for the primitive variable form of the Navier-Stokes Equations. This method was formed by Elman, Howle, Shadid, and Tuminaro in their 2003 paper. We use the iterative linear solve package Belos with block preconditioning handled via Playa and multi-level preconditioning handled via ML to implement this solving strategy.