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Parameter Calibration in wake effect simulation model with Stochastic Gradient Descent and stratified sampling

Wednesday, 15 September 2021 15:00 (30 minutes)

As the market share of wind energy has been rapidly growing, wake effect analysis is gaining substantial attention in the wind industry. Wake effects represent a wind shade cast by upstream turbines to the downwind direction, resulting in power deficits in downstream turbines. To quantify the aggregated influence of wake effects on a wind farm's power generation, various simulation models have been developed, including Jensen's wake model. These models include parameters that need to be calibrated from field data. Existing calibration methods are based on surrogate models that impute the data under the assumption that physical and/or computer trials are computationally expensive, typically at the design stage. This, however, is not the case where large volumes of data can be collected during the operational stage. Motivated by wind energy applications, we develop a new calibration approach for big data settings without the need for statistical emulators. Specifically, we cast the problem into a stochastic optimization framework and employ stochastic gradient descent to iteratively refine calibration parameters using randomly selected subsets of data. We then propose a stratified sampling scheme that enables choosing more samples from noisy and influential sampling regions and thus, reducing the variance of the estimated gradient for improved convergence

Keywords

stochastic optimization, variance reduction, wind energy

Special/invited session

"QSR/INFORMS" invited session

Primary authors: BYON, Eunshin; Dr LIU, Bingjie (University of Michigan)

Presenter: BYON, Eunshin

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