The power of wind energy and how to use it

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Wind offers an immense, never-ending source of energy that can be successfully harnessed to power all of the things that currently draw energy from nonrenewable resources. But wind frequency varies with weather patterns.

Researchers from North China Electric Power University and North China University of Science and Technology recently developed a model to help predict wind frequency and potential contributions to more traditional energy sources. The scientists published their paper in *IEEE/CAA Journal of Automatica Sinica* (*JAS*).

"Reliable load frequency control is crucial to the operation and design of modern electric power systems," wrote Yi Zhang, a doctoral student at the North China Electric Power University and an author on the paper. "Due to the randomness and intermittence of wind power, the controllability and availability of wind power significantly differs from conventional power generation."

Their method is based on "model predictive control," wherein checkpoints across a power grid can exchange information and adjust accordingly. The researchers decentralized this model, so that a problem in one area could be solved to benefit the entire grid. The computer algorithm predicts the variables that influence the grid (like supply and demand) and applies those constraints for any problem that any part of the system might encounter.

A traditionally controlled grid could, for example, redirect otherwise

unused energy from sleeping citizens to a power-hungry hospital or some other entity that continues to require energy even during typical low-load times. In a decentralized system, like the one modeled by Zhang and her colleagues, the system works the same way, but instead of having to clear the redirection with every checkpoint, the variables are assumed and the action is nearly immediate.

To test their algorithm, the researchers compared the volume output and dependability of a four-part system—four plants sharing responsibility for generating power in different areas—with and without the incorporation of wind power.

In the analysis of a conventional power plant, the researchers found that their model required much less computational time compared to the traditional model predictive control. That's a major advantage, as the computing process is expensive in both time and energy.

When the researchers added the hard-to-predict wind turbines as a source of power in the model, it still worked. According to the scientists, the major flaw is that computational needs will increase to maintain system stability, which cannot be guaranteed in their algorithm.

"Our future work is focused on [pursuing] the implementation of [our algorithm] with guaranteeing stability and feasibility while reducing the computation and communication requirements," Zhang wrote.

More information: Yi Zhang et al, Distributed model predictive load frequency control of multi-area power system with DFIGs, *IEEE/CAA Journal of Automatica Sinica* (2017). DOI: 10.1109/JAS.2017.7510346

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