TRANSFORM
Energy Systems through Game-changing Technology

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MAKING MICROGRIDS MORE STABLE

John Simpson-Porco

In an ideal electrical grid, the frequency and voltage stay constant. However, when you have several sources of power, the variations in the amount of power generated create shifts in voltage and frequency.

In a traditional grid where the electricity flows in a single direction from generator to consumer, that's relatively simple to achieve with a centralized control system of primary and secondary controls.

So-called "droop control" stabilizes voltage and frequency, which is good. However, it also tends to shift the frequency away from the North American standard of 60 Hz — and that can damage the appliances you plug into the grid. That's why conventional grids add secondary control to shift the frequency back to 60 Hz.

It gets a bit more complicated in a microgrid powered by many small-scale and unpredictable energy inputs, such as wind turbines and photovoltaic panels, hooked together in a complex network. Adding droop control to the individual energy sources does stabilize the frequency, synchronizing the system involves brief power losses.

University of Waterloo professor John Simpson-Porco and his colleagues in Sweden believe they have the answer: adding a distributed averaging proportional-integral (DAPI) controller as a second measure of control. Their results show that a DAPI controller can significantly reduce transient power losses, and they have identified the optimal tuning to achieve that reduction.

By offering a simple, "plug-and-play" form of decentralized control, DAPI technology makes micro-grids more stable — and, in the process, makes renewable energy more practical.

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