Scientists propose method to help keep new grid components operational and safe

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The power grid's physical components are continuously improving, with the integration of renewable power sources and advances in physical technology. The software underlying the safe function of the upgraded grid, however, isn't keeping up.

Engineers depend on the software to predict and correct for potential errors to set constraints on the rest of the system. Scientists from Case Western Reserve University in Cleveland, Ohio, have proposed a new way to calculate and correct a particularly critical error in large-scale distribution systems. They published their method in *IEEE/CAA Journal of Automatica Sinica* (JAS), a joint publication of the IEEE and the Chinese Association of Automation.

"We need new methods for calculations of emerging distribution systems to properly model and calculate these systems in faulted conditions," said Luka Strezoski, a doctoral student at Case Western Reserve University and an author on the paper.

In the traditional grid system, the power alternates currents, which can result in a fault if it the current encounters an pathway with no resistance. This short-circuit fault can produce power 30 times the intended rate, which can lead power disruption, equipment damage, and even fire.

"The biggest difference between modern distributed generators and traditional alternating current machines [if a fault occurs]... is that the short-circuit currents of modern distributed generators are controlled, whereas traditional alternating current machines lose their control," Strezoski said. It may sound safer to maintain control, but the difference causes several problems.

Engineers use the current range calculated by a short-circuit computation to set the relay limits for the entire system. The computation used on a traditional system is time-tested as accurate and reliable. The same computation on a distributed generation system, with decentralized power dispersal, introduces high errors with a trickle down effect of miscalculations for the rest of the system.

"The real-time short-circuit computation needs to satisfy two necessary assets: it needs to be fast, and it needs to highly accurate," said Strezoski.

Strezoski and his team simplified an existing algorithm, capable of predicting every potential future and past state of a system and using those states to make real-time operating decisions quickly, and combined it with another algorithm capable of modeling traditional and modern power systems. The proposed method was used in four large-scale simulations, and it was able to accurately optimize the system in 74 milliseconds.

The researchers are now examining how to predict and correct other fault types, as well as developing potential control strategies for emerging distributed energy resources.

More information: Luka V. Strezoski et al, Short-circuit analysis in large-scale distribution systems with high penetration of distributed generators, *IEEE/CAA Journal of Automatica Sinica* (2017). DOI: 10.1109/JAS.2017.7510517

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