New open-source software predicts impacts of extreme events on grids

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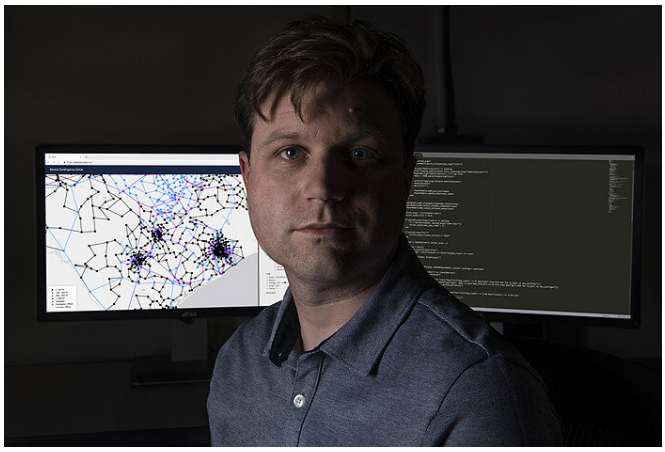

Carleton Coffrin, a computer scientist at Los Alamos National Laboratory, developed the Severe Contingency Solver software to help government agencies better plan for power outages caused by extreme events. The software is now available publicly. Credit: Los Alamos National Laboratory

A new, free, open-source software reliably predicts how damage from hurricanes, ice storms, earthquakes, and other extreme events will restrict power delivery from utility grids. The Severe Contingency Solver for Electric Power Transmission is the only software available—commercially or open-source—that reliably supports analysis of extreme events that cause widespread damage.

"The software was designed specifically to address extreme events where damage to the power grid and the resulting outages are significant," said Carleton Coffrin, a computer scientist at Los Alamos National Laboratory and lead developer of the software. "It can tell users where the greatest outage is expected prior to an event. By offering it as open-source, so it's free and available to the public, we're hoping to help government agencies and grid operators mitigate the devastating effects of extended power outages."

The software determines the maximum amount of power that can be served in a severely damaged grid, subject to real-world operating requirements, such as voltage limits, line flow limits, and generator capability limits. The national cost of sustained power outages is estimated to be $59 billion annually.

The Severe Contingency Solver is the product of hard-earned scientific advances in power grid mathematics that leverages Los Alamos National Laboratory's expertise in physics, mathematics, and computer science. In the past, quantifying the multi-point damage to a power grid depended on extremely complicated calculations simulating the nonlinear physics of the grid—that work involved 100,000 variables and equations. The Los Alamos team created new algorithms making the calculations more reliable and removing the need for human mediation.

This is the first software to reliably, consistently, and accurately analyze extreme-event damage to a power grid—and it is the only software guaranteed to provide a solution for a severely damaged power grid. It runs on a variety of operating systems, including Windows, OS X, and Linux. That way, no matter who the user is, the software can be deployed effortlessly.

The Severe Contingency Solver, which is currently being used by U.S. government agencies, has potentially broader applications. The Los Alamos team is now working on similar solver capabilities in power distribution and gas networks. These new tools will further help network operators and policymakers understand and quantify how multiple critical infrastructures will respond to extreme events where many components are out of service simultaneously. This provides situational awareness beyond commercially available analysis software and helps stakeholders better respond to

extreme events, such as deciding to mobilize FEMA or dispatching additional repair crews from neighboring areas.

More information: Carleton Coffrin et al. Relaxations of AC Maximal Load Delivery for Severe Contingency Analysis, *IEEE Transactions on Power Systems* (2018). DOI: 10.1109/TPWRS.2018.2876507

A PowerModels extension for solving the Maximum Load Delivery problem: github.com/lanl-ansi/PowerModelsMLD.jl

Provided by Los Alamos National Laboratory