New software provides advanced grid simulation capabilities

July 22 2024

ORNL researchers Phani Marthi and Suman Debnath work on developing and scaling up new EMT simulation software to analyze how power electronics in the electric grid will respond to brief interruptions in power flow. Credit: Genevieve Martin/ORNL, U.S. Dept. of Energy

Power companies and electric grid developers turn to simulation tools as

they attempt to understand how modern equipment will be affected by rapidly unfolding events in a complex grid. A challenging and particularly promising type of grid simulation, called electromagnetic transient analysis, or EMT, has the potential to enhance planners' understanding of how modern power electronics will respond when faults interrupt the flow of power. But until recently, EMT grid modeling was so challenging and time-intensive that its utility was limited.

Researchers at the Department of Energy's Oak Ridge National Laboratory have developed effective EMT simulation software using new algorithms to speed up calculations, making expensive supercomputing resources unnecessary. This provides an essential tool for planning, design and operation of the power grid as it incorporates new renewable power generation and electric vehicle chargers.

These resources, as well as battery storage to support the grid, all require a type of power electronics called an inverter, which alters the flow of electrical current to match the larger transmission system. In the long term, inverters will also enable the use of both alternating and direct current in power transmission, which could expand the capacity of the U.S. grid to handle growing population and seize economic development opportunities.

The new ORNL-developed software can currently simulate tens to hundreds of inverter-based resources. The research team demonstrated the benefits of using multicore and graphics processing units, or GPUs, for faster EMT simulation, reducing the time required from days or several hours to minutes. "Using GPUs, we have found we can simulate hundreds of inverter-based resources with tens of thousands of individual inverters," said ORNL researcher Suman Debnath.

ORNL is working with vendors to commercialize the software for use in

community power grids. Meanwhile, the research team is continuing to scale up the platform to enable open-source software simulations of as many as 100,000 inverter-based power electronic devices across the U.S. grid within the coming decade, Debnath said. Electric reliability is enhanced by improving the planning capabilities of utilities as well as developers of substations, solar and wind projects.

Debnath's team of ORNL researchers, working with partner Southern California Edison, conducted one of the first successful fault replications using EMT last year when they accurately reproduced the effects of a 2018 California fault.

The EMT software developments will be presented during an EMT simulation workshop at ORNL on August 12-13 in Knoxville, Tennessee. The workshop, which is also sponsored by DOE and the North American Electric Reliability Corporation, will cover the latest advances in EMT simulation algorithms, testbeds and applications.

ORNL researchers Harry Hughes, Kuan-Chieh Hsu, Phani Marthi, Steven Hahn, Jongchan Choi and Qianxue Xia also contributed to the EMT simulation software, which was created as part of the INTERSECT program.

Provided by Oak Ridge National Laboratory