New innovation in modeling and designing power grids

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You can teach an old dog new tricks—this seems to be true for the research group led by Mengchu Zhou, a distinguished professor of electrical and computer engineering at the New Jersey Institute of Technology. In a recent study published in the *IEEE/CAA Journal of Automatica Sinica*, Zhou uses the Petri net, a mathematical modeling language invented several decades ago by Carl Adam Petri, to analyze and model a microgrid.

Modeling a power grid, specifically a microgrid that incorporates renewable energy sources, is a new problem. According to the U.S. Department of Energy, microgrids are more efficient and are often more environmentally friendly. More importantly, a microgrid can disconnect from the main power grid and function autonomously, rendering it less susceptible to power grid breakdowns and more reliable during emergencies.

Zhou analyzed a microgrid consisting of a wind turbine, photovoltaic cell, battery, and diesel generator. He used the hybrid Petri net (HPN) to model this microgrid to account for both discrete and continuous events. Examples of discrete events include instances when the photovoltaic cell or battery is either turned on or off. Continuous events include the amounts of energy stored in the cell or battery, which are real values that can change continuously over time.

Zhou's modeling illustrates how the microgrid behaves under different conditions, such as strong wind or weak sunlight. Such conditions affect

the ability of the wind turbine and photovoltaic cell to support the microgrid's energy demands, and determine whether the generator should come on or if the battery needs to discharge its energy. This analysis yields data that present a clear picture of various schemes within which the microgrid can operate, as well as their respective outcomes. This information also helps engineers estimate the time and cost required for each grid component to switch its operating state.

Zhou's team is hopeful that HPN modeling can identify the most efficient operational schemes for different microgrids and thus improve microgrid design. He wants to further develop this modeling method to analyze more complex microgrids that can meet our increasing energy demands.

More information: Hybrid Petri Nets for Modeling and Analysis of Microgrid Systems: ieeexplore.ieee.org/stamp/stam … number=7589481&tag=1

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