Project

Demand and storage in electricity networks

Making Sure the Power Grid Does Not Go Out of Synch

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The stability of the power grid is at risk if the share of renewable energies used for electricity production increases in the near future. Researchers at the EPFL have developed software that can offset fluctuations in real time.

The more decentralised energy sources such as photovoltaic systems feed the power grid, the more important it is to offset fluctuations. *Source:* Pixabay

At a glance

- An increase in the share of renewable energies will cause fluctuations in the power grid.
- These fluctuations must be counterbalanced. Researchers at the EPFL have developed software that accomplishes this in real time.
- Among other things, they use buildings as virtual storage capacity to achieve this.

The development of photovoltaics and wind energy is one of the main changes envisioned by the Energy Strategy 2050 for Switzerland's future energy supply. This evolution poses a major challenge for the power grid, especially in regard to the load on the grid.

To date, it has been easy to predict this load: power producers know from experience at what times industry and households require electricity. In addition, energy production from nuclear and hydroelectric power plants is constant and therefore straightforward to calculate and control.

This situation will change dramatically once the planned energy turnaround is launched. Power production from many small, decentralised sources will lead to major fluctuations. Depending on the time of day, the weather and the season, solar and wind power plants will cause massive fluctuations in a power grid that was not designed for such inconstancies.

Balancing fluctuations

A stable network and constant availability of energy therefore call for a whole new range of storage systems. Since feed-in fluctuates hourly, daily and from one season to the next, systems that can store and release energy over periods of time varying between milliseconds and months are required.

In addition, the power grid is becoming more intelligent. The use of so-called smart meters, i.e. devices that can measure and control the energy consumption of appliances and systems, will increase sharply. Equipped with such smart meters, thermal loads such as heat pumps, charging stations for electric cars, photovoltaic modules, fuel cells and batteries can be switched on and off as needed, at points in time that are optimal for the power grid.

This flexibility offers enormous potential when it comes to compensating for the expected fluctuations in the power grid. Connecting the smart meters of whole neighbourhoods, entire cities or all of Switzerland creates a network of electricity consumers that can be controlled in a flexible manner. Depending on energy requirements, any number of devices can be switched on or off by centrally located software.

Real time control

To compensate for the fluctuations and to exploit the potential of smart metering devices, the power flow must be controlled in real time. Researchers working with Professor Jean-Yves Le Boudec (Laboratoire pour les communications informatiques et leurs applications, EPFL) and his colleague, Professor Mario Paolone, (Distributed Electrical Systems Laboratory, EPFL) have developed software that precisely meets these requirements. Using a functional, full-scale network prototype, the researchers were able to demonstrate that their software can react to fluctuations within less than a second and thus adapt the power flow to constantly changing conditions. The software, patent pending, can provide extremely short-term load forecasts and calculate the energy available in photovoltaic systems.

Produkte aus diesem Projekt

- A Multiport Isolated DC-DC Converter
  Date of publication: 18.09.19
- Multiport Resonant DC-DC Converter
  Date of publication: 18.09.19
- Day-ahead promised load as alternative to real- time pricing
  Date of publication: 18.09.19
- Distributed model predictive control of energy systems in microgrids
  Date of publication: 18.09.19
- The swiss potential of model predictive control for building energy systems
  Date of publication: 18.09.19
- Contribution of Model Predictive Control in the Integration of Renewable Energy Sources within the Built Environment
  Date of publication: 18.09.19
- Multi-time scale coordination of complementary resources for the provision of ancillary services
  Date of publication: 18.09.19
- Enhancing the dispatchability of distribution networks through utility-scale batteries and flexible demand
  Date of publication: 18.09.19
- Dispatching active distribution networks through electrochemical storage systems and demand side management
  Date of publication: 18.09.19
- Experimental Implementation of Frequency Regulation Services Using Commercial Buildings
  Date of publication: 18.09.19
- Stochastic MPC for controlling the average constraint violation of periodic linear systems with additive disturbances
  Date of publication: 18.09.19
- Model-based optimization of distributed and renewable energy systems in buildings
  Date of publication: 18.09.19
- Experimental demonstration of buildings providing frequency regulation services in the Swiss market
  Date of publication: 18.09.19
- TEDx Martigny
  Date of publication: 18.09.19

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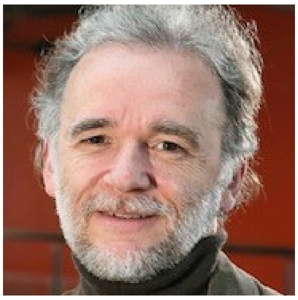

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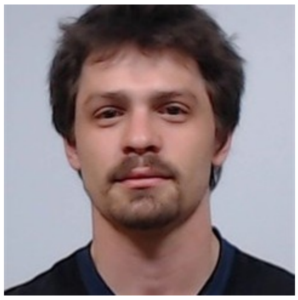

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All information provided on these pages corresponds to the status of knowledge as of 10.05.2019.