TECHNOLOGY OFFER

Guaranteeing operational safety in power grids

Due to the fluctuating power production and periods of peak demand, node potentials and line currents in the power grid can reach critical values which may be inacceptable for grid infrastructure. The proposed hierarchical model-based predictive control proposes optimal consumption constraints to consumers at critical times in order to secure reliability and safety of the power grid.

BACKGROUND

Modern power grids face many challenges ranging from integration of fluctuating power production of renewable energy sources, integration of electrical vehicles, to increased peak-to-average consumption. These issues affect the security, reliability and cost of power grids. Several methods for load management in power grids exist, however they do not take grid topology and distribution infrastructure into account.

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Proposed control architecture is based on the assumption that a certain proportion of the consumers in the grid are able to predict their consumption on a given prediction horizon and incorporate constraints on power consumption when necessary. Also a communication infrastructure between the central unit and consumers is required, and a simplified impedance model of the power grid must be available. The main idea of this invention is that at each time step the central unit calculates the line currents and voltage drops on the prediction horizon based on the obtained consumer predictions and historical data. When the grid constraints are violated, the controller formulates an MPC optimization problem and calculates iteratively optimal constraints for the consumers at the predicted critical time steps.

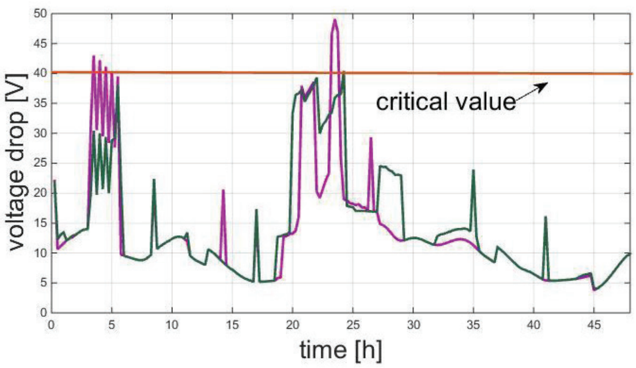

Fig 1. Simulation results: Voltage drop at a critical node on the prediction horizon at first iteration step (purple) and 15th iteration step (green) of the algorithm.

ADVANTAGES

- Reliability and safety of power grid operation
- Peak load reduction at critical nodes
- Low communication requirements
- Controller respects the autonomy of the consumers and it does not prescribe their consumption trajectories
- Non-compliant behaviour of consumers is considered
- Method can easily be adapted to changes in the power grid

POTENTIAL APPLICATIONS

- Critical load alleviation in existing and future power grids (smart grids)
- Maintaining voltage drops and line currents in their allowed ranges

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REFERENCE:
M058/14

KEYWORDS:
- smart grid
- power grid
- operation safety
- load control
- hierarchical controller

DEVELOPMENT STATUS:
Effectiveness and convergence of the method are verified in simulations on an existing urban electric grid

IPR:
European patent application filed

OPTIONS:
- R&D cooperation
- license agreement

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