Scalable and Safe Control Synthesis for Systems with Symmetries

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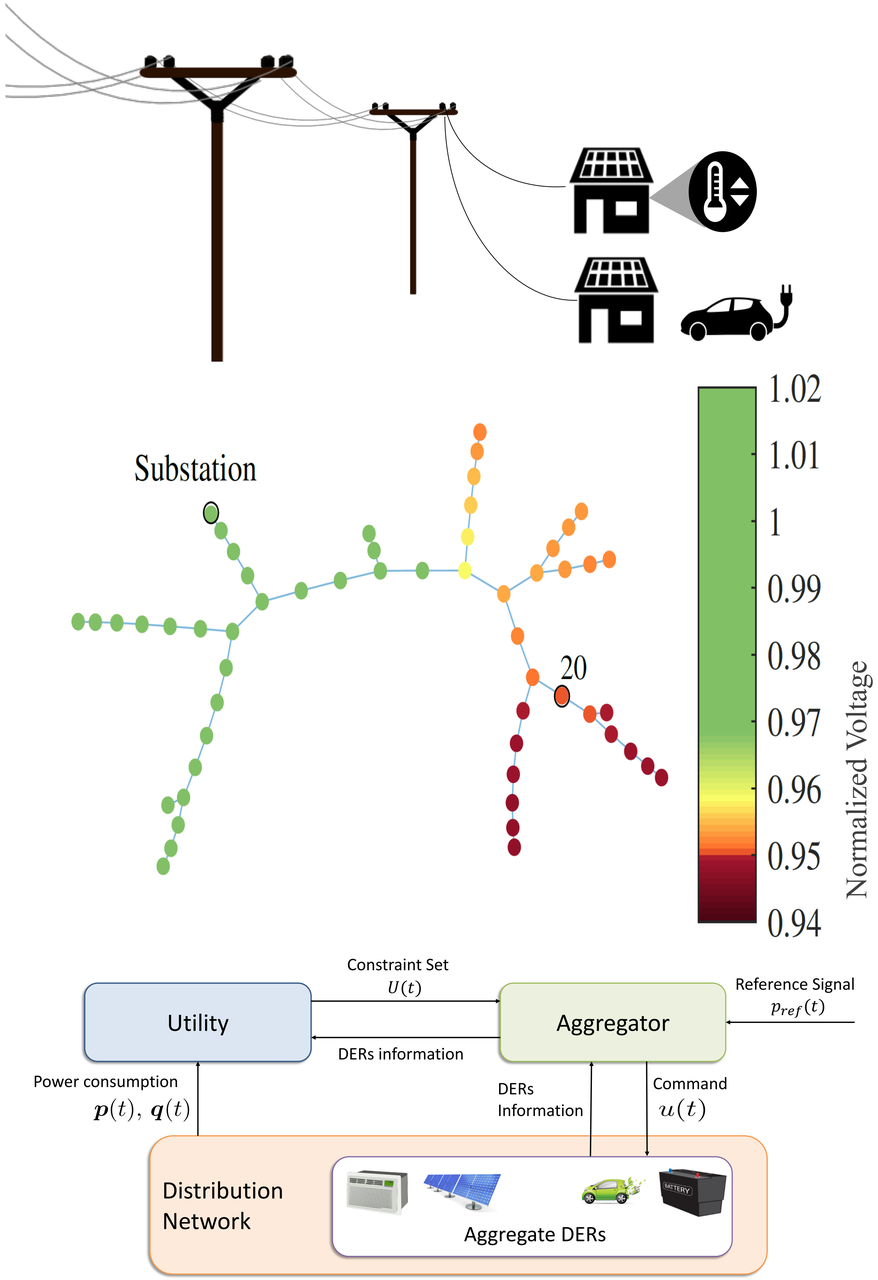
Challenge:

- Many complex engineered systems require scalable methods for ensuring safe operation
  - **Large collection**: Thousands of electrical loads (e.g., electric vehicles and air conditioners)
  - **Common objective**: Collective power consumption is coordinated to help balance supply and demand of energy on transmission network
  - **Safety constraints**:
    - Each load has constraints (e.g., temperature)
    - Groups of loads have collective constraints that ensure safe operation of distribution network

Solution:

- Coordination strategy between an aggregator and a utility that satisfies the chance-constraints on the network safety while providing balancing service.
- A framework without heavy communication requirements and privacy invasion.



Scientific Impact:

- This work provides an applicable network-safe coordination scheme for a network without enough infrastructure for communication.
- The proposed approach can be extended to leverage any other types of DERs, such as electrical vehicles, and solar photovoltaics.
- The proposed solution uses sampling to avoid heavy computation and conservatism that are common in the approaches with safety guarantee.

Broader Impact:

- Improve the grid's ability to host higher percentages of renewable energy generation
- Support third-party aggregators' and residential customers' ability to participate in wholesale electricity markets
- Educate next generation of CPS workforce
- Collaboration with Michigan utility DTE Energy

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