

# Cyber Vulnerability Assessment of 5G-Based Distributed Control for Microgrids

Ardavan Mohammadhassani and Ali Mehrizi-Sani  
The Bradley Department of Electrical and Computer Engineering  
Virginia Polytechnic Institute and State University



INTERNATIONAL  
**Microgrid**  
SYMPOSIUMS

The 16th Annual Symposium on Microgrids  
November 2022

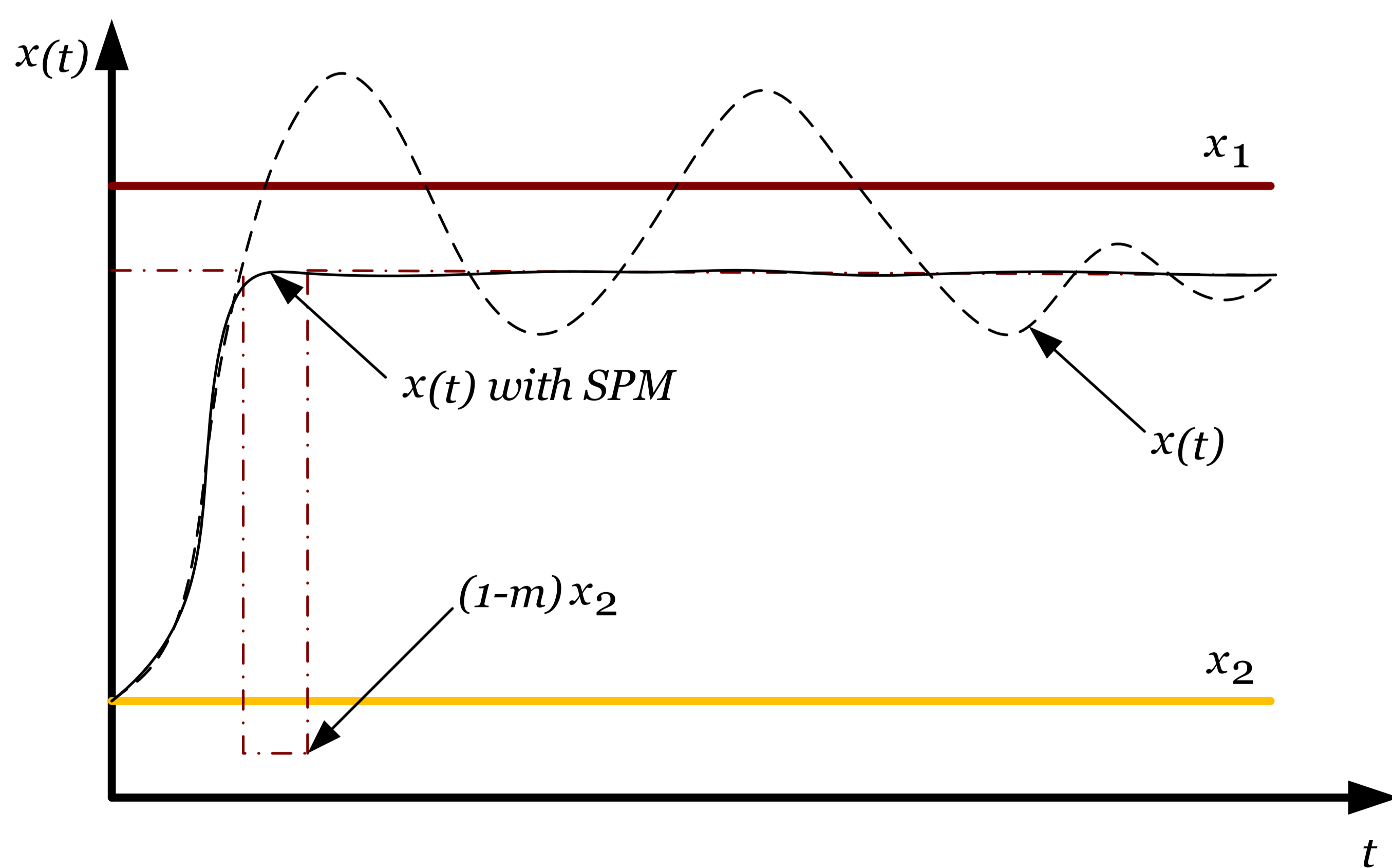
This work is supported in part by the National Science Foundation (NSF) under awards ECCS-1953198 and ECCS-1953213, in part by the Commonwealth Cyber Initiative ([www.cyberinitiative.org](http://www.cyberinitiative.org)), and in part by the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE) under the Solar Energy Technologies Office Award Number 38637. The views expressed herein do not necessarily represent the views of the U.S. Department of Energy or the United States Government.

## Distributed vs Centralized Control

- Centralized control of microgrids may not function properly when the number of inverter-based resources (IBR) is large due to increased computational burden and frequent redesign requirements.
- Distributed control may improve system response but needs the the right communication technology.

## 5G-Enabled Coordinated Set Point Modulation

- Set point modulation (SPM) improves the output of a controller by modifying its set point in the transient stage.

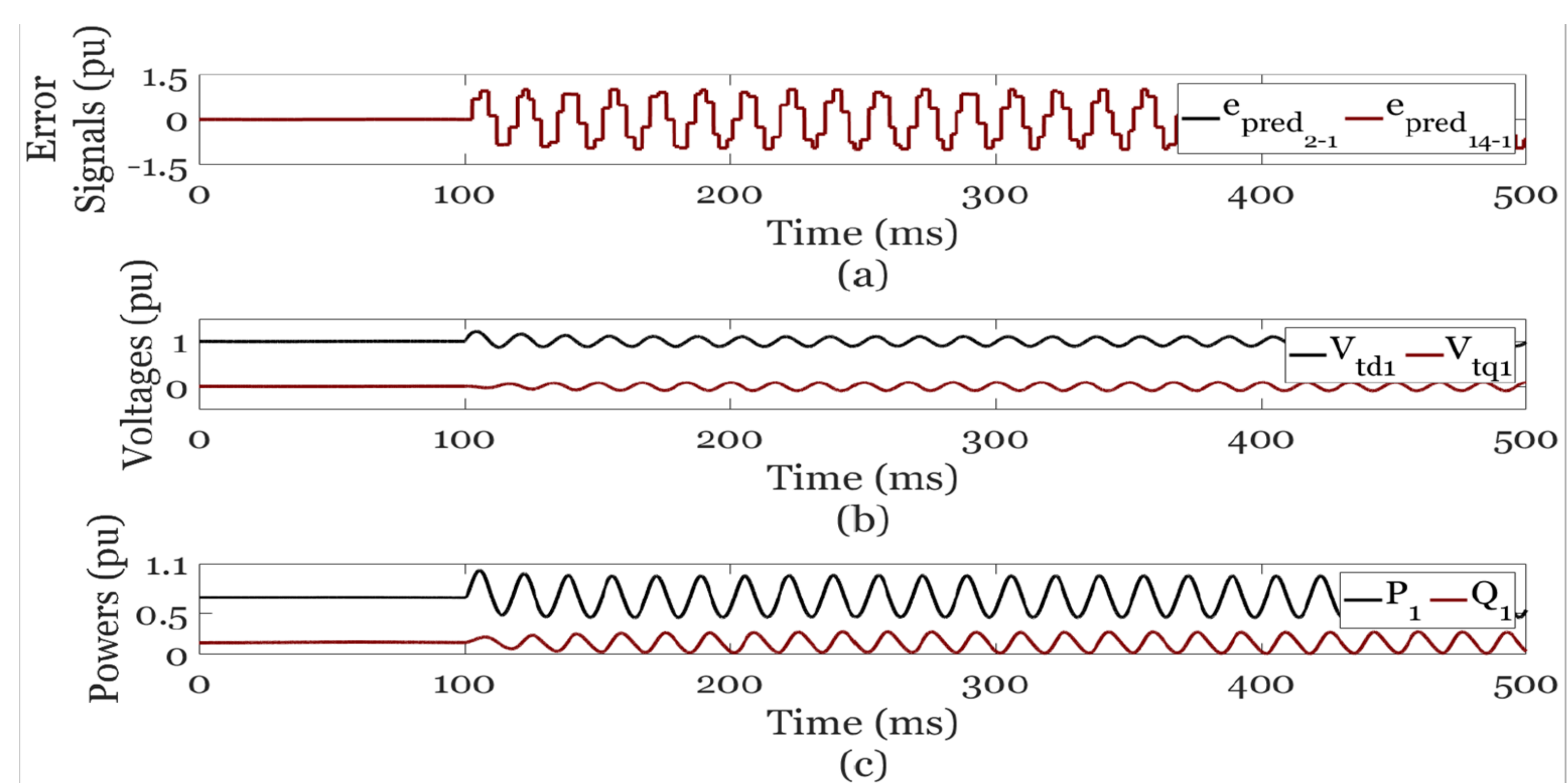


Sample IBR response with and without SPM.

- 5G-enabled coordinated set point modulation (CSPM) modulates the voltage set point by exchanging controller tracking error between IBRs via 5G communication.

## Cyber Vulnerabilities Assessment

- Manipulation of error values via false data injection (FDI) attacks can destabilize the microgrid via loss of consensus.
- Denial-of-service (DoS) attacks on IBRs can lead to their disconnection from the microgrid and cause system-wide disturbances.



Effect of an FDI attack on a single IBR: voltages and powers become oscillatory and unstable.

## Proposed Solutions

- Utilizing the capability of 5G mobile edge computing: This technology can be used to create a centralized measurement unit to provide observability and design tools for attack detection and mitigation.
- Phase retrieval: Reconstruction of communicated signals using autocorrelation measurements and cross-correlation measurements with a local signal can be used to eliminate an uncorrelated falsified injection.