

# Hierarchical Distributed Voltage Control for Active Distribution Networks with PVCs Based on DMPC and ADMM

Guangda Xu<sup>1</sup>, Liang Liu<sup>1</sup>, Yi Lu<sup>1</sup>, Yuan Zhao<sup>1</sup>, Yu Li<sup>1</sup>, and Jing Gao<sup>1</sup>

<sup>1</sup>State Grid Jibei Electric Power Research Institute (North China Electric Power Research Institute Co., Ltd)

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## Abstract

This paper proposes a hierarchical distributed voltage control (HDVC) scheme for active distribution networks (ADNs) with high penetration of photovoltaics based on distributed model predictive control (DMPC) and alternating direction method of multipliers (ADMM). The reactive power outputs of several photovoltaic clusters (PVCs) and photovoltaic (PV) units within each PVC are optimally coordinated to keep PV terminal voltages and the voltages of all critical buses of ADNs within the feasible range and mitigate voltage fluctuations. In the ADN layer, a distributed reactive power control scheme based on DMPC is designed for the PVC, which regulates the voltages of all critical buses to be closed to the rated value and mitigates the reactive power variations. In the PVC layer, the reactive power outputs of PV units are optimized based on ADMM to minimize the voltage deviation of each PV terminal and track the reactive power reference from the PVC control. The proposed HDVC scheme requires communication only between neighboring PVC controller, while each PV controller only communicates with the corresponding PVC controller. This regulates the voltages in a completely decentralized manner and effectively reduces the computation burden of the PVC and PV controllers. A modified Finnish distribution network with 10 PVCs was used to validate the control performance of the proposed HDVC scheme.

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