Real-Time Local Volt/VAR Control Under External Disturbances with High PV Penetration
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Volt/var control (VVC) of smart PV inverter is becoming one of the most popular solutions to address the voltage challenges associated with high PV penetration. This work focuses on the local droop VVC recommended by the grid integration standards IEEE1547, rule21 and addresses their major challenges i.e. appropriate parameters selection under changing conditions, and the control being vulnerable to instability (or voltage oscillations) and significant steady state error (SSE). This is achieved by proposing a two-layer local real-time adaptive VVC that has two major features i.e. a) it is able to ensure both low SSE and control stability simultaneously without compromising either; and b) it dynamically adapts its parameters to ensure good performance in a wide range of external disturbances such as sudden cloud cover, cloud intermittency, and substation voltage changes. A theoretical analysis and convergence proof of the proposed control is also discussed. The proposed control is implementation friendly as it fits well within the integration standard framework and depends only on the local bus information. The performance is compared with the existing droop VVC methods in several scenarios on a large unbalanced 3-phase feeder with detailed secondary side modeling.