**Abstract of Ph.D. Thesis**
**"Design and Control of Grid-Interactive EV Charging Architecture under Multiple Grid Non-Idealities"**
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## Abstract

Advanced regulatory frameworks aimed at curbing CO2 emissions, coupled with supportive policies worldwide promoting sustainable transportation, have led to a notable increase in the adoption of electric vehicle fleets. A growing preference for fast charging, facilitated by high-density batteries, underscores the necessity for a robust charging infrastructure and specialized control architecture to ensure optimal charging power quality, particularly during peak hour demand. However, the proliferation of EV fleets and unregulated charging units poses a significant challenge to distribution utilities, potentially impacting other connected DC and AC ancillary services. To address this concern, it is crucial to explore cleaner and renewable energy sources integration into the grid. Recent literature surveys suggest that without integrating renewable energy sources and reinforcing the grid, clusters of EV charging loads may overwhelm the grid, leading to significant congestion.

Issues such as fast charging, peak-hour charging, grid stability, and converter non-linearity further complicate voltage regulation. In response, multi-objective energy management strategies and grid integration offer promising avenues to reduce grid dependency. Coordinated energy management and voltage regulation leveraging various auxiliary energy resources can help maintain utility power quality during high-power EV charging operations. The integration of renewable infrastructures with the grid and their standalone operations have proven beneficial for distribution operators in ensuring healthy utility power quality during periods of peak demand. The current thesis offers a comprehensive examination of existing technologies and proposed controllers and topologies for EV charging operations. Typically, EV chargers connect to the grid power via both on-board chargers and off-board charging stations to extend a four-quadrant charging mode, facilitating vehicle-to-grid and grid-to-vehicle operations.