A Model Predictive Control Framework for Combining Energy Arbitrage and Power Quality Applications From Energy Storage Systems

Ujjwol Tamrakar[1], Niranjan Bhujel[1], Tu Nguyen[1], Raymond Byrne[1], Babu Chalamala[1]

[1]Sandia National Laboratories

Energy storage systems (ESSs) are a flexible resource that will be vital to meet ensure a secure and reliable energy grid. However, the economic gains from ESSs can be limited due to large capital investments and monetization challenges. It is thus desirable to utilize ESSs for multiple techno-economic benefits to justify deployment costs. In this work, a framework to simultaneously dispatch ESSs for energy arbitrage and power quality applications is presented. More specifically, a model predictive control (MPC)-based framework that can dispatch energy storage to accomplish multiple techno-economic objectives is proposed. This is achieved without impacting market revenues while satisfying all power system and ESS constraints. Simulation results indicate that power quality applications such as voltage regulation and power factor correction can be stacked with arbitrage without significantly impacting arbitrage revenues and in some cases even improving the revenues. A controller-hardware-in-the-loop (CHIL) study of the proposed framework is also performed to demonstrate the practical feasibility of the framework.

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