Comparison between Synthetic Inertia and Fast Frequency Containment Control Based on Single Phase EVs in a Microgrid

The increasing share of distributed and inertia-less resources entails an upsurge in balancing and system stabilisation services. In particular, the displacement of conventional generation reduces the available rotational inertia in the power system, leading to high interest in synthetic inertia solutions. The objective of this paper is twofold: first, it aims to implement and validate fast frequency control and synthetic (virtual) inertia control, employing single phase electric vehicles as flexibility resources. Second, it proposes a trade-off analysis between the two controllers. The interdependency between frequency containment and synthetic inertia control on the transient frequency variation is shown analytically. The capabilities and limits of series produced EVs in providing such services are investigated, first on a simulation based approach and subsequently by using real hardware. The results show that fast frequency control can improve the transient frequency behaviour. However, both on the simulation and on the experimental level, the implementation of synthetic inertia control is more challenging. In fact, due its derivative nature and the system dynamics, its performance is limited. Furthermore, the crucial importance of the EVs’ response time for both controllers is highlighted.