Direct Power Control Design for Charging Electric Vehicles: A Passivity-Based Control Approach

Abstract

This paper explores the controller's design for charging batteries for electric vehicle applications using the direct power representation of the system. These controllers' design is made via passivity-based control (PBC) theory by considering the open-loop port-Hamiltonian representation of the converter. The usage of PBC theory allows designing controllers for closed-loop operation, guaranteeing stability operation in the sense of Lyapunov. Two different PBC methods are explored in this contribution; these are i) interconnection and damping assignment PBC, and ii) proportional-integral design. These methods work over the system's incremental model for reaching a control law that ensures asymptotic stability. Numerical validations show that both controllers allow controlling active and reactive power independently in four-quadrants. This is important due to allow using batteries as dynamic energy compensators if it is needed. All the simulations are conducted in MATLAB simulink via SymPowerSystems library.