Reinforcement Learning Based Smart Grid Control of an 8MVA Microgrid Operated in Grid Tied and Island Modes

Abstract

This work will focus on improving the control schemes for a 0.6 kV Microgrid that is supplying power to a dynamically changing load operating in grid-tied and islanded modes. The control scheme uses a Reinforcement Learning (RL) Agent trained using Proximal-Policy Optimization (PPO) and optimizes the system by implementing Maximum Power Point Tracking (MPPT) of a Photovoltaic (PV) system, controlling the charging/discharging of a Battery Energy Storage System (BESS), and adaptively tunes the Proportional-Integral (PI) parameters of the PV system, BESS, and Wind Energy Conversion System. The results were compared to classical methods for MPPT using Perturb and Observe (P&O), and non-adaptive PI parameters, the RL agent was able to efficiently optimize the power flow, increase voltage stability with faster response, and improve the power quality by reducing the total harmonic distortions to stay within safe values below 0.05.

Keywords— Distributed Energy Resources, Microgrids, MATLAB Simulink, Reinforcement Learning, Adaptive PI Control