ABSTRACT

The stability of a power system heavily relies on the performance of its generators, which serve as the primary energy sources. Thus, effective control of synchronous generators is crucial in maintaining system stability. This study focuses on analyzing the control dynamics of a Single Machine Infinite Bus (SMIB) system, where a single generator is connected to a large distribution network, and the grid's external voltage and frequency are assumed to be constant. In this research, the controller's output is utilized to adjust the gain of the Power System Stabilizer (PSS) in response to disturbances, thereby ensuring robust control against various disruptions. Past studies have utilized Reinforcement Learning (RL) algorithms like Deep Q-Network (DQN) for discrete actions and Deep Deterministic Policy Gradient (DDPG) for continuous actions. Although coming with its advantages that allow for continuous control signals, DDPG exhibits sensitivity to actions, potentially leading to unstable policies and unreliable estimates, which could hinder convergence. Therefore, to mitigate these drawbacks, the Twin Delayed Deep Deterministic Policy Gradient (TD3) algorithm is used in this study. This study aims to design a learning-based controller for enhancing the stability of SMIB system. Subsequently, the controller's performance will be evaluated under both small and large disturbances, comparing it with Conventional Power System Stabilizer (CPSS) to assess its effectiveness in improving the stability of the SMIB system when facing disturbances. The findings of this research demonstrate that RL-based PSS can significantly enhance system stability against various disturbances.

Keywords : Single Machine Infinite Bus (SMIB), Power System Stability , Reinforcement Learning (RL) , Power System Stabilizer (PSS) , Twin Delayed Deep Deterministic Policy Gradient (TD3)