

Abstract

In this paper, the design and implementation of a model reference adaptive control (MRAC) applied to a three-phase three-level boost-type Vienna rectifier are presented. The proposed adaptive controllers are designed for inner loops, targeting to balance partial output DC bus voltages, while maintaining unity power factor and minimum AC line currents harmonics. The dqo nonlinear multiple-input multiple-output (MIMO) state space model of the rectifier is first over-parameterized. Then, the controllers are designed based on adequate input-to-output linearization and Lyapunov-based parameters adaptation scheme, with a view to track the reference model and compensate the system parametric variations. The outer voltage loop is set consequently, assuming fast inner loops dynamics. The proposed control law is designed in Simulink/Matlab and executed in real-time on a 1.5 kW laboratory prototype using the DS1104 controller board of dSPACE. The experimental results are given under various operating conditions, including steady state operation at different power levels, unbalanced DC load steps, temporary phase loss and - 30% AC supply voltage dip/ swell. The proposed control law ensures low output voltage ripple, minimum AC line-current THD, small overshoots and fast settling times, face to a wide clan of disturbances.