Abstract

This paper analyses the performances of a 1.5 kW three-phase/ level/ switch Vienna rectifier, using quasi-linear, nonlinear and model reference adaptive control laws. For this aim, the three control techniques are experimented in real-time using the DS1104 controller board of dSPACE, then compared based on several criteria: the computational complexity, the sensing efforts, the steady state performances and the converter robustness to severe load/ utility disturbances. The three control techniques are arranged in a multi-loop configuration and are designed with the same philosophy: one inner loop to control the active power transferred to the load, a second one to compensate the reactive power and a third to balance split DC bus voltages. The total DC bus voltage is regulated to its reference value via an outer loop. The obtained experimental results demonstrate that steady state performances are quite similar for the three control techniques, without implying important increase in computational times for nonlinear techniques. It is also proved that the proposed nonlinear methods join the high performance of more sophisticated nonlinear control schemes, and the quite low computational efforts required for linear controllers. Moreover, their practical implementation is rendered very simple using a powerful digital processor, such as dSPACE. Nevertheless, such techniques yield the measurement of the whole converter variables, thus significantly increasing the deployed sensing efforts.

Index Terms— Three-phase/switch/level rectifier, high power factor, low AC current THD, nonlinear systems, real-time control.