A High Accuracy Control of Dual Active Bridge DC-DC Converter Using PSO Online Direct Tuning

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Abstract The dual active bridge (DAB) is amongst the popular DC-DC converter in literature due to its attractive feature such as bidirectional power flow, galvanic isolation and high power density. The conventional proportional-integral (PI) controller is a controller that has been widely used in power electronics field including DAB converter due to its reliability. However, it has less performance especially at the condition that far from the point of tuning**.** This paper proposes an online tuning of phase-shift angle using particle swarm optimization (PSO) algorithm for the 200 kW 20 kHz DAB system. The system is controlled directly by PSO without the existence of PI controller. Simulation has been carried out with the objective to minimize the steady-state error, e_{SS} of the DAB. The DAB performance with the proposed solution is evaluated in terms of e_{SS} by testing the system under various reference voltages at different loads. Comparative analysis between the proposed method and the PI using Ziegler-Nichols (ZN-PI) method performance are presented. In order to validate the simulation results, a hardware-in-the-loop (HIL) experimental circuit is built in Typhoon HIL-402 to verify the steady state performance of the system. The DAB system with proposed method produces higher accuracy by producing smaller e_{SS} as compared to the DAB system with ZN-PI method.

Keywords Dual active bridge · DC-DC converter · Particle swarm optimization · Steady-state error · Accuracy

1 Introduction

The world energy crisis is becoming as a big issue in recent time where the conflict of power supply and power demand is existing, which the demand is always increased

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