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Novel and simplified model representing Current-Output Phase-Shift Full-Bridge DC-DC LCLC Resonant Converter in Arc Welding Application

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Abstract: In this paper, a novel and simplified model representing current-output phase-shift full-bridge DC-DC LCLC resonant converter in arc welding application is thoroughly presented. First, a switched model written in state space representation and featuring a bilinear form is proposed. The latter facilitates the derivation of both the reduced and full order averaged models in continuous conduction mode (ROAM and FOAM). Although the FOAM can be employed in linear or nonlinear control schemes and the derivation of steady state behavior, in this paper the ROAM is considered in designing both voltage mode control and current mode control by using the classical PID and the fractional order PID controllers. Simulation confirms that the switched model, ROAM and FOAM are quite accurate compared to the circuit simulation using SimPowerSystem toolbox of MATLAB/SIMULINK. Results clearly showed that depending on the switching frequency, the proposed topology can be applied either in constant voltage characteristic or dropped characteristic welding machines fulfilling either zero current Switching (ZCS) or zero voltage switching (ZVS). Besides, the fractional order PID controller seems to be more adapted for arc welding application than its traditional version.

Keywords : LCLC resonant converter, switched model, reduced order averaged model, full order averaged model, arc welding, FOPID, IGWO