Title: High-Efficiency Hybrid Three-Level Dual Active Bridge DC/DC Converter

Abstract:

For bidirectional DC/DC converters, dual active full-bridge converters (Dual Active Bridge Converter, DAB) are widely used in high-power occasions such as DC microgrid and electrified transportation power supply system due to their simple structure and flexible control methods. The large return power in the voltage range and the inability to implement soft switching limit the application in a wide voltage range. To solve this problem, the hybrid three-level dual active bridge (H3L-DAB) converter is selected as the research object. Compared with the traditional two-level DAB converter, the three-level bridge arm of H3L-DAB introduces an intermediate level, which adds a degree of freedom of control, thereby controlling the inductor current more flexibly.

The typical three-level structures will be compared, the advantages and disadvantages of three-level converters will be given as well. The basic working principle of the bidirectional hybrid three-level DAB converter will be discussed. On this basis, the working principle of H3L-DAB converter under PWM+phase shift control will be analyzed in detail, the working modes will be divided, several common working modes will be selected, and the working characteristics and soft switching characteristics of the converter will be analyzed.

Then, for the application of hybrid three-level dual active bridge converter in high-voltage input and high-current output scenarios, a multi-objective optimization control strategy will be proposed to comprehensively optimize the modulation strategy and take into account multiple optimization objectives. Specific optimization objectives include: Realize ZVS on the high voltage side; realize ZCS on the high current side; reduce the effective value of the inductor current. Finally, a simulation model and a bunch of experimental results will be given to verify the control strategy.