Discontinuous PWM Modulation Strategy with Circuit-Level Decoupling Concept of Three-Level Neutral-Point Clamped (NPC) Inverter

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A new pulse width modulation (PWM) strategy which is an alternative approach of discontinuous PWM (DPWM) for a three-level neutral point clamped (NPC) inverter is developed and presented in this paper. The proposed PWM scheme not only takes advantage of the special properties available in NPC inverters, but also reduces the switching loss of the inverter along with an inherent neutral point (NP) voltage control. Based on a circuit-level decoupling concept, the NPC inverter can be decoupled into two three-level Buck converters in every defined operating section, and thereby the controller design can be simplified. The salient features of the proposed scheme, as compared with the existing carrier-based DPWM strategies, are: 1) its reduced computational processing time, 2) its capability to balance the DC-link voltage without any additional control and 3) its reduced complexity e.g. only one carrier wave needed for pulse width modulating. Same as a space vector modulation, the maximum modulation index, 1.1547, can be attainable by the proposed scheme. Moreover, compared to conventional continuous sinusoidal pulse width modulation, using this technique here the switching losses of the devices can be reduced by one third. In order to explain the operation of this topology properly, the decoupling principle including the driving signal synthesis and the NP potential variation are analyzed in detail in this paper. Finally the viability and performance of the proposed modulation scheme are shown through simulation and experimental results in a laboratory prototype.

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