

电力电子与电力传动

二极管钳位型单相三电平逆变器空间矢量脉宽调制方法

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摘要: 对单相二极管钳位型对称三电平逆变器和一种新型单相不对称三电平逆变器两种拓扑进行研究, 提出一种适用于这两种拓扑结构的单相三电平逆变器空间矢量脉宽调制(space vector pulse width modulation, SVPWM)方法。该方法将单相空间矢量图分为4个区间, 根据伏秒平衡原理, 利用区间内的两个电压矢量实现对输出参考电压矢量的合成。提出根据负载电流方向和直流侧电容电压偏差的大小, 来调整正负小矢量的作用时间的五段式脉宽调制方法, 实现单相对称三电平逆变器直流侧电容中点电位的精确控制, 减小开关器件的频率。在该调制方法下, 新型不对称逆变器允许开关速度较快的器件和耐压值较高的器件工作在一起, 结合了这些开关器件的特点。对两种单相三电平逆变器进行分析比较, 并在两种拓扑上对本文所提SVPWM方法进行仿真和实验验证。

关键词: 单相三电平 空间电压矢量脉宽调制 电容电压平衡 冗余矢量

Study of SVPWM Method for Single-phase Three-level Diode-clamped Inverter

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Abstract: In this paper, the topology of single-phase neutral-point-clamped (NPC) symmetric and asymmetric three-level inverter were studied, and a space vector pulse width modulation (SVPWM) method was proposed for the two kinds of topology. Based on the proposed method, the single-phase space vector diagram is divided into four regions, and the output reference voltage vector is synthesized by the two voltage vectors of the region according to the volt-second balance principle. The five-stage modulation strategy was proposed to control the neutral point potential balance by modifying the effective time of the positive and negative small vectors, only requiring the information of the direction of the load current and the capacitor voltage. The precise control of midpoint voltage and the lower switch frequency is realized based on the proposed modulation method, the novel asymmetric three-level inverter permits faster devices and high voltage devices operating in synergism, which combining the characteristics of the two switching devices. Comparison with the two kinds of single-phase three-level inverters topology was presented in this paper, and the feasibility of the proposed PWM method has been verified via simulation and experiment results.

Keywords: single-phase three-level space vector pulse width modulation (SVPWM) capacitor voltage balance redundant vectors

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