AN ABSTRACT OF A THESIS

PWM STRATEGIES IN POWER CONVERTERS

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An analytical technique is developed for the determination of the expressions for the modulation signals used in the carrier-based non-sinusoidal and generalized discontinuous PWM modulation (GDPWM) schemes for two-level, three-phase voltage source inverters. The resulting modulation schemes are applicable to inverters generating balanced or unbalanced phase voltages. The results obtained analytically generalize the several expressions for the modulation signals already reported in past literatures. Confirmatory experimental results are provided to illustrate some of the feasible modulation signals.

A novel carrier-based discontinuous pulse-width modulation (PWM) scheme based on a novel Space Vector modulation methodology is developed for four-leg converters. Using the zero sequence voltage component and partitioning the feasible sixteen modes into three separate sets, the expressions for the modulation signals for the discontinuous carrier based PWM scheme are set forth. Significantly, the switching devices can be clamped either to the positive or negative rail for 120 degrees under all operating conditions of unbalanced three-phase voltages; ensuring the reduction of switching losses and the effective switching frequency of the inverters. The discontinuous PWM modulation methodology developed is shown by experimental results to synthesis desirable balanced or unbalanced three-phase voltage sets complements and further clarifies the results of the 3-dimesional Space Vector Modulation scheme (3-D SVM) for four-leg converters reported in the literature. For the continuous carrier based PWM scheme in four legged converters for the indeterminate, defining output voltage equations expressed in terms of the existence functions of the switching devices are solved using an optimization technique.

The modulation scheme for four legged converters are used for the dynamic control of a four legged inverter for regulating the output voltage of a three-phase (balanced, unbalanced or nonlinear) load with a neutral connection using the concept of nonlinear input-output linearization with decoupling. The same technique is applied to a four-leg active power filter used for compensation of the harmonic currents and reactive power on the source side under balanced unbalanced or nonlinear loads. Simulation results using MATLAB/SIMULINK validate the proposed modulation scheme and high performance is achieved by the control scheme adopted.