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A sinusoidal band hysteresis current controller for voltage source AC chopper

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Abstract

Current-controlled voltage source inverters offer substantial advantages in improving motor system dynamics in high performance ac drive systems under field orientation. The controller switches a voltage source inverter (VSI) such that the motor current follows a set of reference current waveforms. Fixed-band hysteresis (FBH) current control has been widely used for the PWM inverter. We want to apply the same controller for the PWM AC chopper. In this paper, a hysteresis controller employing sinusoidal band has been studied and its performance compared with fixed-band current control. The aims of the controllers are to optimize the harmonic content at both the input and output sides, while maintaining acceptable losses in the ac chopper and to control in wide range the fundamental output voltage. Both fixed and sinusoidal band controllers have been simulated and analyzed for a single-phase AC chopper and are easily extended to three-phase systems. Simulation confirmed the advantages and the excellent performance of the modulation method applied for the AC chopper.

Key words: *AC chopper, Input power factor, Distortion factor, PWM, Current controller, Hysteresis*

1. Introduction

The phase angle control (PAC) of ac voltage regulators is extensively employed in many applications such as industrial heating, lighting control, and starting and speed control of induction motors. This technique offers the advantages of simplicity and ability of controlling a large amount of power economically. However, a delayed firing angle causes a discontinuity and significant harmonics in load current, and a lagging power factor also occurs at the ac side even though the load is completely resistive (Bidweihy *et al.*, 1980). There is a PWM AC chopper which solves these problems. Ac choppers or ac voltage regulators have been widely used to obtain a variable AC voltage from a fixed AC source.

These problems can be partially solved by using more advanced control such as symmetrical angle control (SAC) (Revankar *et al.*, 1977), asymmetrical angle control (AAC) (Williams, 1982; Choe *et al.*, 1991; Hong *et al.*, 2004;), and time ratio control of high frequency (TRC), or by introducing a freewheeling path in the power circuit. In development of power semiconductor devices, PWM techniques are increasingly being encouraged and can

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