An optimum PWM technique to maximize the continuity of inverter output

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Abstract

New varied-pulse-width technique (VPW) for a high performance power inverter has been presented in this paper. The VPW technique improves the inverter output voltage in the way to produce an output cycle of a less discontinuity and fewer harmonic contents. In VPW technique, the original pulse-width of an inverter operation is divided into multiple pulses of variable widths per half cycle. The division of an original single-pulse of width (δ) into number of pulses (p) per half cycle produces uniform pulses of width (σ). Increasing the pulse-width for some pulses and decreasing the same amount of width from other pulses, result in variable-width pulses. To maintain the same operation for the inverter, the adding and subtracting of pulse-widths for the pulses must be equivalent. Due to the software ability of modifying the number of pulses per half cycle and their widths, the VPW technique provides an inverter operation with less generation of harmonics. Test results are presented to examine the performance of VPW technique and to compare it with the performance of the conventional methods.

Key Words: PWM inverter, Energy conversion, Power converters, PWM control, power processor.

Symbols

PWM	Pulse-Width Modulation
p	number of pulses per half cycle
A_c	carrier signal amplitude
A_r	reference signal amplitude
δ	original single-pulse per half cycle
σ	uniform pulse width
α	gating angle
v_0	inverter output voltage
Vs	dc- source voltage of the inverter
n	harmonic order
m	modulation index
k	pulse order
σ_k	pulse-width of k^{th} pulse order
MLP	most-left pulse
T_s	half cycle period

1. Introduction

Power electronic systems are used in industry to process and control the flow of electric energy by supplying the voltages and currents in a form that are optimally suited for the loads and providing energy conservation. The inverter is a dc-ac converter that its output voltage can be controlled by varying the conduction time of the power semiconductor switches [1]. The employing of inverters eliminates the throttling and restrictive devices and offer the possibility for significant energy saving [2, 3]. The output of an ideal inverter is a sinusoidal waveform but this is invalid for the practical inverter in which its output is discontinuous and contains harmonics. This discontinuous operation is undesirable for practical applications due to its problems such as extra power losses [4, 5]. The Pulse-Width- Modulation (PWM) inverters convert the constant voltage into a controlled magnitude and frequency output voltage. A discontinuity and harmonic effect appear in the inverter output voltage due to PWM- discontinuity technique [6, 7]. Many schemes for the pulse-width- modulated inverters tried to make the inverter output voltage close to a sinusoidal form as possible. As the inverter output voltage is close to a sine wave as a better output voltage can be obtained with fewer harmonics [8, 9]. In a sinusoidal pulse-width-modulation control, a sinusoidal reference signal is produced and it compares with a triangular carrier signal to generate several pulses per half cycle, in which the width of each pulse is varied depending on its corresponding amplitude of the sinusoidal reference signal [10, 11]. The inverter output voltage along with this technique has little harmonic amplitudes. If the reference signal is taken as a rectangular form, a number of pulses of a uniform width