



Carrier Based PWM Methods For AC/DC/AC and AC/AC Power Conversion Systems

Abstract:

Switch mode power converters such as voltage source inverters/converters (VSI/VSC) are widely employed in most electric energy systems (in AC motor drives in industry, wind turbine and PV systems in renewable energy, in HVAC systems in residential areas, in electric drives of HEV applications, etc.). Operating with fixed DC bus voltage, VSIs provide controlled frequency and voltage output at the AC terminals by means of pulse width modulation (PWM) techniques. Recently reaching the commercialization stage, matrix converters also utilize the PWM techniques. Thus, PWM methods are widely employed in AC/DC/AC or AC/AC switch mode power conversion.

Starting in 1960s and developing rapidly (at the most accelerated pace over the last decade), the carrier based PWM (CB-PWM) techniques have been exclusively researched. With various power converter topologies available and large number of PWM techniques existing, the understanding, selection, and implementation of CB-PWM methods is a significant challenge; a methodical classification, selection, and implementation technique is required. Intended, for intermediate level audience, this tutorial provides the attendant the necessary in depth background on CB-PWM methods for switch mode power converters. The modern power converter topologies utilizing CB-PWM are reviewed, CB-PWM principles reviewed, and then CB-PWM methods are investigated in detail. The methods are classified, their performance characteristics evaluated, and their implementation and application examples are discussed. Attendees can directly apply the knowledge gained to their practical design and implementation problems.

The proposed tutorial is a half day tutorial with approximately 2.5 hours duration and 150 PPT slides and it consists of the four main parts below listed (tutorial outline given at the bottom of this document).

Part 1: Basic Voltage Source Converter Topologies Utilizing PWM

Part 2: The Task and The Location of The PWM Unit in The VSI/VSC of a Power Conversion System

Part 3: PWM Principles, Methods, Performance Characteristics, and Implementation Issues

Part 4: Applications of PWM Methods in Power Converters:

Lead Instructor:

Title: **Professor**

Name: **Seung-Ki Sul**

Affiliation: **Seoul National University, School of Electrical and Computer Engineering**

Street Address: **School of Electrical and Computer Engineering**

City / State / Zip Code: **Seoul, Korea, 151-742**

Telephone / FAX: **+82-2-880-7243, +82-2-878-1452**

E-Mail Address: **sulsk@splaza.snu.ac.kr**

Other Instructors:

Assoc. Prof. Dr. Ahmet M. Hava

Department of Electrical and Electronics Engineering

Middle East Technical University

İnönü Bulvarı, 06531 Ankara, TURKEY

hava@metu.edu.tr

Phone: +90-312-210-2377

Fax: +90-312-210-2304

Instructor Bios

Seung-Ki Sul (S'78, M'87, SM'98, F'00) was born in Korea, in 1958. He received the B.S., M.S., and Ph.D. degrees in electrical engineering from Seoul National University, Seoul, Korea, in 1980, 1983, and 1986,

respectively. From 1986 to 1988, he was an Associate Researcher with the Department of Electrical and Computer Engineering, University of Wisconsin, Madison. From 1988 to 1990, he was a Principal Research Engineer with LG Industrial Systems Company, Korea. Since 1991, he has been a member of faculty of School of the Electrical and Computer Engineering, Seoul National University, where he is currently a Professor. He was promoted as a fellow of IEEE with the contribution to PWM technology. Prof. Sul is one of pioneers in the area of carrier based PWM technology applied to the control of the power converters. He has 84 IEEE journal papers and a total of more than 200 international conference papers in the area of PWM and electric machine control. He was the program chair of IEEE PESC'06. He has been actively involved in various industry projects sponsored by many Korean, Japanese, and American companies. For his sabbatical year from 2003 to 2004, he worked as a director of research center of Yaskawa Electric Company, Japan.

Ahmet M. Hava (S'91, M'98) He received the B.S. degree from Istanbul Technical University, Istanbul, Turkey, in 1987, and the M.Sc. and Ph.D. degrees from the University of Wisconsin, Madison, in 1991 and 1998, respectively, all in electrical engineering. In 1995, he was with Rockwell Automation-Allen Bradley Company, Mequon, Wisconsin, USA, where he conducted research on PWM techniques. From 1997 to 2002, he was with Yaskawa Electric America, Inc, Waukegan, Illinois, USA and he was involved with the development of commercial three-level inverter and matrix converter drives. Since 2002 he has been at the Middle East Technical University, Electrical and Electronics Engineering Department, Ankara, Turkey where he is currently an associate professor. His research interests include power electronics, motor drives, and power quality. Dr. Hava has extensively published on PWM and control methods related to motor drives, active filters, UPS systems, PWM rectifiers, and power conditioners. He has published 16 journal papers and a total of more than 80 papers, most of which cover the PWM techniques on voltage source inverters, matrix converters, and other power converters for industrial applications.