Reducing Torque Ripple Techniques for Five-Phase Motor Drives

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Abstract
As multi-phase (defined as greater than three-phase) motor drives become more popular and practical, new research in this area investigates potential advantages including lower torque ripple and better power density. The added dimensions of a multi-phase machine leads to a completely different operating nature than standard three-phase machines and merits research into new modulation methods. The five-phase and six-phase machines have been traditionally studied in the literature applying voltage-source modulation methods such as sine-triangle modulation and space-vector modulation (SVM) for current harmonic elimination. However, it can be shown physically and mathematically that certain harmonics do not contribute to torque production and therefore the torque is not directly tied to the current wave-shape. A method is proposed to utilize this property to demonstrate a substantial increase in voltage range and a reduction in torque ripple through the use of added voltage harmonics. An analysis of a five-phase motor is presented followed by a range of modulation techniques. It is shown that by proper selection of third, fifth, and seventh harmonics, the required dc voltage can be reduced by eighteen percent and the torque ripple can be reduced by nearly sixty percent over traditional methods at the expense of higher current THD; which may not be a disadvantage in certain applications. Another method introduces a new walking pattern SVM method which frees up the vector and sequence selection.

Biography
Jing Huang received the BSEE degree from Nan Chang University, Nan Chang, China, in 1997 and the M.S.E.E degree from the North China Electrical Power University, Beijing, in 2000. She had been a product research and development engineer in Beijing Sifang Automation Co., Ltd from 2000 to 2003. She got her M.S.E.E degree from the University of Missouri - Rolla in December 2005 where she is now pursuing the Ph.D. degree. Her research interests include multi-level converters, power electronics, electrical machinery, and motor controls.