

# Generation of low-EMI PWM Patterns for Induction Motor Drives with Chaotic Maps

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Electromagnetic radiation of power switches is an intrinsic characteristic of modern power conversion, since electronic converters adopt switching techniques, where the transistors are operated at very high frequencies, from a few kHz to some Mhz. The availability of reliable, fast and efficient power switches has spread the adoption of power inverters in many industrial applications. Among them drives for pump, high performance fan, heating systems, traction, are the most common areas of application. Recently, increasing attention has been focused on the emission of electromagnetic radiation of the converters which are commonly operated at fixed frequency at several amps, depending on the size of the motor. This results in a peak in the current spectrum at the switching frequency, which affects directly the emission of radiations and indirectly acoustic noise and mechanical vibrations.

Aim of this contribution is to demonstrate the feasibility of the application of random chaotic sequences to the generation of PWM patterns for reducing EM emission in induction motor. A comparative analysis between the standard PWM and chaos-based PWM (CB-PWM) generation units is performed in terms of acoustic noise, efficiency and emissions in the simple case of an open loop motor control. In this case, the obtained reduction of the power spectral density peak of the PWM signal is no less than 20dB. Moreover unlike other solution in literature the bandwidth of the CB-PWM spectrum can be tailored in order to be consistent with high dynamics drive control, adjusting the inferior frequency in agreement with the current loop bandwidth.

In this paper the design of CB-PWM for DC/AC converters for electric drives is investigated. A drive prototype was designed which allows the experimental validation of EMI produced in a shielded or anechoic room, and the evaluation of drive performances, from the point of view of torque ripple and efficiency. From theoretical analysis and experiments it is shown that a reduction of

the peak emission around the switching frequency up to 20 dB, without affecting performances.

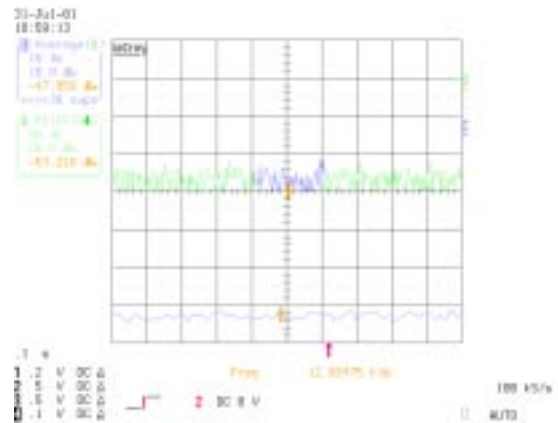


Fig. 1. Motor phase current spectrum with a standard PWM pattern enlarged around the switching frequency, with CB-PWM.

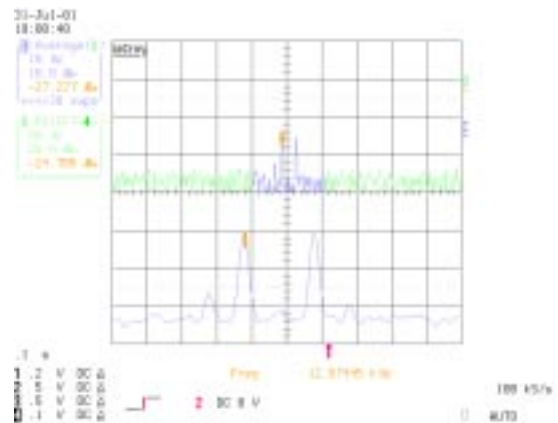


Fig. 2. Motor phase current spectrum with a standard PWM pattern enlarged around the switching frequency, with classical PWM.