Closed-form Calculation of DC link Harmonics

Adam Shea

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1 Introduction

Investigating harmonic contributions of oscillator tolerance (50ppm) would be difficult if not intractable using standard FFT-based methods due to the requirement to simulate seconds of data at MHz sampling rates in order to get acceptable resolution. To cope with this, we compute a closed form of the DC-link current spectral content. DC-link capacitor sizing is driven by the harmonic content of the DC-link current. Usually various standins are used such as ripple voltage or a rule of thumb factor based on converter output current, but these crude methods make significant assumptions based on electrolytic capacitor current handling and standard-3-phase inverter or rectifier topologies. As DC-link capacitor sizing dominates converter size, optimal capacitor choice is important.

2 Teh Maths

Closed form calculation of the harmonics of asymmetrical sine-triangle PWM for a single half-bridge we start by parameterizing the top-side DC-link current as a function of two variables $x = \omega_c t$ and $y = \omega_0 t$ being the carrier and modulation per-unit phase respectively.

This gives us a 2D function of current as shown in **??**. This function can be defined as a piecewise surface Equation 1.

$$I_{ph}(t) = \begin{cases} I_p k \cos(\omega_0 t + \theta_{pf}) & \text{if } 1 + M\cos(\omega_0 t) \leqslant t \leqslant 1 - M\cos(\omega_0 t), \\ 0 & \text{else} \end{cases} \tag{1}$$

2.1 Fourier Integral

We then can calculate the

3 Conclusion

The conclusion goes here.