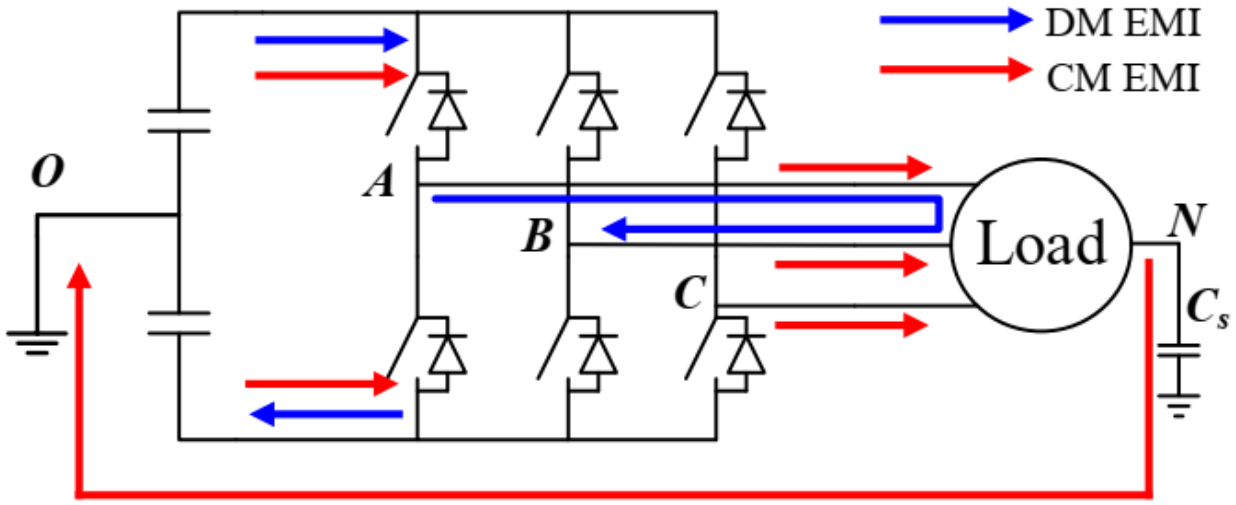
CM EMI reduction in three phase multilevel inverters applied to electrical motor drives through PWM methods

Electric drives have been increasingly adopted in many industrial sectors due to their ability to yield highly controllable, fast response and high-power density systems solutions. However, as the switching frequency and switching speed of power devices and the inverter power continue to increase, the problems posed by Electromagnetic Interference (EMI) in electric drives are exacerbated. EMI has the potential to cause deterioration in the performance of electrical machines and its drive system through a variety of failure mechanisms, including, inter-alia, bearings damage, unexpected actions of power devices, interference on analogue feedback signals, etc. These problems eventually lead to system performance degradation or even shutdown. EMI in electric drives can be classified as conductive EMI and radiated EMI. The conductive EMI is defined with the frequency range from 150 kHz to 30 MHz in standard DO160. Accounting for different conductive paths, conductive EMI can be divided into differential-mode (DM) EMI and common-mode (CM) EMI. DM EMI is caused by the voltage differences between phases and results in conduction between the three phases. CM EMI is caused by the common-mode voltage (CMV), which can be defined as the voltage potential relative to a common reference point. In an inverter-fed motor system, the common reference point can be the earth O. The CMV of each phase is the voltage pulse between the phase input and O, and can be expressed as VAO, VBO, VCO in a three-phase system. The voltage pulses have the same pattern as the driving signal of the upper-leg devices, but their amplitudes can be as high as the VDC. In a traditional three-phase inverter, the average output CMV is defined as the voltage potential between the neutral point N and O and can be expressed as $V_{CM} = (V_{AO} + V_{BO} + V_{CO})/3$. The rapid CM voltage pulses are coupled to the earth through the parasitic components, resulting in high-frequency CM current, and finally produce interference on other components of the system.



This thesis introduces a pulse-width modulation (PWM) technique to reduce common mode voltage (CMV) in multilevel inverters applied to electrical motor drives.