# Bachelor/Master thesis

TECHNISCHE UNIVERSITÄT DARMSTADT

Fachgebiet Elektrische Antriebssysteme

## Investigating the Impact of Motor Type and Dimensions on Common Mode-Mode Impedance

**Background of the topic:**

The trend of using pulse-width modulation (PWM) systems has become a widely adopted technique for controlling the speed and torque of AC motors by varying the frequency and voltage of the power supplied to them. While PWM enhances the performance and efficiency of variable frequency drives (VFDs), it also introduces challenges related to common mode (CM) electromagnetic interferences (EMIs). These CM-EMIs propagate through the electrostatic stray capacitance present in the drive system, leading to undesired shaft voltages and bearing currents within the electric drive system. This impacts the reliability of electric machines and can potentially cause premature machine failure and increased maintenance costs. CM impedance in electric motors is a crucial factor that affects the CM noise level. It provides valuable insights for evaluating and estimating the CM current, which is the source of shaft voltage and bearing currents. The magnitude of CM impedance is influenced by a variety of parameters, including type of motor, winding configurations, geometrical dimensions, grounding configurations and so forth. The aim of this thesis is to study the effect of motor type and geometrical dimension on CM impedance.

**Target and task description:**

In the first step relevant literature on CM EMI in electric drive system will be reviewed and summarized. Next, existing motors in our laboratory will be identified, and geometric dimensions of selected motors will be measured. Based on the measured data, CAD models of the selected motors will be developed, incorporating the accurate geometric dimensions. Following this, 2D/3D finite element (FE) electrostatic simulation of the motors will be carried out using JMAG software. These simulations will focus on determining parasitic capacitances between the stator winding and stator core, between the stator winding and the rotor, and between the inner and outer bearing races**.** To validate the simulation results, practical measurement of CM impedance and parasitic capacitances of the motors must be measured using impedance analyser, covering frequencies from 1kHz up to 10MHz. A comparison will be made between the simulated results and the measured impedance and capacitance values. Finally, conclusions will be drawn regarding the impact of motor type, motor geometry, winding configurations, and grounding practices on the common mode impedance of the motors**.**

**Requirements:** Basic knowledge of electromagnetic field, high frequency modelling. Knowledge of numerical simulation methods and first experience with JMAG simulation software is helpful. Having passed the lecture “Motor development” would be beneficial.

**Appointments and organizations:**


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