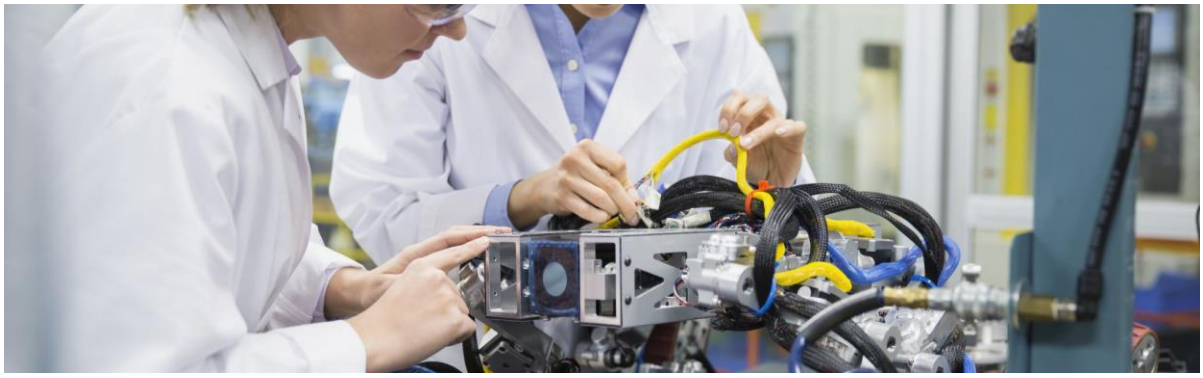

Master's thesis student on "High-Frequency Modelling and Analysis of Electrical Machine"

The current trend in electric drives is to leverage high frequency (HF) enabled by advancements in power semiconductor switches. However, this causes problems like higher voltage peaks due to wave reflections, demanding voltage gradients (dv/dt), and electromagnetic interferences, which could lead to electrical failure if the insulation is not designed to withstand such stresses. Therefore, it is crucial to have an accurate understanding of the machine at high frequency and represent its behaviour in the desired frequency range, in terms of modelling and experimental evidence. Regarding the modelling approach, analytical and numerical methods can be used to model machine response at a high frequency. These HF models can help predict critical phenomena like electromagnetic couplings, leakage currents, voltage stress on the insulation, bearing currents and voltage transients on the machine terminals. As for the experimental approach, voltage reflection measurements can be done, with the possibility of evaluating the turn-to-turn voltage.

Key Accountabilities:

- Conduct literature research on available models for High Frequency modelling of electrical machines from the basis of an already available literature set
- Evaluate applicable methodologies for high-frequency modelling of an electrical machine
- Perform initial assessment using analytical methods
- Further development of the current existing tool in the Simscape Electrical environment in Matlab for Overvoltage and Reflection Factor estimation by either:
    - Developing HF equivalent circuit of an electrical machine winding system and determine relevant parameters, such as leakage inductances and parasitic capacitors
    - Developing HF simulation model in conjunction with power electronic converters using appropriate circuit simulator software
- Study the voltage distribution within the machine and voltage stress on the winding insulation
- Perform analysis of the dv/dt dependent voltage reflection and inter-winding coupling phenomena in the context of electric drive system
- Execution of experimental measurements in-house to validate / correct the developed models
- Document and report results

Qualifications:

- Final year master's student in electrical engineering, physics or related
- Good understanding of electric drive architecture and operation
- Good understanding of electrical circuit analysis
- Experience in MATLAB/Simulink and/or circuit simulators (e.g., PSpice, LTspice, etc.)
- Ideally familiar with electrical laboratory instruments like signal generators, oscilloscopes, measurement probes, impedance analyzer and related
- Strong problem-solving ability
- Self-motivated and able to work independently
- Good command of English, German language skills advantageous

If you are interested, please contact Tadele Lijalem Yirisaw <Email: Tadele.Yirisaw@rolls-royce-electrical.com Mobile: +491725743483> or Dr. Diego Machetti <Email: Diego.Machetti@Rolls-Royce-Electrical.com Mobile: +49 (0)1522 1747131>.