TUM

Opportunities for Talents

Master Thesis

High Efficiency Current Source Rectifier

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Description

A three-phase grid interfaces with an Electric Vehicle (EV) through an AC/DC converter. The rectifier ensures sinusoidal grid currents in phase with the grid voltage, maintaining unity power factor. A subsequent DC/DC stage regulates the output voltage, providing a wide output voltage range. The Current Source Converter (CSC) is a promising choice for the rectifier stage. It minimizes filter volume by reducing the number of magnetic components (DM/CM), enabling high power density. However, it requires 12 semiconductors (six pairs of anti-series connected SiC MOSFETs). With the emergence of bidirectional GaN devices, this number can be halved to six semiconductors, making the topology even more attractive.
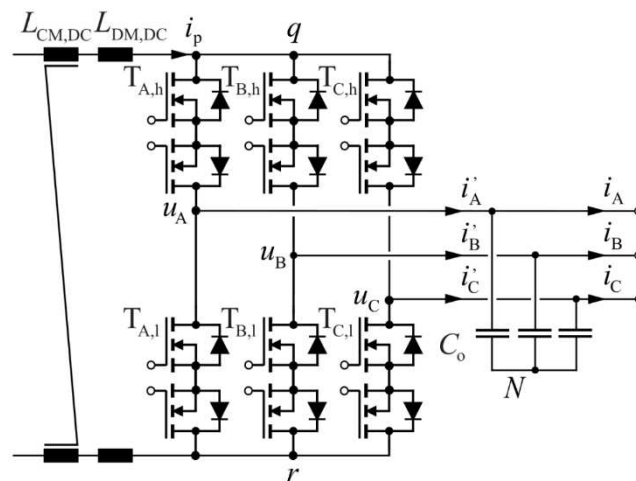
Tasks

- **Literature Review:** Conduct a thorough review of the CSC topology.
- **Theoretical Analysis:** Perform an analysis of the proposed converter, including the derivation of analytical equations. This includes switching loss calculations, magnetics design, and capacitor selection.
- **Circuit Simulations:** Simulate a closed-loop controller aiming for unity power factor on the grid side while controlling the output voltage to the desired level.
- **Pareto Optimization:** Perform Pareto optimization to find the most optimal design.
- **Hardware Prototype Development:** Develop a hardware prototype.
- **Commissioning:** Commission the converter and perform efficiency measurements.

Prerequisites

- Strong understanding of the fundamentals of power electronics.
- Experience in circuit design and simulation using MATLAB and PLECS.
- Some experience with designing passive components, such as inductors and capacitors.
- Basic C programming skills; familiarity with VHDL is a plus.

Contact and further information

- Please attach your CV and the latest study transcript to the application

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