

Development of a Low-Order Lumped-Parameter Thermal Network for an Inductively Electrically Excited Synchronous Machine

For the operation of an inductively electrically excited synchronous machine (iEESM), monitoring the temperature—particularly the rotor temperature, which cannot be measured without significant complexity—is of critical importance. Consequently, a thermal model for such a machine is to be developed. Typically, thermal analysis can be performed using Computational Fluid Dynamics (CFD) or the Finite Element Method (FEM) to solve the heat conduction equation. However, these methods require enormous computational resources, making them unsuitable for real-time monitoring. A suitable alternative for determining the temperatures of critical components is Low Order Lumped-Parameter Thermal Networks (LOLPTN). These networks are based on the idea of simplifying the complex thermal behavior of a system and representing the heat transfer processes through the use of equivalent circuit diagrams. The goal of this work is to implement such a network for real-time capability and to conduct analyses over various load profiles.

Studierenden-Profil:

- Basic knowledge in the field of electrical machines, electrical engineering, and thermodynamics
- ☐ Experience with MATLAB Simulink
- ☐ Experience with FEM (Finite Element Method) is desirable
- ☐ Structured, independent, and thorough work approach

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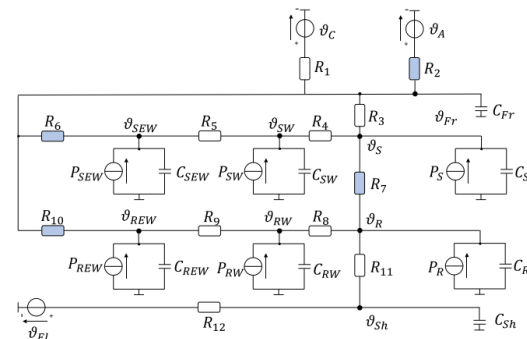


Abb. 1: Example structure of a LPTN for an EESM [1]

Work Packages:

- Familiarization with the topic and relevant literature
- Identification of existing thermal models for EESM/iEESM
- Development of a real-time capable simplified thermal network in MATLAB Simulink
- Parameterization of the network using FEM (Motor-CAD/Comsol) based on suitable algorithms
- Thermal analysis over various load cycles
- (Validation using measurements)
- Detailed and well-organized documentation and code preparation

[1] Wang, Eryang; Grabherr, Philip; Wieske, Peter; Doppelbauer, Martin (2022): A Low-Order Lumped Parameter Thermal Network of Electrically Excited Synchronous Motor for Critical Temperature Estimation. In: 2022 International Conference on Electrical Machines (ICEM). 2022 International Conference on Electrical Machines (ICEM). Valencia, Spain, 05.09.2022 - 08.09.2022: IEEE, S. 1562–1568.