TECHNISCHE UNIVERSITÄT CHEMNITZ

Multiphysics finite element analysis of a partially filled rotating miniature heat pipe

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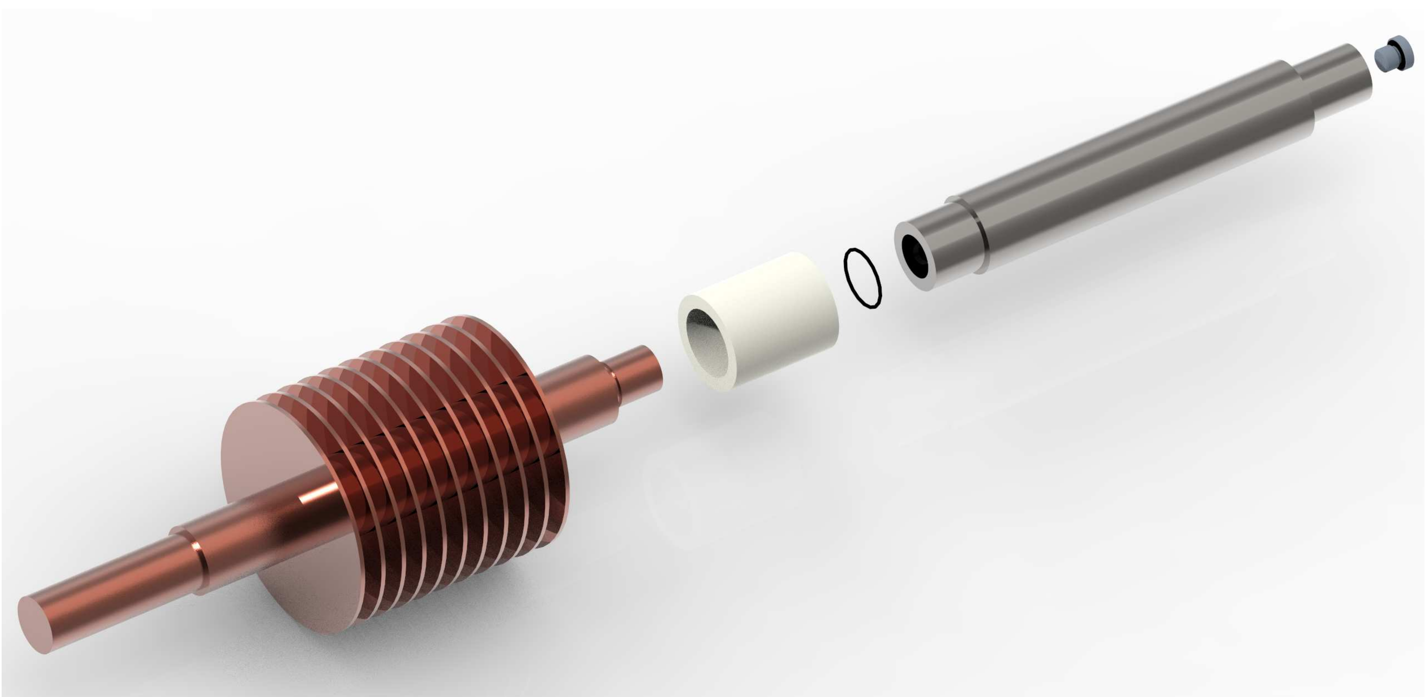
Introduction:

Heat pipes are characterized by their exceptional heat transport capabilities and are commonly used as a cooling system in electronic systems. Nevertheless, the technology is also widely spread in multiple different scientific sectors. A liquid fluid will vaporize at the heat sink and allow a two-phase heat flow inside the pipe. Therefore, the heated gaseous phase will flow to a cooling sink where it eventually condense. The transport to the heat sink will be obtained by varying physical laws. Most heat pipes utilize capillary structures or gravitation to close the heat flow process. Furthermore, a centripetal force of a rotating pipe can achieve identical effects. A conical shaped geometry enables this process. Hence, a more complex, dynamic and flexible utilization of heat pipes in the industry e.g. machine processing or turbine engines could be possible.



Problem definition:

This thesis utilizes a miniature heat pipe model. To optimize the geometry and shape of the pipe setup, a deeper understanding of the mechanical behavior is required. Therefore, this thesis should investigate the theory and application of filled rotating heat pipes. Alongside approximated scientific models, an FE-simulation should examine the characteristics of a partially filled rotating pipe. Therefore, a FE-model has to be implemented in ANSYS. Boundary conditions need to be derived from the setup and implemented realistically. Initially, a modal analysis of the empty pipe should be executed. After recreating the given rig setup in ANSYS, a fluid should be implemented in the simulation. Considering varying fluids and filling levels, the modal behavior of the pipe should be examined. An investigation of thermal effects and fluid flow inside the pipe should be done additionally. Furthermore, a setup for a multibody simulation could be prepared. The preserved results should be discussed objectively. Detailed documentation obtains the crucial steps for simulating heat pipes. Establishing a universal workflow for further investigations would be beneficial. The thesis should fullfill the TMD-requirements by using a given LATEX template. A handcover version has to be submitted within the deadline. A digital version and all required data should be added to allow accurate evaluation.

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