TECHNISCHE UNIVERSITÄT
CHEMNITZ

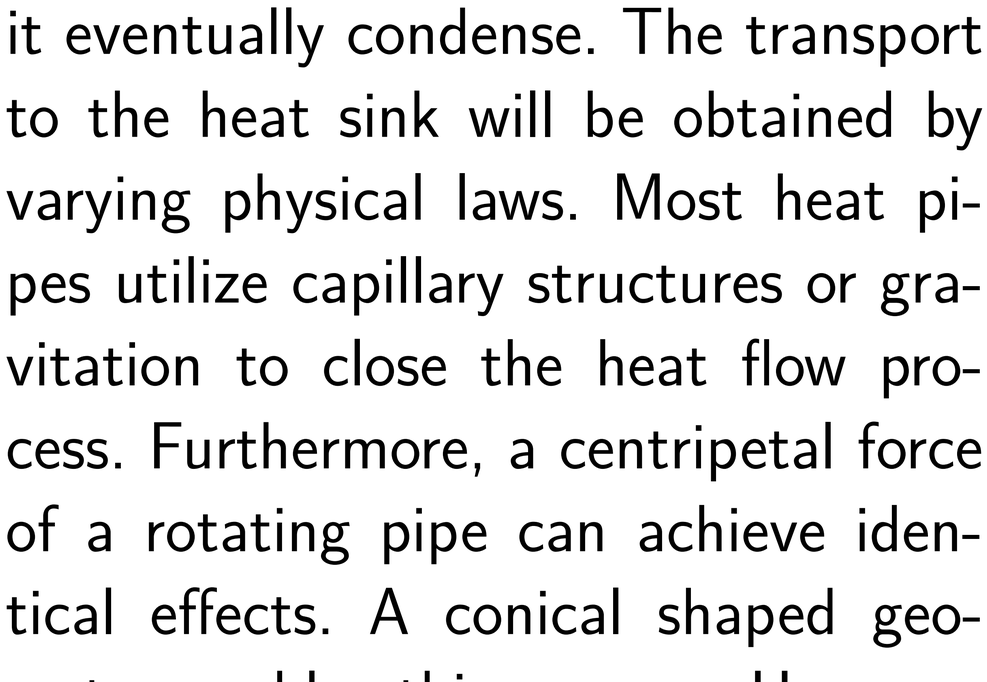
Multiphysics finite element analysis of a partially filled rotating miniature heat pipe

Institut für Mechanik und Thermodynamik

Professur Technische Mechanik/Dynamik

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 should simulate a miniature rotating heat pipe model based on a design proposal (see figure). To optimize the geometry and shape of the pipe setup, first, a deeper understanding of the mechanical behavior should be obtained by modal analyses. Then, the thesis should also investigate the working principle of partially filled rotating heat pipes. Based on the knowledge from semi-analytical models in the literature, the FE-simulations should show the characteristics of a partially filled rotating heat pipe. Therefore, a FE-model of the pipe has to be implemented in a fluid-structure dynamics software. Boundary conditions need to be derived from the test rig setup and to be implemented realistically. Initially, a modal analysis of the empty pipe should be executed. Then, a fluid should be included in the simulation. Considering varying fluids and filling levels, the modal behavior of the filled 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 of the whole test rig could be prepared. A detailed documentation should includes the crucial steps for simulating the heat pipe also with other software. The thesis should fullfill the TMD-requirements by using a given LATEX template. All required data should be added to guarantee future works.

Student: T.B.A.
Supervisors: Francesca Concas, Torsten Buschner
Auditor: Michael Groß