Numerical modeling and analysis of the active magnetic regenerator - DTU Orbit (20/02/2019)

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In this thesis the active magnetic regenerator (AMR) is analyzed using various numerical tools and experimental devices. A 2-dimensional transient numerical model of the AMR is developed and implemented and it is used to investigate the influence of a range of parameters on the performance of the AMR. The model simulates a regenerator made of parallel plates. The operating parameters, such as uid ow rates, thermal utilization, magnetocaloric properties etc. are varied as are geometric properties such as plate and channel thickness, regenerator length and porosity. In this way the performance expressed as temperature span versus cooling power is mapped as a function of the central parameters.

Since regenerators built of several magnetic materials distinguished by their respective magnetic transition temperatures are reported to perform better than single-material AMRs this concept has been investigated using the numerical AMR model. The results show indeed that the performance may be enhanced significantly and it may thus be concluded that the performance of the AMR is dependent on a vast number of parameters (material composition, magnetic eld source, regenerator geometry, regenerator eciency, operating conditions etc.). The results presented in this thesis thus provide an overview of the in uence of many of these parameters on the AMR performance. It is also concluded that the internal eld of an AMR is far from homogeneous. Indeed, it does depend on both regenerator geometry, orientation of the applied eld, the temperature distribution in the material and the material composition. A magnetostatic 3-dimensional model is developed (by the author of this thesis in close collaboration with Mr. D.V. Christensen, Ris DTU). The results from this show that the resulting internal eld in an active regenerator may vary so signicantly that clearly preferable congurations exist and in particular that certain congurations should not be considered. The combination of the model for the internal eld and the transient AMR model has not been fully implemented and the performance impact of the internal eld model remains thus to be investigated. Finally, suggestions for future work are provided based on the knowledge presented here. These include alternative regenerator geometries, a list of physical eects that have not been investigated in terms of their impact on the AMR performance yet etc. Several ready-to-go projects are thus suggested for future work.

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