

# 3D FEM-Simulation of Magnetic Shape Memory Actuators

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## Abstract

The magneto-mechanical behavior of magnetic shape memory alloys (MSM) has been investigated by means of different simulation and modeling approaches by several research groups among others by ETO MAGNETIC GmbH. Based on these approaches, the target of this work is to simulate actuators driven by MSM alloys building a three-dimensional model using COMSOL Multiphysics® software (AC/DC Module). The results are evaluated with measurements and existing 2D FE-simulations of the alloy. For this work an already known magnetic circuit is used to perform these tests. In order to not exceed the limits of this work, only one approach of modeling MSM actuators is described in this paper. The used approach is so far the most accurate but also the most time consuming. The reason is that the results and the magneto-mechanical relations have to be evaluated and reformulated after every simulation step, which is depending on continuously increasing current. This means that every current step needs an isolated static simulation. Reaching acceptable results with 3D FEM-based software like COMSOL would increase efficiency and quality of developing products based on an actuation with magnetic shape memory alloys.

## Reference

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## Figures used in the abstract

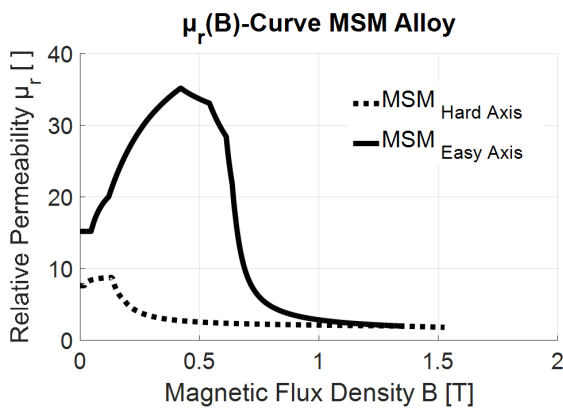


Figure 1:  $\mu$ B-Curve MSM Alloy.

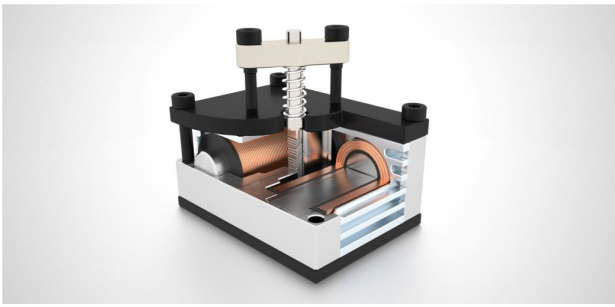


Figure 2: Rendered 3D - CAD - Model of the Actuator.

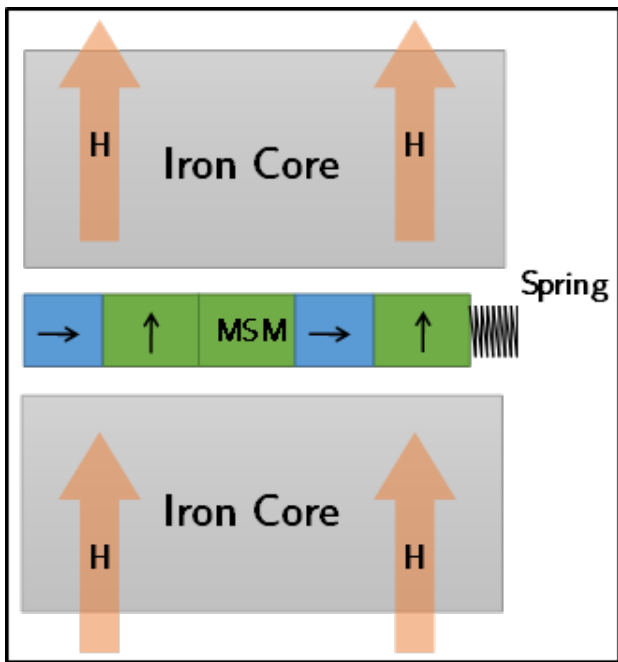


Figure 3: Schematic Sketch of Actuator.

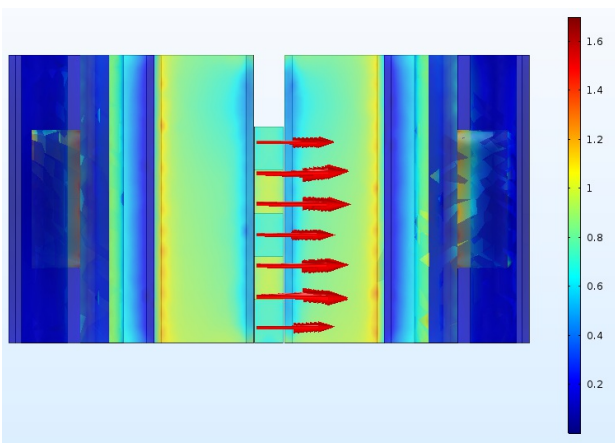


Figure 4: Plot of Flux Density in the Actuator.