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# Computational micro-magneto-mechanics

**Christian Dorn**[1,*] **and Stephan Wulfinghoff**[1]

[1] Kiel University
Institute for Materials Science – Computational Materials Science
Kaiserstr. 2
24143 Kiel
{cdo,swu}@tf.uni-kiel.de
https://www.tf.uni-kiel.de/matwis/cms/en
* presenting author

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Magnetic materials exhibit a challenging multiscale structure. The quantum mechanical origin of magnetism lies on the sub-nanometer scale. Domain walls feature a characteristic length of nanometers and magnetic domains are relevant on the micrometer to millimeter scale. To capture domain phenomena on the microscale correctly it is crucial to resolve underlying domain wall processes on the nanoscale. This multiscale nature of magnetic materials poses the first major challenge of micromagnetics and requires powerful computational tools and sophisticated material modeling.

We formulate a material model within the framework of generalized standard materials which yields thermodynamic consistency. The coupled problem includes magnetization, scalar magnetic potential and displacement degrees of freedom. We formulate the mechanical problem in the small strain setting and assume an additive split of strain into an elastic and a magnetostrictive part. The second major challenge of computational micromagnetics, the restriction of magnetization to the unit sphere, is approached with the exponential map algorithm. Simo et al. [1] applied exponential map to the shell director in shell theory before the idea was used in micromagnetics by Lewis and Nigam [2] and Miehe and Ethiraj [3]. We solve the micro-magneto-mechanically coupled problem using finite element method. We demonstrate our approach with numerical examples.

## REFERENCES

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