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Multi-scale modelling and computational approaches to continua with micro-structure

Adam Sky[1,*], Andreas Warkentin[2,†], Stephan Lange[2]

[1] University of Luxembourg, Luxembourg

[2] University of Kassel, Germany

Micro-structured materials, such as metamaterials or porous media, induce complex kinematical behaviour on the macro scale. This can be traced back to the distortion caused by the mechanics of the underlying micro-structure. As such, their computation is met with the necessity of either modelling the entire geometry of the material, including every micro-cell, or relying on an averaging strategy in order to approximate the overall behaviour. Examples for recent averaging strategies are: the introduction of generalised continua with enriched kinematics , for example in acoustic metamaterials, or the use of multi-scale computational methods, e.g., in polycrystalline ferroelectrics.
Every computational approach presents its own challenges. Completely resolving the underlying geometry is often bound by computational resources. The same holds true for multi-scale methods, where several solution layers with varying refinement are required. Generalised continua approaches encompass the problem of proving well-posedness and thermodynamic consistency of the novel model, as well as constructing appropriate numerical schemes, where the continuity of the newly introduced kinematical fields is correctly addressed.

This minisymposium is dedicated to discussing recent computational approaches to materials with a pronounced micro-structure. Viable topics are (but not limited to):

- Generalised continua approaches for complex and smart materials
- Multi-scale methods for e.g. ferroelectrics and metamaterials
- Advanced modeling approaches to thermo-electro-mechnically coupled material behavior at small and finite strains
- Applications to coupled problems, composite materials, etc.
- IGA, VE- and FE-methods in the computation of metamaterials and porous media
- Computational homogenisation techniques across length scales

Keywords:

- Generalised continua
- Metamaterials
- Porous media
- Smart materials
- Ferroelectrics
- FEM
- IGA

This Minisymposium aims to provide a platform for researchers from the GACM community to present, exchange and discuss ideas and recent developments in this field. The multidisciplinary nature of the Minisymposium encourages contributions from both mathematical and engineering perspectives, as well as from theoretical, computational, and applied perspectives.

*Corresponding author: Adam Sky (✉ adam.sky@uni.lu)
†Corresponding author: Andreas Warkentin (✉ warkentin@uni-kassel.de)