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# Editorial - Recent Fails and Findings of Numerical Methods in Mechanics

The challenging but fascinating field of numerical methods in mechanics combines two disciplines: applied mathematics with the focus on numerical analysis of partial differential equations, and mechanics with the emphasis on phenomena in solid and fluid mechanics. Bringing both together allows to simulate mechanical processes in a robust and reliable way, which makes simulation techniques competitive and successful. Even though rigorous results from a numerical point of view are available for several toy problems, the situation is much less satisfactory for the application to mechanics in experiments. In the light of the aims and scopes of ExCo, the purpose of this special issue is to gather recent contributions that are specific to represent the state-of-the-art failures and findings of numerical methods concerning problems in mechanics.

A typical phenomenon staying in the way of robust numerical approximations is the so-called locking phenomena appearing in linear elasticity when the lamé parameter describing the incompressibility of the parameter tends to infinity (see [1]). Similarly, in poromechanics, the numerical formulation needs to be robust with respect to the system parameters as demonstrated in [2]. This also reflects the fact that different scales often need to be taken into account, as in [3] where the parameters in a monolithic quasi-static phase-field fracture model are very relevant for the quality of the approximation, or as in [4] for the description of phase changes introducing structural transformation of the host lattice and even affecting the lattice symmetry. This occurs, for instance in lithium-ion batteries, for which a space and time adaptive solution algorithm in derived in [5]. In [6] the effect of curved boundaries on the approximation is studied and a special construction leading to optimal convergence rates is provided, while in [7] a geometric multigrid method with multiplicative Schwarz smoothers for the eddy-current problem is designed. The Maxwell equations provide a counter example to underline the complexity of those approaches. Finally, in [8] some pitfalls when solving differential equations with neural networks are discussed, enlightening the reader towards this current hot topic.

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