

Development of algorithmic strategies for numerical simulation of coupled mechanical-diffusion problems based on variational formulations

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Abstract

The aim of the research is the exploration of novel algorithmic strategies for numerical simulation of non-linear strongly coupled mechanics-diffusion problems. The proposed approach is based on a variational formulation which provides a natural framework for coupled problems, with numerical benefits such as efficiency, flexibility and robustness in algorithms overcoming classical results. Through a variational formulation, the solution for a mechanics-diffusion problem can be stated as an optimization process.

The main topics of the research are two. On the one hand, the mathematical formulation of the problem is sought in a variational form. This formulation involves to treat concentration as an internal variable. Moreover, this form of the problem is also exploited to develop different physically-based solution strategies for the coupled problem. On the other hand, a generic solution framework for monolithic approaches is used and delved, exploiting the mathematical structure from the variational formulation. Comparison of the block physically-based preconditioners will be shown against generic block preconditioners for coupled problems. The aforementioned altogether envisions the development and analysis of different algorithmic strategies while dealing with mechanic-diffusion systems, covering from the mathematical formulation of the problem to its solution.

Keywords

Variational formulation, coupled problems, chemo-mechanics, solution strategies, irreversible processes