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Non-standard modeling and discretization approaches for multi-physics phenomena in porous media

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Many applications involve multi-physics phenomena in the sub-surface, such as groundwater remediation, hydrocarbon production, enhanced geothermal systems, solid waste disposal, carbon sequestration, hydraulic fracturing. In a different context, modeling soft biological tissues, such as the brain, the heart and tumors, share common features with the previous problems. To identify some general traits, these applications are characterized by the complex interactions amongst Thermal-Hydrological-Mechanical-Chemical processes across various time and space scales.

The computational modeling of these problems features several difficulties. At the level of mathematical formulation, these problems may present severe nonlinearities, coming from the variable domain configuration or from nonlinear constitutive laws. Furthermore, the conditions of existence and uniqueness, which may be well understood for each individual component of the model, may become less trivial for coupled equations.

Significant challenges also appear at the level of numerical discretization. Just to mention a few examples, these problems are similar to fluid-structure interaction, because of the difficulty of combining the Eulerian description of flow problems with the typical Lagrangian parametrization of structure problems. Moreover, the domain of interest may embed inclusions such as faults, fractures, channels, etc. whose configuration may also evolve with time.

This mini-symposium aims to gather researchers interested in numerical discretization techniques that aim to overcome the issues described above.

A non exclusive neither exhaustive list of typical examples consists of:
- extended discretization techniques specifically applied to multi-physics phenomena in porous media;
- problem partitioning, domain decomposition and mortar methods for problem sub-structuring;
- implicit/explicit time advancing schemes;
- numerical model order reduction techniques;

that may facilitate the solution of Thermal-Hydrological-Mechanical-Chemical processes for realistic applications.