Computational Modelling of Multi-Field and Multi-Physics Problems Involving Multi-Fracturing Rock and Particulate Media

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In several applications of industrial relevance involving multi-fracturing rock masses and/or particulate media, the system response is governed by the presence of an additional phase, either gaseous, liquid or both, or by the need to consider other physical phenomena, such as thermal effects. Alternatively, the problem may involve the combined flow of particles interspersed with fine grained material, necessitating a multi-scale approach to solution. The presentation considers the essential issues necessary for an effective computational treatment of such coupled systems, with the most effective route to solution being highly problem dependent.

Specific problems that are addressed include (a) ***ground water flow*** through fracturing rock masses necessitating consideration of fluid flow both through individual rock blocks and along joint systems, (b) ***rock blasting*** applications where coupling takes place through an interdependence between the evolving gas pressure distribution driving the fracturing process which, in turn, provides the porosity distribution which controls the gas pressure, (c) ***particle transport*** problems in which the particles being transported through the fluid are large and extend over several fluid grid cells and (d) ***fines migration*** problems in which fine particles that are several orders of magnitude smaller than the main rock fragments flow through the moving particle system. A further problem addressed is ***heat transfer*** between a moving particle system at elevated temperatures and a surrounding pressure driven gas environment.

Applicability of the methodology developed is illustrated through several practical examples related to hydraulic fracturing, slope stability, simulation of rock blasting operations and mineral mining/processing operations.