Effective numerical model for hydraulic fracturing

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Hydraulic fracturing (HF) is a process in which a fluid is pumped at high pressure into a solid material, with or without a pre-existing crack or fault. The push of the fluid makes the fracture open and propagate. This coupled problem (fluid-solid interaction) reveals very hard to solve because of numerical stiffness, strong non-linearity, presence of singularities and moving boundaries.

There are a number of numerical simulators (mostly commercial ones) dealing with this problem, but even for the simplest 1D models (time dependent and 1D in space, it represents a planar straight or radial fracture) there is still room for improvement and better understanding [1]. Recently, several groups have been working on the topic, resulting in some significant improvements [2, 3, 4]. We are working on a fast and accurate algorithm for the 1D classic models based on the use of asymptotic analysis. Other computational advantages of our method come from the use of an improved version of the model that takes in account the shear stress induced by the fluid, previously neglected [5].

Our future work will be focused on using the knowledge gained from the experience on the classic 1D models to tackle the much more difficult case of the 2D model (time dependent and 2D in space, it represents a non symmetric planar fracture). We also plan to consider the similar problem of interaction between the fluid and a thin non-elastic tissue, that can be useful in biological applications.

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