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# Development of a new code to solve hydro-mechanical coupling, shear failure and tensile failure due to hydraulic fracturing operations.

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Nowadays, there are still some unsolved relevant questions which must be faced if we want to proceed to the hydraulic fracturing in a safe way. How much will the fracture propagate? This is one of the most important questions that have to be solved in order to avoid the formation of pathways leading to aquifer targets and atmospheric release. Will the fracture failure provoke a microseismic event? Probably this is the biggest fear that people have in fracking.

The aim of this work (developed as a part of the EU - FracRisk project) is to understand the hydro-mechanical coupling that controls the shear of existing fractures and their propagation during a hydraulic fracturing operation, in order to identify the key parameters that dominate these processes and answer the mentioned questions.

This investigation focuses on the development of a new C++ code which simulates hydro-mechanical coupling, shear movement and propagation of a fracture. The framework employed, called Kratos, uses the Finite Element Method and the fractures are represented with an interface element which is zero thickness. This means that both sides of the element lie together in the initial configuration (it seems a 1D element in a 2D domain, and a 2D element in a 3D domain) and separate as the adjacent matrix elements deform.

Since we are working in hard, fragile rocks, we can assume an elastic matrix and impose irreversible displacements in fractures when rock failure occurs. The formulation used to simulate shear and tensile failures is based on the analytical solution proposed by Okada, 1992 and it is part of an iterative process.

In conclusion, the objective of this work is to employ the new code developed to analyze the main uncertainties related with the hydro-mechanical behavior of fractures derived from the hydraulic fracturing operations.