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A New Method to simulate Shear and Tensile Failure due to Hydraulic Fracturing Operations

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The progress of certain geological activities like the geological storage of CO_2, the enhanced geothermal energy or the hydraulic fracturing operations has revealed the lack of knowledge in the field of induced seismicity and the propagation of the fractures. In fact, sometimes, after shut-in seismic events take place and the pattern of fracture growth is unclear.
In order to perform these activities in an effective and safe manner it is necessary to discover what parameters are key in the process of fracture propagation and induced seismicity. This is the main goal of this work (developed as a part of the EU - FracRisk project) which consists on the development of a new thermo-hydro-mechanical code with a new method to solve shear and tensile failure of fractures. This new method is focused in hydraulic fracturing operations which take place in hard, fragile rocks where it is possible to assume an elastic matrix and to impose irreversible displacements in fractures when rock failure occurs. Hence, the formulation used to simulate shear and tensile failure is based on the analytical solution proposed by Okada (1992) and it is part of an iterative process. The analytical solution allows to avoid numerical issues and to calculate the failure in a straightforward manner, reproducing the possible avalanche of consecutive slip events.
In conclusion, the aim of this work is to investigate the most relevant parameters in the thermo-hydro-mechanical coupling process that take place in rock failure and induced seismicity by means of the new code and the new failure method that has been developed.