Modelling of shear bands in fluid saturated poroplastic solids with embedded strong discontinuities

Mijo Nikolic[1], Adnan Ibrahimbegovic[2]

[1]University of Split, Faculty of Civil Engineering, Architecture and Geodesy, Split, Croatia

[2]Université de Technologie de Compiègne/Sorbonne Universités, Laboratoire Roberval de Mécanique, Compiègne, France

mijo.nikolic@gradst.hr

Simulations of shear bands require special treatments due to its localized nature. Namely, localized failure is mesh-dependent when standard finite element method is used. Various methods have been developed to tackle this difficulty. However, it is still challenging to be able to simulate this problem in complex environments, such as porous heterogeneous medium with multiple phases and where we could have multiple shear band developments interacting with each other. The presence of fluid inside such medium brings additional complexities. In this work, we present the way to compute such problem in efficient way. The framework for considering multi-phase material with multiple shear bands is based on lattice element method, while pathological mesh dependence with localized failure is eliminated by using embedded strong discontinuities inside elements. No global tracking procedure is required in this approach which also enables easier propagation of multiple bands and their interaction. Moreover, computational algorithms are efficient due to such strategy. Additional strength of the algorithm is that embedded discontinuities are computed at element level and no additional degrees of freedom for existence of localized failure are required. Presence of fluid and its influence to shear band forming is provided with Biot poroelastic approach. Here, we consider material to be plastic with microcracks prior to localized shear band forming. The Darcy law is used to compute fluid flow inside the poroplastic domain.

Acknowledgements: This work has been supported by the Croatian Science Foundation under the project number UIP-2017-05-3429