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SPECTRAL PROPERTIES OF DISCONTINUOUS BIFURCATION ANALYSIS IN GRADIENT-BASED POROPLASTICITY

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Abstract. In this work, the spectral analysis of discontinuous bifurcation problem in gradient-based poroplastic media is examined.
To evaluate the dependence of the transition point between ductile and brittle failure regime in terms of the hydraulic and stress conditions, the localization acoustic tensor for discontinuous bifurcation is formulated for both drained and undrained conditions, based on wave propagation criterion. The material model employed in this work to describe the plastic evolution of porous media is the Modified Cam Clay, which is widely used in saturated and partially saturated soil mechanics.
In the thermodynamically consistent porous media framework it was demonstrated in previous works of these authors the need to include a new micromechanical property of the porous phase in the nonlocal gradient-based constitutive formulation. This microstructure information is the internal characteristic length of the porous phase (lp) which should be complimented to the internal characteristic length of the solid skeleton (ls) used in non-porous continuous media. Hence it is proposed an evolution law of the internal characteristics lengths depending on the saturation degree (Sw) as well as the confinement level for lp and ls, respectively.
On the other hand, an analytical expression for the critical hardening/softening module was obtained by exploring the spectral properties of the acoustic tensor for drained and undrained conditions.
Finally, a localization analysis of the modified Cam Clay plasticity model is presented showing the influence of the saturation degree and confinement level in porous media on the location of the transition point between ductile and brittle failure regime.