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ANALYTICAL-NUMERICAL ANALYSIS OF ELLIPTICITY FOR LARGE STRAIN THERMO-PLASTICITY

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Instability, caused by material and/or thermal softening, can lead to ill-posedness (loss of ellipticity) of the boundary value problem and, consequently, to a pathological mesh-sensitivity of results in numerical tests. Thus, the identification of the onset of unstable material response is crucial for reliable simulations which then require regularization. The consequences of instabilities are well-understood for small strain isothermal inelastic material models. However, when one wants to drop the assumptions, the analysis becomes complicated, so it usually is performed with some limitations, e.g. for small strain regime [2] or for elasticity [1].

In this paper a hybrid analytical-numerical approach to ellipticity analysis for large strain thermo-plasticity is presented. First, the conditions of ellipticity loss for the two-field model are derived. This can be performed using either a perturbation analysis [1] or conditions of equilibrium on a discontinuity surface [2]. The latter involve acoustic tensors (isothermal and adiabatic). Second, a verification of the analytically derived conditions is performed for a specific three-dimensional model of finite strain thermo-plasticity. At selected Gauss points in an elongated sample the acoustic tensors are calculated for a set of normal vectors and a proper material tangent, which are computed using automatic differentiation available in *AceGen* package for *Wolfram Mathematica*.

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