A Hybrid Total-Updated Lagrangian Formulation for large strain problems

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ABSTRACT

Total Lagrangian (TLF) and Updated Lagrangian (ULF) Formulations, see Bathe [1], are widely used in computational mechanics. TLF approach is written in terms of material variables in the original configuration where constitutive equations, movement description and momentum balance are considered. Then objectivity is naturally satisfied. However in practice the interpretation and calibration of constitutive models is easily carried out in terms of spatial variables and the ULF is widely chosen with this purpose. Then both Objectivity and Incremental Objectivity have to be satisfied in this case. In the literature ULF has been widely adopted for large strain plasticity problems, see the works of García Garino et. al. [2] and Ponthot [3] and references therein.

However another authors have simulated large strain problems considered TLF based codes. For instance Cabezas and Celentanto [4] have studied the simple tension test of rectangular bars using this kind of codes. Car et. al [5] have discussed anisotropic large strain models for fiber reinforced composite materials. Another, different coupling of TLF and ULF found in the literature [6] will be considered as well in order to provide a taxonomy for the proposed approach.

In this work an hybrid Total-Updated Lagrangian Formulation is discussed. In this way movement description and momentum balance are written in terms of material variables at Original Configuration while constitutive equations are written in term of spatial variables. Proper transformation of tensorial variables, push forward and pull back operations, couples global (forces) and local (consitutive) variables. In practice it is important to discuss the degree of coupling of material and spatial variables in order to implement efficient codes and to implement the cited tensorial transformations in an efficient way in order to save CPU effort.

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