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ADAPTIVE REMESHING ISSUES IN THE PRESENCE OF SOFTENING CONSTITUTIVE MODELS ASSOCIATED WITH DUCTILE DAMAGE PREDICTION

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ABSTRACT

The modelling of complex metal forming processes often requires the use of adaptive remeshing procedures so that high quality meshes are guaranteed over the whole simulation process or that, in many occasions, the processes themselves can be modelled. Typically these adaptive procedures are based on error estimations obtained from some energy norm associated with the plastic deformation.

Nevertheless in many forming processes formability limits may be conditioned by the development of ductile damage associated with the initiation, growth and coalescence of cavities and micro cracks induced by large deformations. In the modelling of such processes the use of phenomenological models, based on Continuous Damage Mechanics, is a useful procedure in order to describe, at the macro scale, the material failure of ductile materials by including, at the constitutive level, a softening behaviour which reflects the evolution of damage at a smaller scale. In these cases, in which damage is involved, the traditional error estimators may not be adequate and should be based on the damage dissipation or rate of damage work [1-2].

The softening introduced by the damage evolution induces very often in the finite element solutions a pathological effect of mesh dependence in size and orientation. A common solution is the introduction of non-local models, which include at the macro level parameters which take into account length scale effects due to microstructure heterogeneity [3-4]. However these techniques are never combined with adaptive methods. Therefore in this work an investigation is made on how adaptive remeshing techniques may or not hide mesh dependence problems by comparing solutions obtained with non-local models and adaptive methods. In the traditional adaptive methods the error is usually estimated locally on a patch whose length depends on some

geometric criterion. A new strategy is here put forward in which the size of local support used for evaluating the error estimates depends on a length scale parameter associated with the length scale effects due to microstructure heterogeneity.

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