FAILURE MODELLING IN LS-DYNA FOR CRASH APPLICATIONS

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The numerical analysis of failure processes in structures has been intensely debated in recent years. In the context of the smeared continuum approach for failure modeling, localization due to loss of ellipticity in statics and loss of hyperbolicity in dynamics are responsible for the loss of mesh-objectivity. The occurrence of so-called weak discontinuities manifests itself in narrow localization bands where the deformations are trapped resulting in mesh dependency. In order to overcome these difficulties several approaches have been proposed. The more successful regularization procedures are non-local material formulations, rate-dependent viscoplastic material formulations, higher order continuum theories and strain-gradient descriptions.

Some of these strategies have been implemented recently in the commercial Finite Element code LS-DYNA. This presentation will give an overview of the currently implemented failure models and highlight the merits and limits of non-local and rate-dependent formulations with regard to their regularization properties for localization phenomena. Our particular focus in this contribution will be on the application to practical problems.

In automotive structures materials with rather brittle failure characteristics are becoming of more interest due to increasing requirements on weight reduction. Thus even for crash loading components made out of cast aluminum and others made out of composite material have to be considered. Numerical examples are presented to show the effects and problems involved.