International Conference on Extended Finite Element Methods - XFEM 2013
September 11 – 13, 2013, Lyon, France
A. Gravouil, Y. Renard and A. Combescure

An Irreducible NURBS based element for high resolution of shearbands on coarse meshes

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Key Words: *Shearbands, regularization, NURBS, convergence, coupled fields.*

ABSTRACT

One of the most interesting instabilities in metals is the formation of shear bands due to impact and blast. Shear bands are localized bands, on the order of micron scales, of intense plastic deformation and high temperatures which would be an indication of an irreversible damage that eventually cause fracture.

Recent work on shear band [1] reformulated the numerical model as a mixed formulation of coupled thermo-mechanical set of equations with diffusive regularization. Diffusion serves as a length scale, governed by competition between shear heating and conduction, and will regularize the problem in the softening regime. In that work, a global Newton solver was proposed which accurately eliminates the error at every time step.

In the current work, we develop an irreducible, locking free NURBS based element for monolithic solution of the problem. We show that high order NURBS converges rapidly on very coarse meshes achieving high rates of convergence. Thus, this approach can potentially resolve accurately multiple interacting shearbands without special mesh refinements.

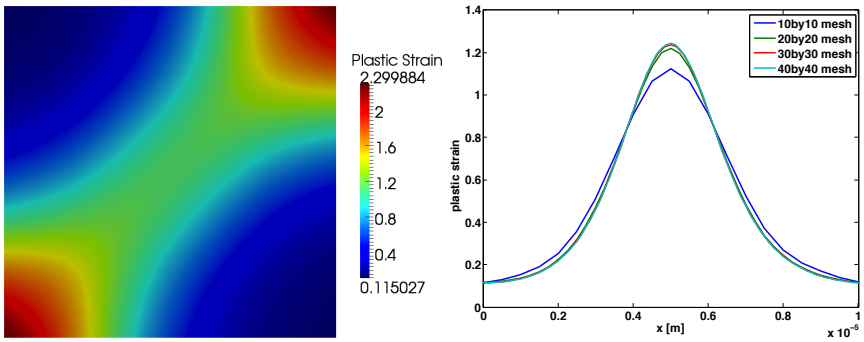

Figure 1: Rapid convergence of a NURBS based element to a 45 degree shearband

REFERENCES

[1] C. McAuliffe and H. Waisman. Mesh insensitive formulation for initiation and growth of shear bands using mixed finite elements. *Computational Mechanics*, 1–17, 2012.

[2] L. Berger-Vergiat, C. McAuliffe and H. Waisman. An Irreducible NURBS based element for high resolution of shearbands on coarse meshes, *in preparation*, 2013.