

ANALYSIS of METAL FORMING TECHNIQUES by USING ISOGOMETRIC ELEMENTS

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ABSTRACT

New numerical analysis method named as isogeometric analysis (IGA), based on usage of non-uniform rational basis spline (NURBS) basis functions is studied in order to examine the behavior of parts in the forming processes. NURBS is a mathematical modeling method used for representing any kind of curves, surfaces and 3-D shapes and it is widely used in computer aided design (CAD) software packages since its favorable and flexible nature makes modelling of complex geometries possible. Isogeometric analysis has emerged with the idea of using same basis functions for both analysis and design stages and it aims to eliminate time consumption during required geometry transformation between these stages. NURBS basis functions have been chosen as common basis function because they enable higher continuity and exact geometry contrary to polynomial based finite element method basis functions. Moreover, due to the recursive nature of NURBS, more general and robust algorithms can be developed for computation procedure. In this study, isogeometric analysis has been used for plasticity problems which are; uniaxial loading of a sheet, v-die bending and square deep drawing by using LS-DYNA analysis software. Same analyses were also run by using classical finite element method with utilizing another commercial analysis software Abaqus. Additionally, experiments were conducted to get actual results other than simulation programs. According to obtained results, accuracy and computational efficiency of IGA have been compared with FEA. At the end, isogeometric analysis was evaluated as a suitable technique for analysis of metal forming processes because it gives more accurate results in shorter time compared to finite element analysis.

Keywords: NURBS, Isogeometric Analysis, Finite Element Analysis, Sheet Metal Forming, V-Die Bending, Springback, Square Deep Drawing, Thickness Strain