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# A NOVEL FINITE ELEMENT SENSITIVITY METHOD FOR PLASTICITY

**Abstract**

The complex variable finite element method, ZFEM, has been enhanced in this research to compute derivatives with respect to shape, material properties, and loads for a nonlinear solid mechanics model undergoing plastic deformation. This method presents a new and novel approach that uses complex variables to estimate derivatives within an incrementaliterative procedure for the solution of nonlinear finite element equations. ZFEM offers significant advantages over real-valued finite element analysis in that highly accurate derivative information may be obtained from a single analysis. The method has been implemented within the commercial Abaqus finite element software package using the user element and user material options. A strategy was developed to allow Abaqus' solver algorithm to handle complex variable operations needed by ZFEM to perform sensitivity analysis. Numerical results confirm the high accuracy of the method through the analysis of a thick-walled cylinder case employing the perfectly plastic hardening model.