

## **An Improved Numerical Integration Algorithm for Elastoplastic Constitutive Equations**

**Diogo L. Cecílio, Philippe R. B. Devloo, Sônia M. Gomes and Nathan Shauer**

Universidade Estadual de Campinas - Unicamp,  
Av. Albert Einstein, 951 - 13083-970 - Campinas - SP - Brazil

<http://www.labmec.org.br>

[cecilio.diogo@gmail.com](mailto:cecilio.diogo@gmail.com), [phil@fec.unicamp.br](mailto:phil@fec.unicamp.br), [soniag@ime.unicamp.br](mailto:soniag@ime.unicamp.br)  
[nathan.sh@gmail.com](mailto:nathan.sh@gmail.com)

**Key Words:** *Spectral decomposition, Plasticity, Geomechanics, Return-Mapping*

In this work an efficient code is developed for the simulation of the mechanical behavior of an oil well during drilling. The method is based on the discretization of a general mathematical model for small elastoplastic deformations by the finite element method. A new methodological approach is proposed for elastoplastic calculation showing that the direction that minimizes the square of the distance between the total strain and the corresponding plastic deformation surface layer has the same direction as the evolution of plastic deformation. This procedure, in combination with a representation of tensors in terms of principal values, allows complex elastoplastic models to be addressed in a simplified manner. The implementation of the proposed methodology is applied to the elastoplastic SandlerDimaggio model, and the results of the material's response are compared to those presented in the literature by [1] and [2]. A stability analysis of the well is performed by using the finite element method coupled with the proposed elastoplastic model.

### **REFERENCES**

- [1] F. L. DiMaggio and I. Sandler (1971) Material Model for Granular Soils. Engineering Mechanics Division
- [2] I.S. Sandler and D. Rubin (1979) An algorithm and a modular subroutine for the cap model. International Journal for Numerical and Analytical Methods in Geomechanics