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Nestor Zouain, Rafael SantAnna

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Computing the asymptotic cyclic response of elastoplastic solids with nonlinear kinematic hardening

Nestor Zouain[a,*], Rafael SantAnna[a,b]

[a] *Mechanical Engineering Department, COPPE, EE / UFRJ - Federal University of Rio de Janeiro, PO Box 68503, ZIP 21945-970 RJ, Brazil*
[b] *PETROBRAS, Visconde de Duprat Street, Cidade Nova, ZIP 20211-230 RJ, Rio de Janeiro, Brazil*

Abstract

We propose a direct method to compute the steady state response to cyclic loadings of elastoplastic solids with Armstrong-Frederick nonlinear kinematic hardening. The algorithm obtains the elastoplastic asymptotic cyclic response without true incremental integration. The method performs much faster than using the step-by-step procedure until stabilization. Including nonlinear kinematic hardening in this asymptotic analysis allows modeling the ratcheting phenomenon, which is important in safety assessment of structures under variable loadings. To the best of the authors knowledge, this is the first direct procedure for computing the asymptotic cyclic response of elastoplastic solids with nonlinear kinematic hardening.

Keywords: Elastoplasticity, Nonlinear kinematic hardening, Cyclic loads, Direct methods, Ratcheting and shakedown

1. Introduction

We propose a direct method to compute the steady state response to cyclic loadings of elastoplastic solids with Armstrong and Frederick (1966) nonlinear kinematic hardening (AF). The proposal follows the guidelines of the computational formulation introduced in Zouain and SantAnna (2017), where we addressed a similar problem in ideal plasticity.

*Corresponding author
Email address: nestor@ufrj.br (Nestor Zouain)