Fatigue life estimates under non-proportional loading through continuum damage evolution law

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Abstract. *This paper seeks to use Lemaitre's Continuum Damage Model to obtain fatigue life estimates under multiaxial proportional and non-proportional loadings. Initially, the Lemaitre's mathematical model is presented, by formulating the necessary constitutive relations. Chaboche's model was chosen to describe the kinematic hardening law. Then, the numerical model necessary to solve the constitutive relations is developed, utilizing the Chaboche's law with 3 terms and Euler's implicit discretization. Then, the material parameters are identified for 304 and S460N steels and 6061-T6 aluminum alloy. The model is implemented in a FORTRAN routine, which is submitted to uniaxial and proportional and non-proportional multiaxial loading histories. The fatigue life data obtained from Lemaitre's damage model is compared to experimental data. Then, a stress amplitude analysis is conducted and the numerical stresses are compared to experimental data. Damage evolution curves are also obtained for each material and loading. The results show that Lemaitre's damage model describes adequately the behavior of the analyzed materials under low cycle fatigue, when low strain amplitudes are being applied to the specimen.*

Keywords: *Damage mechanics, non-proportional loading, fatigue life estimate, kinematic hardening, parameter identification.*