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PII: S0142-1123(18)30428-6
DOI: https://doi.org/10.1016/j.ijfatigue.2018.08.030
Reference: JIJF 4826

To appear in: *International Journal of Fatigue*

Received Date: 19 May 2018
Revised Date: 17 August 2018
Accepted Date: 22 August 2018

Please cite this article as: Liu, B., Yan, X., A new method for studying the effect of multiaxial strain states on low cycle non-proportional fatigue prediction, *International Journal of Fatigue* (2018), doi: https://doi.org/10.1016/j.ijfatigue.2018.08.030

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A new method for studying the effect of multiaxial strain states on low cycle non-proportional fatigue prediction

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Abstract

In this paper, a new method is put forward to predict fatigue life under low cycle non-proportional loadings. Modified from the thought of Modified Wöhler Curve Method, a multiaxial ASME strain based approach is presented to estimate low cycle fatigue damage under proportional loadings. Based on it, the new method can consider the multiaxiality effect on the determination of reference proportional strain path and the calculation of non-proportionality factor F_{np}. For the first time, a viewpoint of inhomogeneous integral path for calculating factor F_{np} is proposed, and a path-dependent weight factor is defined to describe this heterogeneity. The experimental tests on 3 sets of metallic materials with various loading cases are referenced to validate the present study. As a result, the proposed method can more accurately quantify the non-proportionality degree of loading paths.

Keywords: Multiaxial influence; Non-proportionality factor; Integral path model

Nomenclature

a	material sensitivity parameter to non-proportional damage
A_ρ, C_ρ	multiaxial material parameters of *S-N* equation
dD_{NP}	increment form of non-proportional fatigue damage
D_{NP}	fatigue damage caused by non-proportional loading

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