

# Accepted Manuscript

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PII: S0749-6419(17)30201-2

DOI: [10.1016/j.ijplas.2017.08.003](https://doi.org/10.1016/j.ijplas.2017.08.003)

Reference: INTPLA 2230

To appear in: *International Journal of Plasticity*

Received Date: 15 April 2017

Revised Date: 25 July 2017

Accepted Date: 21 August 2017

Please cite this article as: Lee, E.-H., Stoughton, T.B., Yoon, J.W., A new strategy to describe nonlinear elastic and asymmetric plastic behaviors with one yield surface, *International Journal of Plasticity* (2017), doi: 10.1016/j.ijplas.2017.08.003.

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# **A new strategy to describe nonlinear elastic and asymmetric plastic behaviors with one yield surface**

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## Abstract

This paper proposes a new strategy to describe both nonlinear elastic and asymmetric plastic behaviors (early re-yielding, transient Bauschinger effect, permanent softening, and work-hardening stagnation) only with one yield surface. There have been the popular models, such as Yoshida-Uemori and Quasi-Plastic-Elastic (QPE) models, that have led to remarkable improvements in describing material's behavior and predicting springback. Although the Yoshida-Uemori model describes the asymmetric plastic behavior, it is challenging to follow the nonlinear elastic response. On the other hand, the QPE model does not capture the work-hardening stagnation though it follows the nonlinear elastic behavior. Besides, the above models have multiple surfaces leading to a complex mathematics and, then leading to increased computation time. In this study, a new one surface method incorporates state of strain change or state of energy change as well as the stress state in determining the deformation mode, so that it is possible to keep only one yield surface. In order to capture the work-hardening stagnation, the one surface method traces the equivalent plastic strain, then

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