An insight on the parameter identification of a new hysteretic model addressing asymmetric responses

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Abstract. It is presented an investigation concerning an inverse identification algorithm for the experimental characterization of the constitutive parameters relevant to a recently developed constitutive model addressing asymmetric hysteresis.

Introduction

Within the context of nonlinear analysis of structures exhibiting hysteretic phenomena, generalized classes of new phenomenological material models have been recently proposed [1] and extended to asymmetric [2] smooth hysteresis loops with hardening and softening behavior, thus permitting the analytical computation of uniaxial responses.

The hysteretic model

Compared to constitutive models having similar behaviours, classes proposed in [1] and [2] turn out to be significantly more efficient since they do not present any differential relationship and, hence, the need to invoke iterative procedures. Nevertheless, due to their phenomenological nature, these models are characterized by sets of constitutive parameters that need to be calibrated by matching experimental evidences, a task of particular complexity for the asymmetric model presented in [2].

The identification procedure

The identification procedure is based on the definition of least-square residuals between the theoretical and experimental responses that are minimized by simplex- and gradient-based optimization algorithms. In particular, due to the occurrence of hardening and softening phenomena, three different residuals must be defined in order to match a given experimental response both in terms of amplitude, stiffness, and transition between the tensile and compressive regions.

Moreover, in order to ensure a robust convergence, and especially to formulate a standard identification protocol, the procedure includes pre-processing phases in which suitable first-trials of the parameter sets, to be used by subsequent minimization procedures, are esteemed.

Numerical applications, as well as a comparison with the Generalized Bouc-Wen material [4], prove the robustness of the presented strategies as well as the capabilities of such phenomenological models within the context of seismic analysis of nonlinear structures and vibration isolation.

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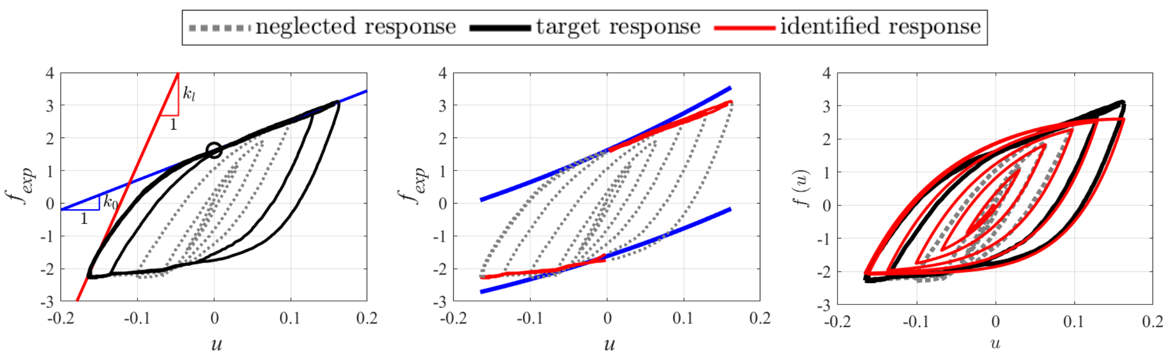

(a) Pre-processing data (b) Asymptotic optimization (c) Global response

Figure 1: Pre processing data, asymptotic and global response optimization.

References

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