

CONSTITUTIVE RELATION ERROR FOR DYNAMICS MODEL VALIDATION WITH UNCERTAINTIES

P. Ladevèze and A. Deraemaeker

LMT-Cachan
(E.N.S. de Cachan / Université Paris 6 / C.N.R.S.)
61 Avenue du Président Wilson / 94235 CACHAN CEDEX, France
ladeveze@lmt.ens-cachan.fr

Controlling and mastering both the mechanical and numerical models has always been a major preoccupation in Mechanics, especially for engineers. So, what has changed ? Quantitative tools have started to appear ; they are capable of quantifying the quality of an approximate model with respect to a reference.

This paper is focused on the situations where the experimental simulations are the reference (responses to static loads, or modal and forced vibrations). The first and most critical concern is to develop error measures which are able to quantify the quality of the model used, both the mathematical model and its parameters. The approach is based on the "mechanics concept" of constitutive relation error estimator introduced previously for quantifying the quality of finite element analyses [1, 2]. The basic features of this estimator and its capability for model updating has been previously studied in [3, 4, 5, 6] in the case where a deterministic reference is used (i.e. one set of measurements).

In this paper we deal with the case where the reference is given by a set of measurements from which a probability density function can be extracted and the model is uncertain. The crucial point is to be able to quantify the quality of the uncertain model with respect to a probabilistic reference. Here it is proposed to extend the CRE approach. This extended CRE allows us to quantify the quality of the model and therefore to carry out model updating and validation. First applications will be shown.

References

- [1] P. Ladevèze and D. Leguillon. Error estimate procedure in the finite element method and application. *SIAM J. Numer. Anal.*, 20(3):485–509, 1983.
- [2] P. Ladevèze and J.P. Pelle. *Mastering computations in linear and non-linear mechanics (in french)*. Hermes, 2002.
- [3] P. Ladevèze, D. Nedjar, and M. Reynier. Updating of finite element models using vibration tests. *AIAA Journal*, 32(7):1485–1491, 1994.
- [4] A. Chouaki, P. Ladevèze, and L. Proslie. Updating Structural Dynamic Models with Emphasis on the Damping Properties. *AIAA Journal*, 36(6):1094–1099, June 1998.
- [5] P. Ladevèze and A. Chouaki. Application of a *posteriori* Error Estimation for Structural Model Updating. *Inverse Problems*, 15:49–58, 1999.
- [6] A. Deraemaeker, P. Ladevèze, and Ph. Leconte. Reduced bases for model updating in structural dynamics based on Constitutive Relation Error. *Comp. Meth. in Applied Mech. and Engrg.*, 191(21-22):2427–2444, 2002.