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Determining the Best Pareto-solution in a Multi-Objective Approach for Model Updating

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Abstract

Using a multi-objective optimization algorithm avoid the use of weighting factors to balance the different residuals in a finite element model updating procedure under the maximum likelihood method. By using this approach, the fittest model is not unique and a set of solutions that form a curve, so-called Pareto optimal front, is obtained. Within this paper, first a review of the state of the art on the criteria used to determine the most adequate model among all the solutions of the Pareto front is presented. Subsequently, a case study of a real footbridge is considered. A finite element model of the footbridge is updated based on its experimental modal parameters. The Non-Dominated Sorting Genetic Algorithm is used to obtain the Pareto front. Since all the solutions in the Pareto front are non-dominated, the selection of the best candidate requires a reasonable criterion. Herein, different procedures to select the best updated model are discussed.

Keywords: model updating; footbridge; multi-objective optimization; decision making; bend angle.

1. Introduction

Model updating emerged in the 1990 as a tool of great importance for the construction, design and maintenance of mechanical systems and civil engineering structures. Essentially, this technique involves defining numerical models that capture reality as accurately as possible. The classical reference by Friswell and Motterhead [1] introduces the first group of techniques used for Finite Element (FE) model updating. The basic techniques use experimental vibration test results as reference for numerical solution. Once the experimental identification of the modal parameters of the considered structure is done, the main stages of a FE model updating procedure can be summarized as follows:

i. Experimental and FE model correlation. This correlation provides information about the discrepancies between both models. The most used correlations are: the natural frequency

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