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Damage Identification for Space Structure by Regularized Approaches

Abstract
Structural damage identification is a key issue for several sectors, and the damage issue can be formulated as a class of inverse vibration problem. This inverse problem can be formulated as a generalized least square problem. The stiffness matrix is the goal for the identification process, where the measurements are the reference for the best matching with a mathematical model associated with a regularization operator. The forward problem is solved by the finite element method, and an entropic regularization is also used for the cost function. Here, two types of inverse methods will be applied. An inverse solution is estimated by combining a stochastic metaheuristic (MPCA: multi-particle collision algorithm) with a local searching method (HJ: Hooke-Jeeves) [1], and a second technique employing a variational approach [2]. The proposed methodologies are applied to different study cases: the cantilever beam and space truss structure, the last one as a simplified representation of the International Space Station (ISS).

Keywords
Damage identification, regularized inverse solution, hybrid optimization techniques, Multi- Particle Collision Algorithm (MPCA) and Hooke-Jeeves (HJ) method, variational scheme.

References
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Biography
Haroldo F. de Campos Velho: Senior researcher at the National Institute for Space Research (INPE, Brazil), with interest on inverse problems for space research, data assimilation, hybrid computing, and mathematical turbulence modeling.
Reynier Hernández Torres: Independent researcher with experience in scientific computing, artificial intelligence, computer vision, and data science.
Leonardo D. Chiwiacowsky: Adjunct professor at the University of Caxias do Sul (UCS, Brazil), with experience on computer science, production engineering, aeronautics and mechanics, with a focus on linear and non-linear optimization, computer simulation, multi-criteria decision analysis, and high-performance processing.