
A Robust Impact Force Determination Technique for Complex Structures

I. MUELLER, K. VONNIEDA, S. DAS and F.-K. CHANG

ABSTRACT

Real-time impact monitoring is widely acknowledged as important key technology within an integrated health management concept for composite airframe structures. To achieve the goal of efficient and reliable impact monitoring systems novel approaches are discussed in this contribution which allow to mitigate or to overcome stability and accuracy issues of ARX models used for real-time impact monitoring.

According to theory of inverse problems and model fitting, it will be shown that these low-order ARX models are highly dependent on the signal window which has to be chosen carefully for each specific application to utilize the meaningful part of the acquired signals before the analysis. For this purpose, an optimization approach will be introduced to achieve the ARX models with the highest quality within an automated process which will be applied during the offline training step. In addition, the same approach was adopted to facilitate the selection of the most meaningful sensor for the ARX training and the best model order. As shown by the results for the analytically inverted ARX models this procedure clearly provides tremendous improvements and allows to achieve high quality ARX models by selecting the best possible inputs from acquired training data.

In extension of these innovations, a novel methodology based on direct inverse identification models (DI-ARX) within a MISO framework will be presented which attacks the improvement of stability, accuracy and speed of the load identification process in a different way. The striking feature of this methodology is given by the fact that the inversion of the ARX model is already performed during the training process that no numerical inversion step, as a source of severe errors, is needed by any matrix operation etc. In such a way, further improvements were achieved even for those structures that could not be successfully handled with the traditional approach.

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Ключевые слова:

Содержание.