Data-Driven Autoregressive Model Identification for Structural Health Monitoring in an Anisotropic Composite Plate

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ABSTRACT

A simple data-driven autoregressive with exogenous inputs (ARX) model can be used to assess a model to describe and to prognosticate the time-series outputs of the sensors for different operating conditions in composite structures [1]. Thus, this paper presents the potentiality of the use of ARX models to detect and, mainly, to extrapolate the features as damage sensitive index, based on changes in forecasts errors in anisotropic composite structures. To illustrate this novel proposal, an aeronautical composite panel with bonded piezoelectric elements [2,3], that act both as sensors and actuators, is used to study the relationship between the variation of the parameters of the identified model and the presence of simulated damage assuming different operating conditions and noise. The results obtained have shown the high dependence of the path of wave propagation chosen with the choice of the ARX model order, an issue that has potential to be explored to locate the damage region in the structure. Another critical point observed is that the variation of the ARX model's coefficients between the healthy and damaged conditions can be insensitive to the presence of operational changes if the model is identified adequately. A damage progression evaluation by extrapolating the ARX parameters is also proposed and tested based on spline cubic functions to verify the future state and to observe how the damage can evolute to help to have a decision about a possible required repair.

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