Study and development of new acoustic technologies for nacelle products

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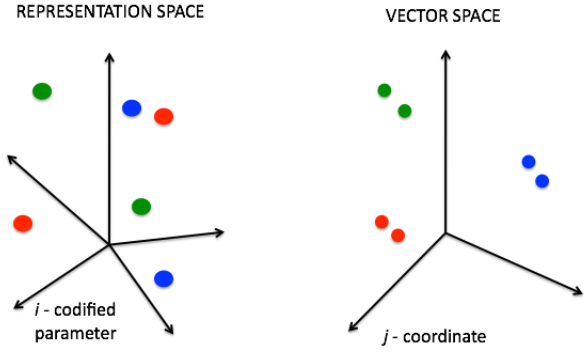
Abstract

The PhD Entitled ‘ Study and development of new acoustic prototypes for nacelle products ‘ visits all the stages taking part in the conception of a new technology from the industry 4.0 point of view, where data-driven approaches and artificial intelligence techniques are becoming leading-edge. The objective of this dissertation is to establish the tools that can help design and manufacture faster new technologies in development. First of all, manufacturing processes are a hot-topic of the dissertation. The state of art for manufacturing acoustic liners for nacelles will be presented, and later, the use of artificial intelligence techniques (regression trees and S-PGD) for optimizing a composite forming process will be highlighted.

Later on, a deep analysis of an acoustic resonator will be presented, along with a hybrid technique combining modal-analysis and Fourier transform for solving the dynamic system modeling of an acoustic asset.

Regarding the industrial framework in which this dissertation is born (development of new acoustic prototypes) there are two main concerns: new designs require new physical models and in this scenario is the available data is reduced. The most well-known artificial intelligence techniques rely on ‘big-data’ in order to perform accurate regressions that will lead to discrete models. For this dissertation a new algorithm called ‘Code2Vect’ (depicted in the Figure) is presented to solve both: visualization of high-dimensional data and regression in the low-data limit. Code2Vect will build regressions and contribute to a reduction of the development time by means of reducing the number of test samples required. Moreover, this algorithm will be proved to be powerful in many different industrial fields, such as manufacturing processes and material certification



One last question arises then, is it possible to find a ‘compact’ model of a new prototype rather than a discrete model as contrary to a regression technique? To answer this question, a minimization technique that leads to a compact template is presented in this dissertation. To sum up, numerical tools to help speed up all the stages from conception of a new design, first analysis, first samples and testing and manufacturing are visited in this dissertation.

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