

NONLINEAR STATIC ANALYSIS OF AN EXHAUST SYSTEM USING OPTIMAL NEURAL NETWORK

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Standard development process involves several CAD and CAE analysis in order to determine parameter values satisfying technical product specifications. In case of nonlinear static behaviour of the system, the computational time may quickly increase depending on model complexity, case load and cycles of analysis.

This work is focused in the development of an alternative methodology based on neural network to analyse virtual models. The case study consists of an exhaust system. The objective is to determine the stiffness parameters of the rubber hangers which cause a certain nonlinear response. The response of the system, made of stress, strain and displacements at four points, comprises the input for the neural network. The output is the stiffness of the rubber hangers. The database chosen for the experimentation has been carried out from FEA analysis and specimen tests. The cross validation is employed with the intention of getting better results. Thus, results from FEA and tests are used respectively as training and validation subsets.

This approach adjusts the design parameters with the same accuracy as FEA, but it strongly reduces the simulation time. The, approximately, hour and an half needed by FEA to analyze the critical points is reduced to few seconds using neural networks.

As known, the performance of a neural network is critically dependent on, among others, the choice of the processing elements (neurons), the architecture and the learning algorithm. In particular the connection density determines its ability in store information. A reduced number of connections may disable the network to approximate the function, on the other hand, densely connections may cause overfitting. In this work an effective neural network has been obtained to analyse exhaust virtual models.

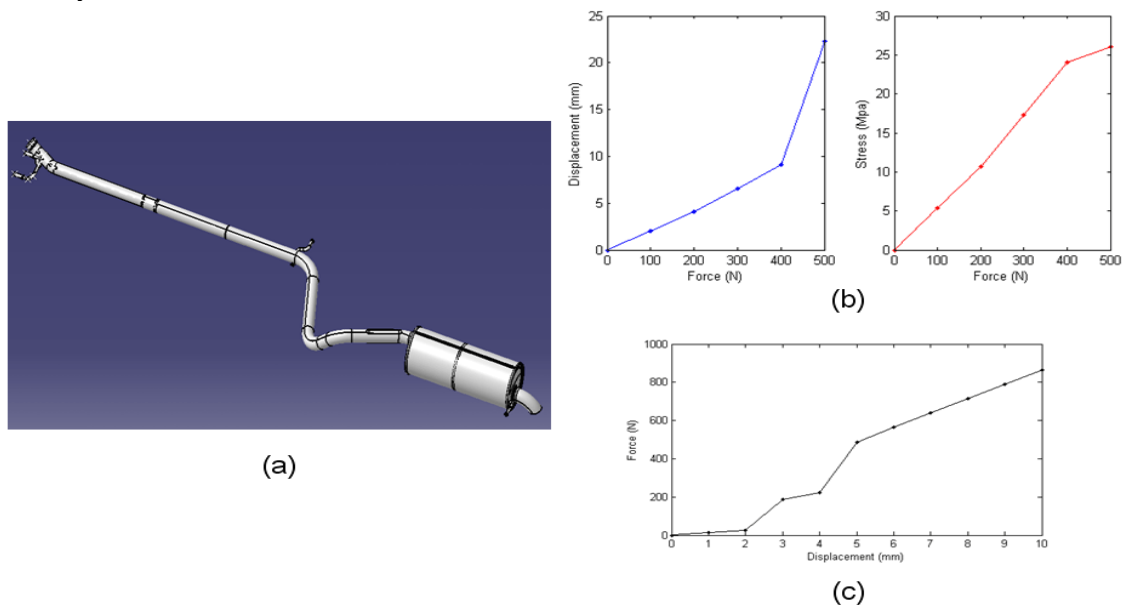


Fig.1 Exhaust system as a CAD model (a); Inputs of the neural network at the maximum stress point (b); output of the neural network for one of the rubber hanger (c).