Optimization of Products and Applications Design Using Artificial Intelligence Techniques

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Introduction

Living in a quiet and comfortable environment becomes a new trend in our society. Consequently, it demands the manufacturing of quiet products from the field of automotive industry to home appliances.

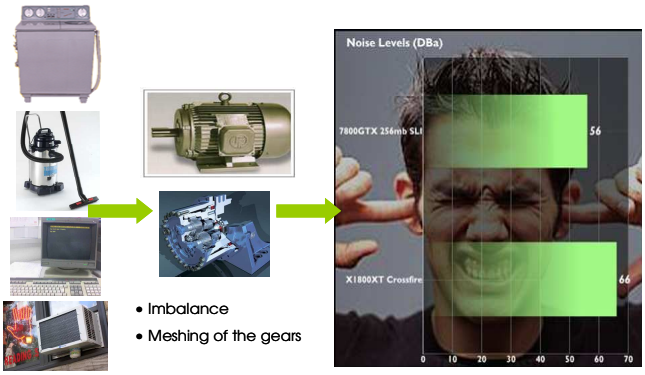


Figure 1 : Meshing of gears or imbalance of rotating parts can cause noise in products.

Objective

Optimization of dynamic behavior of products in order to reduce the radiated sound by using Artificial Intelligence (AI) techniques.

Methods

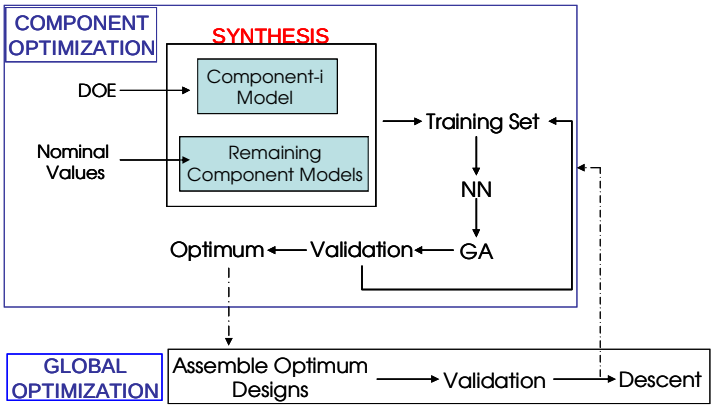
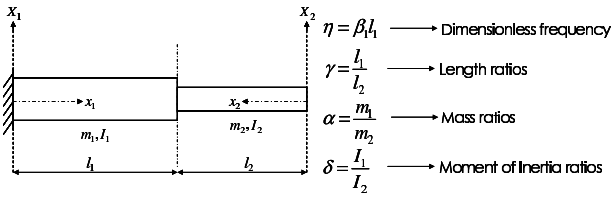


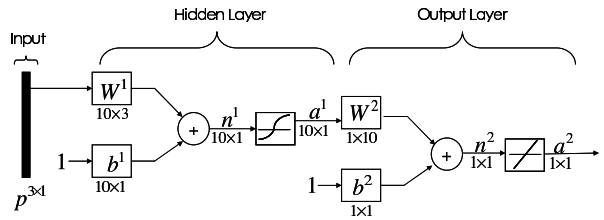
Figure 2 : Global-Local Optimization scheme.

- *Global-Local Optimization*: The optimization strategy is first performed on component level and then transferred to the whole structure.
- *Component Mode Synthesis (CMS)*: Both on component level and global level reduced dynamic models are used, using CMS.
- *Neural Networks (NN)*: Used as fast approximators to the FE/CMS model.
- *Genetic Algorithms (GA)*: Used to optimize the NN approximation model.

Results

Neural Networks (NN) are used to estimate the first bending frequency of a stepped beam. The data generation $p = [\gamma, \alpha, \delta] \in \mathbb{R}^{3\times 64}$ is done using an analytical model (see Figure 3).





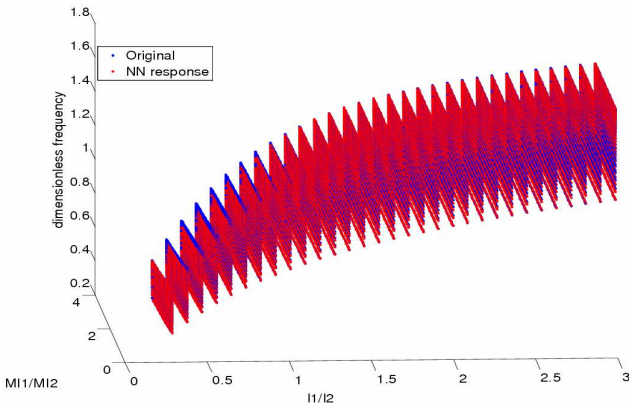


Figure 3 : Problem, training and validation.

In the figure, it is visualized that the NN response is a good approximation to the underlying behavior.

Further Work

- Combining NN with GA in MATLAB.
- Combining ANSYS (FEM) and MATLAB (optimization algorithm).
- Analysis on component level.