Discrete Flow Mapping - a mesh based simulation tool for high-frequency vibro-acoustics of complex engineering structures

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Modelling the vibro-acoustic properties of mechanical built-up structures is a challenging task - especially in the mid to high frequency regime - even with the computing powers available today. Standard modelling tools comprise for complex vehicle parts are finite and boundary element methods (FEM & BEM) as well as Multi-Body Simulations (MBS). All these methods are, however, robust only in the low frequency regime; in particular FEM is not scalable to higher frequencies due to the prohibitive increase in model size.

We have recently developed a new method called Discrete Flow Mapping (DFM), which extends existing high frequency methods, such as the so-called Dynamical Energy Analysis, to work on meshed structures. It provides for the first time detailed spatial information about the vibrational energy of a whole built-up structure of arbitrary complexity in this frequency range. The response of small-scale features and coupling coefficients between sub-components are obtained through local FEM models integrated in the global DFM treatment. The computational cost of DFM is largely frequency independent making it possible to get results from the mid-to-high frequency regime. This tool will be important when considering the vibrational response of a structure as a whole moving away from modelling vibrations only in sub-parts of the mechanical body.

The new method has been tested in collaboration with Germanischer Lloyd (ship building) and Jaguar Land Rover. We can in particular show that DFM is capable of modelling the frequency response of complex car-body parts such as car-floor panels or highly structured aluminium castings. Further applications in the car, train, aerospace and ship building industry will be presented.

References:

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