Acoustical relevance of vibrating structures

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An increasing awareness of product sound quality requires better knowledge of both structural vibrations and the sound propagation paths to the listener's ears. In recent years several visualization and auralization techniques have been developed allowing for an aurally adequate evaluation: Laser scanning vibrometry combined with **B**inaural **T**ransfer **P**ath **A**nalysis and **S**ynthesis (BTPA/BTPS) as well as **B**inaural **P**anel **C**ontribution **A**nalysis (BPCA). These tools have been applied e.g. for troubleshooting and sound design of vehicles, measuring first the vibration characteristics of components and second the airborne transfer paths taking advantage of the reciprocity principle. Additionally, advanced real-time microphone array processing can be used to detect disturbing noise sources.

The results of these methods represent a considerable milestone with respect to acoustic analysis and auralization. The engineer can analyze and listen not only to the overall sound comparable to a binaural recording of the product sound, but also to individual components of the total noise transmitted via a single path or a combination of paths to identify the root cause of a particular disturbing noise pattern.

The paper presents an overview of innovative methods for effective evaluation of the acoustical relevance of structural vibrations for NVH design and their application to several examples.

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