NAFEMS World Congress 2023

May 15 – 18, 2023

Place:

Tampa, Florida/USA

Title:

Hybrid NVH modeling approach: High quality of NVH results enables psychoacoustic analysis of numerical computations

Authors:

Tim Kamper, Matthias Wegerhoff, Haiko Brücher, Roland Sottek

Abstract:

In the field of acoustics, the human perception of sound is often more important than the overall sound pressure level. The human perception is highly individual, and is linked to how the user's expectations of the sound and the actual perceived sound match. Thus, generalization is difficult. However, psychoacoustic metrics that are developed and validated by means of jury tests are an established tool in the field of experimental measurements to quantify the human perception for specific acoustic phenomena like tonality, roughness and loudness. Since the precision of numerical simulations results is continuously improving, these psychoacoustics parameters can be applied as well to the results of numerical simulation.

In the proposed talk, the advantages of this approach are shown using the example of a numerical model of an e-bike. E-bikes have become increasingly popular in recent years, used for commuting, to transport loads or, in the case of e-mountain bikes, just for fun. As already mentioned, in acoustics the acceptance of a sound is strongly linked to the expectations of the user. Since the electric drive unit of an e-bike is added to an acoustically known system, the user expects the sound to be quiet rather than dominant.

Different e-bikes are analyzed for the proposed presentation using numerical and experimental methods. The numerical model used in this project predicts the sound generated by the electrical drive unit and radiated by the frame. For the calculation of airborne noise the distribution of velocities on the surface of the frame is used as an input, which is taken from a previous simulation of structure-borne noise. The model to simulate the structure-borne noise consists of a detailed representation of the carbon frame and simplified representations of different components such as battery, fork etc. With the help of the numerical model, different combinations of frame and electrical drive can be analyzed and compared by psychoacoustic parameters. The validity of the approach is shown by means of data from experimental measurements.

HEAD acoustics GmbH
Ebertstraße 30a
52134 Herzogenrath, Germany

Tim Kamper
Mail: info@head-acoustics.de
Telephone: +49 2407 577-0