

Noise and Efficiency Characteristics of High-Rev Transmissions in Electric Vehicles

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Abstract

More and more high-rev transmission concepts are being used in electric cars to enhance the power density of the electric machines and the transmission system as a whole. The lower gear input torques and higher speeds mean that the entire drivetrain's weight and space can be reduced. These advantages due to the higher input speeds are offset by new challenges with respect to load capacity, efficiency and NVH behavior, which are being investigated on a high-speed powertrain prototype in the joint project "Speed2E" under the leadership of the Gear Research Center (FZG) of the Technical University of Munich.

A highly functional powertrain test rig was set up to study the efficiency and vibration behaviour at input speeds of up to 30,000 rpm as part of the research project, managed by the German Aerospace Center (DLR) and funded by the Federal Ministry for Economic Affairs and Energy (BMWi). In order to evaluate the influence of the gear macro design under these challenging conditions, different gear concepts were designed and tested. This publication presents the main results of both the NVH investigations as well as the efficiency analyses of the powertrain.

Finally, we present the follow-up project "Speed4E", which aims to further increase the input speeds up to 50,000 rpm. Further goals of Speed4E are the development of a practically-oriented, highly-integrated powertrain that will be tested in a test vehicle to demonstrate the potentials for cost-effective production and scalability. The described challenges of a high-speed electric powertrain will be solved using the knowledge gained from the Speed2E project to better exploit the benefits of further increasing the input speeds.