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Parametric Optimization of High-Performance Electric Vehicle E-Gear Drive for Radiated Noise Using 1-D System Simulation

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Abstract : For e-gear drivetrain, the transmission error and the resulting variation in mesh stiffness is one of the main source of excitation in High performance Electric Vehicle. These vibrations are transferred through the shaft to the bearings and then to the e-Gear drive housing eventually radiating noise. A parametrical model developed in 1-D system simulation by optimizing the micro and macro geometry along with bearing properties and oil filtration to achieve least transmission error and high contact ratio. Histogram analysis is performed to condense the actual road load data into condensed duty cycle to find the bearing forces. The structural vibration generated by these forces will be simulated in a nonlinear solver obtaining the normal surface velocity of the housing and the results will be carried forward to Acoustic software wherein a virtual environment of the surrounding (actual testing scenario) with accurate microphone position will be maintained to predict the sound pressure level of radiated noise and directivity plot of the e-Gear Drive. Order analysis will be carried out to find the root cause of the vibration and whine noise. Broadband spectrum will be checked to find the rattle noise source. Further, with the available results, the design will be optimized, and the next loop of simulation will be performed to build a best e-Gear Drive on NVH aspect. Structural analysis will be also carried out to check the robustness of the e-Gear Drive.

Keywords : 1-D system simulation, contact ratio, e-Gear, mesh stiffness, micro and macro geometry, transmission error, radiated noise, NVH
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