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Title: Cabin Noise Studies for the Orion Spacecraft Crew Module

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Abstract:

Controlling cabin acoustic noise levels in the Crew Module (CM) of the Orion spacecraft is critical for adequate speech intelligibility, to avoid fatigue and to prevent any possibility of temporary and permanent hearing loss. A vibroacoustic model of the Orion CM cabin has been developed using Statistical Energy Analysis (SEA) to assess compliance with acoustic Constellation Human Systems Integration Requirements (HSIR) for the on-orbit mission phase. Cabin noise in the Orion CM needs to be analyzed at the vehicle-level to assess the cumulative acoustic effect of various Orion systems at the crewmember's ear. The SEA model includes all major structural and acoustic subsystems inside the CM including the Environmental Control and Life Support System (ECLSS), which is the primary noise contributor in the cabin during the on-orbit phase. The ECLSS noise sources used to excite the vehicle acoustic model were derived using a combination of established empirical predictions and fan development acoustic testing. Baseline noise predictions were compared against acoustic HSIR requirements. Key noise offenders and paths were identified and ranked using noise transfer path analysis. Parametric studies were conducted with various acoustic treatment packages in the cabin to reduce the noise levels and define vehicle-level mass impacts. An acoustic test mockup of the CM cabin has also been developed and noise treatment optimization tests were conducted to validate the results of the analyses.