Remote Sensing for a Lining Integrated Active Structural Acoustic Control System

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ABSTRACT

In the framework of the EU project ACASIAS an aircraft sidewall panel (lining) with structurally integrated actuators and sensors is developed. Each lining has a digital unit which samples the sensor signals, performs filtering operations and supplies the actuators with control signals. The whole system makes up an active structural acoustic control system aiming at the reduction of low-frequency multi-tonal aircraft interior noise. The novelty of this approach compared to past implementations of active noise control (ANC) systems in aircraft is its modularity. Each so-called smart lining is autonomous in the sense that it processes only structural sensor data from its own integrated sensors. The use of external microphones for error sensing is avoided because this conflicts with the modularity of the smart lining. Hence, one important design task is the replacement of the physical error microphones by the integrated structural sensors and an acoustic filter (observer) running on the digital unit. This method, which is called the remote microphone technique for active control, has never been applied to a complex aircraft structure so far.

The detailed design of the smart lining module comprises several steps which are taken within work package 3 of the ACASIAS project. Experimental data of an aircraft typical double panel system is captured in a sound transmission loss facility. The system is excited with a loudspeaker array placed directly in front of the fuselage structure. Different acoustic load cases are used for the definition of the sensors and the actuators. A multi-tonal excitation with high sound pressure level is relevant for the actuator dimensioning and a broadband excitation with multiple independent sound sources is relevant for the sensor definition. 19 accelerometers are mounted on the lining and 20 microphones are placed in front of it. All sensor signals are sampled simultaneously for deterministic and broadband load cases. The lining is equipped with two inertial mass actuators which are used for the active control. Measured frequency response functions of actuators at 39 positions are used for the optimization of the actuator locations. The measurement data is also used for the derivation of an observer and for the simulation of a smart lining with remote microphones.

In this contribution, the steps undertaken for the detailed design will be described and simulation results of the noise reduction performance of the smart lining with remote microphones will be presented.