3D Interior Measurement

The Acoustic Camera as an Effective Tool for NVH Analysis in an Aircraft

CHALLENGE

A company responsible for the interior design business jets discovered excessive in-flight sound in their cabin design of high end business airplanes during steady flight. Business jets have a high standard of quality, and the NVH (Noise, Vibration and Harshness) experienced during the flight should be kept to a minimal, comfortable level. To efficiently improve the acoustic insulation during the next maintenance cycle of the aircraft, the major sound sources during the flight needed to be identified.

SOLUTION

The Acoustic Camera is a precision instrument for 3D analysis of complex structures to quickly identify the sources of acoustic noise. Different noise types (broadband, narrow-band, stationary or impulse noises) can be analyzed and located accurately, even in low frequency ranges and in loud environments. After identifying the dominant sound sources inside the aircraft cabin, the client could design improvements to maximize comfort inside the airplane.

BENEFITS

- Fast and easy measurement set-up and analysis
- Mobile and completely battery powered system for on-board measurement in small spaces while in motion
- Unparalleled dynamic range for precise localization in any sound environment
- Psychoacoustic analysis
- Full 3D analysis of the airplane interior

MEASUREMENT

Measurement object	Bombardier BD-700- 1A10 Global Express
Microphone array	Sphere48 AC Pro
Software NoiseImage 4	Acoustic Photo 3D Recorder Interface Spectral Analysis Psychoacoustics Advanced Algorithms
Data acquisition	Data recorder mcdRec
3D Scan	Faro Scanner

To cover the whole area of the passenger cabin, three different measurement positions were chosen – front, middle and back of the cabin. A 3D model of the cabin was created in situ using a Faro Scanner. The acoustic data was mapped onto the 3D model in the acoustic analysis software NoiseImage. The complete testing set-up took less than 20 minutes.

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RESULTS

During the flight, only stationary noises occured. The sound pressure levels (SPL) showed a significant increase of 2 dB in the front and the middle sections of the cabin. After applying an A-weighting filter, the difference did not seem to be as significant (less than 1 dBA). The major emissions could be located in the middle of the passenger cabin, above 630 Hz.

The acoustic data was analyzed in the frequency domain and in the time domain.

Frequency domain: The origin of the noise was found in various third octave bands of 250 Hz, 315 Hz, 3150 Hz and 6300 Hz. The sound was radiating from the floor in the middle of the cabin and from the side of the fuselage (Figure 1).

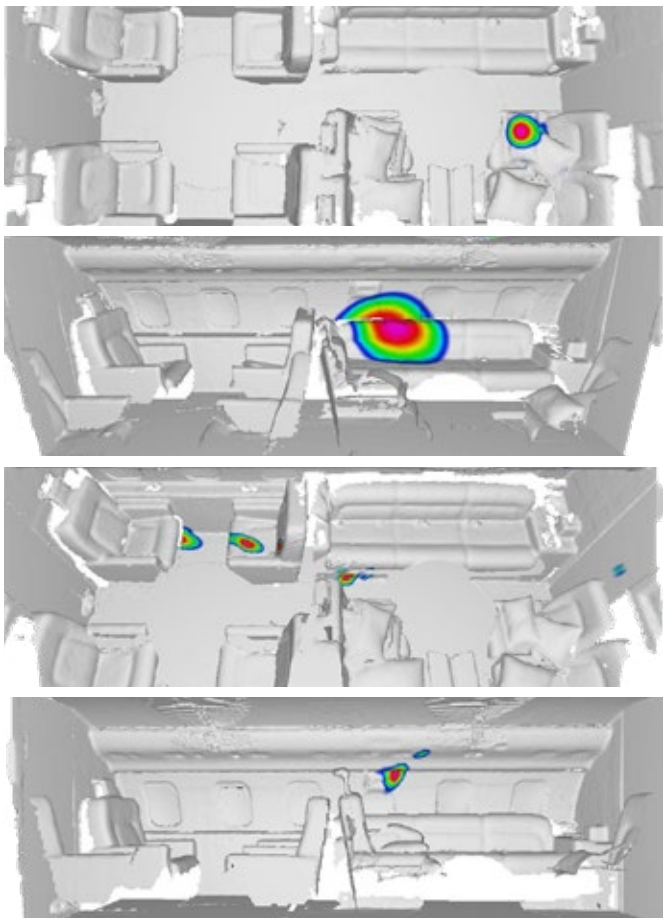

Fig. 1: From top to bottom respectively: Spectral analysis for the third octave bands of 250 Hz at 59.17 dBA, 315 Hz at 53 dBA, 3150 Hz at 22 dBA and 6300 Hz at 15.67 dBA measured from the back of the cabin

Time domain: Figure 2 visualizes the results from two different array positions. The loudest sound sources were located at the ceiling above the chosen measurement position, 85.22 dB (front) and 83.06 dB (back). In both scenarios, ground-reflected sources, around 68 dB, can also be seen.

Fig. 2: Time domain results for the front and the back measurement positions

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