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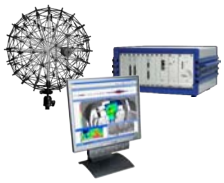
Application Note. Interior Noise Measurements.

acoustic camera

System Characteristics



Array Sphere48
48 microphones
35 cm diameter
Carbon fiber structure
Dynamic of the microphones: 35 dB -130 dB
Recommended mapping frequencies: 1 kHz - 20 kHz
Typical measurement distance: 0.4 - 2 m

Data Recorder
192 kHz Sampling frequency
48 to 144 channels per 10 inch rack (24 channels per card)
Ethernet Interface → high transfer rate → 20 MByte/s, network-compatible
Digital card with 12 extra channels for recordings of RPM, rotation angle, reversal point, etc.
Integrated PC with Windows XP (embedded)

Software
NoiseImage3

Power Supply
Mobile power supply / battery pack

3D Measurements – Airplane Cavity

Cabin mapping of a Cessna C 172

This application example demonstrates the application of the Acoustic Camera for the analysis of flight noise in the cavity of an airplane. For this purpose a one-propeller Cessna C 172 has been analyzed during flight and landing. Besides different flight modes several targeted excitations inside the cabin have been measured and mapped.

Application Area

Acoustic analysis of cavities in aircrafts during operation

Measurement Object

Cessna C 172 (4-seat, high-wing, one-propeller airplane)

Measuring Set-up

The set up of the Acoustic Camera inside the airplane took about 10 minutes. After another 5 minutes for the connection of the mobile power supply and the fitting of the array position into the 3D CAD model of the airplane the system was ready to go.

Results

At first, it has been analyzed how well squeak and rattle noises can be detected during flight. Knocking noises at the casing have been manually introduced at different locations inside the cavity. Despite the relatively loud flight noise all excitations have been located without any difficulty (Fig. 4 and 5).

During the analysis of the flight noise certain frequency bands were distinctive. Between 750 and 1300 Hz an entry from the front airplane roof into the cabin occurred (Fig. 6). In this region the connections to the wings of the high wing airplane are located. However, the emission has been stronger on the right side than on the left side.

Fig. 1 Measuring object Cessna C 172

Fig. 2 System set-up

Fig. 3 Array position inside cavity

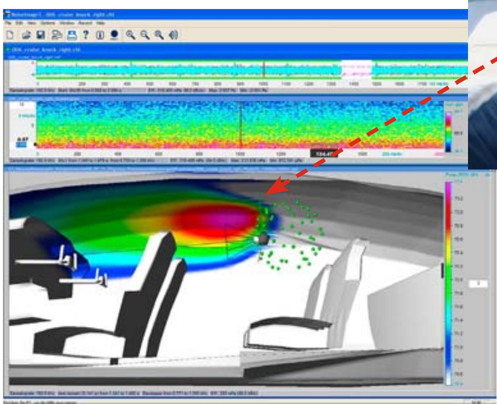


Fig. 4 Localization of knocking onto the inner casing

Fig. 5 Position of knocking

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Application Note.
Interior Noise Measurements.

acoustic camera

The broad band analysis of noises between 2 and 6 kHz showed a leakage at the rear sealing of the left B-pillar and an emission through the right side window (Fig. 8)

In the higher frequency range a very distinct emission appeared at the right A-pillar (Fig. 11, Spectrogram), which indicated a defect door fastening. This squeaking noise is highly relevant under psycho-acoustic consideration.

The noise which is generated during the landing / touchdown mainly came from the right back cabin floor. The analysis of the distinctive frequency band between 660 and 1400 Hz shows the spot of emission very precisely (Fig. 13). This is the exact position of the mounting of the chassis.

Conclusion

The 3-dimensonal analysis of cavities in connection with the utilization of hardware and software autarkical at any place permits to conduct analysis of complex noise structures during flight with the Acoustic Camera. Both sources of impulse type and stationary noise can be located even in low frequency ranges.

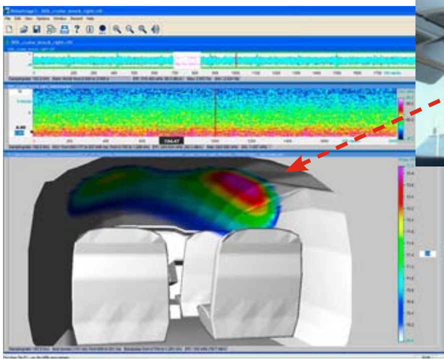

Fig. 6 Localization of the entry over the wing to the cavity; band between 750 and 1300 Hz

Fig. 7 Position of the source, 750 to 1300 Hz

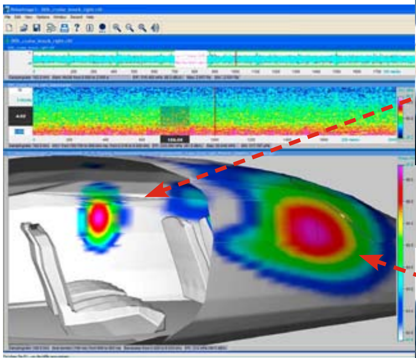

Fig. 8 Localization of an emission at the right side window and the left B-pillar; Band between 2 and 6 kHz

Fig. 9 Source at B-pillar; 2 to 6 kHz

Fig. 10 Side window as source; 2 to 6 kHz

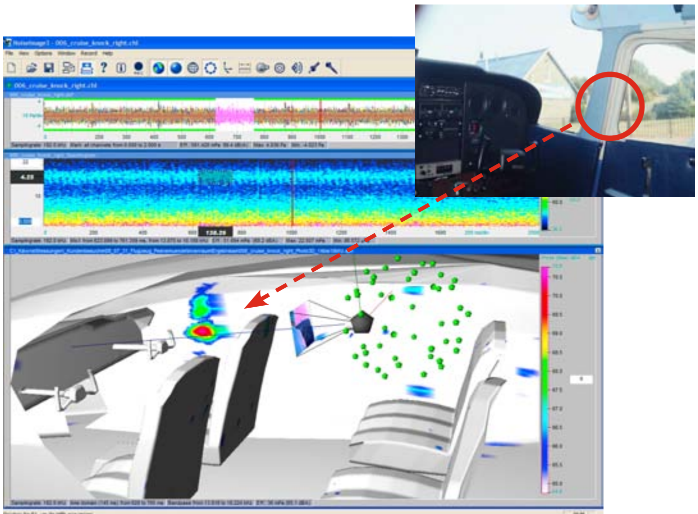

Fig. 11/12 Localization of an entry over the right A-pillar; Band between 14 and 18 kHz / Leaky A-pillar; 14 to 18 kHz

Fig. 14 Position of the source is the right chassis mounting

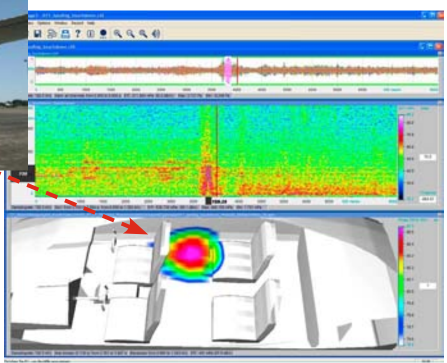

Fig. 13 Localization of the hitting noise at touch-down; Most distinctive between 660 and 1400 Hz

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