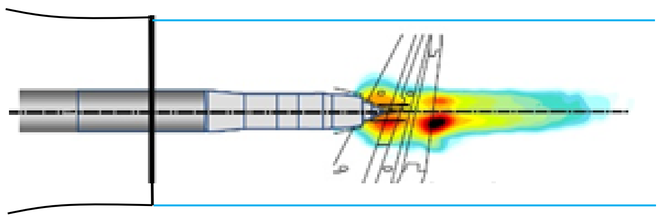
ACOUSTIC SOURCE LOCALIZATION TECHNIQUES

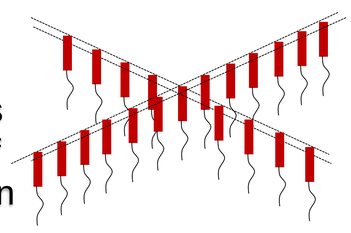
Implementation of microphone array to localize and quantify acoustic sources

Measurement techniques applied to different experimental conditions: wind tunnel, static bench, in-flight, flyover

PRINCIPLE : ESTIMATE ACOUSTIC SOURCE DISTRIBUTION REPRODUCING THE MEASUREMENTS



Measurement of the Interspectral Matrix between microphones = Fourier transform of the time intercorrelation function



Problem to be solved:

$$\tilde{\mathbf{S}}(\nu) = \arg\min_{\mathbf{S}(\nu)} \left\{ \left\| \mathbf{\Gamma}(\nu) - \mathbf{G}(\nu)\, \mathbf{S}(\nu)\, \mathbf{G}^{\mathrm{H}}(\nu) \right\|_{\mathrm{F}}^{2} \right\}$$

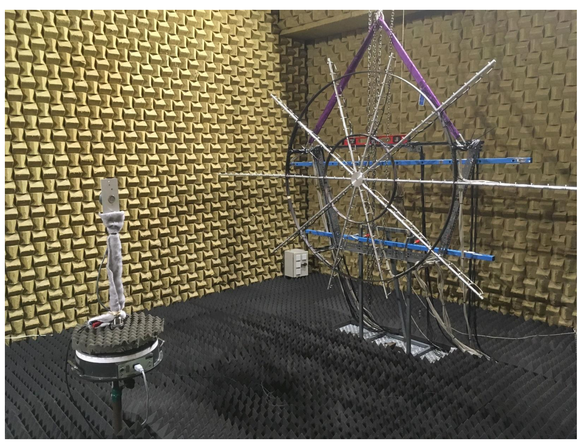
- $\mathbf{\Gamma}(\nu)$: Measurement
- $\mathbf{G}(\nu)$: Green function = propagation term
- $\mathbf{S}(\nu)$: Estimated sources

Several models

- **Beamforming: single monopole**
  Hypothesis: Sources uncorrelated and spatially separated
  $S = \begin{pmatrix} S_{ii} & & 0 \\ & \ddots & \\ 0 & & 0 \end{pmatrix}$
- **DAMAS: uncorrelated monopoles**
  Hypothesis: Sources uncorrelated
  $S = \begin{pmatrix} S_{11} & & 0 \\ & \ddots & \\ 0 & & S_{mm} \end{pmatrix}$
- **DAMAS-C: correlated monopoles**
  Hypothesis: sources correlated
  $S = \begin{pmatrix} S_{11} & \cdots & S_{1j} \\ \vdots & \ddots & \vdots \\ S_{i1} & \cdots & S_{mm} \end{pmatrix}$
- **DAMAS-MS: moving sources**
  Dedicated method including Doppler effect

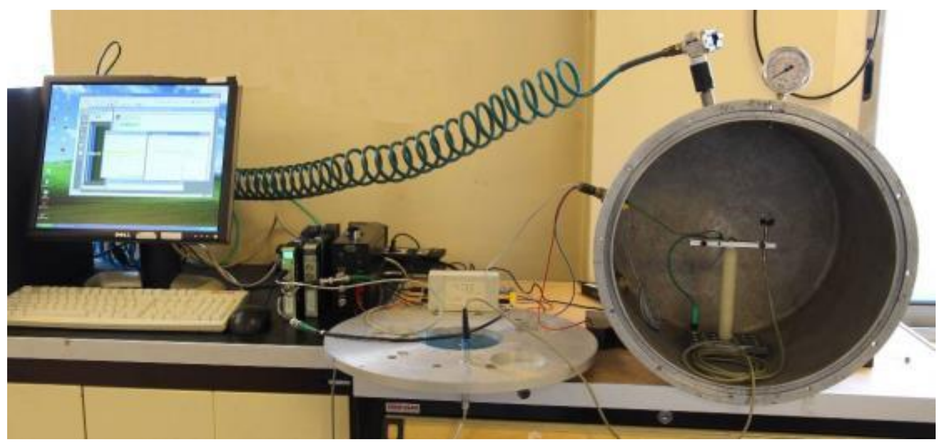
MEASUREMENT MEANS

- More than 500 microphones
- 321 synchronous channels B&K LanXI acquisition system; up to 262 kHz of sampling frequency
- Several microphone array geometries; adaptation to specific configurations if needed



Typical microphone array (characterization in anechoic room)

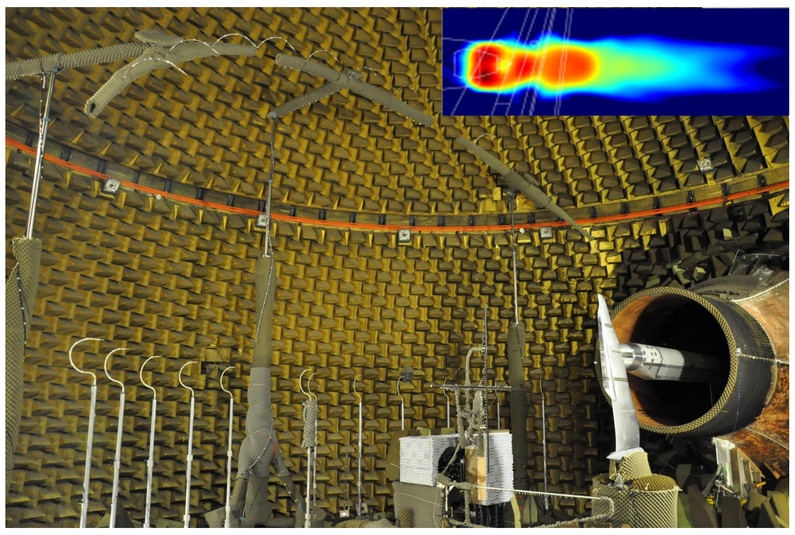
Modular B&K Lan-XI acquisition system



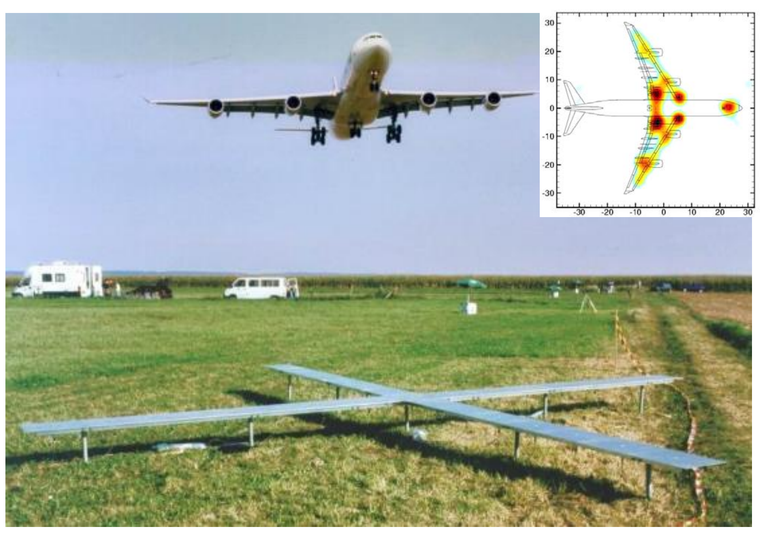
Calibration of microphones up to 4 bar (for Reynolds effect in pressurized wind tunnel

PREVIOUS EXPERIENCES

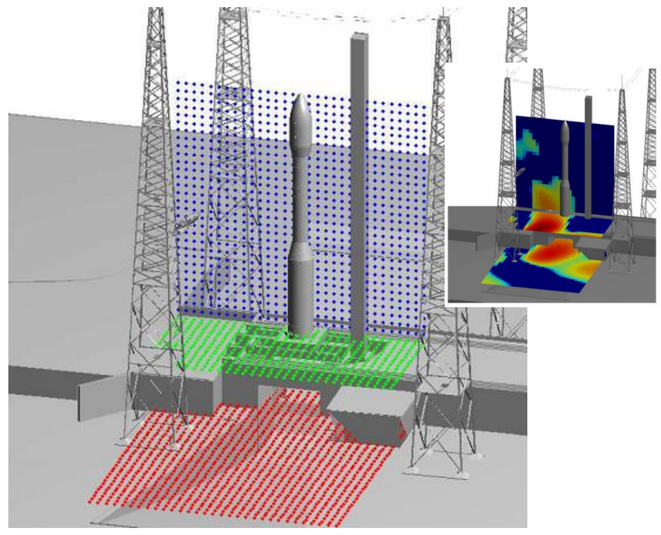
- Airframe noise, jet noise and jet flap interaction noise characterization in aeroacoustic wind tunnel (CEPRA19)
- First applications in aerodynamic wind tunnel (without acoustic treatments of the wall)
- Scale one measurement on A320, A340, A380
- Characterization of acoustic environment of launch pad at lift-off (small scale for Ariane 6, full scale for VEGA)



Installed jet configuration in CEPRA 19



A340 flyover



VEGA launch pad full scale

CONTACT

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