

# Phased array B737 fly-over measurements for assessing noise level variations

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# Introduction

- Variations in aircraft measured noise levels
  - Ground reflections
  - Interfering noise sources
  - Different aircraft configurations
  - Altitude
  - Atmospheric conditions
- Assess the effect of these parameters on the variations
- Tool: Acoustic camera



# Contents

- Measurement Set-up
- Measurement Approach
- Results
- Conclusions

# Measurement Set-up

- Acoustic camera with 32 microphones in a spiral configuration
- Location underneath the flight path of landing aircraft
- Fly-over height approximately 40m
- 8 Measurements
- Acoustic camera characteristics:
  - Blocks of data
  - Measurement time 3.6 sec



# Measurement Approach

- Create a database of measurements
- Only Boeing 737
- Rotterdam The Hague Airport





# Measurement Approach

Parameter: Interfering noise sources

- Beamforming
- Distinguish individual noise sources
- Only consider noise coming from the aircraft

# Measurement Approach

Parameter: Different aircraft configurations

- Optical camera
- Deduce aircraft configuration



# Measurement Approach

Parameter: Atmospheric conditions

Measurement	Temperature (C)	Humidity (%)	Alpha (dB/100m)
1	11.1	67	1.0612
2	11.1	67	1.0612
3	11.1	67	1.0612
4	9.8	68	1.0934
5	12.2	74	0.9927
6	10.4	85	0.9493
7	10.3	83	0.9615
8	6.2	76	1.1481

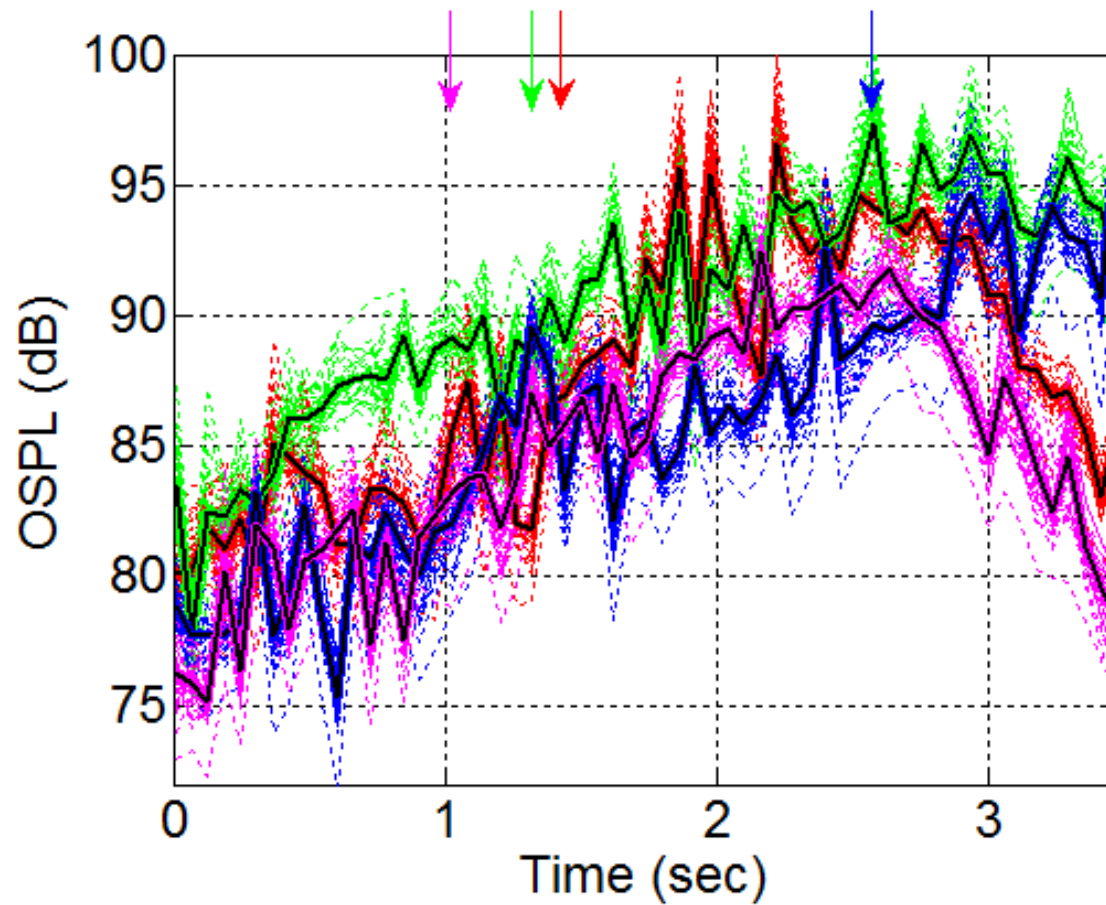
Obtained from KNMI:

<http://www.knmi.nl/klimatologie/uurgegevens/#no>



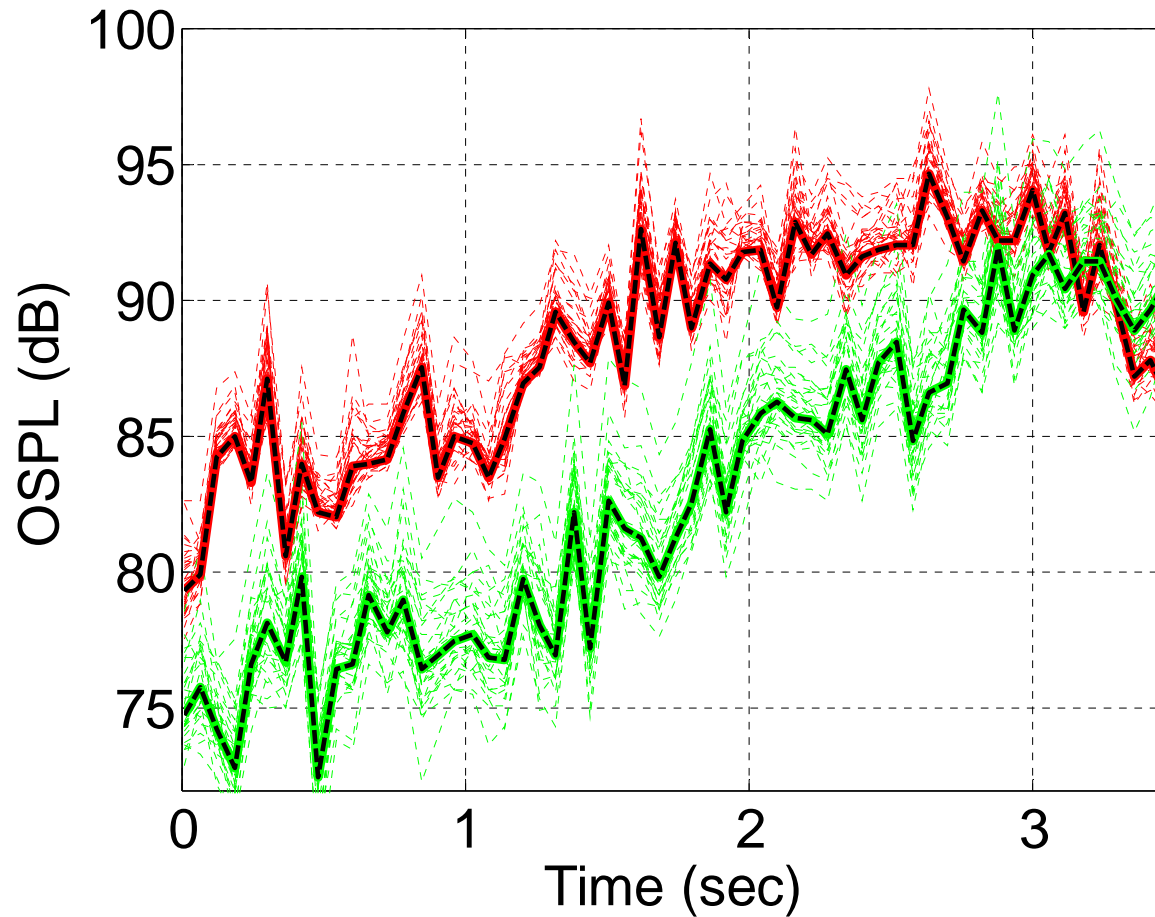
# Results

## Overall Sound Pressure Level



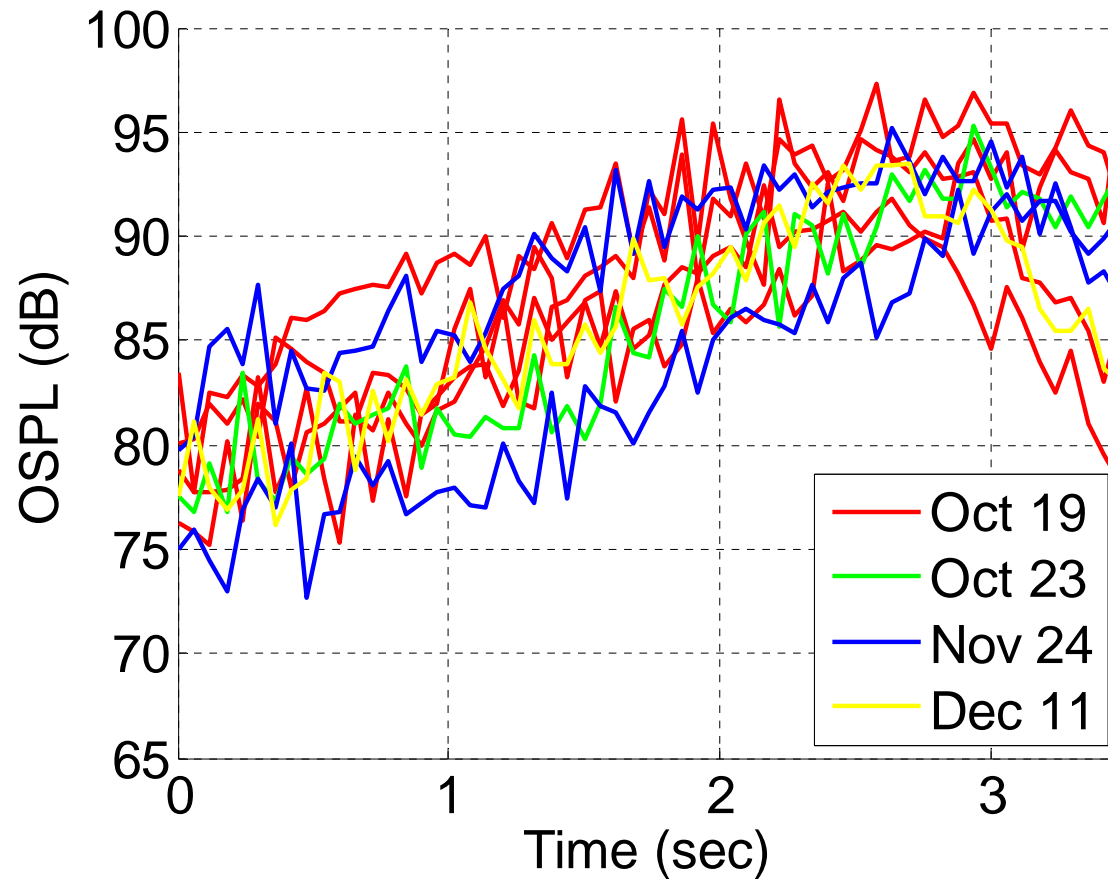
# Results

## Overall Sound Pressure Level



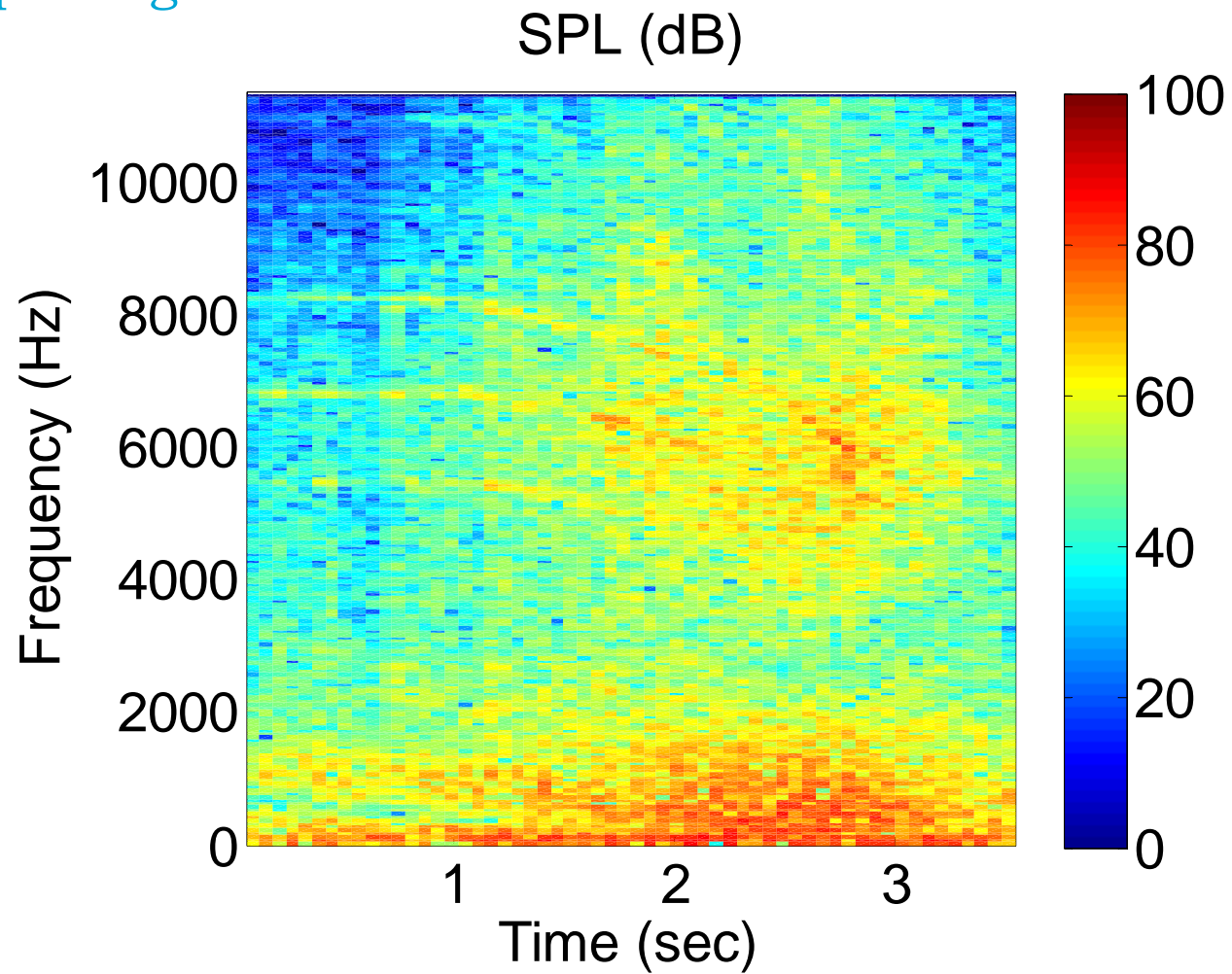
# Results

## Overall Sound Pressure Level



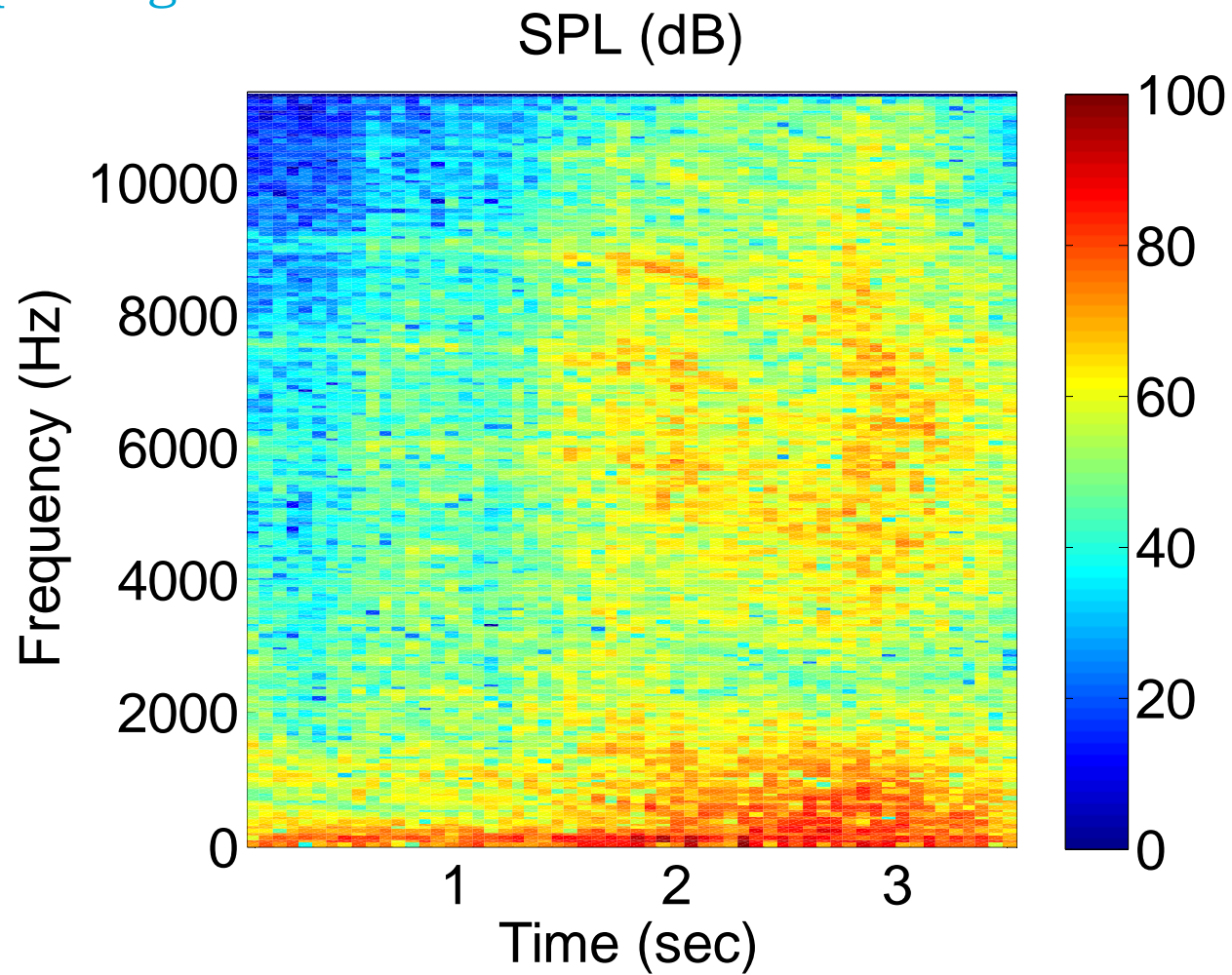
# Results

## Spectrogram



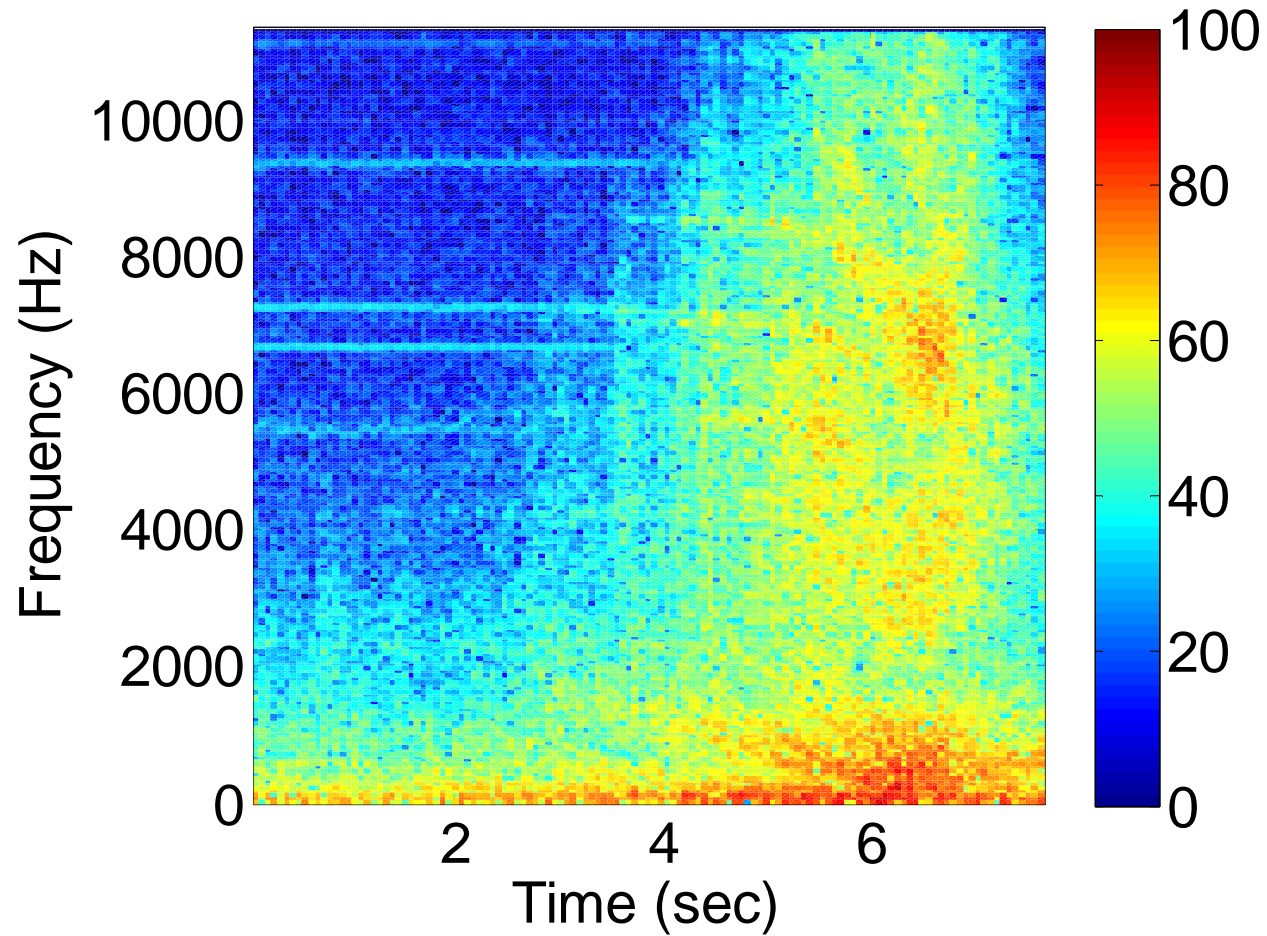
# Results

## Spectrogram



# Results

Spectrogram measurement 8  
SPL (dB)





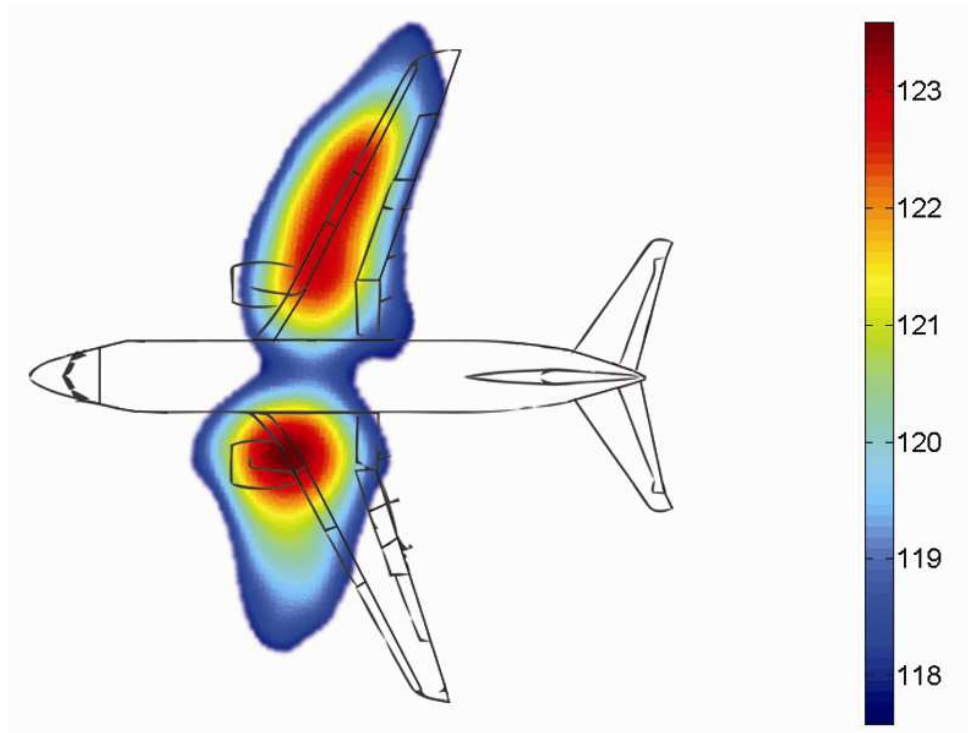
# Results

## Beamforming

- Frequency selection: 1500-4000 Hz
- Conventional beamforming
- Range of 6 dB

# Results

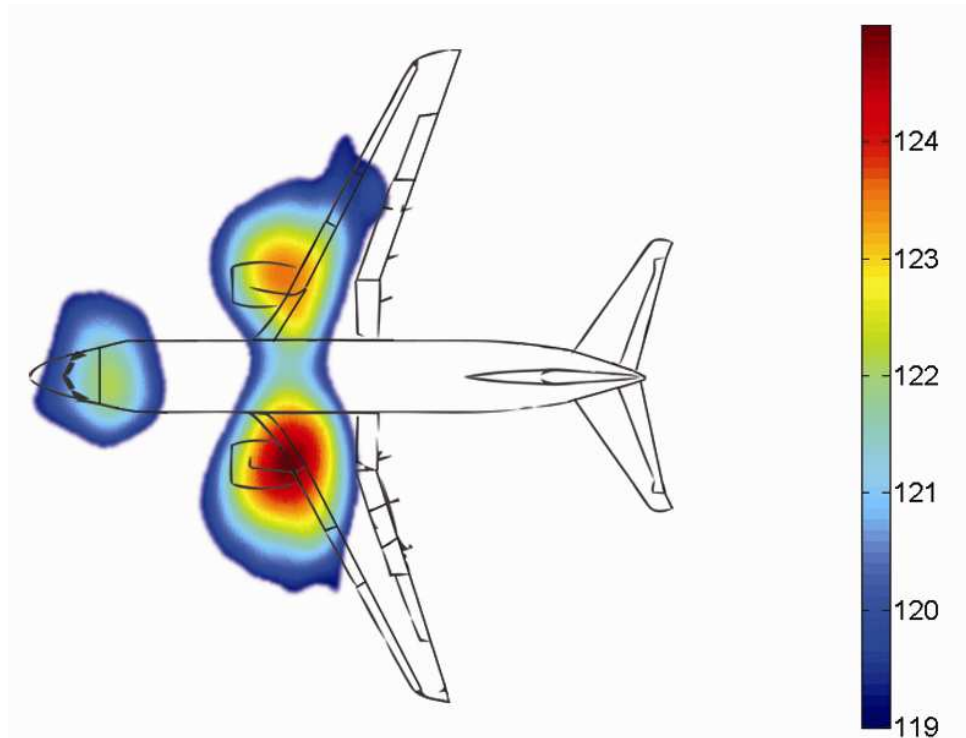
Beamforming 1500-4000 Hz measurement 3





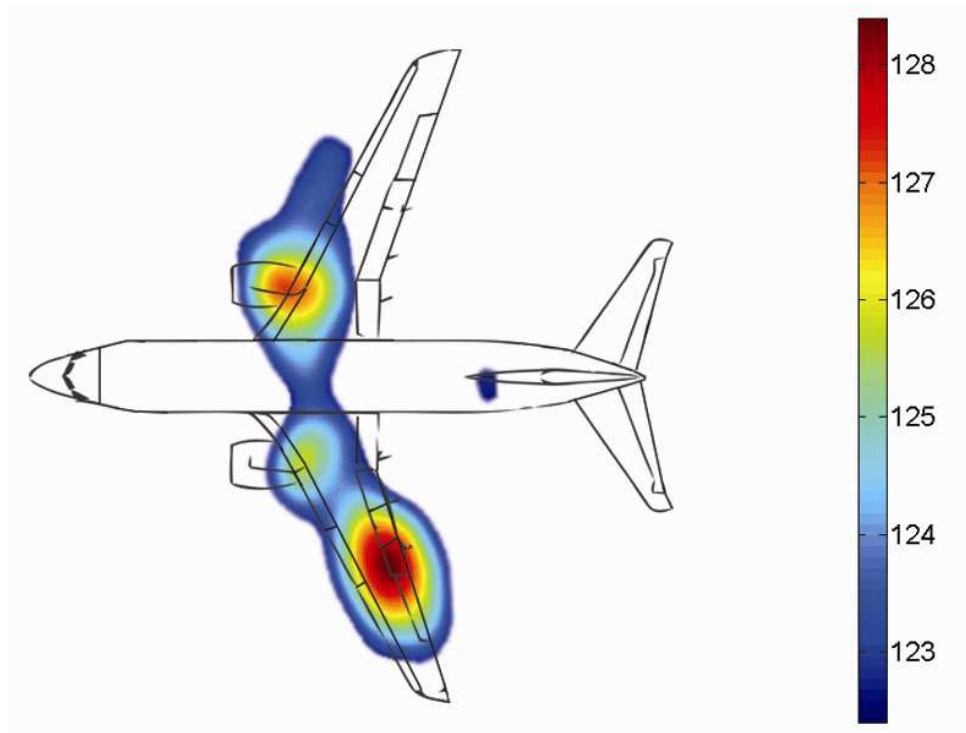
# Results

Beamforming 1500-4000 Hz measurement 4



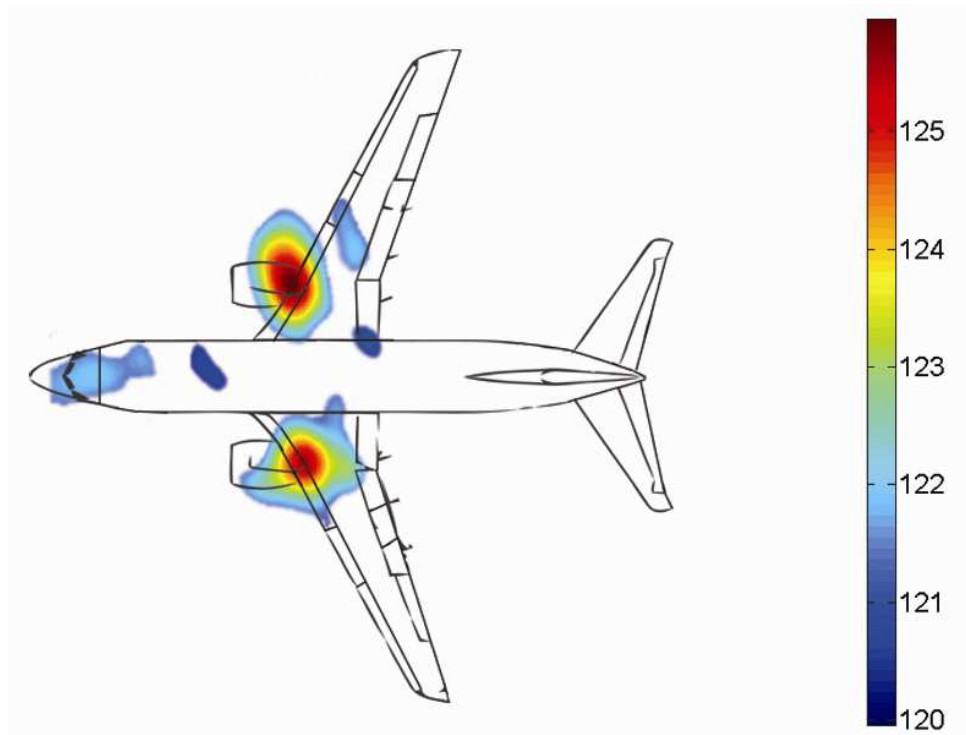
# Results

Beamforming 1500-4000 Hz measurement 6




# Results

Beamforming 1500-4000 Hz measurement 8



# Conclusions

- All required data to determine the influence on the overall sound pressure level of the following parameters:
  - Ground reflections
  - Interfering noise sources
  - Different aircraft configurations
  - Altitude
  - Atmospheric conditions
- Improved acoustic camera
  - More microphones
  - Continuous data
  - Long measurement times



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