Array Analysis Methods Benchmarking
Analytical Benchmark 7 - Four Point Sources

Ennes Sarradj

Brandenburgische Technische Universität

2016-2-29, BeBeC, Berlin
Four Point Sources

Setup

- 64 microphones
- white noise point sources
- subcases
  - a: sources have the same power
  - b: sources have different power (0, -6, -12, -18 dB)

Version history:
- Feb. 2015: initial version 1
- Nov. 2015: version 2, parameter defaults
Contributors:

- Chris Bahr (NASA), Ric Porteous (Univ.Adeelaide), Pieter Sijtsma (PSA3), Ennes Sarradj (BTU)

Methods (default parameters):

- DAMAS (NASA, BTU: 200 iter.; Univ.A: ?; BTU: 500 iter.)
- DAMAS Jacobi (NASA: 1000 iter.)
- Clean SC (PSA, BTU: dampest=0.9, Univ.A: damp=0.99)
- Orthogonal Beamforming (BTU: 16 Eigenvalues)
- Covariance Matrix Fitting (BTU: NNLS Solver)

Parameters:

- Grid spacing: NASA, BTU: 0.025, PSA3: 0.01, Univ.A: 0.02/0.04
- Integration sector: NASA: square 0.1 m, Univ.A: square 0.2 m, BTU: circle 0.1 m
Results

Estimation error for subcase a

Source 0

Source 1

Source 3
Results

Estimation error for subcase b

Source 0 (strongest, 0 dB)

Source 3 (weakest, ca. -18 dB)

(source has no power for BTU DAMAS)
Preliminary conclusions

- different methods - different results
- different providers, same method - different results
Array Analysis Methods Benchmarking
Analytical Benchmark 8 - Three Sources in an Open Jet

Ennes Sarradj

Brandenburgische Technische Universität

2016-2-29, BeBeC, Berlin
Open Jet with sources
Setup for version 1 (Feb. 2015)

- 64 microphones
- three white noise point sources at $x, y$: (0,0), (0,0.12), (0,0.24) m
- $U_\infty = 68.6$ m/s ($M = 0.2$)
- Challenges: find position and SPL in array center for each source
Open Jet with sources

Example maps (Beamforming, no deconvolution)

Without shear layer correction

[Graphs showing frequency mappings for different sources]

With shear layer correction

[Graphs showing frequency mappings for different sources]
Contributors:
  - Chris Bahr (NASA), Ennes Sarradj (BTU)

Methods:
  - DAMAS (NASA: 200 iter.; BTU: 500 iter.)
  - DAMAS Jacobi (NASA: 1000 iter.)
  - Clean SC (BTU: damp=0.6)
  - Orthogonal Beamforming (BTU: 16 Eigenvalues)
  - Covariance Matrix Fitting (BTU: NNLS Solver)

Parameters:
  - grid spacing: NASA: 0.01, BTU: 0.01 m
  - shear layer correction: NASA: Morfey and Joseph method (JSV 2001), BTU: ray tracing (acoular)
Results

Error of estimated position

Source 0 at (0,0,0.5)

Source 1 at (0,0.12,0.5)

Source 2 at (0,0.24,0.5)

BTU DAMAS
BTU CLEAN SC
BTU ORTH
NASA JACOBI
NASA DAMAS

(same results for NASA DAMAS and DAMAS Jacobi for Source 0)
Results

Estimation error for SPL (source strength)

Source 0 at (0,0.0,0.5)

Source 1 at (0,0.12,0.5)

Source 2 at (0,0.24,0.5)

BTU DAMAS
BTU CLEAN SC
BTU ORTH
NASA JACOBI
NASA DAMAS

(same results for NASA DAMAS and DAMAS Jacobi)
Preliminary conclusions

- infinitely thin shear layer assumption adds some error in this case
- level error more severe for higher frequencies
- shifts sources 10 cm downstream to avoid sources at 'special' locations
- adds extra benchmark information on the sound propagation through shear layer

sound travel times vs. co-ordinate