Array Analysis Methods Benchmarking

Analytical Benchmark 7 - Four Point Sources

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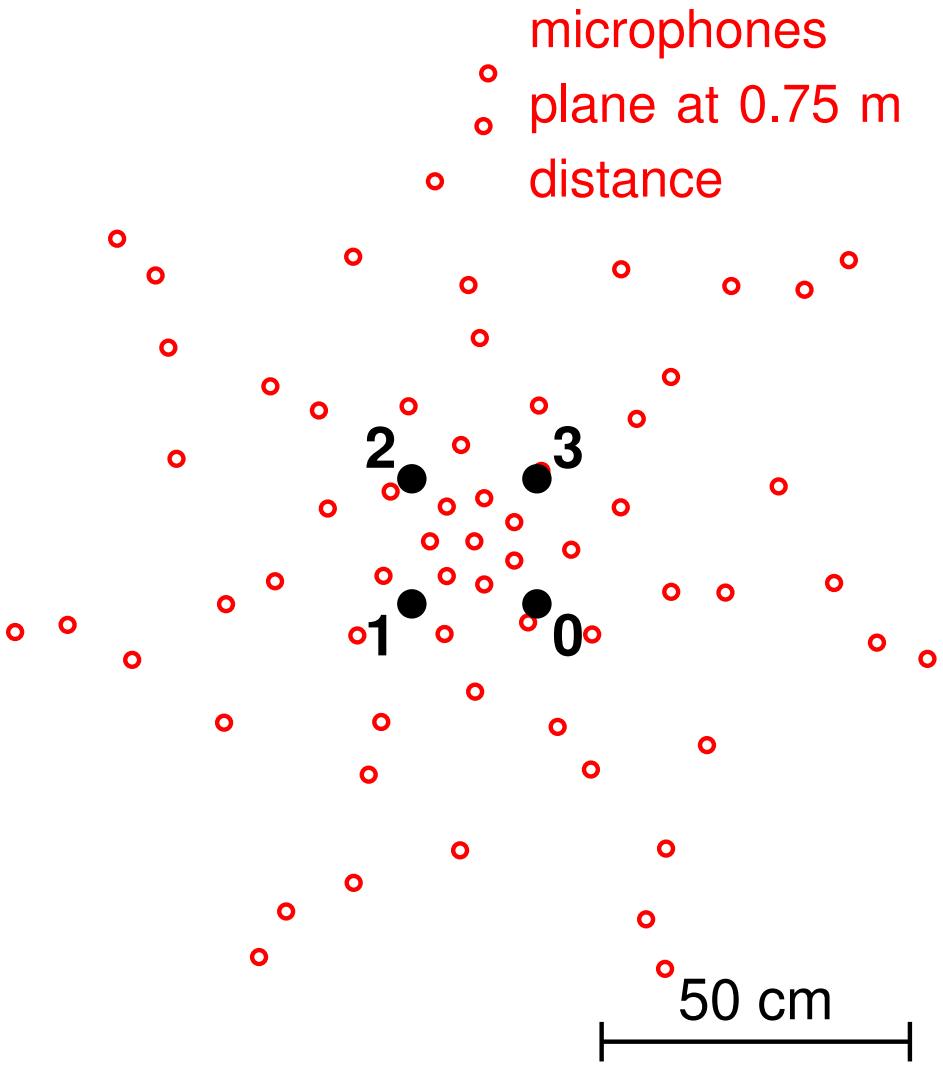
2016-2-29, BeBeC, Berlin

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

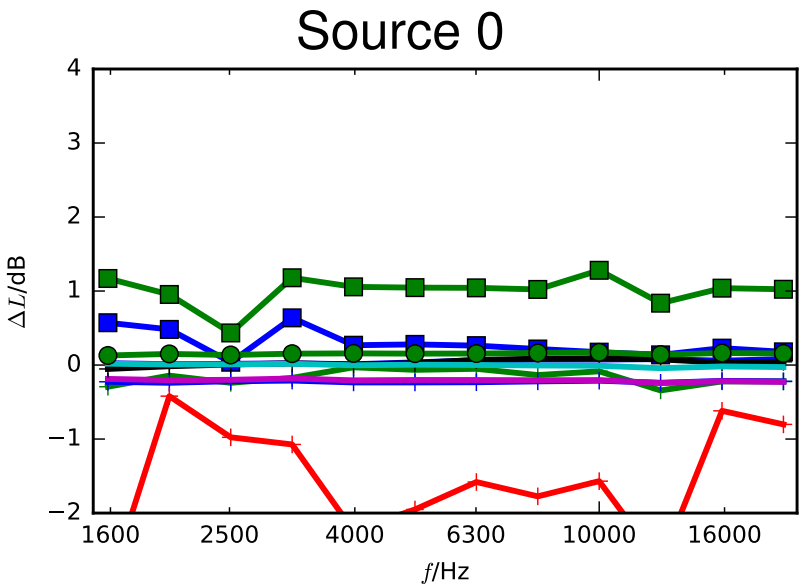
Contributions

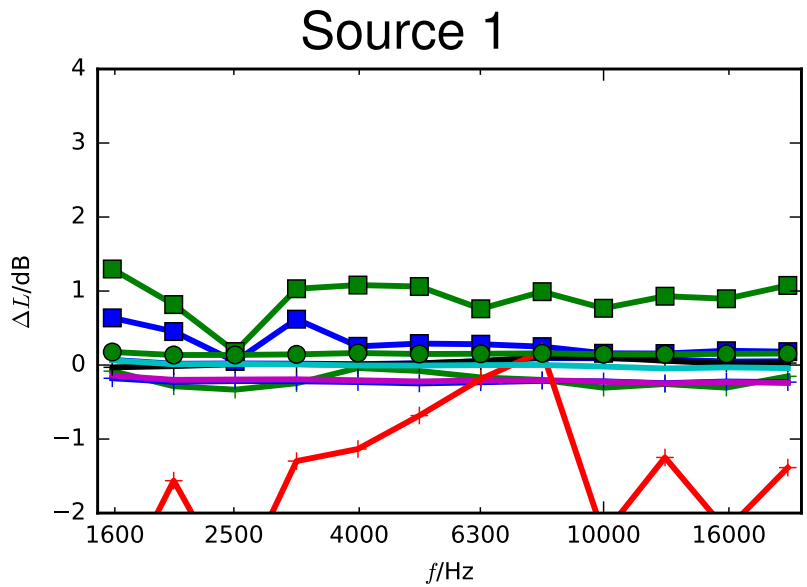
February 2016

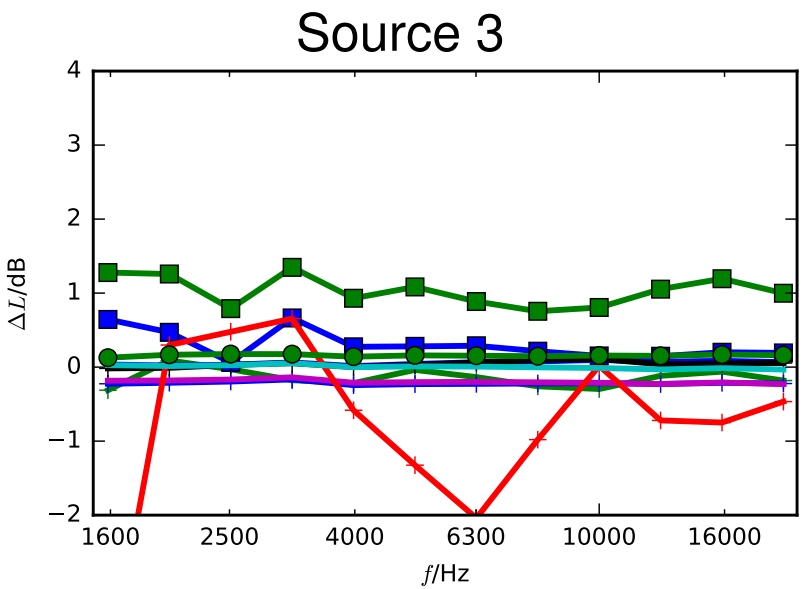
- Contributors:
  - Chris Bahr (NASA), Ric Porteous (Univ.Adelaide), Pieter Sijtsma (PSA3), Ennes Sarradj (BTU)
- Methods (**default** parameters):
  - DAMAS (NASA, BTU: **200 iter.**; Univ.A: ?; BTU: 500 iter.)
  - DAMAS Jacobi (NASA: 1000 iter.)
  - Clean SC (PSA, BTU: **damp=0.9**, Univ.A: damp=0.99)
  - 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

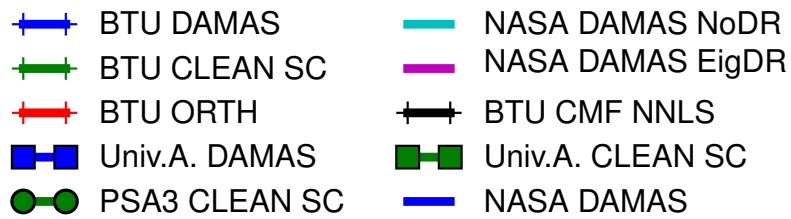
Results

Estimation error for subcase a



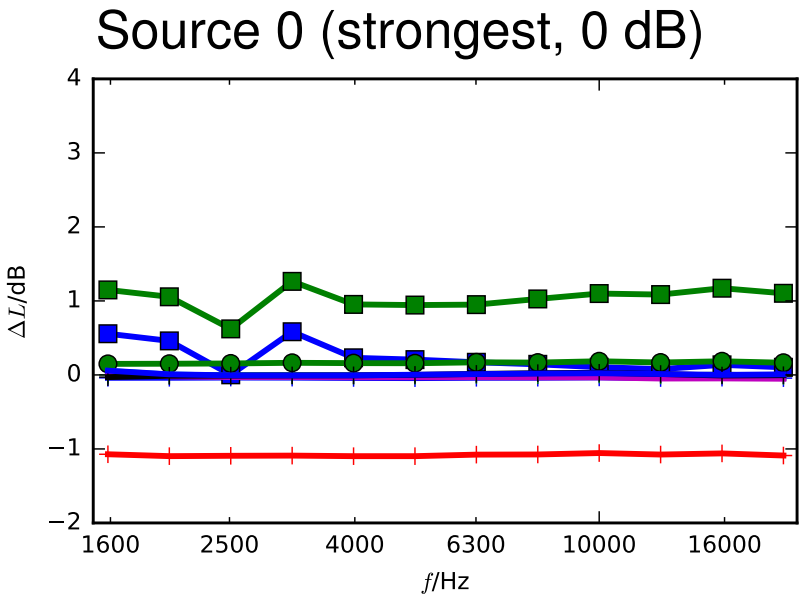


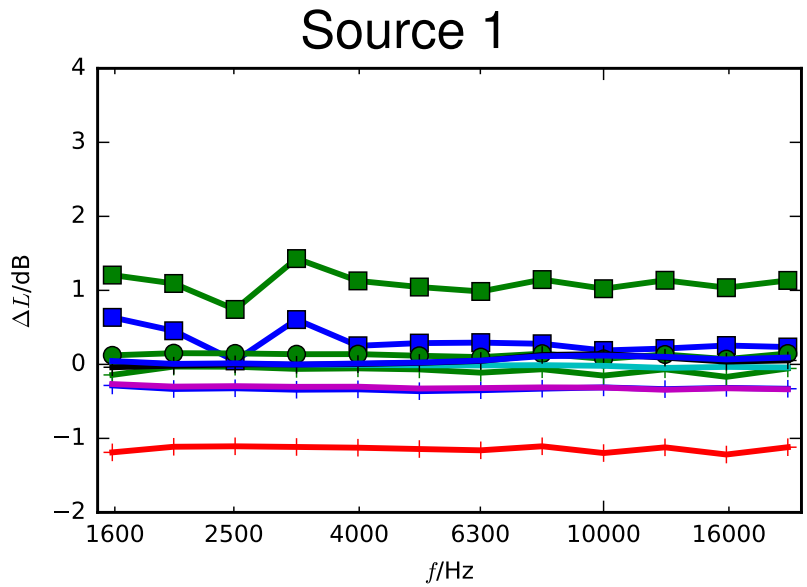


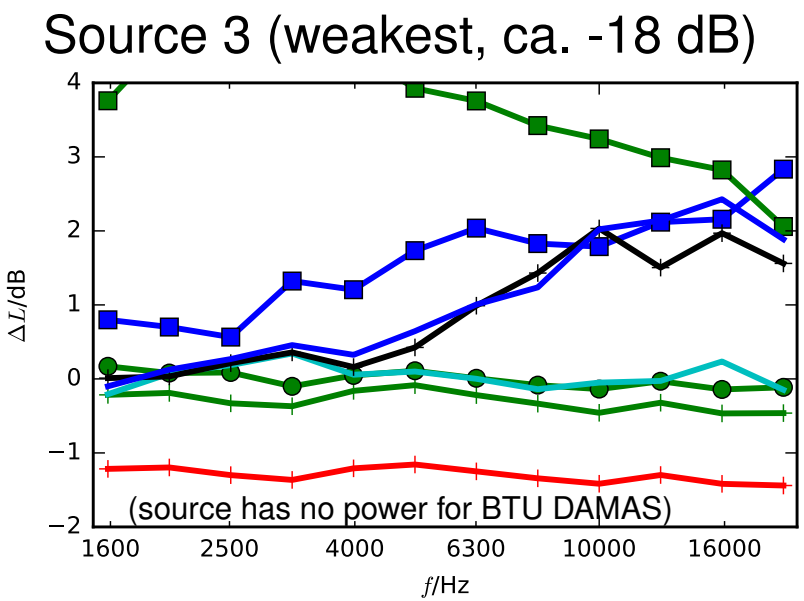


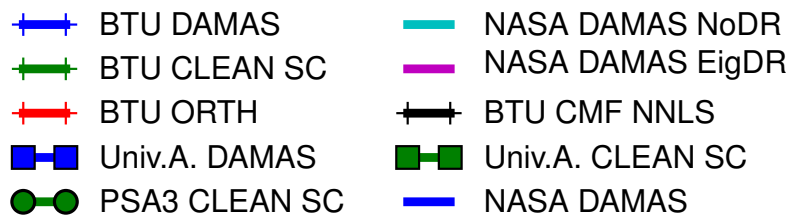
Results

Estimation error for subcase b









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

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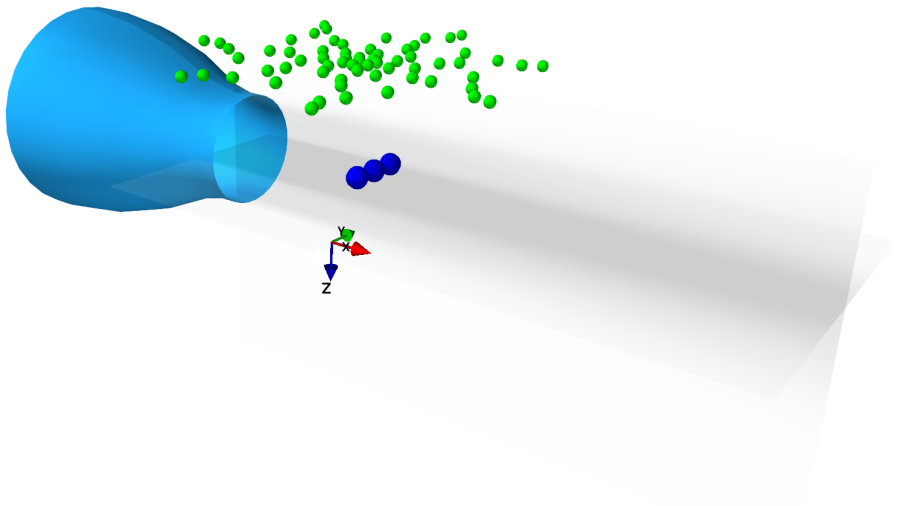
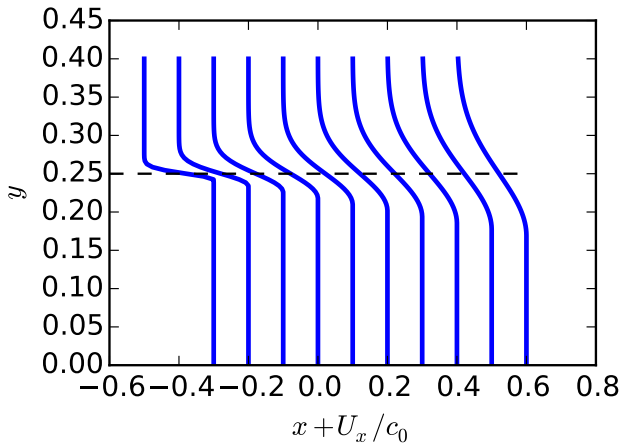
Open Jet with sources

Setup for version 1 (Feb. 2015)



Jet Flow Field

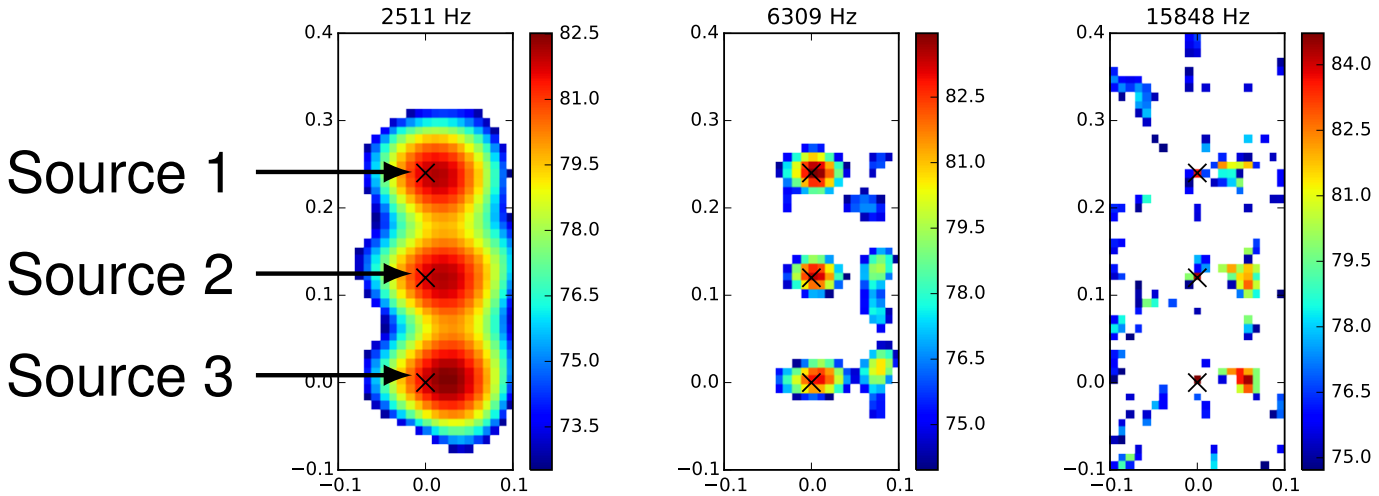


- 64 microphones
- three white noise point sources at x, y: (0,0),(0,0.12),(0,0.24) m
- $U_\infty = 68.6$ m/s ($M = 0.2$)
- Challenges: find **position** and **SPL in array center** for each source

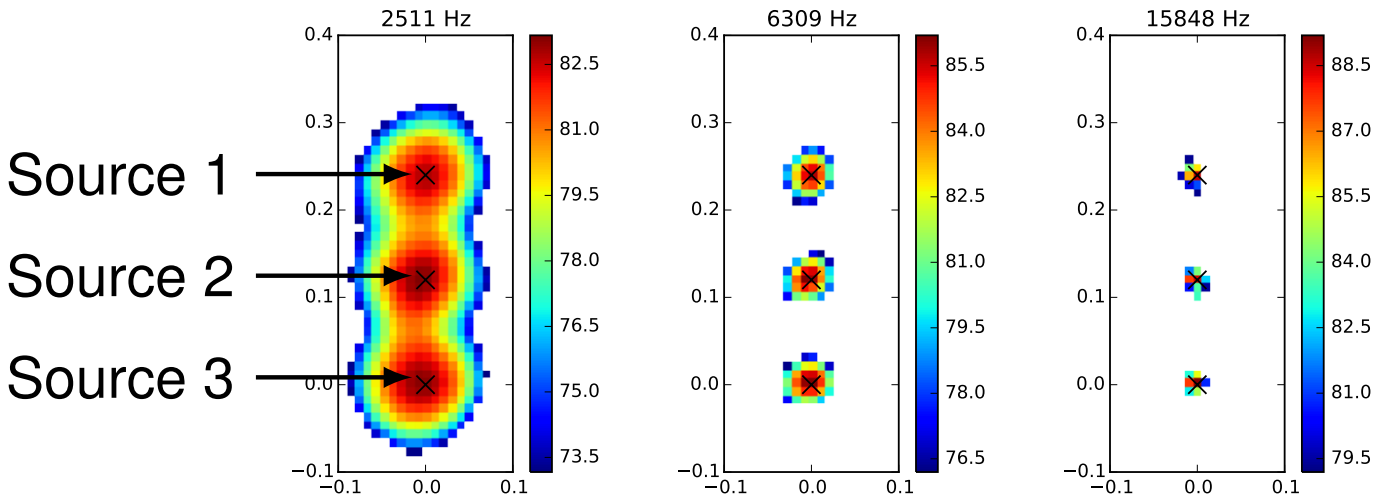
Open Jet with sources

Example maps (Beamforming, no deconvolution)

Without shear layer correction



With shear layer correction



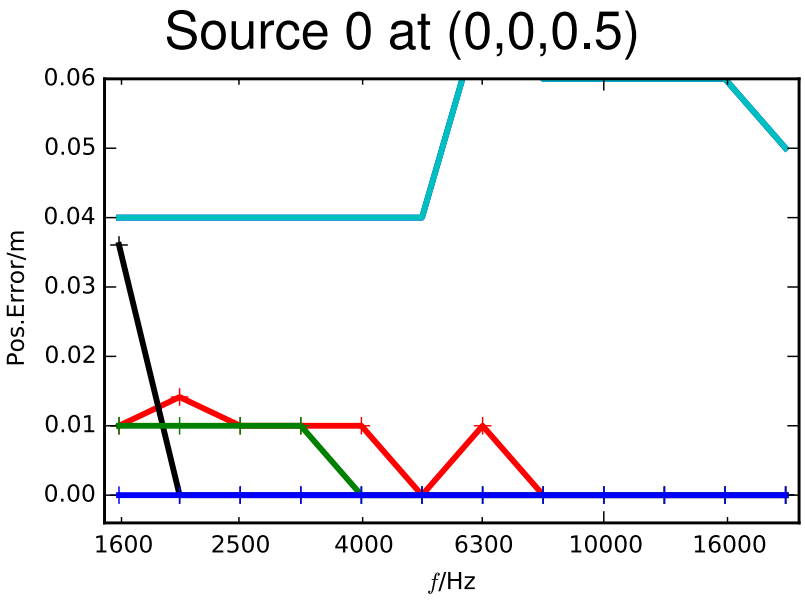
Contributions

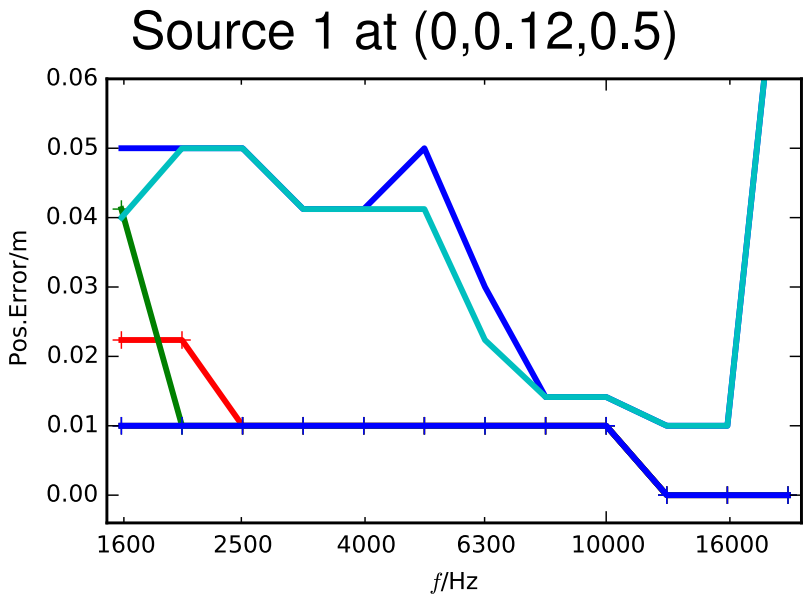
June 2015

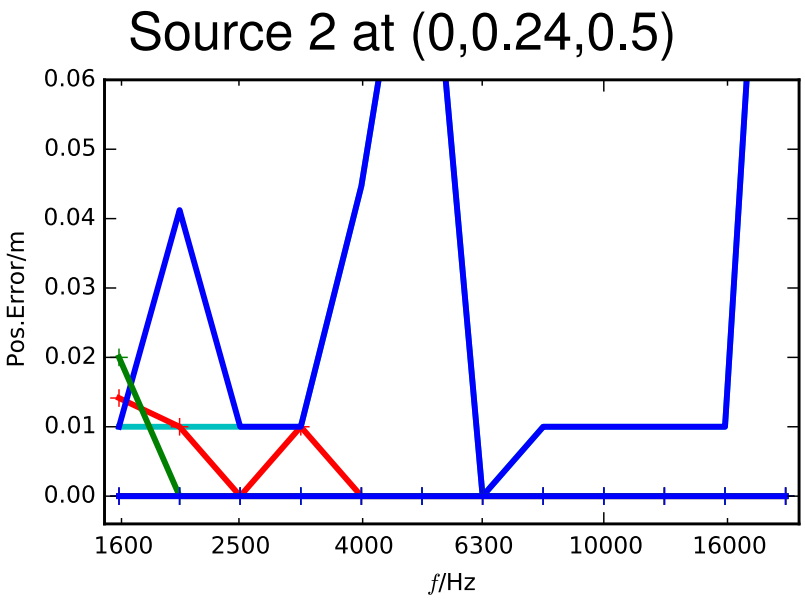
- Contributors:
  - Chris Bahr (NASA), Ennes Sarradj (BTU)
- Methods:
  - DAMAS (NASA: 200 iter.; BTU: 500 iter.)
  - DAMAS Jacobi (NASA: 1000 iter.)
  - Clean SC (BTU: damp=0.6)
  - Orthogonal Beamforming (BTU: 16 Eigenvalues)
  - Covariance Matrix Fitting (BTU: NNLS Solver)
- Parameters:
  - grid spacing: 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





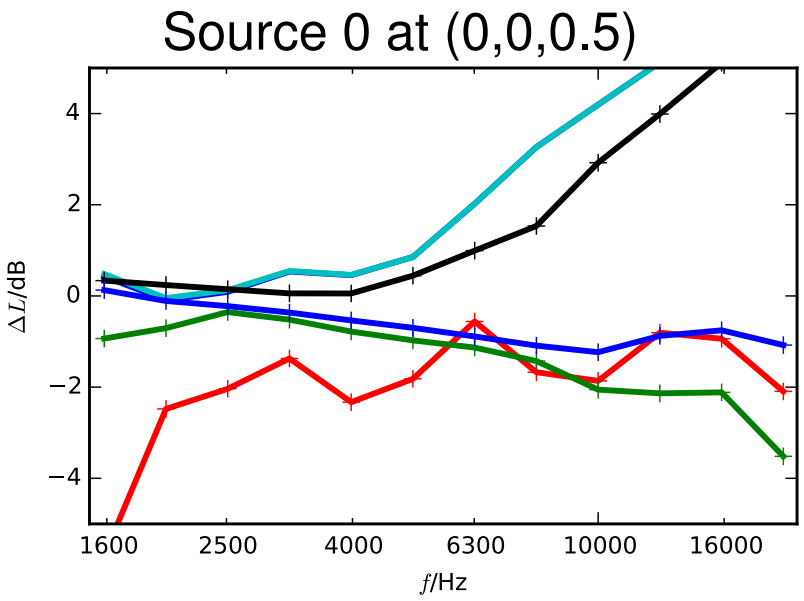


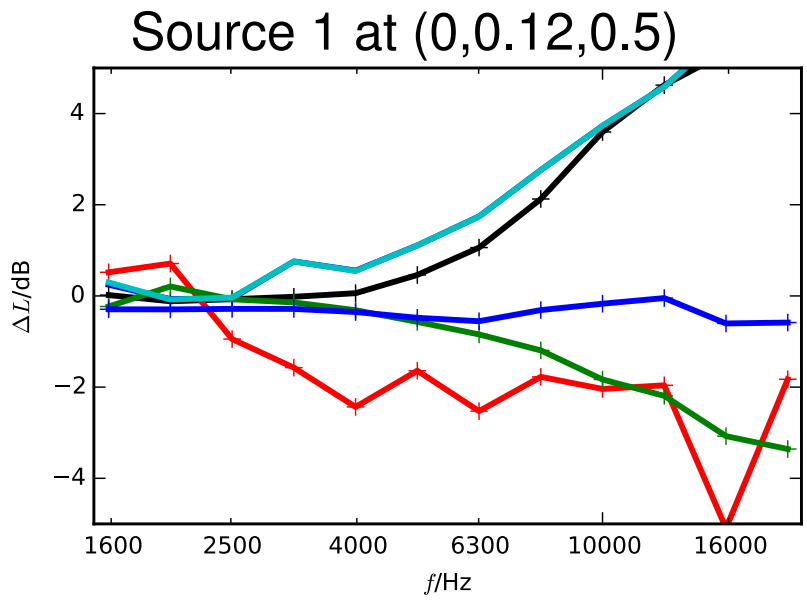
BTU DAMAS
BTU CLEAN SC
BTU ORTH
NASA JACOBI
NASA DAMAS
BTU CMF NNLS

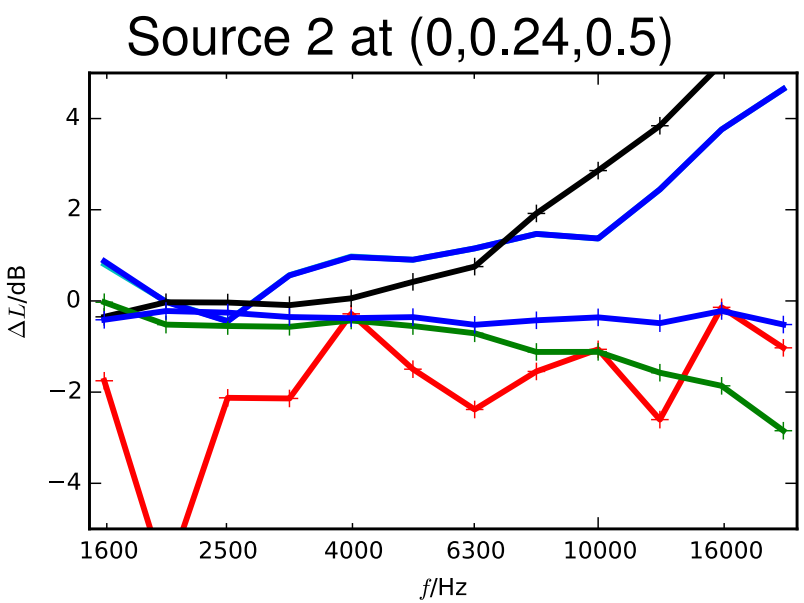
(same results for NASA DAMAS and DAMAS Jacobi for Source 0)

Results

Estimation error for SPL (source strength)







BTU DAMAS
BTU CLEAN SC
BTU ORTH
NASA JACOBI
NASA DAMAS
BTU CMF NNLS

(same results for NASA DAMAS and DAMAS Jacobi)

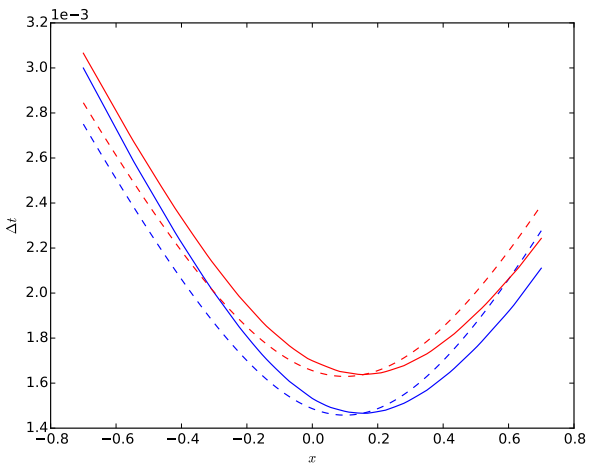
Preliminary conclusions

- infinitely thin shear layer assumption adds some error in this case
- level error more severe for higher frequencies

Version 2

Nov 2015

- 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