Robust multi-frequency sparse Bayesian learning: data results

Kay L. Gemba\textsuperscript{1}, Santosh Nannuru, Ned Richards, William S. Hodgkiss, and Peter Gerstoft

Marine Physical Laboratory of the Scripps Institution of Oceanography
University of California at San Diego
\textsuperscript{1}gemba@ucsd.edu
Presentation objectives

We investigate SBL performance for MFP and CBF and demonstrate using data:

1. SBL behaves similarly to an adaptive processor. The output of SBL is compared to the white noise constraint (WNC), MVDR, and MUSIC processor in a two-source MFP scenario. SBL performs similar to MUSIC and is robust to a "degree" of array-tilt mismatch.

2. SBL can be used to help identify ray-arrivals for CBF.

- Results are demonstrated with simulated and the SwellEx-96 & Noise-09 data.
SNR Localization Curves – Simulation Intro

S\textsubscript{1}S\textsubscript{2}R = 3 dB

No mismatch

1° tilt mismatch

Bartlett

WNC -3dB

SBL

MUSIC

(a)

(b)

(c)

(d)

(e)

(f)

(g)

(h)
Simulations
166 & 201 Hz

No mismatch
1° tilt mismatch

(a) (c)

(b) (d)

1F
2F

SNR [dB]

F_L

SBL
Bartlett
WNC -3dB
MVDR
MUSIC
Simulations 166 Hz and 201 Hz

**SNR vs mismatch**

- **0 dB**
- **-5 dB**
- **-10 dB**
- **-20 dB**

Array tilt mismatch [deg]

**SNR f2 vs SNR f1**

- **-10 dB**
- **-15 dB**
- **-20 dB**

SNR f1 [dB]
SWellEx-96 2-Source Localization: 166 Hz

0° tilt (more mismatch)  1° tilt (less mismatch)

Bartlett

WNC -3dB

SBL

MUSIC
SWellEx-96 2-Source Localization: 166 & 201 Hz

0° tilt (more mismatch)  

1° tilt (less mismatch)

Bartlett

WNC -3dB

SBL

MUSIC
SWellEx-96 Event S5 2-Source Localization

0° tilt (more mismatch)  1° tilt (less mismatch)

![Graphs showing the comparison of 0° and 1° tilt in SWellEx-96 Event S5](image)

- Bartlett
- WNC -3dB
- SBL
- MUSIC
SWellEx-96 Event S59:

- 1 source (60 m) & 1 interferer (surface)
- 45 Processed Frequencies:
  - 166 201 Hz (top set at 158 dB)
  - Entire 2nd set (13 F at 132 dB)
  - +/- 1 bin
- FFT Length: 4096 samples
- Fs: 1500 Hz
- 21 Snapshots @ 50% overlap / segment
Event S59: Deep Source with Surface Interferer
Conclusions

• SBL behaves similarly to an adaptive processor and can discriminate against sidelobes. For MFP, SBL performance is comparable to MUSIC.

• SBL appears robust to modest data replica mismatch demonstrated using array-tilt. It also appears robust in situations when multiple snapshots or frequencies correspond to adjacent range-depth cells at the expense of possible additional solutions (SBL yields an ambiguity surface).

• SBL requires less tuning than Basis Pursuit and is computationally faster.

• SBL appears as a convenient tool in identifying ray arrivals.

Gemba K L, Nannuru S, Gerstoft P, and Hodgkiss W S. Multi-frequency sparse Bayesian learning for matched field processing in the presence of mismatch, J Acoust. Soc. Am., to be submitted
- End of presentation -
SBL MFP

SBL ver. 2.23 (explicit $N_{\text{sources}}=1$ for noise)

SBL ver. 2.6 (automatic noise estimate)

Depth [m]

Range [km]

6 F SWellEx-96 Paper Example