Unary adaptive subtraction of joint multiple models with complex wavelet frames

S. Ventosa(1), S. Le Roy, I. Huard, A. Pica(2), H. Rabeson, L. Duval*(3)

CPG (1), CGGVeritas, (2) IFP Energies nouvelles

Contact: ventosa@ipg.fr, laurent.duval@ifpen.fr

Motivation: Multiple model data

Redundancy selection

Key features

- fast off-line parameter selection
- realistic synthetics
- varying random noise realizations
- SNR-based wavelet parameter selection
- controllable redundancy allows:
  - simple stable synthesis dual frame
  - resistance to field noise
  - computational efficiency balanced
- Morlet wavelet frame
  - approximately analytic
  - sliding window processing along scales

Unary filter estimation

- Windowed adaptation: complex \( \psi_{j,v} \)
  compensates local delay/amplitude mismatches:
\[
\hat{\psi}_{j,v} = \arg \min_{\psi_{j,v}} \left\| \mathbf{d} - \sum_k \mathbf{a}_k \mathbf{X}_k \right\|
\]

- Vector Wiener equations for complex signals:
\[
\mathbf{d} = \sum_k \mathbf{a}_k \mathbf{X}_k
\]

- Time-scale synthesis:
\[
\hat{\psi}_{j,v} = \sum_k \hat{\psi}_{j,v}^k
\]

Time-scale data and model trace representations

Complex wavelet domain adaptation

TaM0: Non-stationary, wavelet-based, adaptive multiple removal
TaM1: “Complex” wavelet transform + simple one-tap (unary) filter
TaM2: Redundancy selection: noise robustness and processing speed
TaM3: Smooth adaptation to adaptive joint multiple model filtering

Results: field data multiple filtering

References