Surface-consistent Gabor deconvolution

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DIVETSCO TESTS

(From Perz et al., 2005, CSEG meeting)

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From Wiener to Gabor

1. Constant Q theory



3. Gabor transform $G[s](\tau, f) = \int_{0}^{\infty} s(t)g(t-\tau)e^{-2\pi i f t} dt$



 $\widehat{s}(f) = \widehat{w}(f) \int \alpha_{Q}(f,\tau) r(\tau) e^{-2\pi i f \tau} d\tau$

2. Nonstationary convolutional model







Gabor deconvolution

Gabor transform of the trace



Deconvolutional operator:

 smoothing
 phase: using Hilbert transform



Estimate of the Gabor reflectivity

Wavelet removal and compensation for attenuation are simultaneous

Minimum phase, linearity, causality and Hilbert transform.

A(f)

f

Minimum phase

 $=H(\log($

 $\Phi(f)$

 Explosive sources are also minimum phase.





Surface Consistency



 $\sigma(s, r, x, h, t) = a(s, t) \otimes b(r, t) \otimes c(x, t) \otimes d(h, t)$ $\hat{\sigma}(s, r, x, h, \omega) = A(s, \omega)B(r, \omega)C(x, \omega)D(h, \omega)$

Surface-consistent Gabor deconvolution

$G[\sigma(\tau, f) \approx \widehat{w}(f) \alpha_{\varrho}(\tau, f) G[\rho](\tau, f)$



$G\sigma(f,\tau,h,r,s) = [w_s(f,s)] \alpha_Q(f,\tau,h) [G\rho(f,\tau,h)] [w_r(f,r)]$

h, r, s: midpoint, receiver and source coordinates respectively

Surface-consistent Gabor algorithm



Surface-consistent Gabor algorithm



Synthetic raw data (Courtesy DIVESTCO)



The dataset is made up of 78 shots, 96 channels per shot Q=40, sample rate=2ms, length=2 sec. Station interval=34 m.



Brute stack

Synthetic raw data (Courtesy DIVESTCO)

V=3500





Q = 40



Strong attenuation

Surf. Consist. wavelets

Strong random noise

After single channel Gabor

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After Surf. Cons. Gabor

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Conclusions

- A poor S/N could harm the estimation of the minimum phase Gabor deconvolution operator, introducing undesirables artefacts
- The Surface-Consistent implementation of Gabor deconvolution allows a robust estimation of the minimum phase deconvolution operator in the presence of
 - Strong random noise
 - Strong variations of the near-surface features

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