Automatically tying well logs to seismic data

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data provided by Rocky Mountain Oilfield Testing Center
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Artificial example

Sample index $i$

$f(t_i)$ artificial seismic trace

$g(\tau_j)$ artificial synthetic seismogram
Alignment errors: $e(t_i, \tau_j) = [f(t_i) - g(\tau_j)]^2$
Accumulated errors: $d(t_i, \tau_j)$
Minimum accumulated error

Sample index $j$

Sample index $i$

$d(t_i, T_j)$
Optimal alignment path

$d(t_i, T_j)$
\( g(\tau_j) \rightarrow \tilde{g}(\tau_i) \)

Sample index \( i \)

- \( f(t_i) \) artificial seismic trace
- \( g(\tau_j) \) artificial synthetic seismogram
- \( \tilde{g}(\tau_i) \) artificial aligned synthetic seismogram
Teapot Dome example

\[ f(t_i) \] seismic trace

\[ g(\tau_j) \] synthetic seismogram
Alignment errors: \( e(t_i, \tau_j) = [f(t_i) - g(\tau_j)]^2 \)
Accumulated errors: $d(t_i, \tau_j)$
Optimal alignment path

Synthetic time $\tau$ (s)

Trace time $t$ (s)

$d(t_i, T_j)$
$g(\tau_j) \rightarrow \tilde{g}(\tau_i)$

- $f(t_i)$ seismic trace
- $g(\tau_j)$ synthetic seismogram
- $\tilde{g}(\tau_i)$ aligned synthetic seismogram
\( g(\tau_j) \rightarrow \tilde{g}(\tau_i) \)

- \( f(t_i) \) seismic trace
- \( g(\tau_j) \) synthetic seismogram
- \( \tilde{g}(\tau_i) \) aligned synthetic seismogram
\[ \tilde{T}_z \text{ time-depth from alignment} \]
\[ T_z \text{ time-depth from velocity log} \]
Using $\tilde{T}_z$

**Distance (km)**

3 3.5 4 4.5

**Time (s)**

0.4 0.6 0.8 1 1.2 1.4 1.6

formation tops in well
Using $\tilde{T}_z$

formation tops in well
\( \tilde{\tau}_z \) time-depth from alignment

\( \tau_z \) time-depth from velocity log
Future work

better constrain alignment path

new interval velocity curve

better estimation of synthetics

deviated wells, dip, faults

multiple wells
Thank you

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Using $\tilde{T}_z$