3D seismic image processing for faults

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3D seismic image

Image provides by Kees Rutten & Bob Howard via TNO
Fault images
Fault surfaces
Fault slips
3D seismic image
Unfaulting
Fault geometry

- **Strike angle**
- **Dip vector**
- **Dip angle**

**Strike**: $0^\circ \sim 360^\circ$

**Dip**: $0^\circ \sim 90^\circ$
Fault separation (dip slip only)
Seismic image
Seismic image
Fault likelihood
Fault strike
Fault dip
Thinned fault likelihood
Thinned fault strike
Thinned fault dip
Fault samples
Fault samples
Fault samples
Linked samples
Fault surface
Fault samples
Fault surface
Fault surface
Fault surface
Fault surfaces
Fault surfaces
Fault samples
Fault samples
Fault surfaces
Missing above neighbor
Nearby samples
One nearby sample
Anisotropic Gaussian
Another nearby sample
Anisotropic Gaussian
New fault surfaces
Old fault surfaces
New fault surfaces
New fault surfaces
Old fault surfaces
Old fault surfaces
New fault surfaces
Fault slips

A

B

C

D

Fault throw (samples)
Seismic image
Unfaulted image
Fault images
Fault samples
Old fault image
Old fault image
New fault image
Fault surfaces
Fault slips
3D seismic image
Unfaulted image
Backup slides
Fault surfaces
Strike: 150°~200°
Strike: 100°~150°
Fault surfaces
Unfaulting shifts
Inline shifts
Vertical shifts
Interpolating fault likelihood

\[
f(x_i) = \sum_{k=1}^{k=N} f(x_k) \exp \left( -\frac{1}{2} (x_k - x_i)^\top R^\top S R(x_k - x_i) \right)
\]

anisotropic Gaussian function

\[
R = \begin{bmatrix}
u_k^\top \\
v_k^\top \\
w_k^\top 
\end{bmatrix}
\]

\(u_k\): dip

\(v_k\): strike

\(w_k\): normal

\[
S = \begin{bmatrix}
\frac{1}{\sigma_u^2} & 0 & 0 \\
0 & \frac{1}{\sigma_v^2} & 0 \\
0 & 0 & \frac{1}{\sigma_w^2}
\end{bmatrix}
\]
Anisotropic Gaussian

$\mathbf{u}_k : \text{dip}$

$\mathbf{v}_k : \text{strike}$

$\mathbf{w}_k : \text{normal}$

$\sigma_\mathbf{w} < \sigma_\mathbf{v} < \sigma_\mathbf{u}$