# AI-Driven PZero Modeling: Enhanced Seismic Data Loading, Grid Section Management, and Automated Interpretation with Sobel, A* Pathfinding, and SAM2

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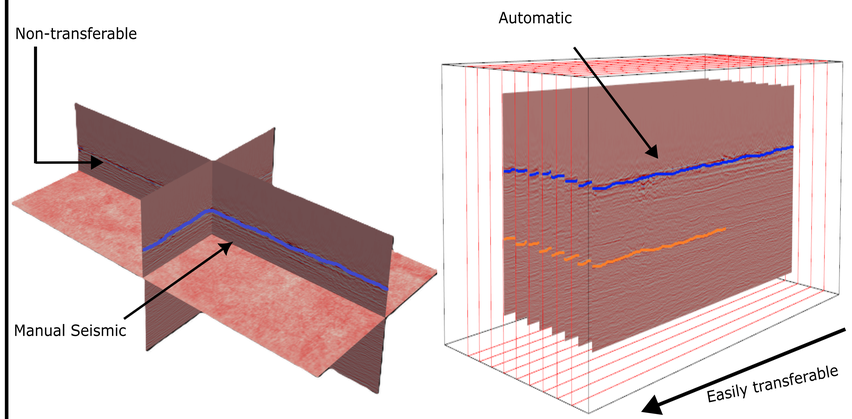
## The Challenge

Manual seismic interpretation

Interpreting large 2D/3D seismic datasets is time-consuming and labor-intensive. PZero aims to improve these workflows using two Workflows.

**Manual Time-consuming Picking** **Faster Automated Worklow**

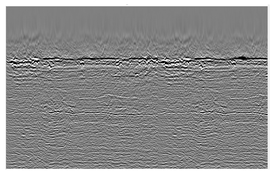



## Workflow 1: Sobel + A*

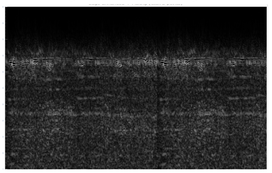
a) Takes input raw seismic
b) Detects the horizon using Sobel Filter
c) User selects points and A* draw the lines between them using shorter path.
d) No propagation but guided tracking

Star algorithm

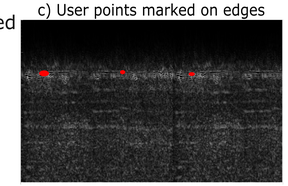
a) Raw seismic



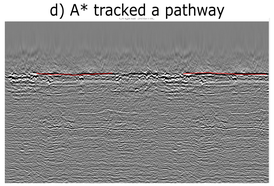
b) Edge detection using sobel



c) User points marked on edges



d) A* tracked a pathway



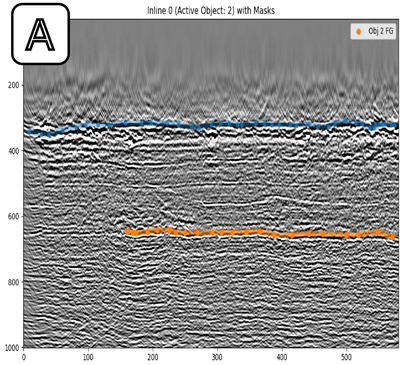
## Core AI Interpretation Engine (Workflow 2: SAM2)

SAM2 Meta-Model

a) User gives prompt to SAM 2 in the form of points and it does initial segmentation and propagtation of predicted masks
b) Vectorization of polyline drawn by SAM2 masks.
c) Using PZERO geomodelling to create surfaces.

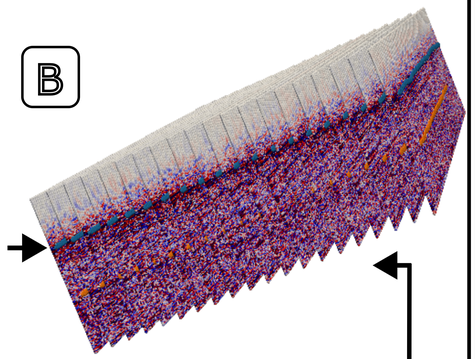
**Initial Segmentation and Propagation**

A




**Vectorization**

B

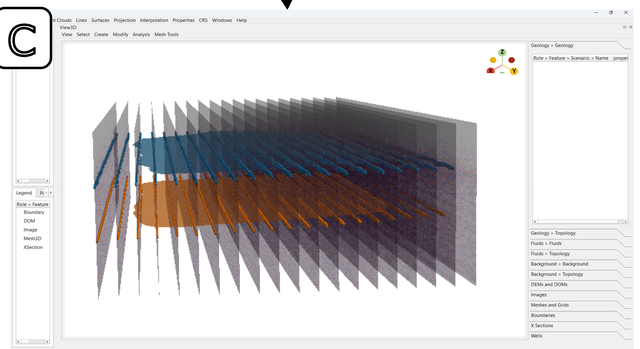


**Modelling in PZERO GUI**

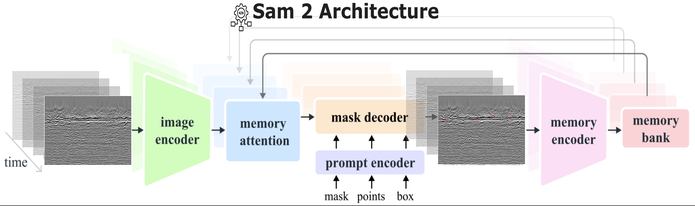
C

Surface Creation

PZero Geomodelling



**Sam 2 Architecture**




## Our Solutions as Simple GUI for the workflows

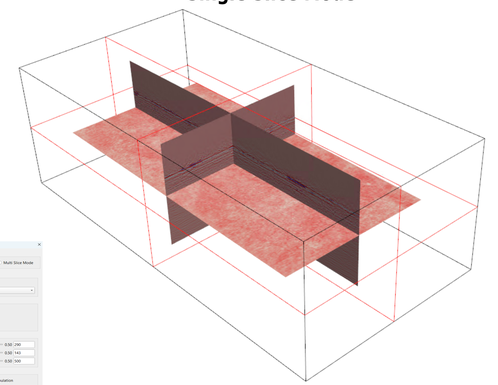
Robust SEG-Y & common format support.

Arbitraary slicing (inline, crossline, Z-slice).

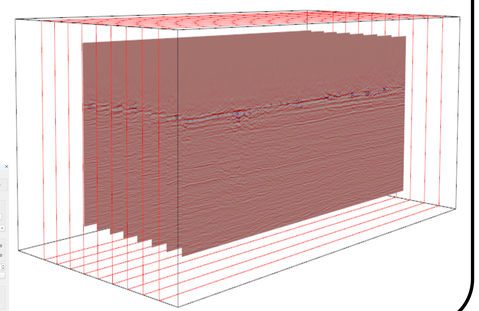
Efficiently manage multiple slice views for possible multiple interpretation viewing.

Efficent interface to adjust position and create slices in different directions for better control over interpretations.

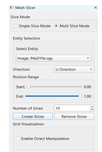
**Single Slice Mode**



**Multi Slice Mode**



PZERO friendly GUI



## Impact & Future Directions

Sobel + A* gives more control with user-guided pathfinding—better for noisy areas.
SAM2 speeds up interpretation by up to 80% (e.g., 10 min manual → ~2 min with SAM2).
Interpretation time reduced from ~15–20 min per horizon to 2–5 min using AI tools.
Refine propagation algorithms, improve stability in noisy data.

**References**

Ravi, N., Gabeur, V., Hu, Y. T., Hu, R., Ryali, C., Ma, T., ... & Feichtenhofer, C. (2024). Sam 2: Segment anything in images and videos. arXiv preprint arXiv:2408.00714.
Sobel, I., & Feldman, G. (1968). A 3x3 isotropic gradient operator for image processing. a talk at the Stanford Artificial Project in, 1968, 271-272.
Hart, P. E., Nilsson, N. J., & Raphael, B. (1968). A formal basis for the heuristic determination of minimum cost paths. IEEE transactions on Systems Science and Cybernetics, 4(2), 100-107.
Thiele, S. T., Grose, L., Samsu, A., Micklethwaite, S., Vollgger, S. A., & Cruden, A. R. (2017). Rapid, semi-automatic fracture and contact mapping for point clouds, images and geophysical data. Solid earth, 8(6), 1241-1253.

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