

## 12.22: Estimation of subsurface stress from seismic data: A synthetic test

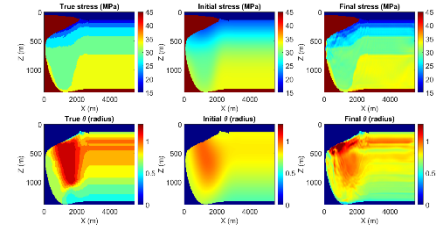
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### ABSTRACT

I demonstrate the feasibility of directly estimating subsurface stress from seismic data on a complex synthetic model. The workflow contains two parts: First, I derive a wave equation where the model parameters are the magnitude and angle of stress; then, I apply multi-scale anisotropic full-waveform inversion (FWI) to invert subsurface stress directly from seismic data.

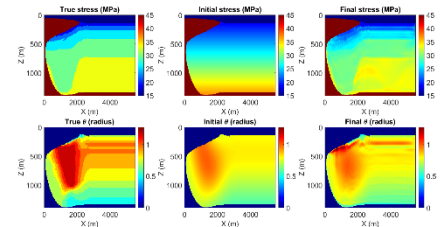
FWI is a highly ill-posed problem and the multi-parameter inversion of the stress model (magnitude and angle) aggravates the ill-posedness. Conventional local optimization FWI is heavily dependent on a good initial model; otherwise, it can get trapped in a local minimum. The global optimization FWI could escape local minima, however, it is computationally very expensive due to the low convergence rate. The multi-scale scheme can escape local minima with a moderate convergence rate and computational cost. The synthetic test on two initial models, as shown in Figures 1 and 2, shows the effectiveness of the multi-scale FWI of stress directly from seismic data.

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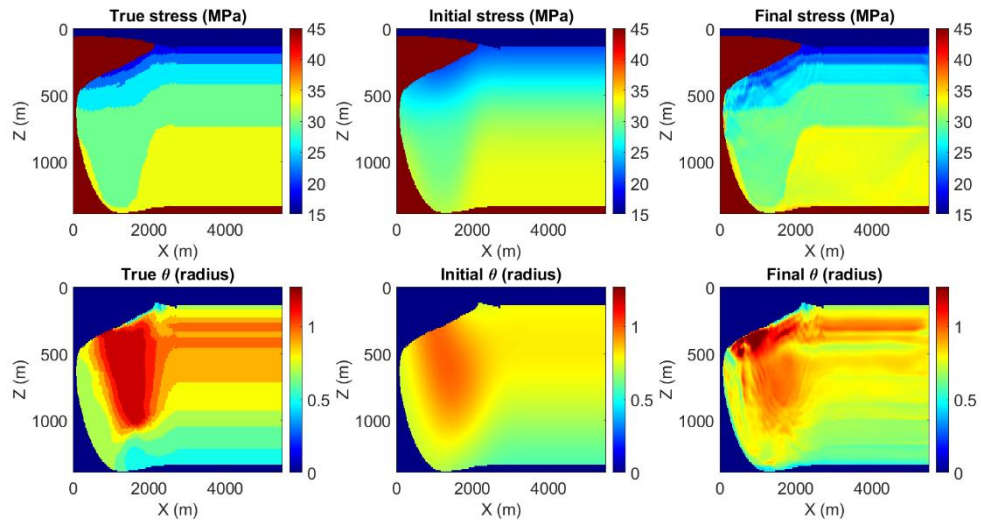
**Fig 1:** Multi-scale Stress estimation

from seismic data with a good initial model.



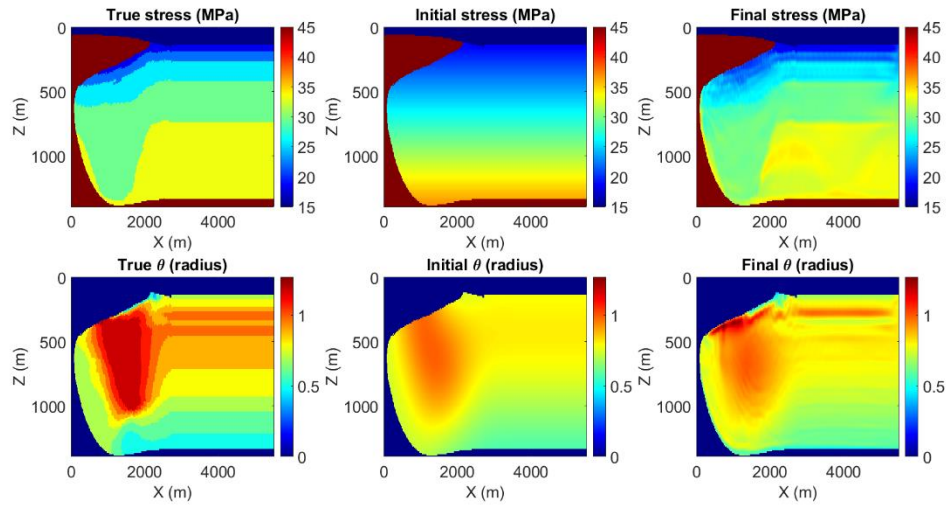
**Fig 2:** Multi-scale Stress estimation

from seismic data with a bad initial model.



**Fig. 1:** Multi-scale Stress estimation from seismic data with a good initial model.

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**Fig. 2:** Multi-scale Stress estimation from seismic data with a bad initial model.

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