A Hybrid Method for First Break Auto Picking

Don Zhao
Geogiga Technology Corp.

Outline

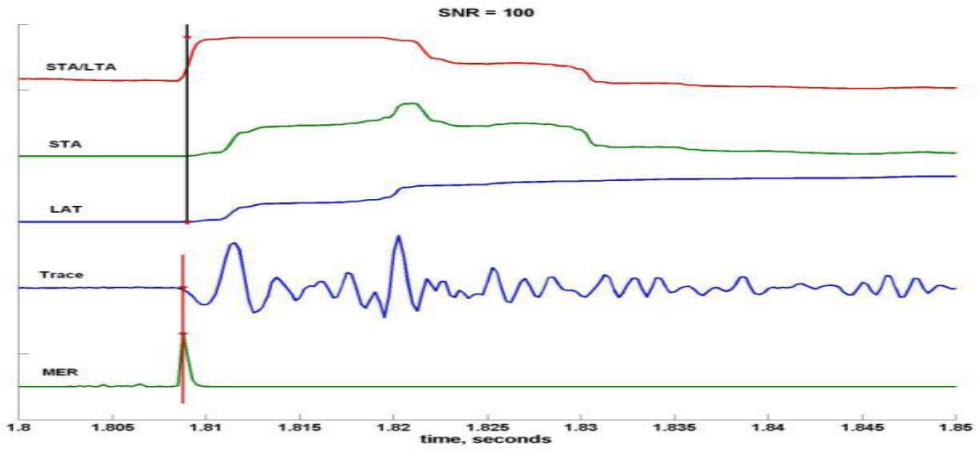
- Review of Auto Picking Methods
- Proposed Method
- Examples
- Conclusion

Review of Auto Picking Methods

There are several methods for first break auto picking:

1. Energy Ratio and Modified Energy Ratio

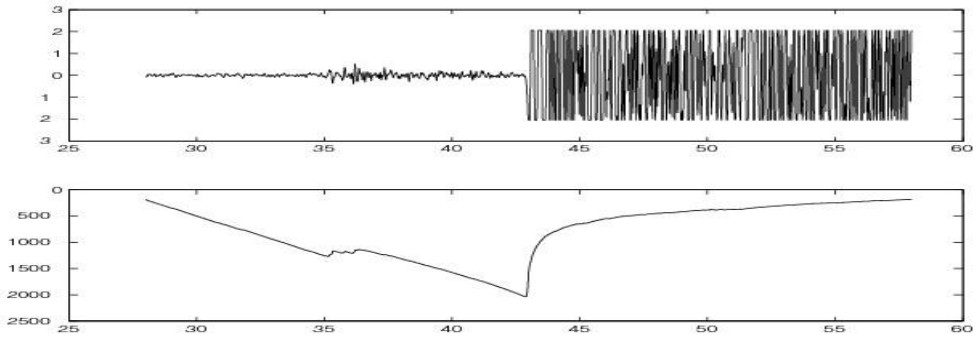
Calculate the energy ratio of seismogram of two windows and use that to differentiate signal and noise (Coppens, 1985; Wong, 2009).



Review of Auto Picking Methods (Cont'd)

2. AIC (Akaike's information criterion)

AIC is applied to demark the point of two adjacent time series with different underlying statistics to detect first breaks (Akaike, 1973; Zhang, 2003).



Review of Auto Picking Methods (Cont'd)

3. Tracking

Detect first breaks from a seed point by making use of cross correlation with adjacent traces.

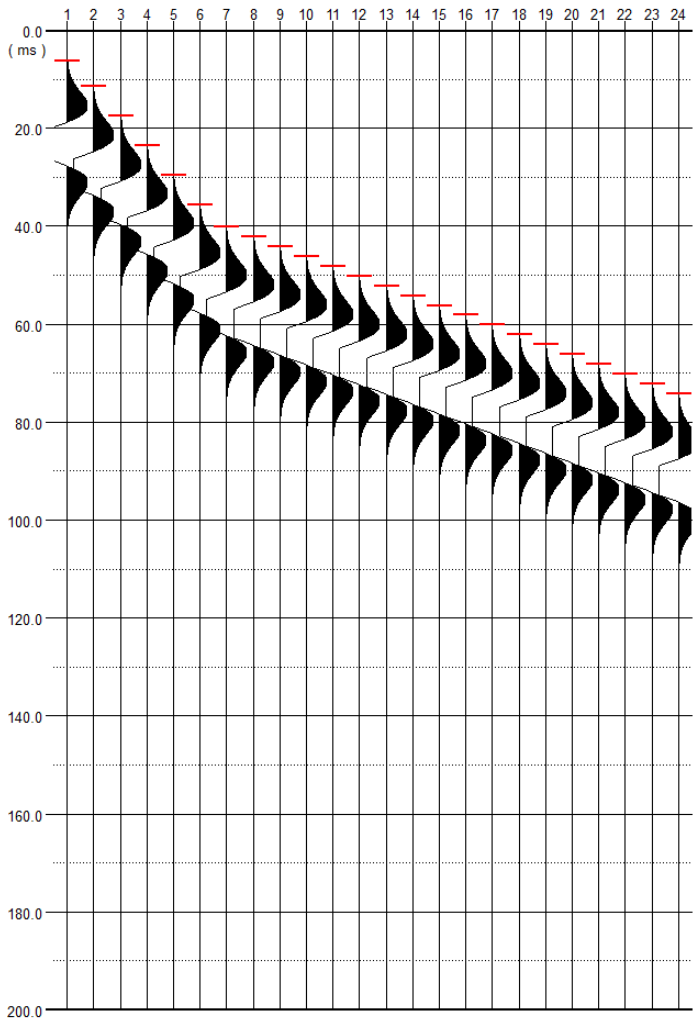
Other methods:

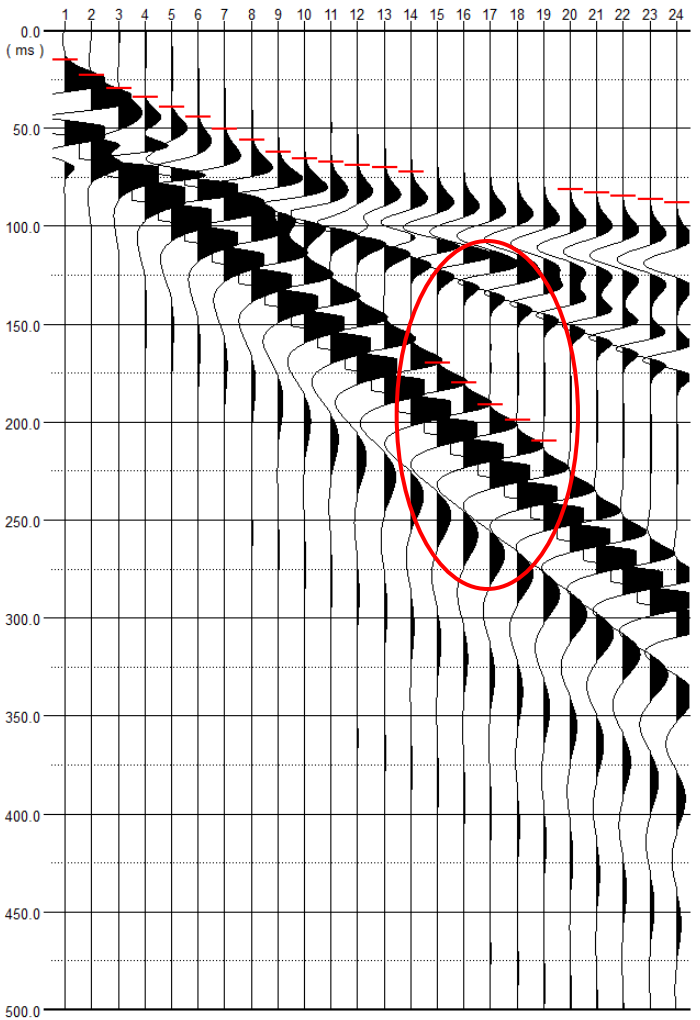
Fractal-based algorithm

Artificial neural network method

Multi-window algorithm

Review of Auto Picking Methods (Cont'd)





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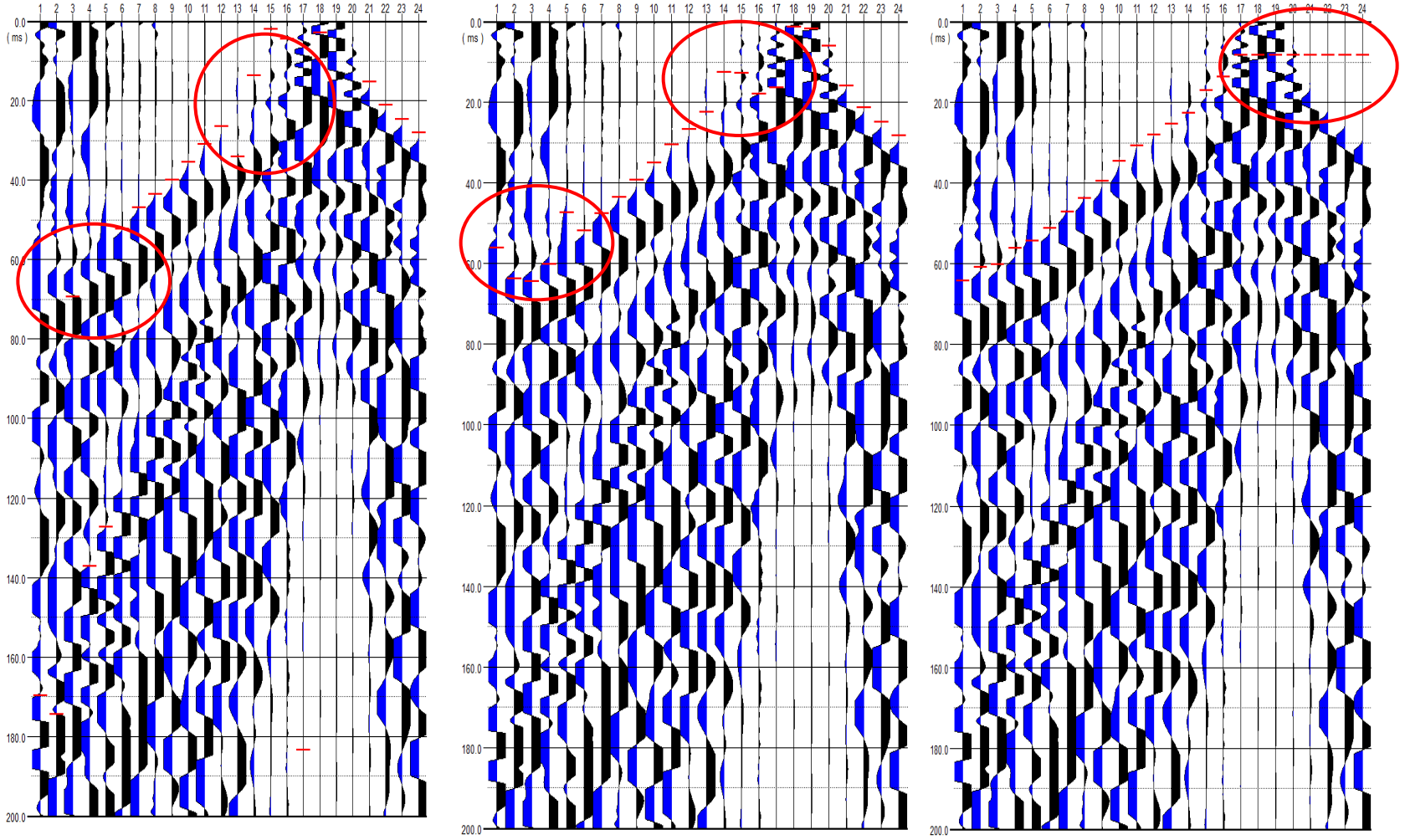
Review of Auto Picking Methods (Cont'd)



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Review of Auto Picking Methods (Cont'd)

- Energy ratio is sensitive to the relative energy and to weak noise.
- AIC strongly depends on the statistical properties.
- Tracking is sensitive to the waveform of adjacent traces.

Proposed Method

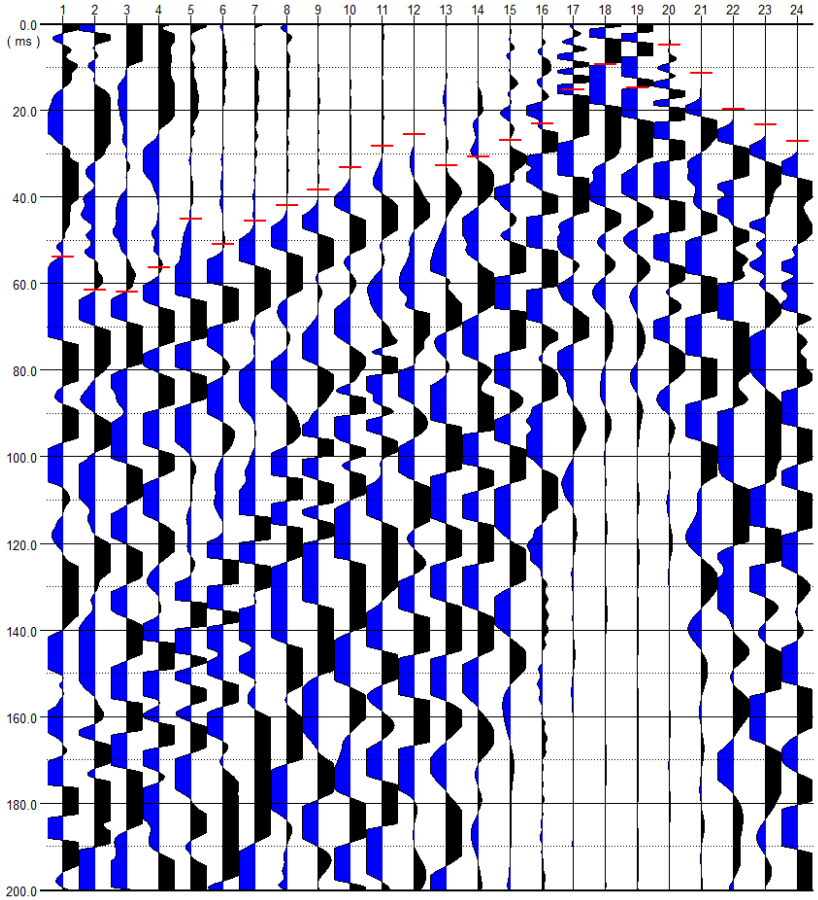
- Spatial information can play an important role in auto picking.
- Combine the strengths of each method and use the spatial information to stabilize auto picking.

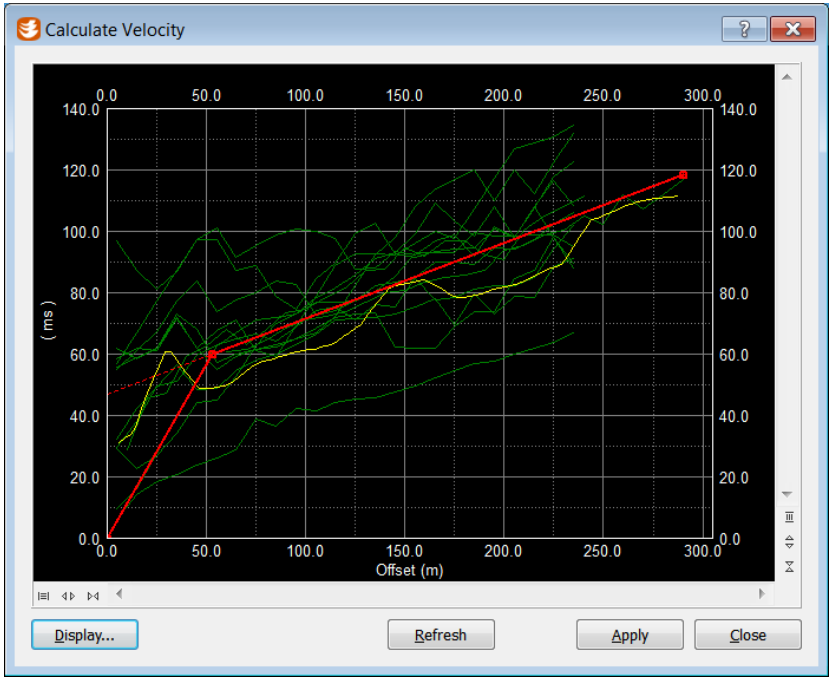
Proposed Method (Cont'd)

The proposed hybrid method is described as fellows:

1. Apply traditional methods to pick individual traces.
2. Build offset~velocity function based on the existing picks.
3. Pick traces guided by the offset~velocity function.
4. Adjust picks phase.
5. Repeat 2~4.

Proposed Method - Pick individual traces





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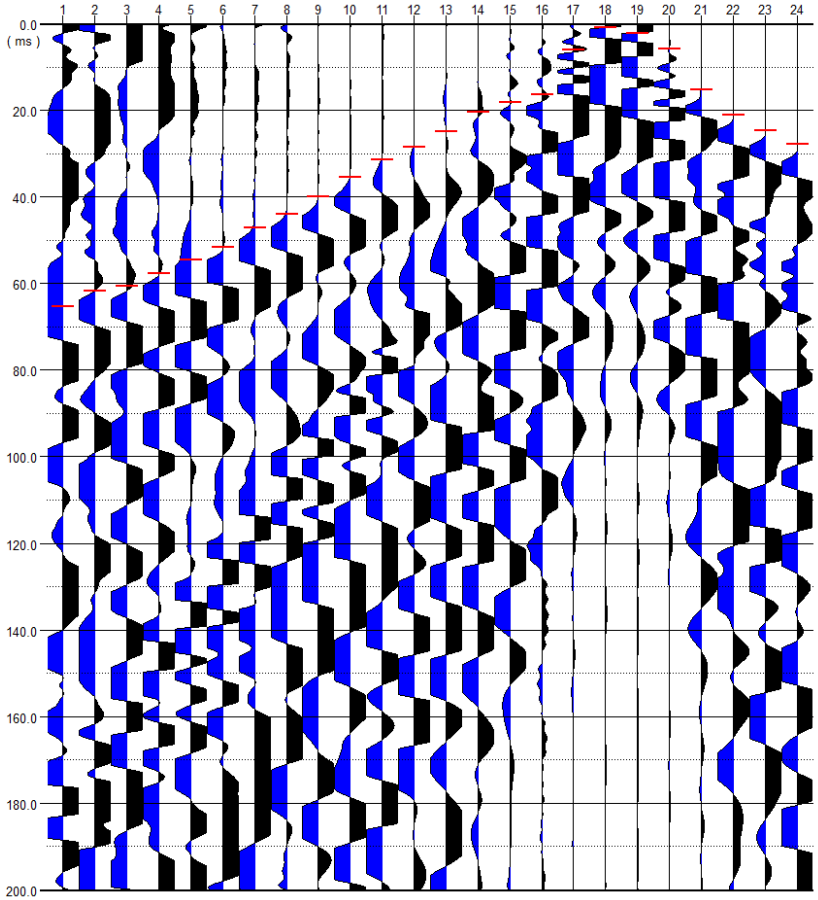
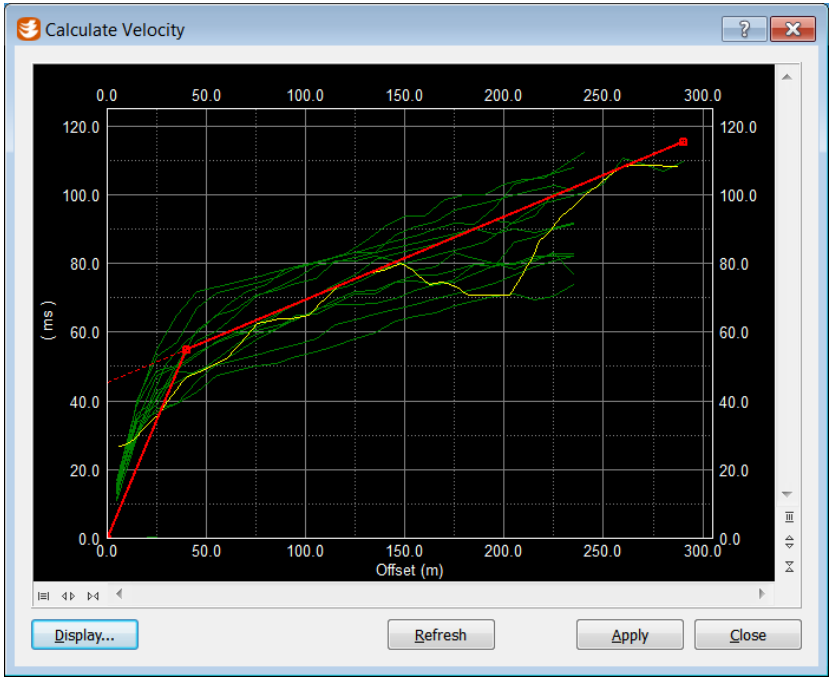
Proposed Method - Constrained Repick





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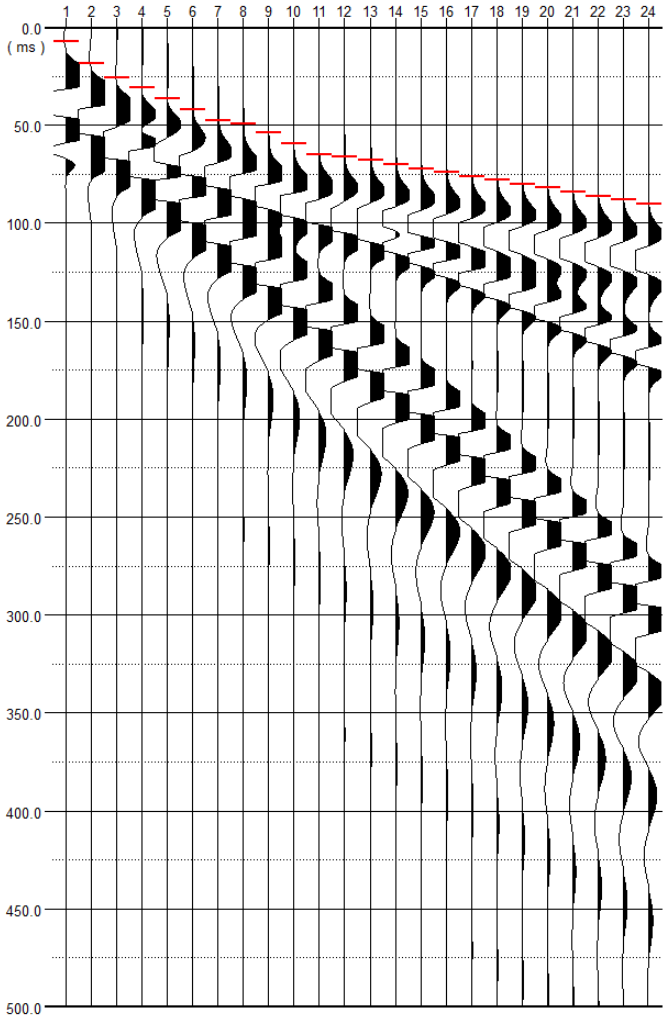
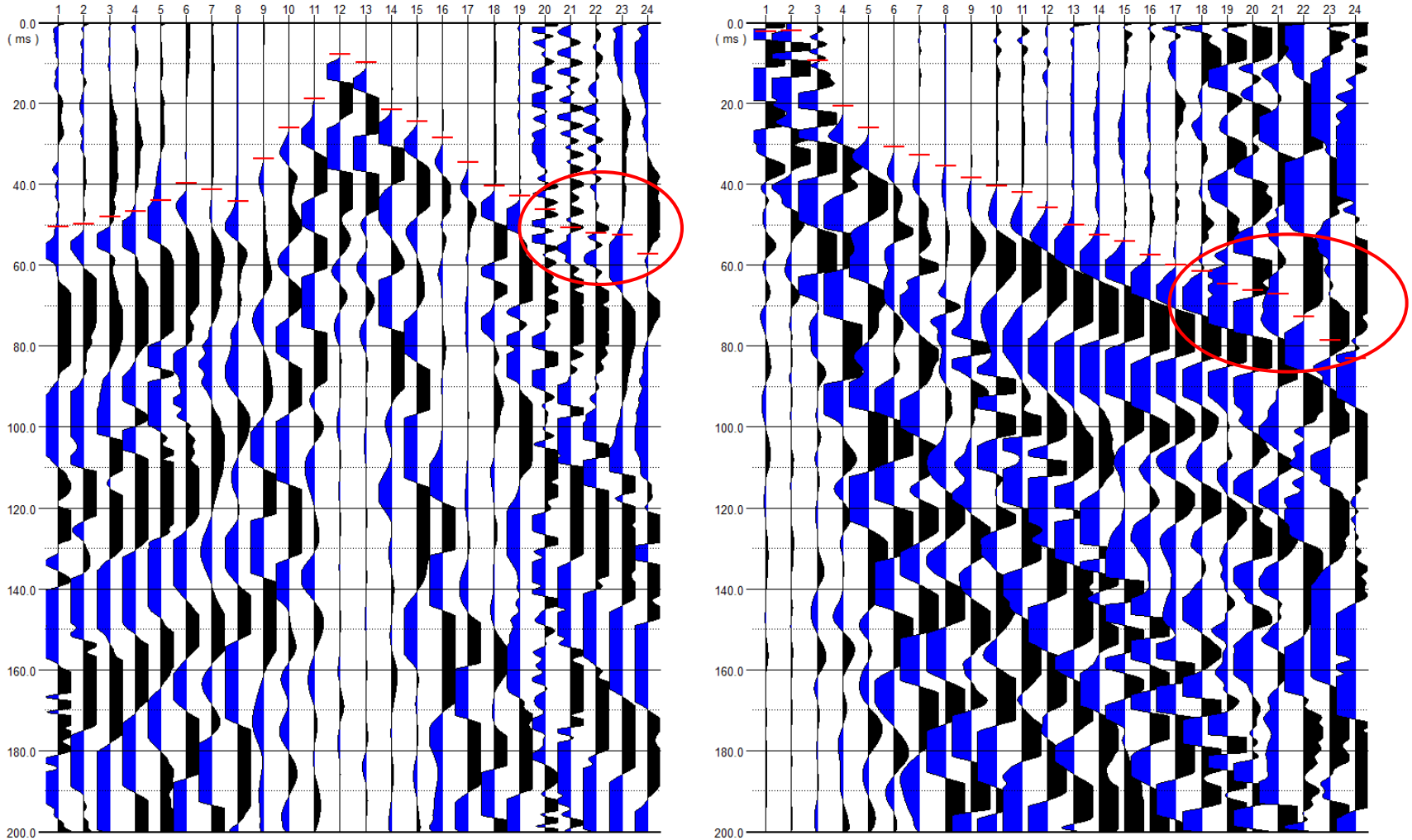
Examples - Synthetic Data



Examples - Field Data 1



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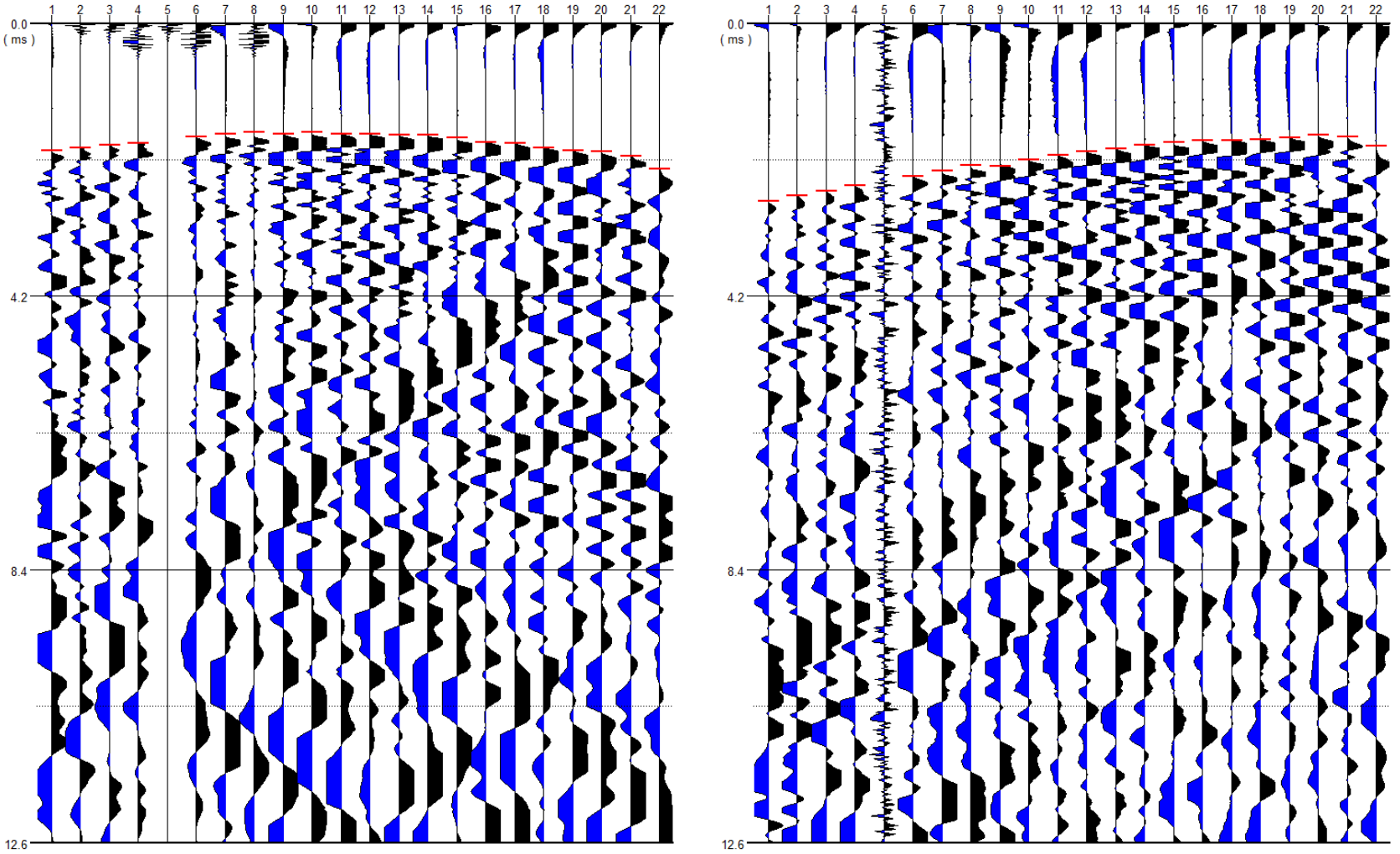
Examples - Field Data 2



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Conclusion

- All existing auto picking methods do not work properly for noisy data.

- The proposed hybrid method combines the strengths of existing auto picking methods and the spatial information. The picks are much more reliable with the proposed method.