SnT 2025
8 SEPTEMBER
ONLINE DAY
9 TO 12 SEPTEMBER
AT HOFBURG PALACE, VIENNA & ONLINE
CTBT: SCIENCE AND TECHNOLOGY CONFERENCE

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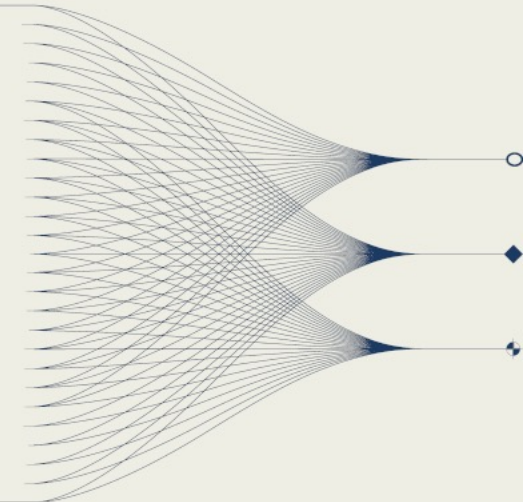# Advanced frequency-wavenumber (FK) analysis in the Geophysical Monitoring System (GMS)

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INTRODUCTION AND MAIN RESULTS

Sandia National Laboratories is developing the Geophysical Monitoring System (GMS) for modernization of the United States National Data Center waveform processing system, now focused on development of interactive analysis capabilities (IAN). The latest GMS release includes a new advanced FK computation capability and users interface that enhances analyst efficiency and accuracy.

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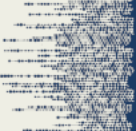
Introduction

- IDC analysts use frequency-wavenumber (FK) to assess azimuth and slowness of a signal detection
- The latest GMS release includes a new advanced FK computation capability and users interface that enhances analyst efficiency and accuracy
- Analysts can view thumbnail images to make a quick decision about which detections need review
- GMS computes multiple FK spectra over a time interval near the detection, allowing the analyst to quickly see how the signal evolves
- IAN display shows an FK beam segment computed with the current azimuth/slowness measurement, as well as traces of the maximum FK spectrum maximum power, azimuth, and slowness over time
- All computations are performed locally in the IAN user interface using C/C++ code compiled to web assembly (WASM)

Implementation
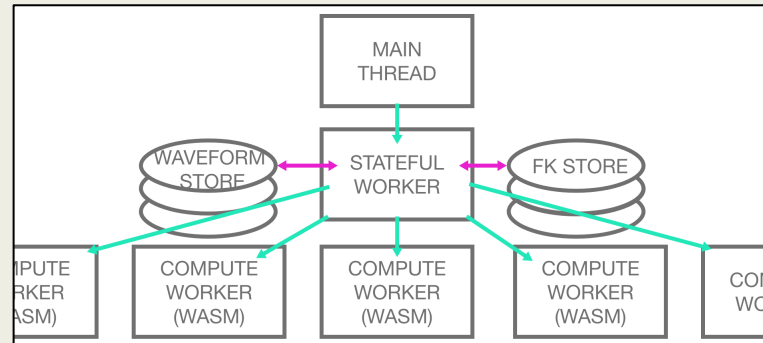
The architecture shown in this diagram is designed to allow GMS to parallelize FK computations in the web browser

1. The main thread (which the user interacts with) sends a request to the stateful worker asking for it to make FKs
2. The stateful worker accesses the waveform store to collect the raw waveform data necessary to produce the FKs
3. The stateful worker sends the raw waveforms to one of the compute workers which run WASM algorithms (stateless, there are many, up to 10)
4. The compute workers utilize WASM to compute FK Spectra and return them to the stateful worker
5. The stateful worker stores the FK Spectra in the FK store, and returns a "claim check" id to the main thread
6. The main thread requests the FK data when it needs to render the FK to the GMS IAN FK Display

IAN FK Display
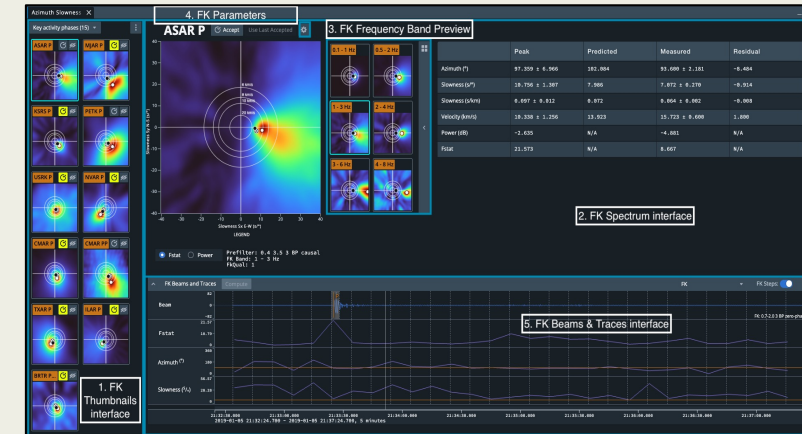
Analysts can:

1. Quickly view all FKs associated to currently open event to assess directionality & match to predictions
2. View larger FK image, associated metadata & select new azimuth/slowness measurements
3. Quickly assess FK at different frequency bands & select best one for FK
4. Manually adjust parameters used to compute FK
5. View FK beam & fstat, azimuth & slowness timeseries to assess quality of signal & whether measurements align with expected peak

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