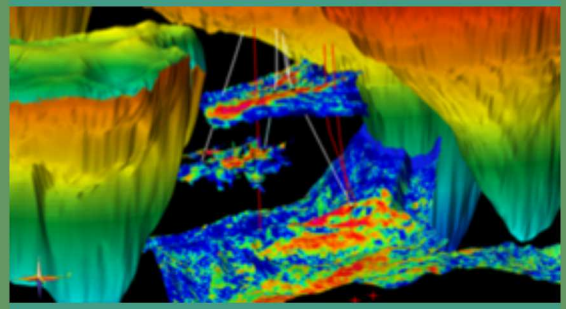
RESEAD Analytics






PRESENTED BY

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RESEAD: REaltime Subsurface Event Assessment and Detection

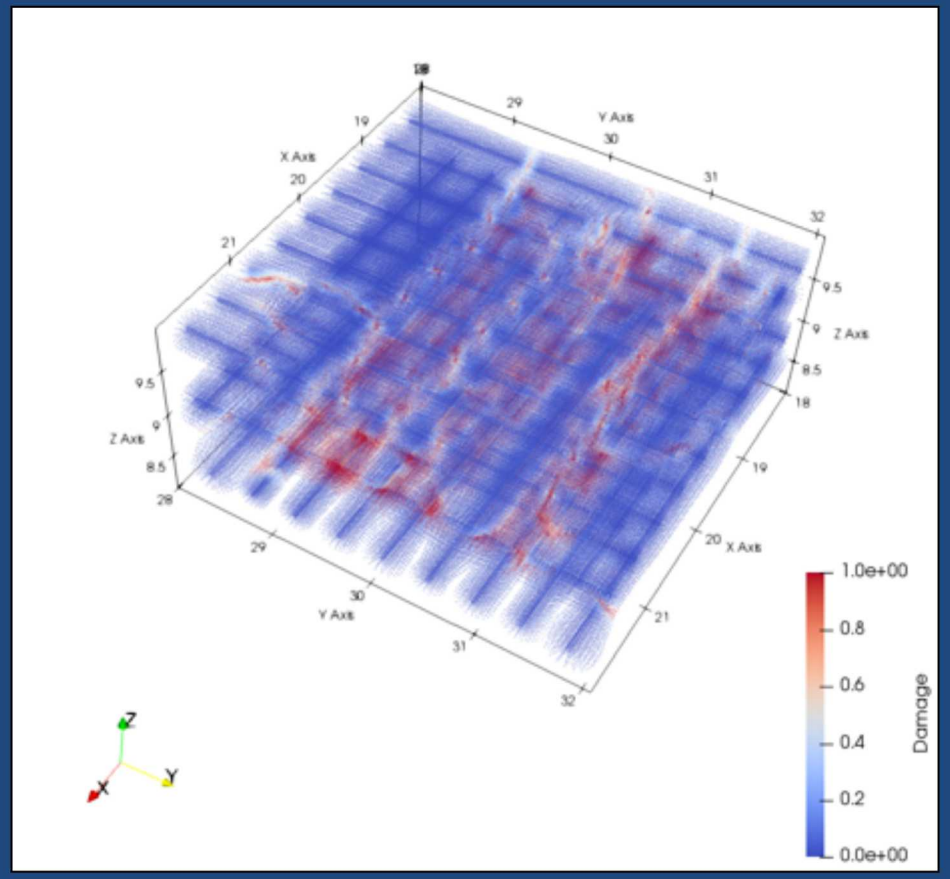
- Purpose: To provide an update on analytics team progress, and future directions in order to generate discussion and gather feedback
- The analytics team is pursuing two main lines of work
  1) Modeling of Peridynamics Simulation Data
  2) Event Detection and Classification for Synthetic Collab Data

Model Peridynamics Data

- Analytic goal: To infer fracture properties using nearby measurements of temperature, stress/strain, EM, etc.
  - How is accuracy/resolution of inference affected when varying number of sensors and proximity to fracture?

- Approach:
  1) Map observed quantities to unobserved quantities
  2) Infer/interpolate observed quantities where not directly measured

- Proposed models:
  - Gaussian Processes
  - Deep Neural Network

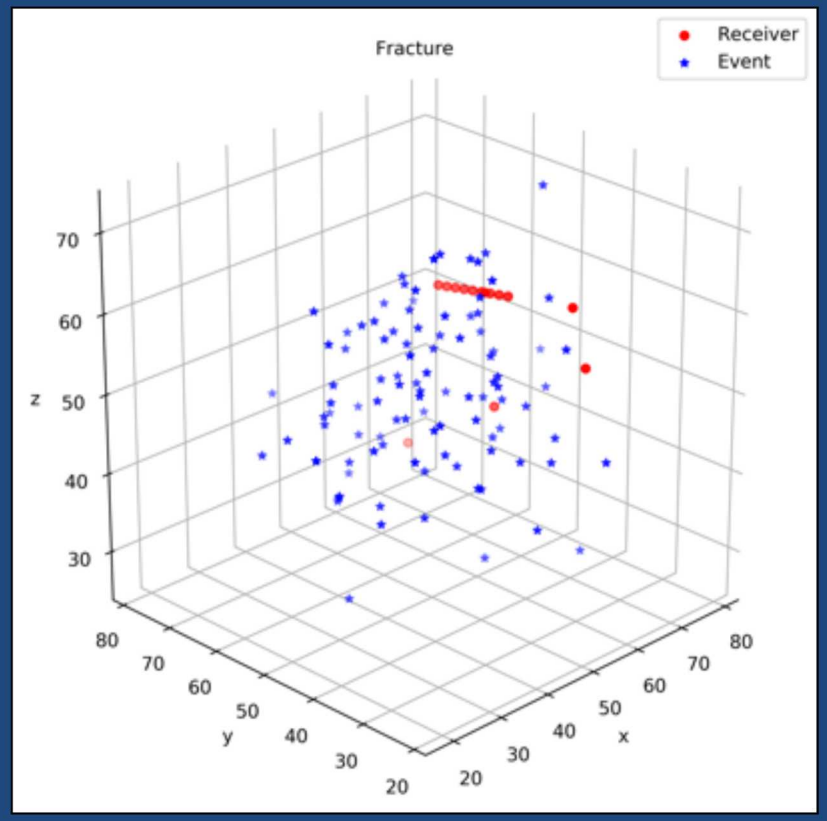


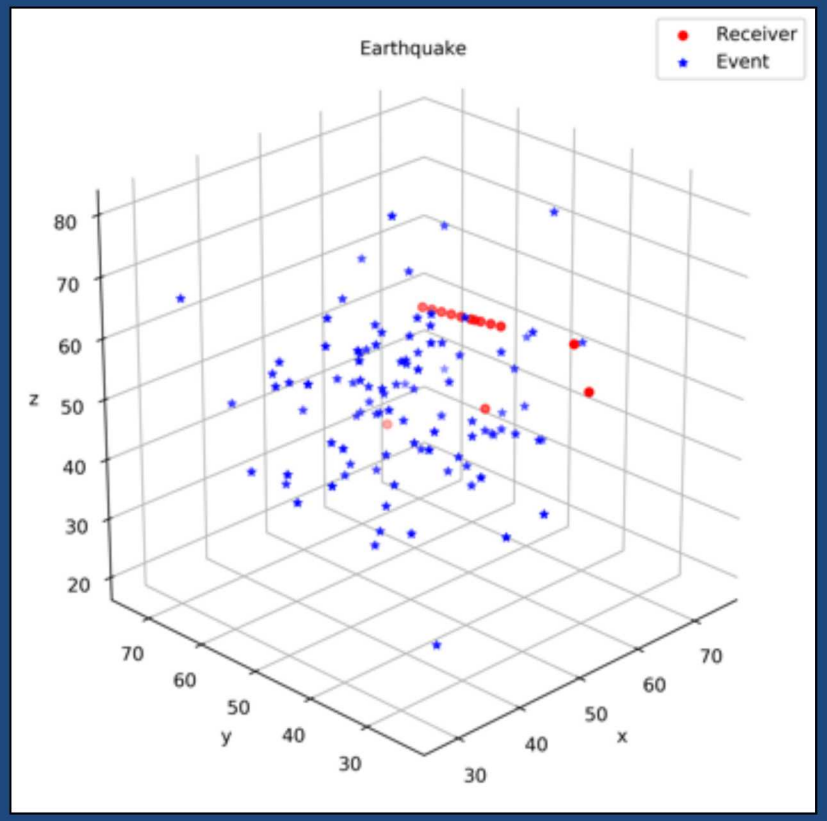
Event Detection/Classification of Synthetic Collab Data

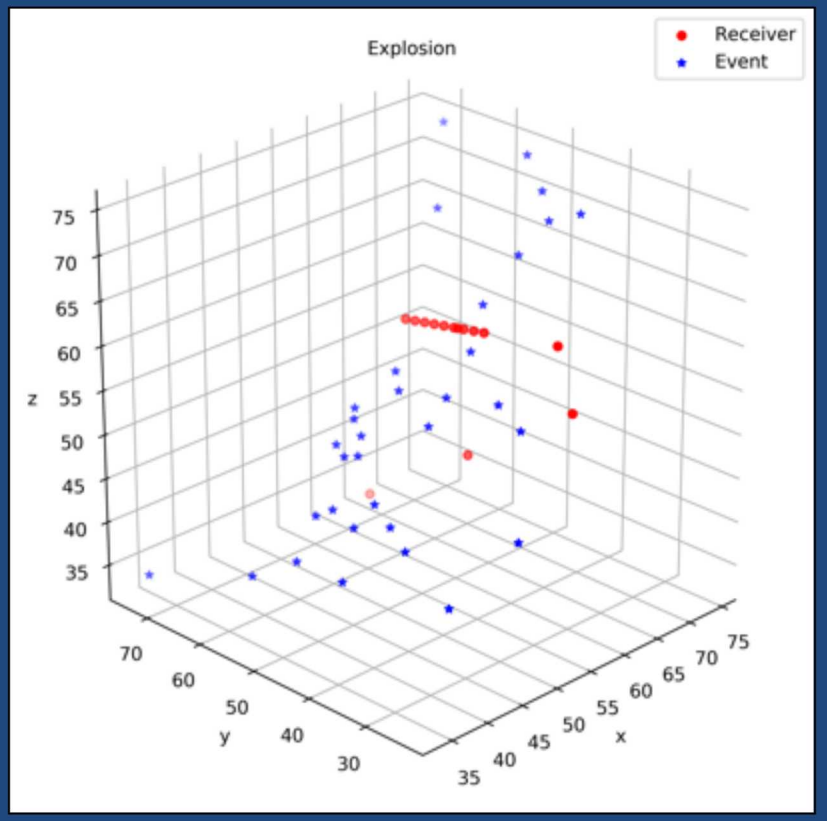
- Analytic Goal: detect and discriminate between different types of local seismic events
  1) Double couple earthquake
  2) Mode-one opening-type fracture
  3) Isotrophic explosion
- Approach:
  - Use time series model or deep learning based models for event detection
  - Use deep learning based classifiers for classification

Synthetic Collab Data

- Locations mimic true Collab sensors
- Events are simulated in vicinity of sensors

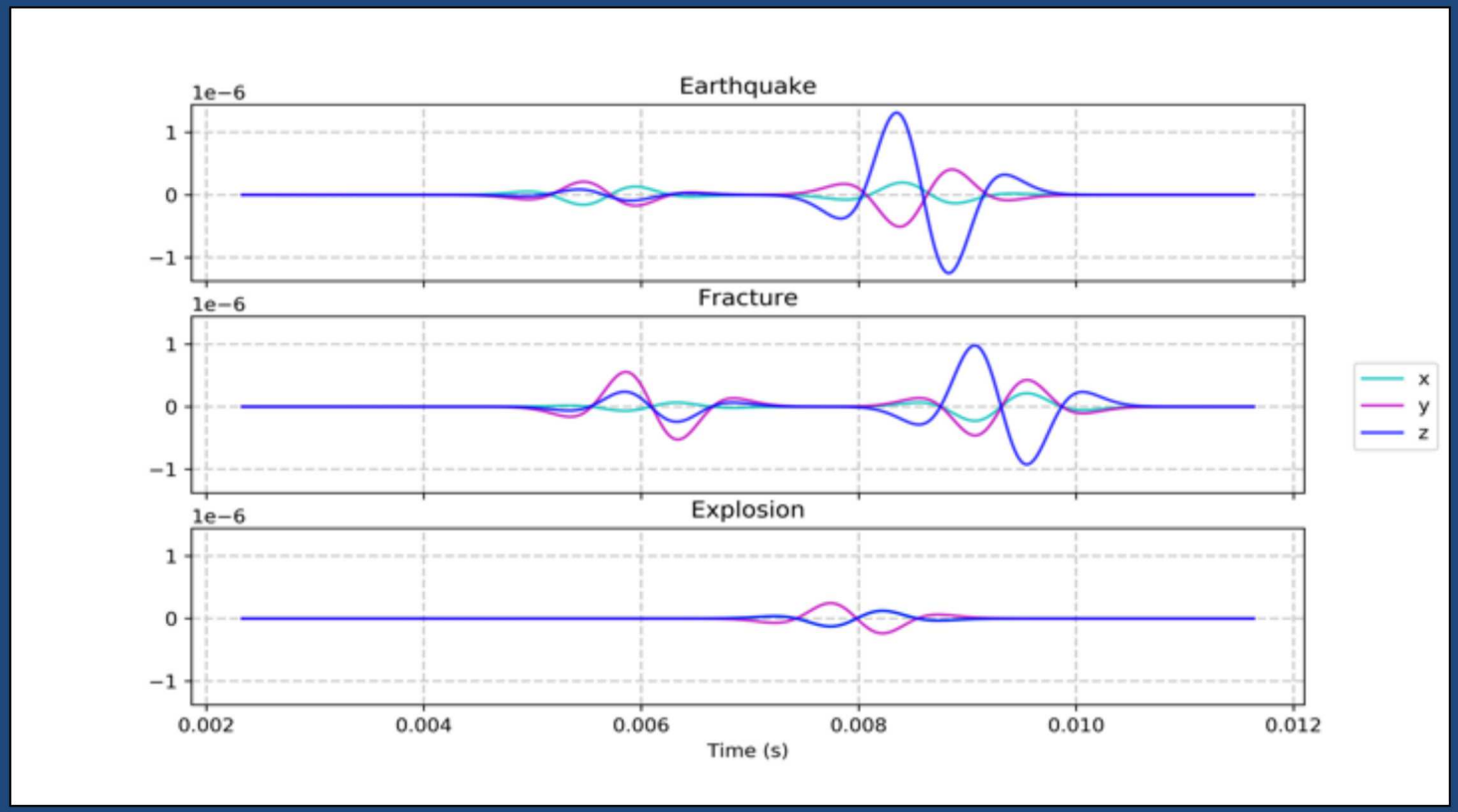






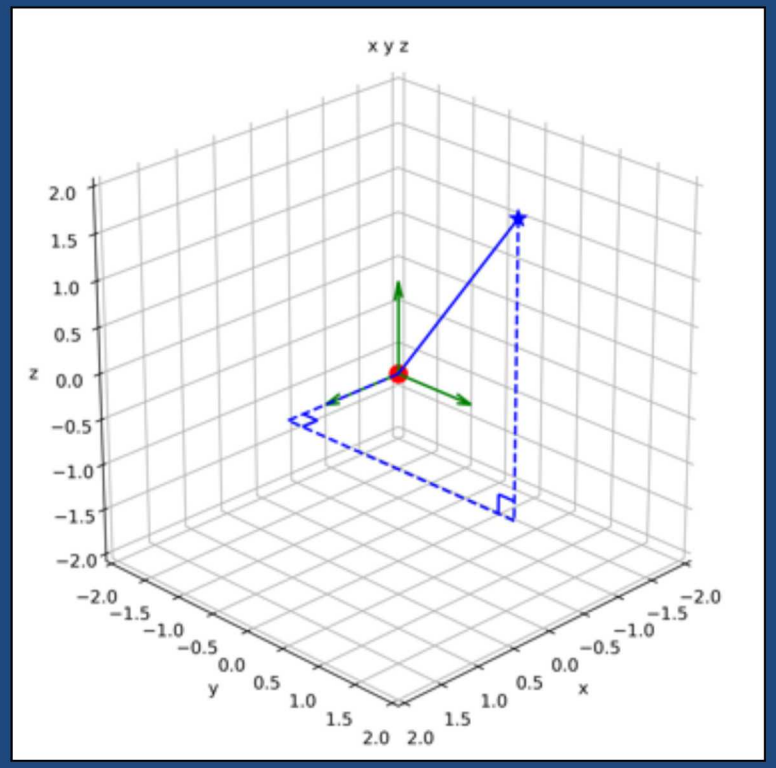
Synthetic Collab Data: Raw Signal

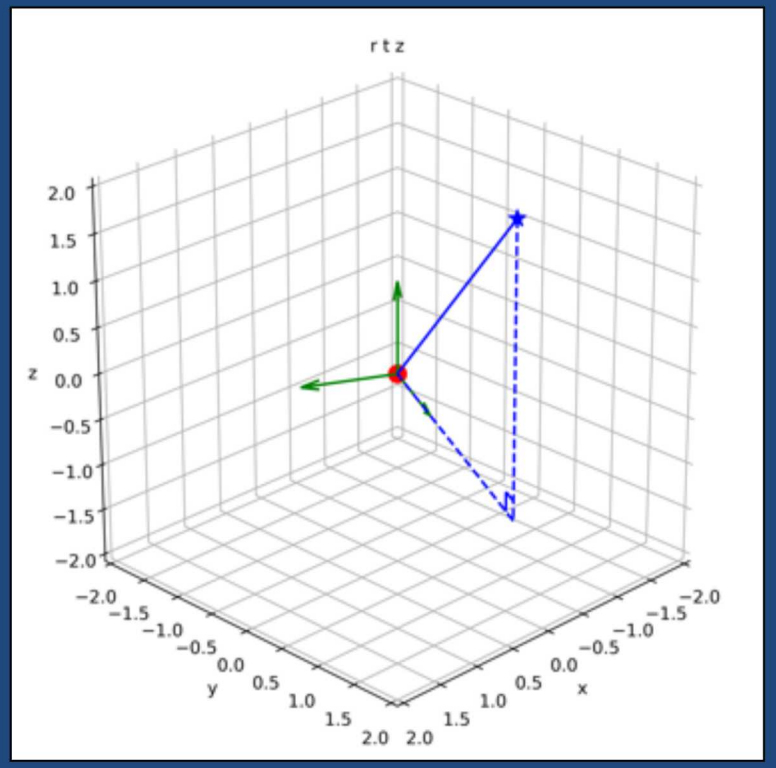
- Signal vs time

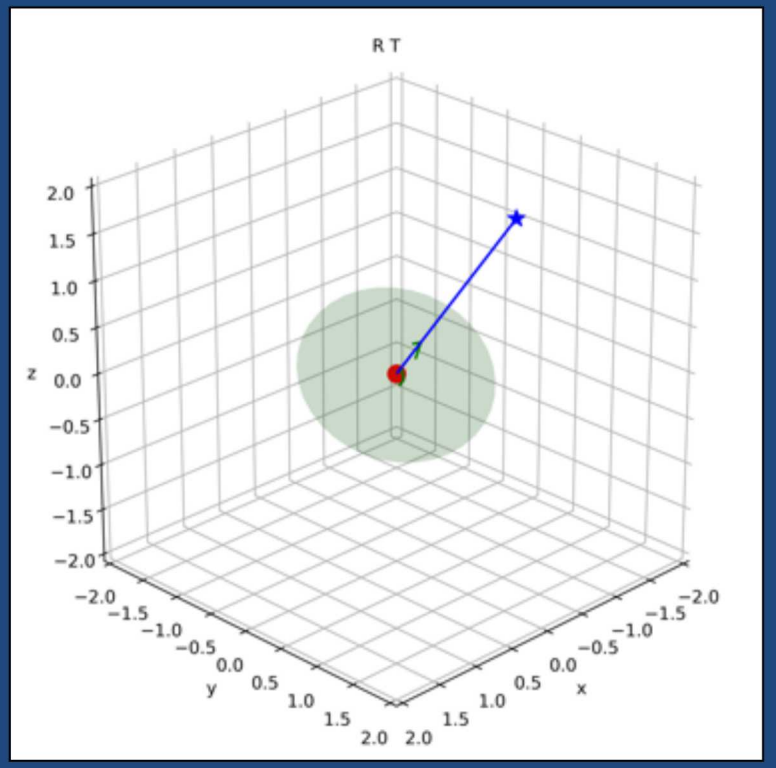


Dealing with 3-axis Seismographic Data

- Transform signals to invariant axes

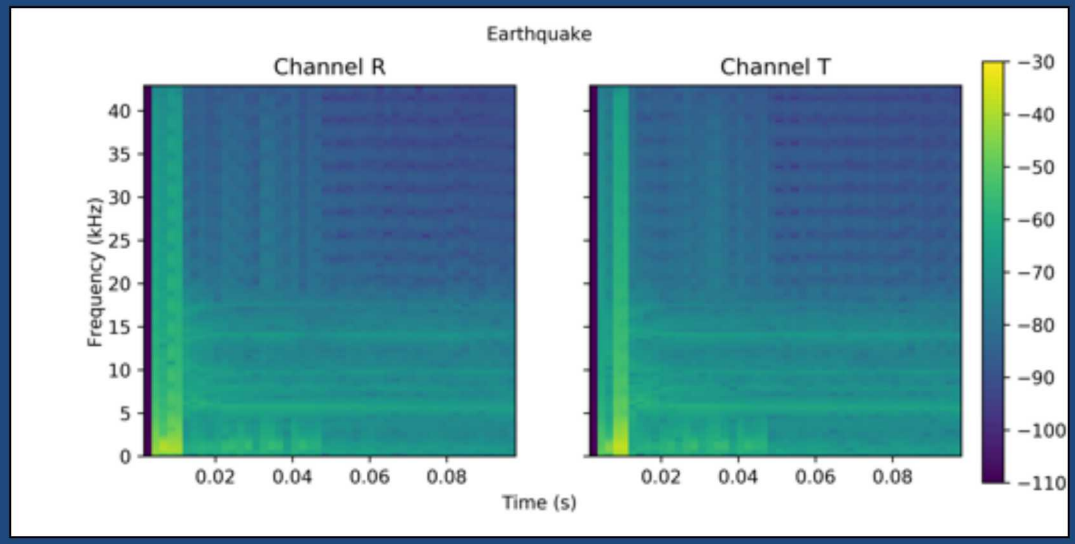


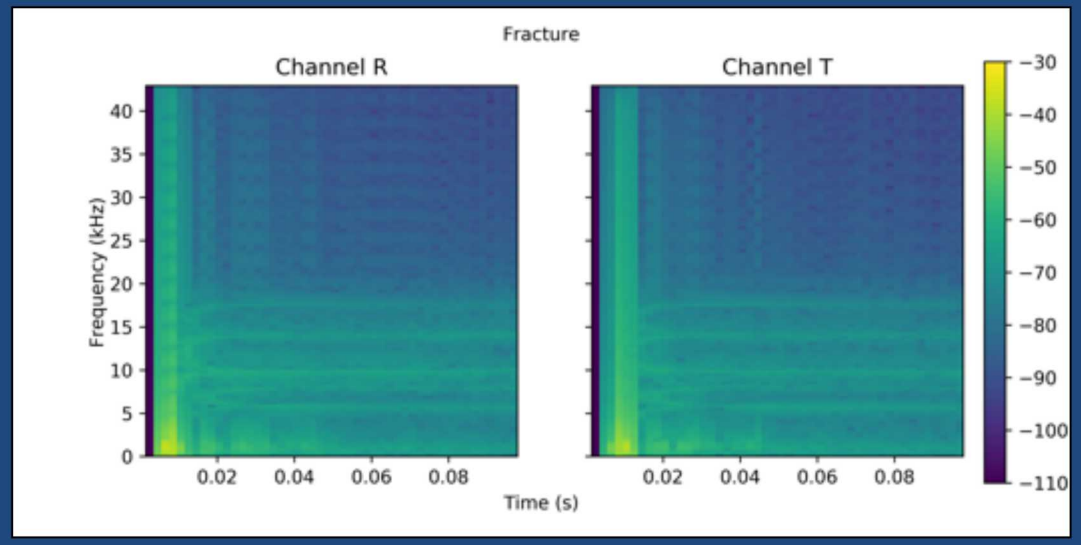


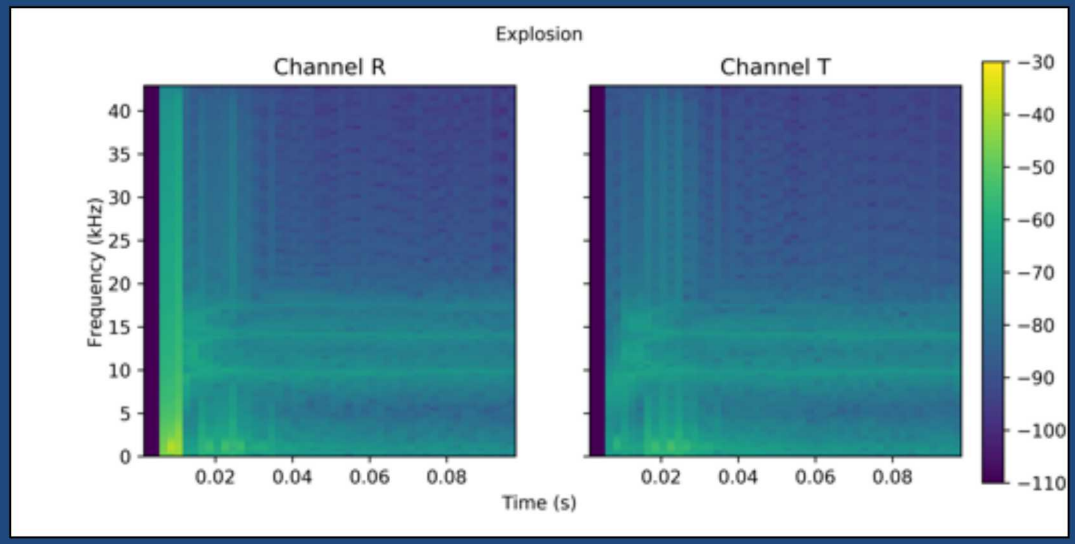


Computing Spectrograms

- Raw signals are transformed into spectrograms showing intensity and frequency for several short time windows.
- Spectrograms are treated as signals and fed into a deep learning model





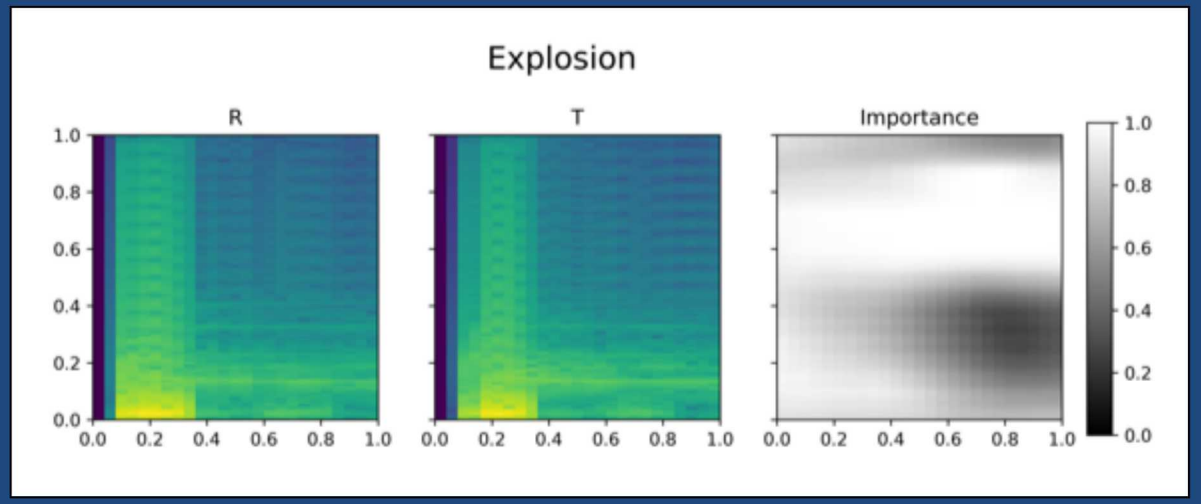


Initial Model Performance

- Classification Accuracy: 88.8%

		Predicted Event Type		
		Earthquake	Fracture	Explosion
True Event Type	Earthquake	2412	0	369
	Fracture	3	2198	25
	Explosion	383	54	2032

- We can identify which image regions are most important for classification:



Way Ahead

	Outstanding Issues	Next Steps
Peridynamics		• Generate Initial Models
Collab	• Duplicate seismograph locations? • Duplicate event locations? • Explosions all appear in a plane?	• Compare performance between locations, distances, • Build models which incorporate several receiver locations • Work on event detection (would need more/noisier data)