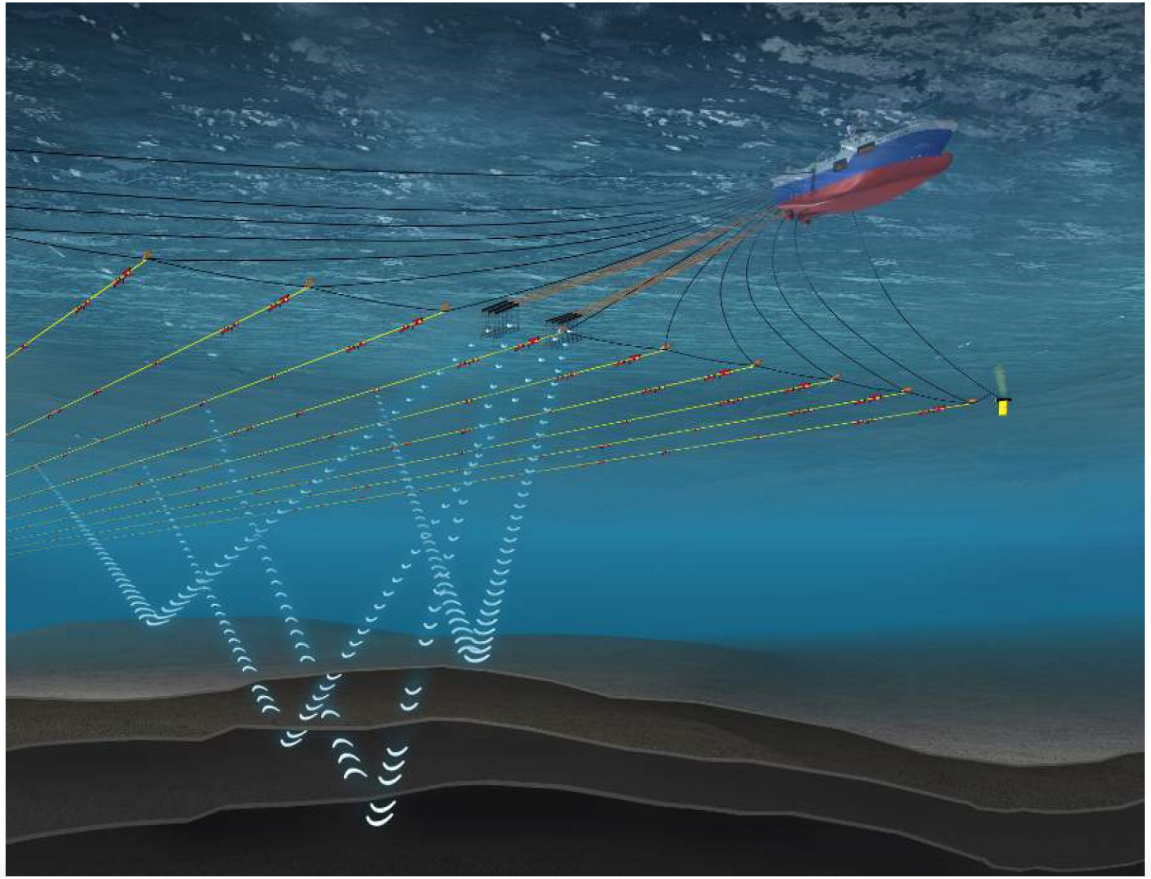
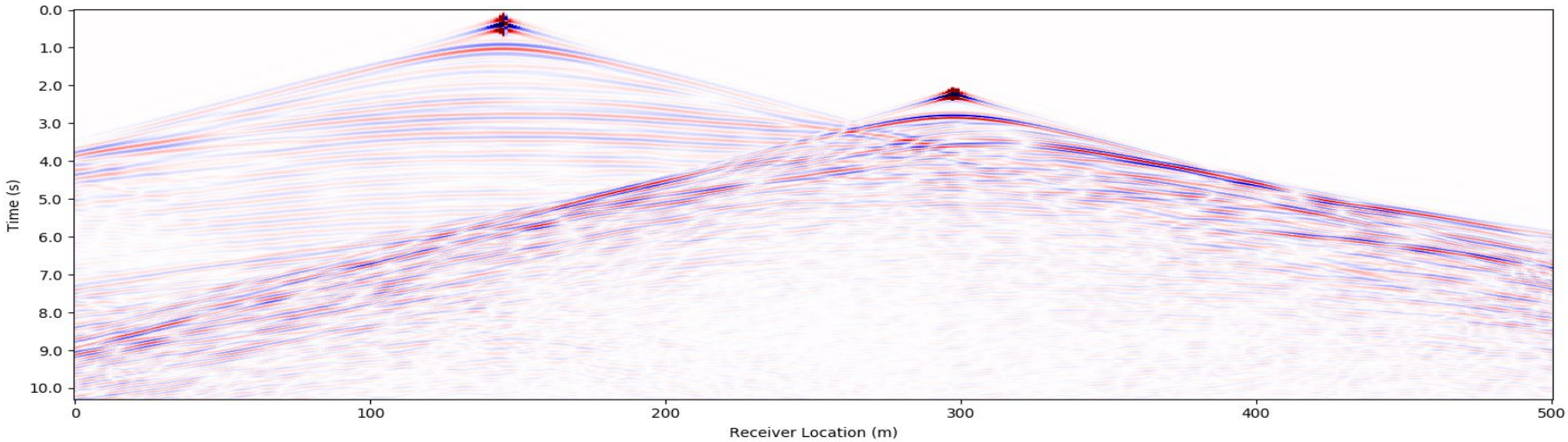
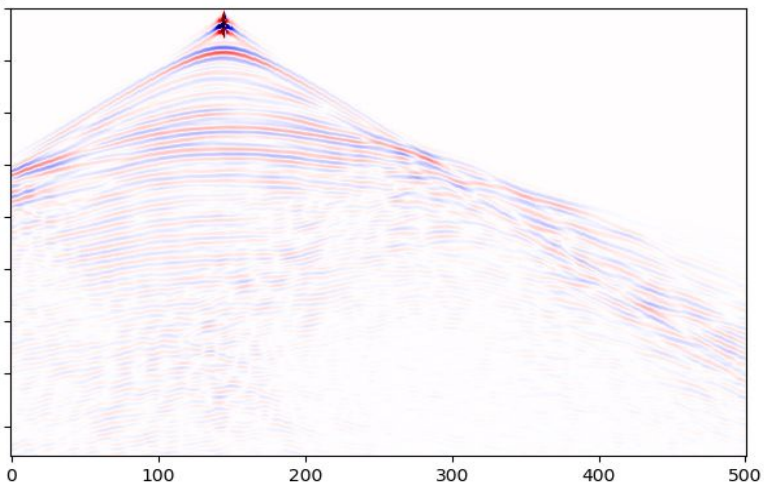
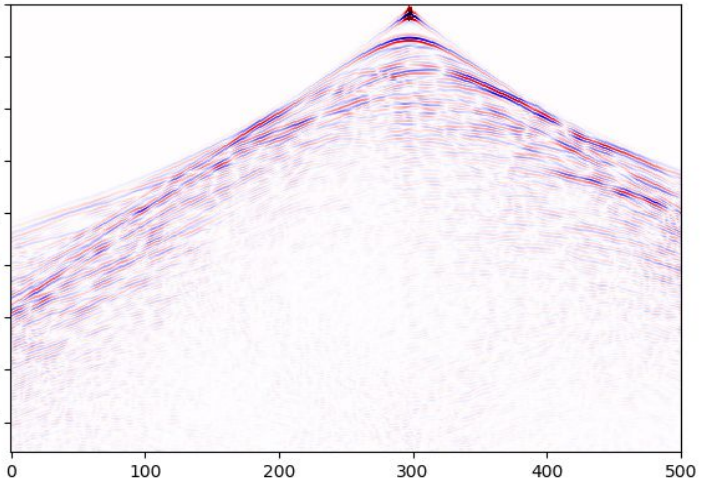
Deblending Seismic Signals

- Marine Seismic Exploration:
  - It is an expensive, high-risk operation.
    - Costs over 1 million dollars from one source to record data for a short period of time.
    - Need to find balance between cost and quality
    - More sources at the same time.
    - Blended seismic source signals are recorded but complicated to seperate (deblend) them.




Time (s)
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
0
100
200
300
400
500
Receiver Location (m)


0
1000
2000
3000
4000
5000
6000
7000
8000
0
100
200
300
400
500


0
1000
2000
3000
4000
5000
6000
7000
8000
0
100
200
300
400
500

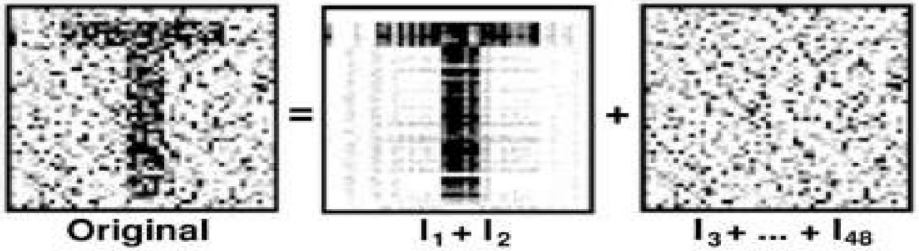
Various Approaches:

1) Singular Value Decomposition (SVD)

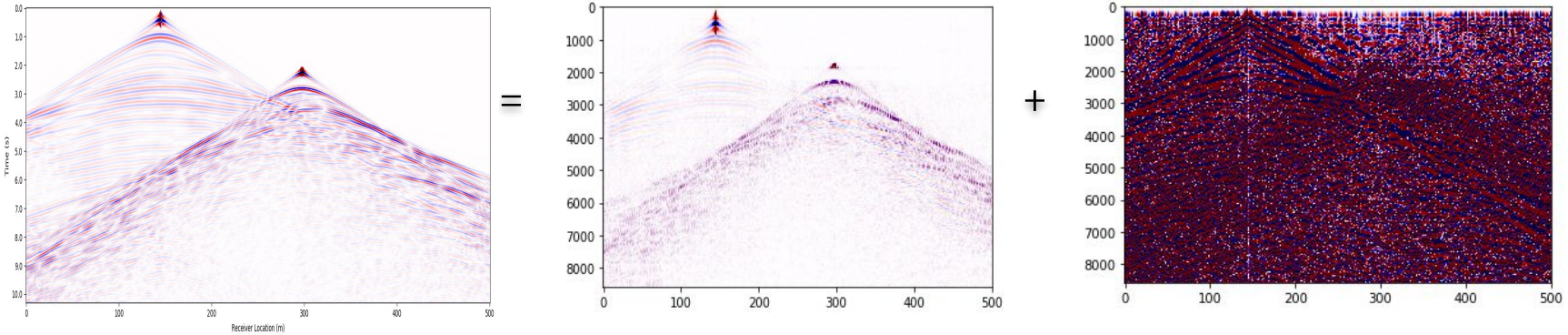
- $\mathbf{A} = \mathbf{U}\Sigma\mathbf{V}^H$ or $A = \mathbf{I}_1 + \ldots + \mathbf{I}_r$

where eigenimages

$$\boldsymbol{I}_i = \sigma_i \mathbf{u}_i \mathbf{v}_i^H$$



- Use SVD to our problem, the first rank 100 matrix



2)Fast Fourier Transformation (FFT)

3) FFT+SVD

- The data is transformed from time domain to frequency domain by FFT.
- For every frequency slice, apply SVD.
- Apply inverse FFT to go back to time domain.

4) Inverse Problem Approach

5) Machine Learning Approach

Thank You

Our Team:

Dilek Erkmen, Anthony Nguyen, Samantha Pinella, Jose Ayllon, Nandita Sahajpal, Yanhua Yuan(Mentor, ExxonMobil)