Recognition of marine seismic data features using convolutional neural networks

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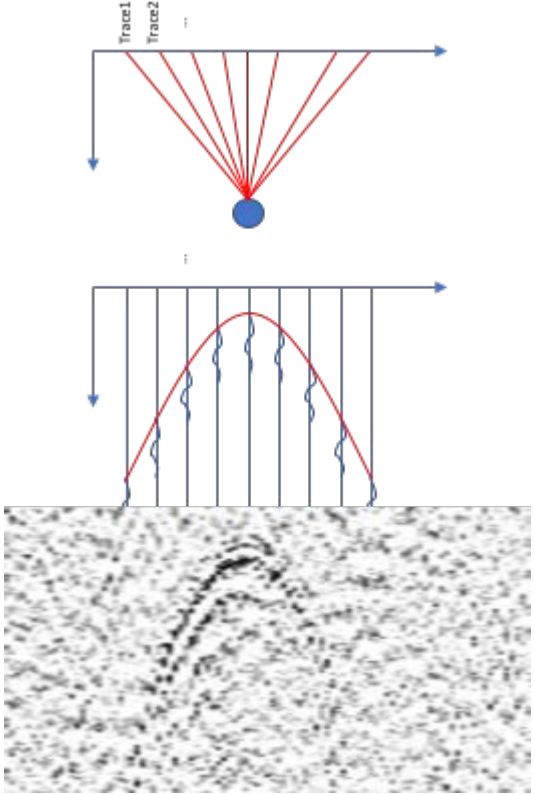
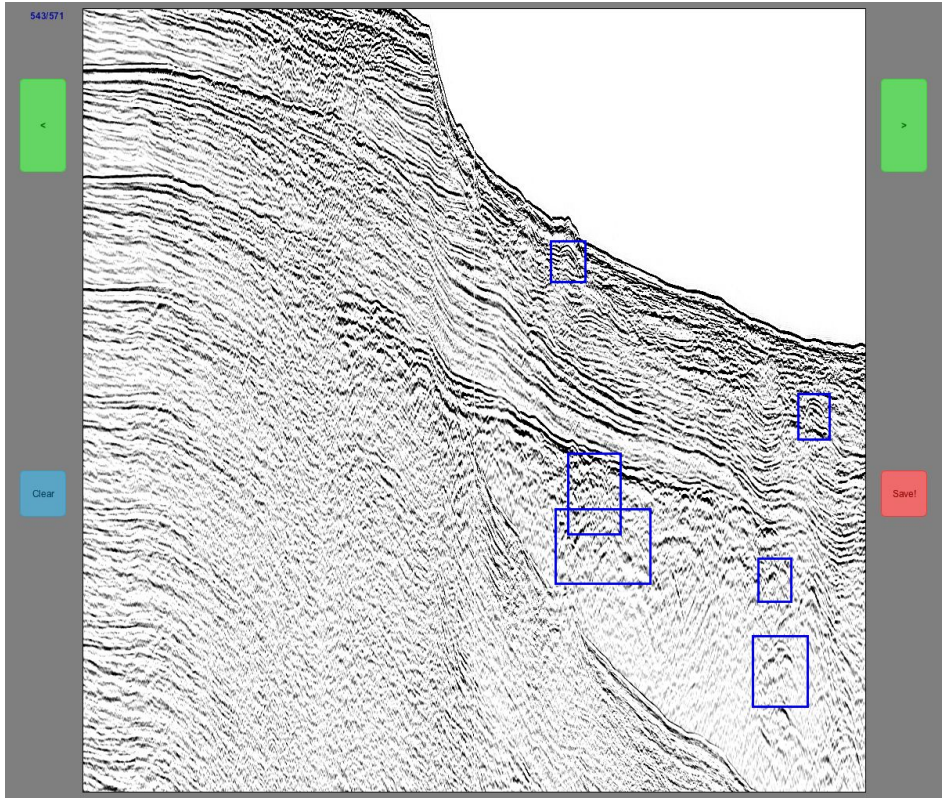
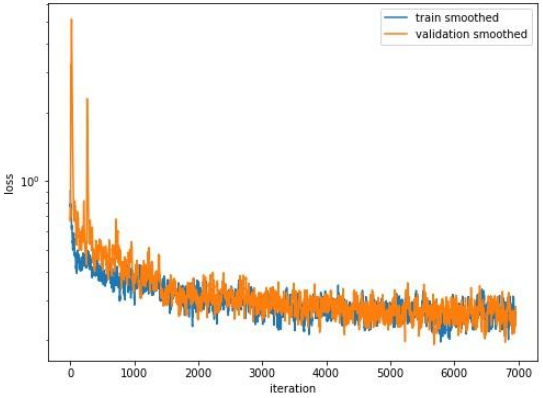
- Exploration seismics data contain signals that can be associated with geological features through interpretation
- Some of these signals can be identified in the seismic image space. Within this work we focused on one of the simplest: Seismic diffractions, that can be associated with structural and stratigraphic features.
- Seismic diffractions image as Hyperbolas on a seismic section, and the aim of this work is to try to identify them automatically in order to ease the work of interpreters.
- We use public seismic data from the **Antarctic Seismic Data Library** (SDLS: http://sdls.ogs.trieste.it) an initiative that is described in another EGU session (ESSI3.2).

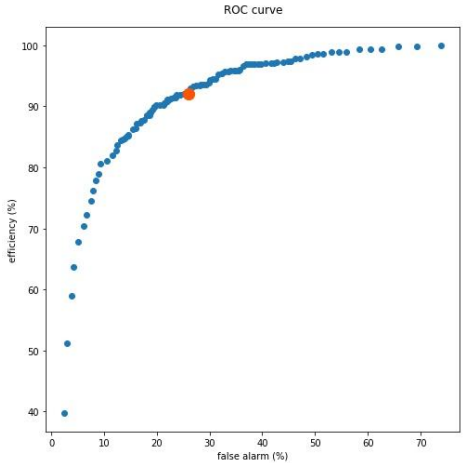


- Original seismic data **SEG-Y** files were transformed into B/W images after some signal pre-processing.
- A collection of 1000x1000 tiles is presented to a pool of researchers with long experience in geophysics.
- By means of a custom developed **GUI application** they manually selected the features.
- Further processing generated the **dataset** with image tiles split into classes.

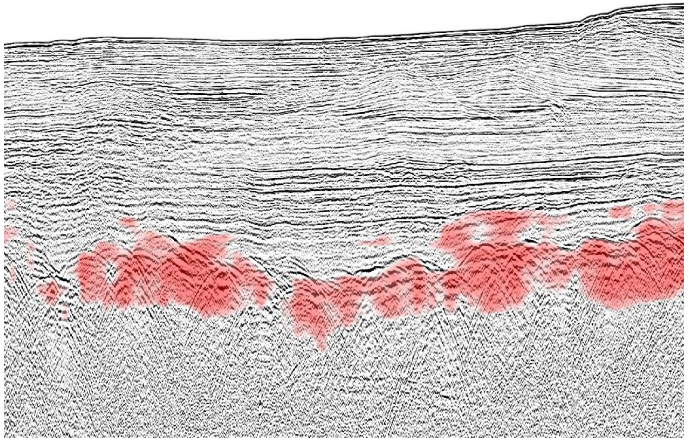


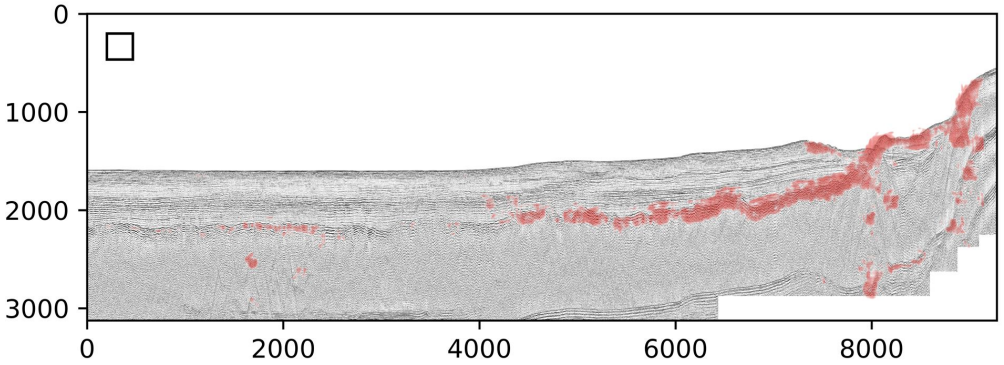
- Our main aim is to understand the feasibility of deep learning for analysis of seismic data
- We train a relatively standard VGG-like convolutional neural network to recognize the presence of a feature from a small patch of the original image
- We employ multiple techniques to improve performance, including real-time data augmentation and batch normalization
- Training time is 2-4 hours, depending on the GPU used





- After the training is completed, the model is not used to classify small patches, but as a **running nonlinear filter** in order to asses the probability for each localized area of the big image to contain a signal. This is a very computationally-intense operation, requiring tens of GPU-hours.
- Here is the resulting **heatmap** for a seismic line off the coast of Eastern Antarctica, with a zoomed detail.





Conclusions

- The work proved that simple geometric features can be identified in the image domain of seismic data profiles.
- From first results, the method seems to be not too much biased by the quality of data. In fact results have been encouraging both with noisy data and vintage data.

Future work

- Extend the work to other geometric features (e.g. faults, amplitude anomalies)
- Combine detection of geometric faults (such as in the case of faults and diffraction)