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Valuable UFT as a preliminary examination to adapt future exploratory work

J. Kumar, I.A. Shakour, M. Soliman

[1] PGS Imaging

Summary

Not Provided

Introduction

An exploration team has limited time to make key decisions and early access to data through fast-track processing can have immense value. Fast track processing has been routine in many exploration surveys with new acquisition, however it is still limited in terms of real time decisions due to the possible turnaround. Although onboard computing and human resources are sufficiently large to execute several testing flows, they are not large enough to process the entire data set in real time. However, it is theoretically possible to achieve this rate in the office. Hence, two primary bottlenecks in achieving faster turnaround are transfer of data from boat to office and automated testing to obtain optimum parameter efficiently.

Recent advancements in low-Earth orbit satellite technology and automation through machine learning algorithms are enabling a step-change in the delivery of early-out data. Thanks to the evolving data transfer technologies that using satellite links, terabytes of data can now be transferred from the vessel to imaging centre in a few hours. On other hand, advancement in machine-learning algorithm means that processing team can use largely standardized automated flows to produce early out datasets generating immense value for an exploration team. Additionally, a database of parameters from past surveys can be automatically mined to obtain parameters t in a similar geological setting with similar acquisition setup. This can speed up the testing phase to get optimal quality for the desired early out dataset.

In this paper, a case study from offshore Greece has been presented, where an ultra-fast track (UFT) data was delivered to the exploration team within three weeks of the acquisition enabling making real time exploration decision during the acquisition period.

Methodology

Long and Martin (2020) proposed a way to automate processing of marine seismic dataset acquired using towed streamers. The author mentioned in their work that their workflows broadly follow three considerations: parameterization with minimal testing, accelerated quality control (QC), and fast derivation of the velocity model. This consideration is very much in line with the method used to obtain the early out dataset presented in this paper. Bekara et al. (2019) describe a machine learning (ML) type QC that is used in conjunction with data analytics tools to quickly validate the parameterization of processing modules. In addition, understanding the expectation from the early out dataset from exploration team and understanding the geology of the area from prior experience allows for a good planning for the velocity model building (VMB)strategy.

The data, presented here, has been acquired off the west coast of Crete, Greece with 2-D acquisition geometry setting using 12000 m long multisensor streamer. Moving from fast track to ultra-fast track (UFT) has been achieved by faster delivery of the data from vessel to office using satellite connections and implementing automation using machine learning in the processing flows. Time savings in the processing were realized through both technical shortcuts and streamlined working practices keeping the expected quality in mind from early out dataset. Figure 1 describe the simplified and streamlined processing flow implemented for the work to produce UFT dataset to enable real time exploration decision.

Denoise process was performed using the automated hydrophone denoise flow with the help of deep machine learning algorithm that was implemented following the work of Farmani et al. (2023). Real image denoising network (RIDNet), a convolutional neural network, is the heart of this machine learning algorithm. A network built on the RIDNet architecture is used to attenuate incoherent noise on hydrophone dataset within the bandwidth of interest and the process is fully automatic with little to no testing involved.

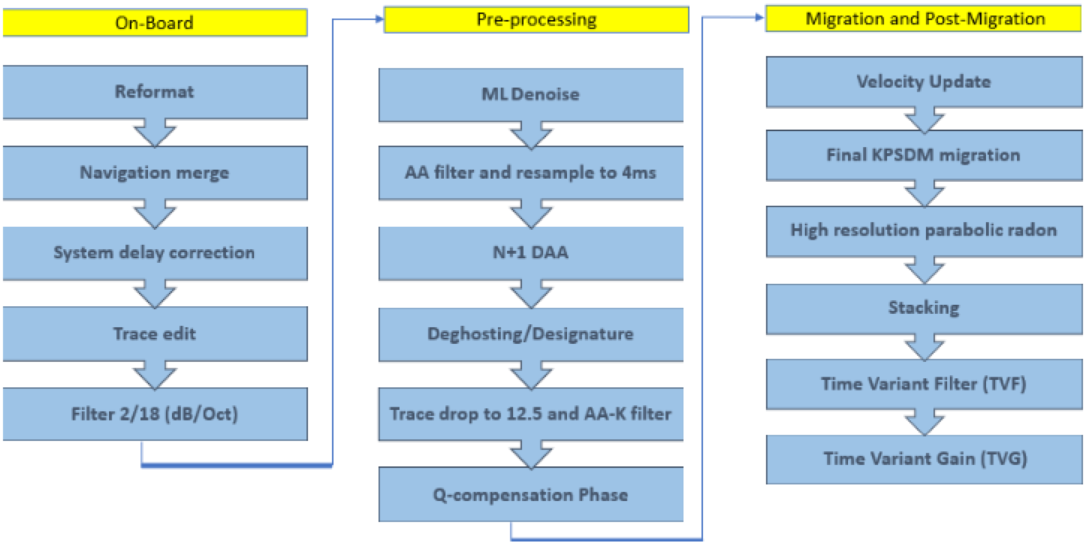

Figure 1 *Fast Track processing flow*

Velocity Model Building Workflow

The initial plan was to use extracted velocity from legacy 2D lines acquired in the region, but due to the complexity of the geological structure changing over short distance and sparsity of the legacy 2D lines, this was proven futile. The plan was then quickly adjusted to manually pick velocity in time on a grid every 1km up to top salt (TOS) event, which has proven its effectiveness in imaging the top salt structures and post salt sediments adequately. This was then followed by a velocity flood using the salt velocity to properly image the base salt, which was then followed by carbonate flood. Figure 2 shows the velocity model and corresponding Kirchhoff image using legacy velocity (top) and updated velocity using described workflow (bottom).

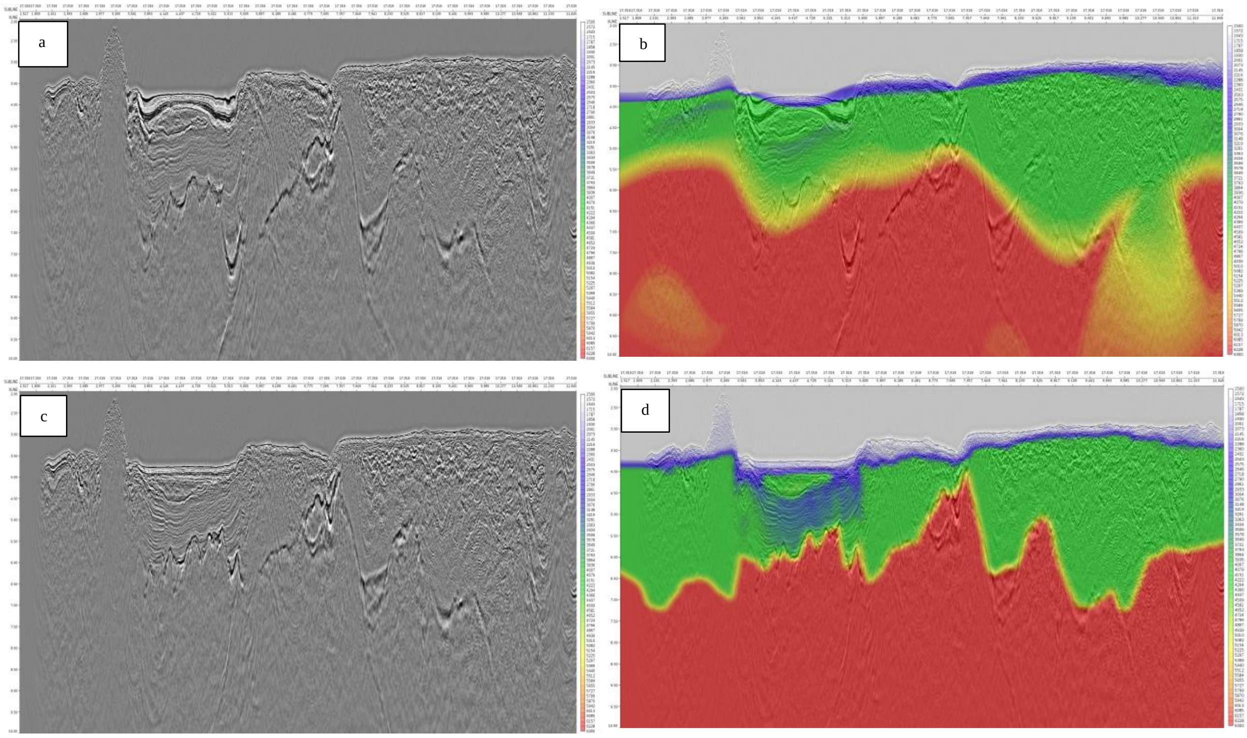

Figure 2 *(a) seismic KPSDM stack using legacy velocity, (b) overlay of legacy velocity, (c) seismic KPSDM stack using updated velocity model, (d) overlay of updated velocity model.*

In total, 43 lines were processed through the UFT workflow, and they were all assessed and accepted by exploration team before delivery. At the end, all these lines were delivered with an average delivery lead time of just two weeks after the data transferred to imaging office, exceeding the initial expectation of 3 weeks before start of the project. Eventually it has helped the exploration team make real time decision to add 31 more 2D lines over the area of interest before the original completion date of the project making most efficient use of their exploration budget. Left image in figure 3 shows the pre-plot of the originally planned acquisition and right image shows the addition of 31 more 2D lines based on the real time analysis of the provided early out UFT product.

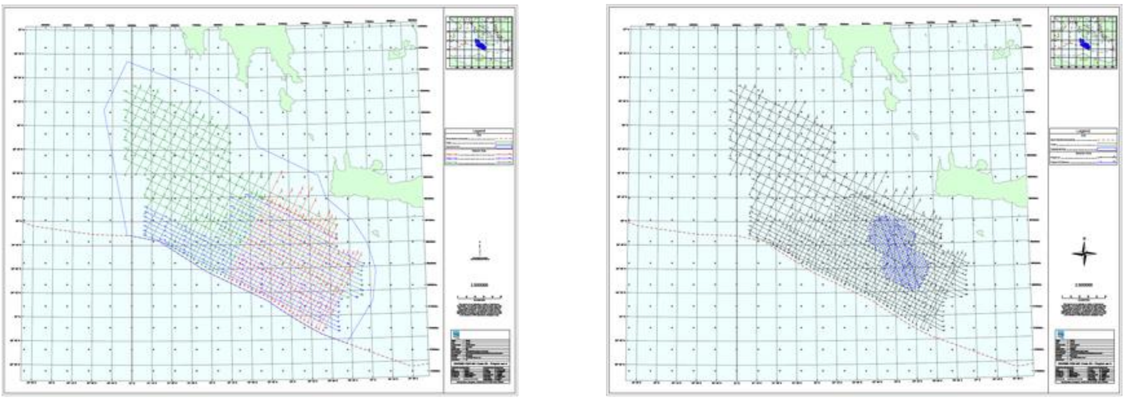

Figure 3 *Left: showing initial base map with 3 colours for the 3 phases. Right: the updated base map based on the UFT results showing added phase 4 lines in blue*

Conclusions

The paper shows an example of very fast delivery of an early out dataset by making use of advancement in various technologies. The UFT has been implemented using a 2D acquisition case study, however there is no reason to not extrapolate this workflow to a 3D survey. Faster transfer of data, simplified workflow based on experience, automatic workflows using ML, machine assisted accelerated QC and pre-defined parameters through data mining of historical work can enable us to provide valuable UFT product to exploration team to make key real time decisions.

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