"OPTIMIZATION OF SEISMIC PROCESSING SEQUENCE USING SYNTHETIC SEISMIC SECTIONS"

A THESIS
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ABSTRACT

AMIRA HAMED: "Optimization of seismic processing sequence using synthetic seismic sections". Master degree/Ain Shams University, Faculty of Science, Geophysics Department, 2012.

In order to process synthetic seismic data using computer software "MATLAB CREWES", a synthetic model has to be created using a velocity subsurface model. The subsurface velocity model was established. Forward modeling was performed by the finite difference method to generate synthetic data. Then, sorting the data into different domains (shot, receiver and CMP domains) to be able to tackle different problems (for example, to remove the noises in the shot domain and also to apply velocity analysis and stacking). The seismic shots are updated with its geometry, then the data became ready for the processing steps.

A linear noise is inserted in the raw data, in-order to attenuate it using the **F-K** Fourier transform. Deconvolution was then applied to remove the effect of wavelet signature. Two types of deconvolution were tested on the data: 1- “spiking deconvolution” is applied in order to compress the wavelet" and 2- “predictive deconvolution” is applied to remove repetition.

Before stacking, the velocity is required to apply NMO correction on the CMP gathers. Constant and semblance (variable) velocity analysis were performed on the data. The semblance analysis gives the best velocity model result to be applied on the data. NMO corrected the CMP-gathers, that were stacked to obtain zero-offset stacks, in order to improve the signal to noise ratio and to prepare the data for the post stack migration.

Before migration, the velocity model should be smoothed. **Kirchhoff post stack migration** was run with different percentages of the smoothed velocity to test the best collapse result of the diffraction hyperbola. Post-stack enhancement is required to be applied to amplify the deep events relative to the shallow events, gain recovery was tested to give good stack balance response.

Two case studies with different structures were modeled, in order to illustrate the difference between the time and depth migration stacks. The depth migration gives a structural image, that is better for interpretation than the time migration image.

Note

The present thesis is submitted to Faculty of Science, Ain Shams University in partial fulfillment for the requirements of the Master degree of Science in Geophysics.

Beside the research work materialized in this thesis, the candidate has attended ten post-graduate courses for one year in the following topics:

1. Geophysical field measurements.
2. Numerical analysis and computer programming.
3. Elastic wave theory.
4. Seismic data acquisition.
5. Seismic data processing.
6. Seismic data interpretation.
7. Seismology.
8. Engineering seismology.
9. Deep seismic sounding.
10. Structure of the earth.

She successfully passed the final examinations in these courses.

In fulfillment of the language requirement of the degree, she also passed the final examination of a course in the English language.

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INTRODCTION

The target of this research “Optimization of seismic processing sequence using synthetic seismic sections” is to model and process seismic data using computer software.

Synthetic seismic data are used to optimize thr seismic processing parameters through the following work plan:

1. Reading SEGY input and pre-processing to sort the data, define geometry and trace editing.
2. Noise elimination and deconvolution (spiking / predictive).
3. Velocity analysis and normal move-out stacking.
4. Velocity feild smoothing and post stack time migration.
5. Trace scaling "Gain Recovery" (post stack).
6. Final stack ready for interpretation.
7. Case studies to show the difference between the time and depth migration stack.

Modeling of seismic data is an important step in:

1. Building the velocity model, which is essential for forward modeling and the creation of synthetic shots.
2. Studying the best surface acquisition geometry and the effect of acquisition parameters on the subsurface spatial data coverage.