MODEL BASED PRE-STACK AMPLITUDE INVERSION

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In order to attempt to extract rock properties and pore fluid information from seismic data we need to make sure that we have input data which has all the amplitude corrections properly applied to the CMP gathers. We present a deterministic approach to predict the amplitude corrections we need to apply to the time gathers prior to the pre-stack amplitude inversion process.

The pre-stack amplitude inversion process requires the removal of all amplitude / offset effects, which are unrelated to the subsurface reflectivity.

Angle - dependent effects as source directivity, receiver directivity are calculated using ray trace modeling through an interval velocity model.
The geometrical spreading is calculated using ray paths through the interval velocity model.
The deterministic approach enables us to predict and remove these effects.
Source and receiver arrays responses, attenuation correction as well as surface consistent scaling is applied to the time gathers prior to the inversion process.

Using the model-based amplitude preconditioned time gathers we can generate AVO attributes sections, which relate more closely to the changes in lithology and fluid content.
Recovery of the Vp and Vs reflectivity sections from pre-stack data requires a precise estimate of the incidence angle associated with each amplitude.
From ray tracing we calculate angles of incidence and reflection point smear values.
The angles of incidence will help us to estimate the near, wide and wide minus near offset stack section angles while the reflection point smear will help to understand if the CMP gather collects the information from a single point or over a segment of the reflector.

Before we perform preconditioning and inversion we can run feasibility test and display QC panels to preview the suitability of the data for AVO analysis.

Using Linearized Zoeppritz Inversion we can generate Pressure and Shear wave reflectivity, Fluid Factor, Pseudo - Poisson Reflectivity section.
Generating the Lame coefficient sections will help us to understand better the rock properties as well as fluid content.

From the Simplified Inversion using Shuey - Hilterman approximation to the Zoeppritz equation we can generate Normal Incidence Reflectivity, Gradient Sections and their combinations: Sign Ro* G and Poisson Reflectivity Section.

The AVO attribute sections could be cross - plotted and various clusters identified on the input sections as well as selecting from the AVO attribute sections and display the selected points on the cross-plot.

Using the well logs we generate synthetic time gathers as well as model AVO attributes traces which could be used for qualitative comparison or / and to determine a scaling factor we need to apply to the seismic derived AVO attributes.

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