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APPLICATION OF OPTIMIZATION METHODS TO THE INVERSION OF AEROMAGNETIC DATA (BRAZIL)

LEITE, LOURENILDO WILLIAME BARBOSA. Saint Louis University, ProQuest, UMI Dissertations Publishing, 1983. 8325388.

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Abstract (summary)

A method for mathematical interpretation of aeromagnetic data has been developed. The method is commonly known as ridge regression and is based on unconstrained optimization for problems which are nonlinear in the parameters to be resolved. The object function is defined as the sum of the squares of the observation residuals. The estimator corresponds to the modified Newton's method of local quadratic approximation to the object function.

The forward model is analyzed through its sensitivity coefficients and parameter correlation matrix. The parameter confidence interval takes into account the measurement of the non-linearity of the quadratic approximation.

The initial approximation is determined by profile analysis and by the geological information that sets the forward model and its constraints. The nonuniqueness of the solution results in an interpretation that can be refined further, as new geological information is used as input.

Synthetic models have been designed to test and study the convergence and statistical properties, and to show the ability of the method to resolve interfering anomalies of various sources.

Real data used in the analysis were obtained from aerosurveys over an oil exploration area of the Brazilian Upper Amazon region called Jurua, which became a pilot area for geophysical ground and air exploration surveys.

The inversion of real data had to be preceded by an editing of the original aeromagnetic digital data in order to have the complete profiles in the processing form. The available data were inverted without heavy filtering; only a smoothing operation was applied to take out local spikes in the data.

The geological information used to set the forward model and parameter constraints was obtained from several boreholes drilled for oil, and from seismic and paleomagnetic studies carried out previously in the area. The final interpretation of the real data is presented in the form of profiles and then condensed into an interpretational map showing the obtained topographic relief of the magnetic basement.