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SHORT NOTE

THE DETERMINATION OF INFLECTION POINTS ON MAGNETIC INTENSITY PROFILES

by

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The inflection points on a total magnetic intensity profile are employed in many analytic interpretation techniques e.g. Grant and Martin (1966), Bean (1965), Moo (1965). The positions of points of inflection on the flanks of a magnetic anomaly are usually difficult to locate by inspection with reasonable accuracy. A simple analytic, trial and error, technique employing "moving strip" central difference coefficients may be used to locate inflection points rapidly from the measured and/or smoothed magnetic intensity data points.

If magnetic intensity values are plotted on the ordinate (y) against horizontal distance on the abscissa (x) then the second derivative $y''(x)$, describes the rate of change of the gradient of the magnetic intensity profile as the point of tangency moves along the profile. The vanishing of $y''(x)$, if it is continuous, is a necessary but not sufficient condition for a point of inflection which requires in addition a change of sign at the point i.e. a sign differential in $y''(x)$ for values of the independent variable slightly less and slightly greater than at the point.

For numerical differentiation many formulae may be found in the literature of Numerical Analysis e.g. Kopal (1961). The rationale of numerical differentiation is to approximate the given function $y = f(x)$ over a short range of x by a power polynomial $Pm(x)$ and then to differentiate the polynomial which can be differentiated far more easily than the function $f(x)$. If the function is tabulated at suitable intervals (as can be readily achieved with magnetic data) then the approximating polynomial is the interpolating polynomial. Most commonly the data are tabulated at equal abscissa intervals to facilitate analysis.

Central difference formulae have been found easy and satisfactory to apply for numerical differentiation. These formulae are more accurate than backward or forward difference formulae and involve the use of pivotal abscissa points symmetrically located with respect to i at which point the second derivative $y''(i)$, is to be determined.

The Lagrangian central difference formula for five pivotal points, evenly spaced by h on the abscissa, generally is sufficiently accurate and rapid. This formula is based on the Lagrangian equal interval form of interpolation and is as follows:

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$$y''(i) = \left[1/12h^2\right]\left[16(y_{\overline{i+1}} + y_{\overline{i-1}}) - 30y(i) - (y_{\overline{i+2}} + y_{\overline{i+2}})\right]$$

The coefficients of this formula can be applied in "moving strip" mode to the tabulated values of magnetic intensity in the inflection point region which should be estimated roughly by visual inspection. In this way the vanishing of the second derivative and change of sign can be found.

It should be noted that data smoothing operations, inaccurate data, polynomial truncation, and rounding errors can vitiate an interpretation and cognisance of these factors should be taken in analysis. The formula cited is also a numerical filter. The characteristics of this and other such formulae can be represented on a standard frequency response diagram.

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