# SHORT NOTE
# THE DETERMINATION OF THE INFLECTION POINTS ON MAGNETIC INTENSITY PROFILES: FURTHER COMMENTS

*by Robert J. Whiteley**

In a recent note, Emerson (1973) described a method for the location of inflection points on magnetic intensity data.

Basically, the method involves the computation of approximate second derivatives along the profiles using a Lagrangian central-difference formula.

Application of this method involves the convolution of what is essentially a filter operator with actual or interpolated field data. To simplify computation, the operator is small in length and repeatedly applied to equi-spaced data along the profile. As a result of this finite length, inflection points can only be exactly located when an original data point exactly coincides with the inflection point.

It should also be noted that although the characteristics of the operator are independent, the result of the convolution is dependent on the nature and spacing of the original data.

In general, as the method described by Emerson is applied in a "moving strip" fashion, the calculated second derivative changes sign and its absolute magnitude passes through a minimum as the inflection point is traversed. The sign change is easily located but determining how close the minimum is to the inflection point is considerably more difficult. To achieve this in practice requires repeated application of the Lagrangian formula, often with different data spacing. This means that a trial-and-error, stepping procedure must generally be repeated at least three times in the vicinity of the inflection point.

With the use of the five-point central difference formula considerable manual computation (desk calculator assisted) and error checking is involved and the process becomes tedious and time consuming if many anomalies are to be treated. For these reasons the method is most suitable for computer calculation.

It is still desirable to have a rapid, theoretically based, manual method for approximately locating inflection points. Such a method should allow a large amount of data to be speedily processed and can be supplemented by second derivative calculation if increased accuracy is required at a later stage.

A little known, graphical method for locating inflection points has been described by Rempel (1966). Mathematical computation is not needed and the only restriction is that the data is required in a smooth graphical form.

Rempel's method is based on the exact location of inflection points for certain classes of single-valued functions $y = f(x)$ ($x$ = distance ordinate) with an inflection at $x=a$ if the following conditions are satisfied:

(1) the third derivative $f'''(x)$ is not identically zero in the neighbourhood of the point $(a,f(a))$

(2) $f(a+x) + f(a-x) = 2f(a)$.

Conditions (1) and (2) are sufficient for an inflection point but not necessary. Also by condition (2) the inflection point will be exactly located for graphs of any third-order polynomial or the trigonometric functions, i.e. sin, cos, tan, etc. For most other functions the positioning of the inflection point will be approximate but extreme errors in location can be easily calculated.

Theory of the method is described in detail by Rempel. The method is simply applied by drawing two parallel tangents to the $f(x)$ curve on either side of the inflection point. A further straight line is drawn midway between these tangents and parallel to them. This line intersects the $f(x)$ curve at or near the inflection point.

The extreme error in locating the inflection point with this method can be calculated from the gradients and intersection points of the parallel tangents with the curve. In practice, errors are usually much less than the extreme error and can be assessed by drawing other sets of parallel tangents at different inclination to the horizontal and locating further inflection points.

Theoretically, the smaller the spacing between the parallel tangents the more accurately the inflection point may be determined. Practically, the results depend on the angle at which the straight lines meet the curve and the larger this angle the more precisely the point of intersection with the curve will be located. Experience has shown that errors in the location of the inflection point are often less than those involved in the construction of the original smoothed profile.

This method can be applied with a parallel and measuring rule but can be achieved more rapidly using a simply constructed transparent rule described by Rempel.

As a final comment the method may be used with any graphical data collected along profiles as a single-valued function (e.g., gravity, magnetics, electro-magnetics, etc.).

**REFERENCES:**

Emerson, D. W., 1973. The Determination of Inflection Points on Magnetic Intensity Profiles. **Bull. Aust. Soc. Explor. Geophys.**, Vol. 4, No. 4, p. 33.

Rempel, G. G., 1966. Method of Determining Points of Inflection of functions from their Graphs. **Geologiya i Geofizika**, 1966, 5, p. 172. Scientific Information Services, Canada, Oct. 1966 T 467R translated by E. R. Hope.

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