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A comparison of edge detecting algorithms in magnetic imaging

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Directional derivatives based algorithms and special filters are widely used for enhancing the magnetic anomalies of the causative sources. The edge-detecting algorithms effectively aids geologic interpretation and may also bring out the subtle details in the data without specifying prior information about the nature of the sources, thus some model parameters of the source body may be estimated via this way which may guide the inversion process. These techniques have the ability of exhibiting maxima over lateral magnetization contrasts if the source magnetization and the ambient field are directed vertically, and hence the edges and lateral outlines of the causative sources may be determined. In the interpretation of the magnetic data, in order to bring out fine details, the frequently used filters are vertical derivatives or downward continuation and the other forms of high-pass filters. Because the shallow bodies produce magnetic anomalies with maximum horizontal gradients located nearly over their edges contrasts if the source magnetization and ambient field are directed vertically, the most popular technique is the first order total horizontal derivatives. The abrupt changes in mass magnetization may be located in anomaly map by using total horizontal gradient technique. Many filters and algorithms based on the use of the directional derivatives of the potential field data have been developed and suggested to determine the source parameters such as locations of the lateral source boundaries.

In this research, the efficiency of several edge detectors such as sobel filter (SED), analytic signal (AS), horizontal derivatives of theta map (THD), horizontal derivatives of tilt angle (TAHD) and normalized standard deviations (NSD) were compared. Tests were performed on theoretically calculated magnetic anomalies resulting from 3D prismatic bodies for different cases. Before the applications of edge detector algorithms to the produced data, reduction to the pole process was performed in order to shift the anomalies laterally to be located over their respective sources. The results produced by the use of different edge detector algorithms were demonstrated with image maps and cross-sectional views for a comprehensive comparison.

Keywords: Magnetic data, reduction to the pole, edge detectors, directional derivatives, 3D bodies