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Edge detection of potential field anomalies using tilt angle and its inferred filters

k. Alamdar, A.H. Ansari, and A. Ghorbani
Department of mining and metallurgical engineering, Yazd University, Yazd, Iran (kamal.alamdar@gmail.com)

Abstract: Potential field images that are obtained in potential field methods (Gravity, Magnetic) are used worldwide as part of exploration programs for mineral resources. These images consist of different anomalies which in many cases are coated with noises. In order to extraction details of these images and enhancing their features, filtering techniques are applied. In this process more effort is balance between signals and noises in filtered images. When data quality permits a range of high-pass filters, such as upward continuation and vertical derivative, can be used to bring out fine details. However, since they are a form of high–pass filter they also have an undesirable property of enhancing noise.

Other applied filters are local phase filters such as tilt angle filter and theta filter which fundamentally of these filters are local phase measuring of the potential field data over images. The tilt angle is ratio of the vertical derivative to absolute amplitude of the total horizontal derivative. The tilt angle is positive when over the causative body, zero near body edges and negative outside the body. Advantages of this filter are possibility of comparison between its results to derivative-based filters, its dimensionless nature and simple interpretation rather than analytic signal. Disadvantage of this filter is encountering with deep sources the detected edge is blurred as form of hallo. For overcome this problem such new tilt inferred filters namely total horizontal derivative of tilt angle (THDR), 2-order vertical derivative of tilt angle, normalized total horizontal derivative (NTHD) are introduced which produce more improvement results. These filters produce useful information in both deep and shallow sources. Furthermore these filters act as a method to separate regional anomalies from residual anomalies.

In this work we applied these filters on synthetic gravity data and on real aeromagnetic data from Abadeh quadrangle in Iran. This region has been located in 55° 35’ longitudes and 32° 31’ latitude. The main structure in this area is Dehshir-Baft fault with NW-SE trend which separates Shirkooh granite in northeast from Abarkooh plain in center. Other magnetic anomaly source is ophiolite outcrop in southeast. With application of these fitters the main geological and structural features such as basic lava in south, ophiolite outcrops in southeast and main fault with NE_SW in northeast have been enhanced.

Keywords: Potential field, Signal, High-pass filter, Derivative–based filter, Local–phase filter, Tilt angle, THDR, NTHD