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Interpretation of gravity anomalies due to simple geometric-shaped structures based on quadratic curve regression

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Abstract: An easy and very simple method to interpret residual gravity anomalies due to simple geometrical shaped models such as a semi-infinite vertical rod, an infinite horizontal rod, and a sphere has been proposed in this paper. The proposed method is mainly based on the quadratic curve regression to best-estimate the model parameters, e.g. the depth from the surface to the center of the buried structure (sphere or infinite horizontal rod) or the depth from the surface to the top of the buried object (semi-infinite vertical rod), the amplitude coefficient, and the horizontal location from residual gravity anomaly profile. The proposed method has been firstly tested on synthetic data set corrupted and contaminated by a Gaussian white noise level to demonstrate the capability and the reliability of the method. The results acquired show that the estimated parameters values derived by this proposed method are very close to the assumed true parameters values. Next, the validity of the presented method is demonstrated on synthetic data set and 3 real data sets from Cuba, Sweden and Iran. A comparable and acceptable agreement is indicated between the results derived by this method and those from the real field data information.

Key words: gravity anomaly, sphere-like structure, semi-infinite vertical rod-like structure, infinite horizontal rod-like structure, quadratic curve regression

1. Introduction

The gravity method is one of the first geophysical techniques used in oil and gas exploration. Most of the geological structures in oil and mineral exploration can be approximated by simple geological structures such as a fault, a sphere, a cylinder, a sheet, semi-infinite vertical rod, an infinite horizontal rod or a dike. According to this approximation, different methods have been already introduced to interpret gravity field anomalies due to simple geometric models in an attempt to best-estimate the gravity

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parameters values, e.g. the depth to the buried body and the amplitude coefficient. Those interpretation methods include, linear optimization-simplex algorithm (*Asfahani and Tlas, 2015*), neural network modeling (*Abedi et al., 2010*), differential evolution algorithm (*Ekinci et al., 2016*), graphical methods (*Nettleton, 1962 and 1976*), ratio methods (*Bowin et al., 1986; Abdelrahman et al., 1989*), Fourier transform (*Odegard and Berg, 1965; Sharma and Geldart, 1968*), Euler deconvolution (*Thompson, 1982*), neural network (*Elawadi et al., 2001*), Mellin transform (*Mohan et al., 1986*), least-squares minimization approaches (*Gupta, 1983; Lines and Treitel, 1984; Abdelrahman, 1990; Abdelrahman et al., 1991; Abdelrahman and El-Araby, 1993; Abdelrahman and Sharafeldin, 1995a*), Werner deconvolution (*Hartman et al., 1971; Jain, 1976*). *Kilty (1983)* extended the Werner deconvolution technique to the analysis of gravity data using both the residual anomaly and its first and second horizontal derivatives, *Ku and Sharp (1983)* further refined the method by using iteration for reducing and eliminating the interference field and then applied Marquardt's non-linear least squares method to further refine automatically the first approximation provided by deconvolution. *Salem and Ravat (2003)* presented a new automatic method for the interpretation of magnetic data, called AN-EUL. Their method is based on a combination of the analytic signal and the Euler deconvolution method. With the AN-EUL, both the location and the approximate geometry of a magnetic source can be deduced. *Fedi (2007)* described the theory for the gravity and magnetic fields and their derivatives for any order, and proposed a method called depth from extreme points (DEXP) to interpret any potential field. The DEXP method allows estimating of source depths, density and structural index from the extreme points of a 3D field scaled according to specific power laws of the altitude. *Salem and Smith (2005)* presented an alternative method to estimate both the depth and model type using the first order local wave number approach without the need for third order derivatives of the field. In their method, a normalization of the first order local wave-number anomalies is achieved, and a generalized equation to estimate the depth of some 2D magnetic sources regardless of the source structure is obtained. *Silva and Barbosa (2003)* derived the analytical estimators for the horizontal and vertical source position in 3D Euler deconvolution as a function of the x, y, and z derivatives of the magnetic anomaly within a data window. *Barbosa et al. (1999)* proposed a new criterion for determining the structural index, based on the correlation between the total magnetic field anomaly and the estimates of an unknown base level. *Salem et al. (2008)* developed a new method for the interpretation of gridded magnetic data, which based on derivatives of the tilt angle, where a simple linear equation, similar to the 3D Euler equation can be obtained. Their method estimates both the horizontal location and the depth of magnetic bodies, but without specifying prior information about the nature of the sources. *Fedi et al. (2009)* proposed a new method based on a 3D multiridge analysis of potential field. The new method assumes a 3D subset in the harmonic region and studies the behavior of the potential field ridges, which are built by joining extreme points of the analyzed field computed at different altitudes.

However, only few techniques have treated the determination of shape of the buried structure. These techniques include, for example, Walsh transform (*Shaw and Agarwal, 1990*), least-squares methods (*Abdelrahman and Sharafeldin, 1995b; Abdelrahman et al., 2001a, b*), constrained and penalized nonlinear optimization technique (*Tlas et al., 2005*). Generally, the determination of the depth, shape factor, and amplitude coefficient of the buried structure is performed by these methods from residual gravity anomaly, where the accuracy of the results, obtained by them, depends on the accuracy in which the residual anomaly can be separated and isolated from the observed gravity anomaly.

Recently, *Asfahani and Tlas (2012)* proposed an efficient approach to interpret the residual gravity anomalies in order to estimate the gravity parameters, e.g. depth, amplitude coefficient and geometric shape factor of simple buried bodies, such as a sphere, horizontal cylinder and vertical cylinder. The method is based on the non-convex and nonlinear Fair function minimization and the adaptive simulated annealing, stochastic optimization algorithm. The main advantage of this approach is that the buried body shape is considered as unknown factor and can be estimated as an independent parameter. However, this approach suffers from the discrepancy and has some disadvantages, because it sometimes necessitates the use of multi-starting or initial guesses of parameters in order to assure the global convergence or to reach the global minima of the objective function.

A recent publication by*Asfahani and Tlas (2015)* focused on a new practical interpretation methodology for interpreting residual gravity field anomalies and best-estimating of model parameters values, e.g. the depth to the top or to the center of the body and the amplitude coefficient related to a buried sphere or a cylinder-like structure. The method uses the deconvolution technique to avoid the local minima, where the nonlinear optimization problem describing the suitable simple geometric-shaped model of structure is transformed into a linear optimization one. The linear problem is thereafter solved by the very well-known algorithm in linear optimization called the simplex algorithm of Dantzig (*Phillips et al., 1976*) in order to definitely reach the global minima.

In this paper, an easy and simple interpretation method based on quadratic polynomial regression is proposed for interpreting residual gravity field anomalies and for best-estimating of model parameters values, e.g. the depth to the top or to the center of the body, the horizontal location and the amplitude coefficient related to a buried sphere, semi-infinite vertical rod or infinite horizontal rod. The reliability and capability of the proposed interpretation method is demonstrated using synthetic data set and contaminated by a white Gaussian noise level of 25%. The results acquired show that the estimated parameter values derived by this method are very close to the assumed true values of parameters.

The validity of this method is also demonstrated using three real field gravity anomalies taken from Cuba, Sweden and Iran. Comparable and acceptable agreements are shown between the results derived by the proposed method and those obtained by other interpretation methods. Moreover, the depth obtained by such a proposed method is found to be in high accordance with that obtained from the real field data information.

2. Theory

A theoretical and synthetic residual gravity anomaly related to various geological models such as a sphere, a semi-infinite vertical rod and an infinite horizontal rod have been treated in this research, in order to demonstrate the validity and the applicability of the proposed interpretation method.

The general expression of the residual gravity anomaly (V) at any point $M(x)$ along the x-axis of a semi-infinite vertical rod-like structure, an infinite horizontal rod-like structure and a sphere-like structure, in a Cartesian coordinate system (Fig. 1) can be given according to *Nettleton (1962), Gupta (1983)* as:

$$V_z(x_i) = \frac{k}{\left((x_i - x_0)^2 + z^2\right)^q} \quad (i = 1, ..., N), \tag{1}$$

where q is the geometrical shape factor of the buried structure given as: $q = 1.5$ for a sphere, $q = 0.5$ for a semi-infinite vertical rod and $q = 1$ for an infinite horizontal rod, x_0 is the horizontal location of the buried body, z is the depth from the surface to the center of the buried structure (sphere or infinite horizontal rod) or the depth from the surface to the top of the buried object (semi-infinite vertical rod), k is the amplitude coefficient

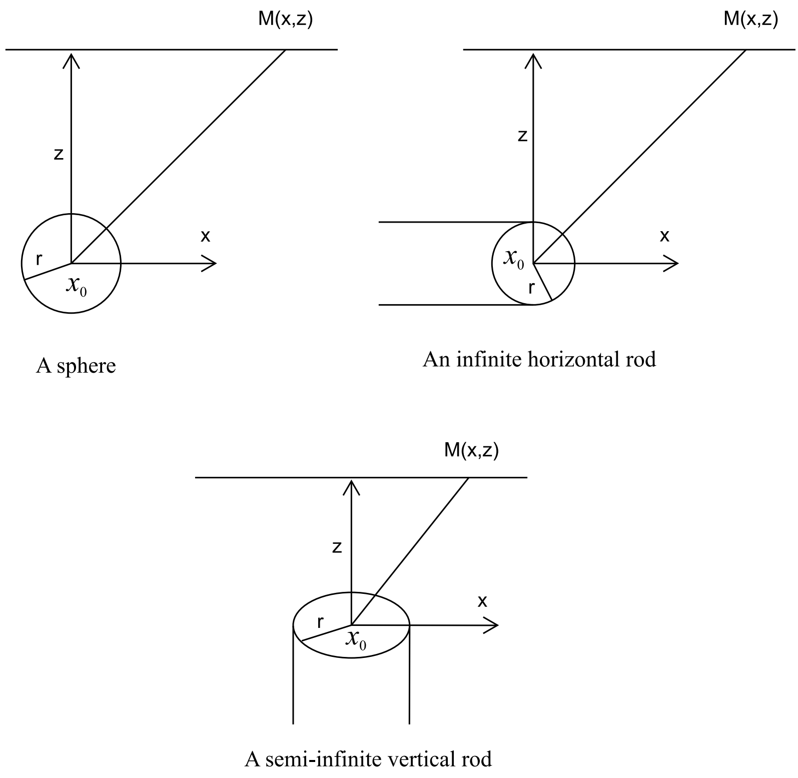

Fig. 1. Diagrams of simple geometrical structures (sphere, semi-infinite vertical rod and infinite horizontal rod).

given by: $k = \frac{4}{3}\pi G\rho r^3 z$ for a sphere, $k = \pi G\rho r^2$ for a semi-infinite vertical rod and $k = 2\pi G\rho r^2 z$ for an infinite horizontal rod, where ρ is the density contrast, G is the universal gravitational constant, r is the radius, and finally x_i $(i = 1, \dots, N)$ is the horizontal position coordinate.

The set of Eq. (1) consists of N nonlinear equations in function of the three independent parameters k, x_0 and z. The term V_i will be used, for simplification, instead of the term $V_z(x_i)$ $(i = 1, ..., N)$, in the rest of the paper.

From Eq. (1), it can be easily observed that the sign of the parameter k is similar and coincident to the sign of V_i $(i = 1, ..., N)$.

Taking the absolute values of both sides of Eq. (1) we find

$$|V_i| = \frac{|k|}{\left((x_i - x_0)^2 + z^2\right)^q} \quad (i = 1, ..., N). \tag{2}$$

The simple manipulation of the Eq. (2) will give us

$$|V_i|^{-\frac{1}{q}} = |k|^{-\frac{1}{q}} x_i^2 - 2x_0|k|^{-\frac{1}{q}} x_i + |k|^{-\frac{1}{q}} \left(x_0^2 + z^2\right) \quad (i = 1, ..., N). \tag{3}$$

And with help of the following symbolism:

$$A = |k|^{-\frac{1}{q}}, \tag{4}$$

$$B = -2x_0|k|^{-\frac{1}{q}}, \tag{5}$$

$$C = |k|^{-\frac{1}{q}} \left(x_0^2 + z^2\right). \tag{6}$$

The Eq. (3) can be written as

$$|V_i|^{-\frac{1}{q}} = Ax_i^2 + Bx_i + C \quad (i = 1, ..., N). \tag{7}$$

The right hand side in Eq. (7), is a quadratic polynomial in function of x_i, the values of the coefficients A, B, and C, can be determined through performing a quadratic curve regression between x_i and $y_i = |V_i|^{-\frac{1}{q}}$ $(i = 1, ..., N)$ using one of the familiar statistical programs as Microsoft Excel or through solving the following set of simultaneously linear equations by the well-known direct method of Gauss

$$\left.\begin{array}{l}\left(\sum\limits_{i=1}^{N} x_i^4\right) A + \left(\sum\limits_{i=1}^{N} x_i^3\right) B + \left(\sum\limits_{i=1}^{N} x_i^2\right) C = \sum\limits_{i=1}^{N} x_i^2 |V_i|^{-\frac{1}{q}} \\ \left(\sum\limits_{i=1}^{N} x_i^3\right) A + \left(\sum\limits_{i=1}^{N} x_i^2\right) B + \left(\sum\limits_{i=1}^{N} x_i\right) C = \sum\limits_{i=1}^{N} x_i |V_i|^{-\frac{1}{q}} \\ \left(\sum\limits_{i=1}^{N} x_i^2\right) A + \left(\sum\limits_{i=1}^{N} x_i\right) B + NC = \sum\limits_{i=1}^{N} |V_i|^{-\frac{1}{q}} \end{array}\right\} . \tag{8}$$

After knowing the unique optimal values of A, B, and C, then the best-estimate of the amplitude coefficient (k) can be easily obtained from Eq. (4) as:

$$k = \frac{1}{A^q}\,, \text{ when } V_i \geq 0\ (i = 1, ..., N), \tag{9}$$

$$k = -\frac{1}{A^q}\,, \text{ when } V_i \leq 0\ (i = 1, ..., N). \tag{10}$$

Also, the best-estimate of the horizontal location (x_0) of the buried body can be found from Eq. (5) as:

$$x_0 = -\frac{B}{2A}\,. \tag{11}$$

Finally, the best- estimate of the depth (z) from the surface to the center of the buried structure (sphere or infinite horizontal rod) or the depth from the surface to the top of the buried object (semi-infinite vertical rod) can be reached from Eq. (6) as:

$$z = \frac{\sqrt{|4AC - B^2\ |}}{2A}\,. \tag{12}$$

It is useful to mention that there is no loss of generality in assuming the source geometry of the gravity anomaly is a priori known. There are in addition no imposed restrictions on the generality of the proposed interpretation method.

Before explaining how we can solve this ambiguity and this inconvenience, we will define the statistical criterion of preference called the Root Mean Square Error (*RMSE; Collins, 2003*), based on the minimal value, between the field gravity data anomaly and the computed gravity one, using the estimated values of z, x_0 and k resulted from Eqs. (9–12) for a specific value of the geometric shape factor $q = 0.5, 1$, and 1.5. The formula of this statistical criterion is given as:

$$RMSE = \sqrt{\frac{\sum\limits_{i=1}^{N} \left(V_i^O - V_i^C\right)^2}{N}}, \tag{13}$$

where V_i^O and V_i^C $(i = 1, ..., N)$ are the observed and the computed gravity values at the point x_i $(i = 1, ..., N)$, respectively.

In the case where the source geometry of the gravity field anomaly is unknown, the following next procedure composed of three steps should be followed:

First, the gravity field anomaly is interpreted by adapting and assuming the source geometry as a semi-infinite vertical rod ($q = 0.5$), where Root Mean Square Error $RMSE\_V$ is computed using Eq. (13) with the estimated values of z, x_0 and k derived from Eqs. (9–12).

Second, the gravity field anomaly is re-interpreted by adapting the source geometry as an infinite horizontal rod ($q = 1$), where the Root Mean Square Error $RMSE\_H$ is also computed using Eq. (13) with the estimated values of z, x_0 and k derived from Eqs. (9–12).

Third, the gravity field anomaly is re-interpreted by assuming the source geometry as a sphere ($q = 1.5$), where the Root Mean Square Error $RMSE\_S$ is also computed using Eq. (13) with the estimated values of z, x_0 and k derived from Eqs. (9–12).

The lowest one of the three reached values of $RMSE\_V$, $RMSE\_H$ and $RMSE\_S$ is selected as a convincible solution, which exactly indicates to the suitable source geometry related to the responsible gravity field anomaly.

The square of correlation coefficient is another statistical criterion of preference that can be also applied to select the best optimum gravity solution. It is defined through the following mathematical expression:

$$R^2 = \frac{\left(\sum\limits_{i=1}^{N} \left(V_i^O - \bar{V}^O\right) \times \left(V_i^C - \bar{V}^C\right)\right)^2}{\sum\limits_{i=1}^{N} \left(V_i^O - \bar{V}^O\right)^2 \times \sum\limits_{i=1}^{N} \left(V_i^C - \bar{V}^C\right)^2}, \tag{14}$$

where $\bar{V}^O$ and $\bar{V}^C$ are the arithmetic means of V_i^O and V_i^C $(i = 1, ..., N)$

respectively. We calculate R-squared for the three assumed types of geometric shapes of the buried structure, R^2_V, R^2_H and R^2_S for a semi-infinite vertical rod ($q = 0.5$), an infinite horizontal rod ($q = 1$), and a sphere ($q = 1.5$) respectively, by using Eq. (14) with the estimated values of z, x_0 and k resulted from Eqs. (9–12).

The highest one of the three reached values of R^2_V, R^2_H and R^2_S is selected as a convincible solution, which exactly and in directly indicates to the suitable source geometry related to the responsible gravity field anomaly.

3. Test on the synthetic data

A synthetic gravity anomaly $V_z(x_i)$ $(i = 1, ..., N)$ due to a spherical structure is generated from Eq. (1), by using the following values of model parameters: geometric shape factor $q = 1.5$, depth from the surface to the center of the buried spherical structure $z = 35\,\text{m}$, amplitude coefficient $k = 1500\,\text{mGal}\,\text{m}^3$ and the horizontal location $x_0 = 5\,\text{m}$.

The generated synthetic anomaly is perturbed and contaminated by a Gaussian random noise of 25% maximum, using continuous normal distribution, where one additional gravity anomaly is generated (Fig. 2). This regenerated gravity anomaly is consequently interpreted by the proposed method. Table 1 summarizes all acquired results concerning this anomaly, the geophysical parameters (z, k, x_0) and the preference criterions $(RMSE, R^2)$, and this for the three structures a priori assumed; a semi-infinite vertical rod, an infinite horizontal rod and a sphere.

Table 1 shows that the lowest $RMSE$ of the three reached values of $RMSE\_V$, $RMSE\_H$ and $RMSE\_S$ or the highest one of the three reached values of R^2_V, R^2_H and R^2_S, and clearly indicates that the suitable source geometry related to the responsible contaminated synthetic gravity anomaly is a sphere.

The results documented and presented in Table 1 show without any doubt that the estimated parameter values, derived by the proposed interpretation method, are very close to the true assumed values of parameters. This clearly proves the efficiency and the capability of the new proposed interpretation method.

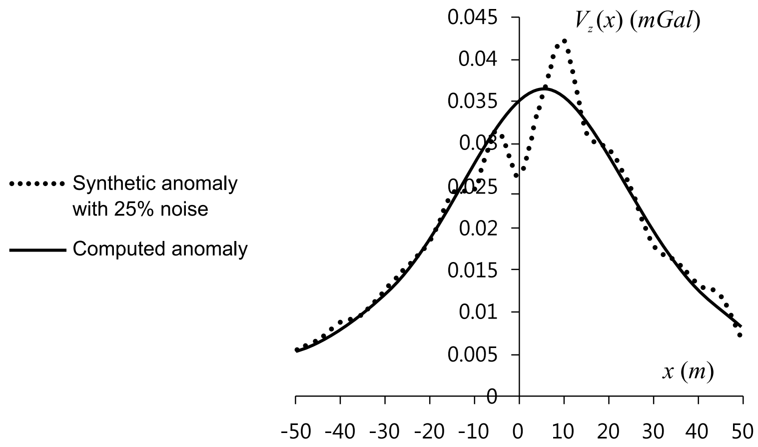

Fig. 2. The effect of the sphere without the noise (solid line) and with 25% noise added (dotted line). The model parameters are in the Table 1.

Table 1. Interpretation of a synthetic gravity anomaly with 25% maximum level of Gaussian random noise.

Source geometric shape	Model parameters	True values of model parameters	Estimated values of model parameters with maximum 25% random noise
Semi-infinite vertical rod ($q = 0.5$)	z (m)	35	13.60
	k (mGal m) x_0 (m)	1500 5	0.33 5.54
	$RMSE$ (mGal) R^2	– –	0.0083 0.9102
Infinite horizontal rod ($q = 1$)	z (m)	35	22.03
	k (mGal m^2) x_0 (m)	1500 5	20.25 4.97
	$RMSE$ (mGal) R^2	– –	0.0037 0.9155
Sphere ($q = 1.5$)	z (m)	35	34.83
	k (mGal m^3) x_0 (m)	1500 5	1503.20 4.76
	$RMSE$ (mGal) R^2	– –	0.0027 0.9276

4. Tests on the real data

Three field residual gravity anomalies over various geological structures are interpreted by the new proposed method. The three field gravity anomalies are interpreted according to the three different geological structures, e.g. a sphere, an infinite horizontal rod, and a semi-infinite vertical rod. The resulting model with the lowest reached value of *RMSE* or the highest reached value of R^2 is selected as the best and the suitable model for estimating the parameters of the field residual gravity anomaly.

4.1. Chromites deposit residual field gravity anomaly, Cuba

Fig. 3 shows a normalized residual field gravity anomaly measured over a chromites deposit in Camaguey province, Cuba (*Robinson and Coruh, 1988*). The gravity anomaly has been interpreted by the proposed method assuming a priori the source geometry is a semi-infinite vertical rod ($q = 0.5$), an infinite horizontal rod ($q = 1$), and sphere ($q = 1.5$). Table 2 shows in details all the obtained results related to this anomaly.

From Table 2, the lowest $RMSE$ of the three reached values of $RMSE\_V$, $RMSE\_H$ and $RMSE\_S$ or the highest one of the three reached values of

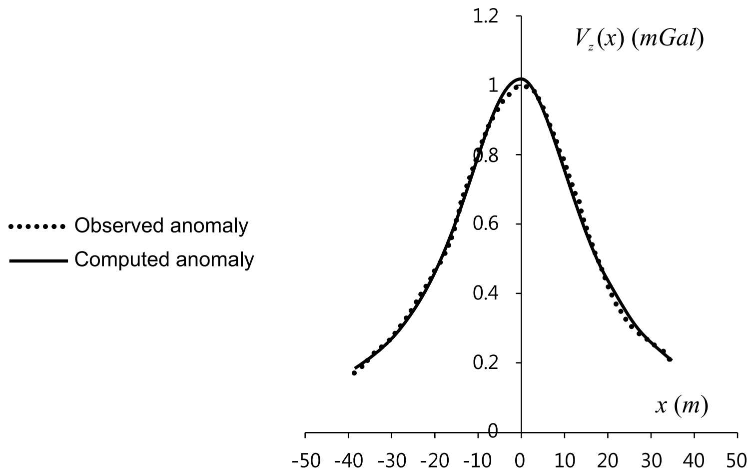

Fig. 3. Normalized residual gravity field anomaly over a chromites deposit, Camaguey province, Cuba (dotted line). The evaluated curve by the proposed method is presented for an infinite horizontal rod model (solid line). The model parameters are in the Table 2.

Table 2. Interpretation of the Chromites field residual gravity anomaly, Cuba.

Model parameters	Semi-infinite vertical rod	Infinite horizontal rod	Sphere
z (m)	7.94	17.55	26.50
k	7.24 (mGal m)	318.55 (mGal m^2)	17256.00 (mGal m^3)
x_0 (m)	0.22	–0.44	–0.62
$RMSE$ (mGal)	0.1264	0.0170	0.0351
R^2	0.9526	0.9969	0.9923

R^2_V, R^2_H and R^2_S has been obtained for the infinite horizontal rod. Results of $RMSE$ and R^2 mean that the field residual gravity anomaly is must to be preferably modeled as an infinite horizontal rod.

The depth obtained in this case ($z = 17.55$ m) is found to be in a good agreement with that obtained from drill-hole information ($z = 21$ m). The computed gravity anomaly has been drawn according to these estimated values of infinite horizontal rod model parameters as shown in Fig. 3. The comparison between field and computed anomalies clearly indicates the close agreement between them, which attests the capability and the validity of the proposed method.

4.2. Karrbo residual field gravity anomaly, Sweden

Fig. 4 shows a field residual gravity anomaly of a profile 25.6 m length measured over the two-dimensional pyrrhotite ore, Karrbo, Vastmanland, Sweden (*Shaw and Agarwal, 1990*). The field gravity anomaly has been also interpreted by the proposed method for the three different geological structures a priori assumed. Table 3 shows the complete obtained results related to this interpreted anomaly.

From Table 3, the lowest $RMSE$ of the three reached values of $RMSE\_V$, $RMSE\_H$ and $RMSE\_S$ or the highest one of the three reached values of R^2_V, R^2_H and R^2_S has been obtained for the infinite horizontal rod, meaning that, the field residual gravity anomaly is preferably to be modeled as an infinite horizontal rod.

The depth in this case ($z = 4.69$ m) is found to be in good agreement with the depth reported by *Tlas et al. (2005)* ($z = 4.82$ m), *Asfahani and Tlas (2015)* ($z = 4.7$ m), *Shaw and Agarwal (1990)* ($z = 5.8$ m), and *El-Araby (2000)* ($z = 5.23$ m). The computed gravity anomaly has been drawn

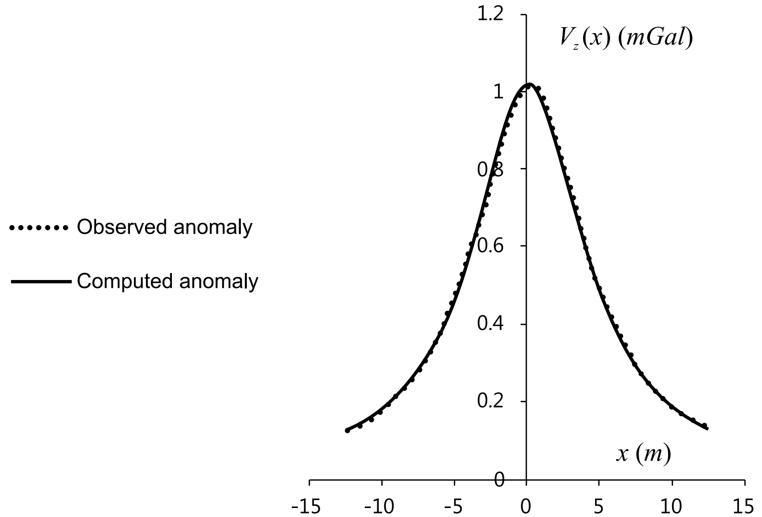

Fig. 4. Residual gravity field anomaly over the two-dimensional pyrrhotite ore, Karrbo, Vastmanland, Sweden (dotted line). The evaluated curve by the proposed method is presented for an infinite horizontal rod model (solid line). The model parameters are in the Table 3.

Table 3. Interpretation of the Karrbo field residual gravity anomaly, Sweden.

Model parameters	Semi-infinite vertical rod	Infinite horizontal rod	Sphere
z (m)	3.04	4.69	7.50
k	1.67 (mGal m)	22.45 (mGal m^2)	365.95 (mGal m^3)
x_0 (m)	0.27	0.21	0.19
$RMSE$ (mGal)	0.2381	0.0063	0.0530
R^2	0.9971	0.9996	0.9869

according to these estimated values of infinite horizontal rod model parameters as shown in Fig. 4. The comparison between field and computed anomalies clearly indicates the close agreement between them, which attests the capability and the validity of the suggested method.

4.3. Dehloran residual field gravity anomaly, Iran

Fig. 5 shows a field residual gravity anomaly measured over an area located in West of Iran in the Zagros tectonic zone, Iran (*Abedi et al., 2010*). The field gravity anomaly has been also interpreted by the proposed method; the obtained results for this anomaly are completely summarized in Table 4.

From Table 4, the lowest one of the three reached values of $RMSE\_V$, $RMSE\_H$ and $RMSE\_S$ or the highest one of the three reached values of R^2_V, R^2_H and R^2_S has been obtained for the infinite horizontal rod, meaning that, the field residual gravity anomaly is preferably to be modeled as an infinite horizontal rod.

The depth obtained in this case ($z = 24.59$ m) is found to be in good agreement with that reported by (*Abedi et al., 2010*) by using three different interpretation methods, the normalized method ($z = 23.73$ m), the least-

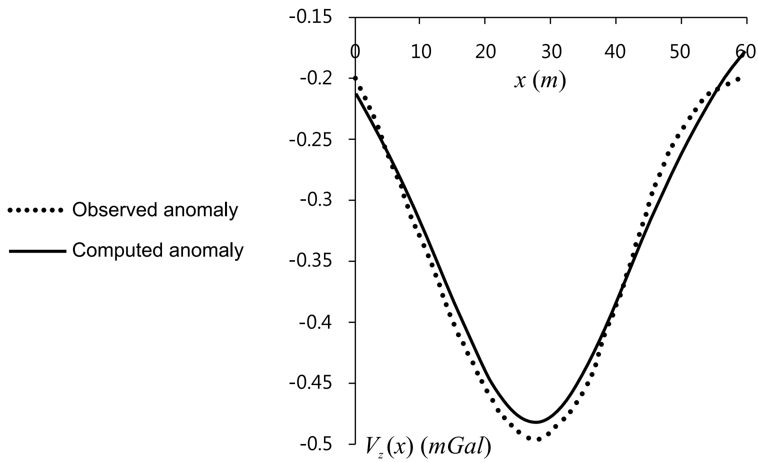

Fig. 5. Residual gravity field anomaly over an area located in West of Iran in the Zagros tectonic zone, Iran (dotted line). The evaluated curve by the proposed method is presented for an infinite horizontal rod model (solid line). The model parameters are in the Table 4.

Table 4. Interpretation of the Dehloran field residual gravity anomaly, Iran.

Model parameters	Semi-infinite vertical rod	Infinite horizontal rod	Sphere
z (m)	12.26	24.59	32.74
k	–6.52 (mGal m)	–291.46 (mGal m^2)	–16641.00 (mGal m^3)
x_0 (m)	27.42	27.62	27.69
$RMSE$ (mGal)	0.0171	0.0129	0.0158
R^2	0.9785	0.9892	0.9834

squares method ($z = 23.31$ m), the neural network method ($z = 22.8$ m) and also with that obtained from drill-hole information ($z = 23$ m).

The computed gravity anomaly has been drawn according to these estimated values of infinite horizontal rod model parameters as shown in Fig. 5. The comparison between field and computed anomalies clearly indicates the close agreement between them, which attests the capability and the validity of the suggested method.

5. Conclusion

A new simple and very easy method is proposed herein for the interpretation of residual gravity anomalies due to different simple geometric-shaped models such as a semi-infinite vertical rod, an infinite horizontal rod and a sphere. The proposed interpretative method is mainly based on quadratic curve fitting to best-estimate the model parameters values, e.g. the depth to the top or to the center of the buried structure, the amplitude coefficient and the horizontal location from a residual gravity anomaly profile. The method has been firstly tested on synthetic data set corrupted and contaminated by a white Gaussian random noise maximum level of 25% in order to demonstrate its reliability and its capability. The results acquired show clearly that the estimated parameter values derived by the proposed method are very close to the assumed true values of parameters.

The validity and the applicability of this new method are also demonstrated by applying it to three real field gravity anomalies from Cuba, Sweden and Iran. A comparable and acceptable agreement is shown between the results derived by the method and those obtained by other interpretation methods.

Moreover, the depth obtained by such a proposed method is found to be in high accordance with that obtained from the real field data information.

The interpretation method can be easily put in MATLAB code or in Excel sheet. Therefore, the new proposed methodology of interpretation is highly recommended for routine analysis of gravity anomalies in an attempt to determine the best-estimate values of parameters related to spheres, semi-infinite vertical rods and infinite horizontal rods-like structures.

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