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Nonlinear Processes in Geophysics
Discussions
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Interactive comment on "Estimation of the total magnetization direction of approximately spherical bodies" *by* V. C. Oliveira Jr. et al.

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General comments

Referee's comment: *"The forward problem described is essentially identical to a mesh-based discretization but with the space-filling mesh cells (prisms, tetrahedra, etc) replaced with spherical (dipole) sources. Hence, the methods presented are essentially identical to those used by Lelievre and Oldenburg (2009) and Ellis et al. (2012)."*

We fully disagree with your comment that the forward problem in our method is essentially identical to the one adopted by Lelièvre and Oldenburg (2009).

The interpretation model adopted by Lelièvre and Oldenburg (2009) consists of an $m_x \times m_y \times m_z$ grid of 3D juxtaposed prisms in the horizontal and vertical directions

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(Figure 1a). Hence, in the Lelièvre and Oldenburg (2009) the associated forward model (their equation 10) requires computing the N by $3M$ full sensitivity matrix being N the number of data and M the number of prisms of the interpretation model. A large data set combined with the discretization of the Earth's subsurface into a fine grid of prisms results in a large-scale 3D forward model. Notice that in our method we do not discretize the earth's subsurface into an $m_x \times m_y \times m_z$ grid of 3D juxtaposed dipoles in the horizontal and vertical directions. Hence, our interpretation model does not consist of a 3D, equally spaced array of dipoles. Rather, the forward problem adopted by our method consists of a set of L dipoles (Figure 1 of our manuscript). Hence, in our method the associated forward model (our equation 16) requires computing the N by $3L$ sensitivity matrix where $L <<<<< M$. Thus, our method deals with a small-scale forward model being completely different from the one adopted by Lelièvre and Oldenburg (2009).

We agree that Lelièvre and Oldenburg' (2009) method solves an underdetermined inverse problem while our method solves an overdetermined problem. However, this characteristic is not the unique difference between these approaches. Table **??** presents a list of the characteristics found in Lelièvre and Oldenburg' (2009) method in comparison with those found in our method in this manuscript. By analyzing the Table below, we can easily conclude that these methods are substantially different. We highlighted (in green) the only two characteristics of these methods that are equal.

References

Lelièvre, P. G. and D. Oldenburg, 2009, A 3D total magnetization inversion applicable when significant, complicated remanence is present. Geophysics, 74(3), L21–L30, doi: 10.1190/1.3103249

Ellis, R. G., B. Wet and I. N. Macleod, 2012, Inversion of magnetic data from remanent and induced sources: 22nd International geophysical conferenceand exhibition, ASEG, Expanded Abrastracts, 1-4.

Table 1. captioncaptioncaptioncaptioncaptioncaption

	Lelièvre and Oldenburg' (2009) method	Our method
Interpretation model consists of a user-specified grid of M juxtaposed prisms in the horizontal and vertical directions	Yes	No
Interpretation model consists of a user-specified set of a few dipoles	No	Yes

Specific comments

Referee's comment: *"Page 2 Sentence starting Line 19: These results show that the non-outcropping sources near from the alkaline complex of Diorama have almost the same magnetization direction of that as the ones in the alkaline complex of Montes Claros de Goiás, strongly suggesting that these sources have been emplaced in the crust almost within the same geological time interval."*

Interactive comment on Nonlin. Processes Geophys. Discuss., 1, 1465, 2014.