

## ***Interactive comment on “Radar Imaging with EISCAT 3D” by Johann Stamm et al.***

### **Anonymous Referee #1**

Received and published: 6 July 2020

The paper has some interesting ideas and potential for the incoherent scatter radar (ISR) community. This paper is jumping to apply MIMO radar techniques to ISR and makes a good case that this can be applied to the E-region of the ionosphere. It argues that Eiscatt 3-D will be able to do some interesting high resolution imaging of the E-region ionosphere. The authors simulate the MIMO radar systems and then find that the SVD seemed to give the best results.

The application of generalized inverse techniques to geospace sensors is something I generally support. I think this paper does a good job at taking specific problem in ISR and tries to apply general inverse theory and gets some promising results. Overall the authors did a good job of arguing that this sort of techniques will be useful for ISR. I think they need add some caveats to clarify the applicability of the technique.

First off the the technique the authors show does not include fitting for ISR spec-

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tra/ACFs to get plasma parameters. This is fine if they specify that this for the E-region only and that is not clear from the title or the abstract. Yes, different techniques are required for different regions of the ionosphere with ISR but it would help the reader understand the current limits of the method you are applying!

I want to also point out there has been work on imaging ISR in the past such as seen in [1], but this was a study that only applied interpolation techniques to ISR data. I think comparing this 2010 paper with the methods here would be helpful and show that this work is new.

The following is a list a technical corrections I've found will need to fixed:

- Page 6 line 25: Do mean truncated cone? Conic section implies a 2-D plane and this is a 3-D volume.
- Page 7 line 1: You state range, which range is this because we're not in a multistatic set up and the term range is ambiguous, transmit, receive, bistatic?
- Page 7 lines 9-10: O<sub>2</sub><sup>+</sup> is used for the calculation but the dominate species in the E-region is NO<sup>+</sup>. I don't think this will create a huge error in the calculations but it should be mentioned that this will not throw off the calculation by much.
- Page 8 Figure 2: I'm having trouble seeing the need for this figure since the assumption is for a monostatic system, and chemical composition is off too. I'm aware with MIMO that the resolution can be chosen but this link budget only accounts for a monostatic system. Plus in a monostatic system the gain from the antenna is directly tied to the resolution.
- Page 13 lines 13-14: Please be more clear about what was done to the image from Figure 1. It seems you just took the magnitude of the image and mapped it from 0 to 1?

Overall, good paper. I think it should be accepted with the changes I've go over above.

[1] J. Semeter, T. Butler, C. Heinselman, M. Nicolls, J. Kelly, and D. Hampton, "Volumetric imaging of the auroral ionosphere: Initial results from PFISR," J. Atmos. Solar-Terrestrial Phys., vol. 71, no. 6–7, pp. 738–743, May 2009.

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