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Interactive comment on "Mean wind vector estimation using the Velocity-Azimuth-Display (VAD) method: An explicit algebraic solution" *by* Gerd Teschke and Volker Lehmann

Anonymous Referee #1

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General comments:

The paper deals with a well-known practical issue of determining a vertical wind profile from a set of known radar measurements. The authors are able by using the measurement directions as a frame to provide a new derivation and an explicit solution (17). The outcome is similar to a Fourier transform of the equidistant radial velocities. The results that the vertical and horizontal winds are the first Fourier components of the azimuthal wind field is well-known although the Fourier expansion is not usually presented explicitly (but see Browning Wexler, page 107). Hence the analytical result is not really new. The greatest value of the derivation is that is provides a starting point to the error and stability analysis which is most interesting and provides new results. The frame concept is very efficient in this respect and allows the authors to derive and optimal angle for the measurement. The elevation angle (35 deg) is larger than those recommended for weather radars, to avoid fall speed contamination in rain, and smaller than those usually used for wind profiling radars as the authors discuss. It would be a valuable addition to estimate how much the error increases when the typical angles for the radar systems are used instead of the optimal angle, assuming that the assumptions are valid.

I disagree with the finding of the authors that increasing the number of beam directions reduces the error. If the number of beams is increased, but the statistical error of radial velocities (σ) is kept constant, the measurement time is increased, which surely decreases the random error. In case the measurement time is kept constant and number of beams increased, the number of observation along any radial is decreased and the error of radial velocities increased. Hence no gain is seen in the derived winds. The error of the wind components depends on the measurement time, independent on how the measurement is arranged, assuming that the problems stays reasonably well-conditioned.

Specific comments:

Page 4, line 11: Vector p is used here although it is introduced only a few lines later

Page 5, line 15 The paper is more mathematical in nature than typical papers in AMT. The authors have taken the readership into account rather well. But I just wonder if introducing $(T^{*})^{T}$ for Eq.(8) is completely necessary.

Page 5, lines 20-23 appear unnecessarily complicated. The last equation should have a number. Section 3.2 This section is less organized as the rest of the paper. I suggest presenting only the stochastic case. In case both error cases are treated the authors should consider the notations. In the deterministic case the error (delta) is given for the full vector, whereas in the stochastic case they are component wise. This might confuse the readers.

Page 10, lines 13-17. There are many ways to solve the angle, but to me it appears much simpler to solve for the $tan^2\phi = 2/\sqrt{c}$, without a need to solve for the case c=4 separately.

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