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Geoscientific Instrumentation Methods and Data Systems Discussions

Interactive comment on "Airborne polarimetric Doppler weather radar: Trade-offs between various engineering specifications" *by* Jothiram Vivekanandan and Eric Loew

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This paper presents a very ambitious project of airborne polarimetric Doppler radar, as a follow on of the previous ELDORA/ASTRAIA radar developed in the 90's between NCAR and CNRS. I approve the main definition features of the project: - C-130 as the aircraft carrier, - Phased array antenna for the radar technology, - Polarisation diversity capability. Very good paper. I have nevertheless some questions or comments:

Table 1- and Figure 6: I understand that the choice of the radar frequency, C band (instead of X band for ELDORA/ASTRAIA) is dictated by the concern of avoiding situation of total extinction of the radar signal in severe weather. However, I am wondering if

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this choice is not too much penalizing in antenna performance -angular resolution and side lobes. - Table 1: I do not understand how you can achieve a 3 dB beam resolution (one-way) of 2.2° with a 38" diameter antenna at C band. A reflector antenna with good sidelobes (<-30 dB), respects a relation like : 3dB_beam_res ≈ 65 λ/D (1). - With this relation, your 3 dB beam aperture should be 3.7°. Can you improve the performance predicted by rel. (1) simply because you may control much more easily the antenna illumination with phase array technique? If yes, it's worth mentioning. - Fig.6, the first sidelobe is at -15 to – 17 dB, which may be quite penalizing from airborne where part of the exploration is made at negative elevation where you must address the problem of the surface clutter. It's the reason why -30dB side lobes were specified for the EL-DORA/ASTRAIA antenna. Did you check (by simulation?) that your antenna sidelobes are compatible with your objective of detecting -10dBZ within 400m of surface at 5 km range?

Section 4: Polarimetric measurement configuration Your discussion about ATSR (alternate transmit and simultaneous receive) and STSR (Simultaneous transmit and simultaneous receive) is interesting. Today in operational, most radars use the STSR mode, since the ATSR mode requires a high-power polarization switch, a component very expensive and unreliable. A big potential interest of the phased array is that it opens the possibility of using very naturally the ATSR mode, which authorized the possibility to measure LDR (impossible with STSR). However, I totally disagree with the argument of the author to discard STSR on the argument that with this mode the "isolation" between H and V should be 44dB. How this "isolation" is defined? Is it the usual crosspolar level? In that case, that would mean the impossibility of STSR methodology since no antenna holds this performance. Meanwhile hundreds of operational polarimetric radars provide satisfactory data (including ZDR) worldwide. In fact, the criteria for appropriate measurement of ZDR with STSR is the same as the one for LDR. It is based of the same ICPR cited by the authors in their formula (1). Simply, It is less stringent with STSR to measure ZDR than with ATSR to measure LDR. I figured out that to measure LDR down to – 27 dB with ATSR, ICPR should be below -33 dB (as recommended by Bringi and Chandraseckar, 2001), while to measure ZDR with 0,2 dB bias with STSR, ICPR should be below -23 dB (In the extreme case where ZDR≈ -10dB (due to differential attenuation). I think it would be wise within this project to maintain the capability of the system to operate polarimetric measurements both with ATSR and STSR methodologies.

Jacques Testud, October 16 th, 2017

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