6.12 UAV-AIDED WEATHER RADAR CALIBRATION

J.YIN[1], F.VAN DER ZWAN[1], E.OUDEJANS[1], P.HOOGEBOOM[1], C.UNAL[1], H.RUSSCHENBERG[1]

[1] Delft University of Technology, the Netherlands
j.yin@tudelft.nl

Weather radar is well recognized as an effective sensor for obtaining the microphysical and dynamical properties of precipitation at high spatial and temporal resolution. Radar calibration is one of the most important prerequisites for achieving accurate observations. Current calibration methods either use a metal sphere hanging underneath a tethered balloon or a trihedral corner reflector locating on the top of a tower or mast. However, there are some problems with these methods: (1) They are location bound. The calibrator should be placed in the far-field, which seems impossible for some radars located on the top of high buildings or towers. (2) It is relatively costly for tower setup or helium balloon purchase. (3) It is not easy to repeat the calibration process for mobile radars, especially for some fieldwork campaigns in complex terrain. (4) For vertically pointing cloud radars, the current methods cannot be used to calibrate them. Therefore we propose a portable, cost-effective and repeatable solution to replace the current calibration techniques.

An industrial-grade UAV serves as the stable aerial platform carrying a metal sphere, flying over the radar illumination areas to complete the calibration process. The flying routine of the UAV can be pre-programmed, thus the antenna pattern may be obtained. To retrieve the position of the sphere, the real-time single-frequency Precise Point Positioning (PPP) type GNSS solution is developed. Both receiver, microcontroller and antenna are mounted inside one GPS box which is placed underneath the metal sphere. With the GPS coordinates obtained from the UAV and GPS box, the position of the sphere is derived. Note that the connecting lines between the UAV and metal sphere and between the metal sphere and GPS box should be long enough to separate each other backscattering. The radar constant is calculated in the range-Doppler domain, and only the data where metal sphere separates from the clutter and other objects are selected. In addition, the spectral-polarimetric features are studied to further verify the recognition of metal sphere. The S-band polarimetric Doppler Transportable Atmospheric Radar (TARA) is used in the calibration campaign. The results demonstrate the following results: 1) alignment calibration can be completed; 2) antenna pattern can be retrieved and weather radar equation can be more accurately defined; 3) differential reflectivity can also be calibrated.