# Calibration for Weather Radars using UAV Hosted Targets

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Calibration is essential for creating accurate measurements from a weather radar. A very reliable method of radar calibration involves transmitting at a standard calibration target such as a sphere or a corner reflector while measuring the power returns. While this method invokes high fidelity returns, it requires a procedure to hold the targets in the line of sight of the radar beam, away from ground clutter. In the past this has been done by flying a metal sphere on balloons or by placing a corner reflector on a tall tower. This can be difficult as surrounding terrain may not be suitable for a tower and may require additional, possibly costly steps to achieve the calibration. Once the tower is built, the corner reflector is constrained to one location, removing the flexibility of performing calibration at different range bins. The procedure using a metal sphere mounted on a weather balloon is not without difficulties. While it provides flexibility to terrain constraints, the difficulty lies in accurately targeting the weather balloon as it flies away.

Recently, a UAV supported calibration methodology has seen adoption in initial proof of concept studies (Yin et al) in which a metal calibration sphere is suspended to a drone. By using a drone as the medium of transport for the sphere, it is possible to remove terrain dependencies as well as the unpredictability introduced by the weather balloon. In theory, the UAV also allows for calibrations to be performed at different locations, adding to the redundancy needed to accurately calibrate the radar. In this paper, we document the performance of the UAV guided calibration methodology tested on many radars including the CSU CHILL radar, at S and X bands and the NASA D3R radar at Ku and Ka band. This work reports on the results of the radar calibration campaign at CSU with UAV. Additionally, we present an analysis of error for the UAV based calibration. We also present best practice guidelines to successfully repeat the calibration method, making sure to document how to reduce the back-scattering contamination from the drone as well as the accuracy of using a sphere as a primary method for end to end radar calibration.

Keywords: Radar Calibration, UAV, Dual Polarization , Weather Radar