Partial Beam Blockage Area Identification and Estimation in an X-band Networked Radar Environment

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The weak echo and blind area caused by ground clutter contamination are an important list of factors associated with the data quality and precipitation estimation of radar. The traditional algorithms of partial beam blockage estimation can be roughly divided into two classes: The first one is to simulate the beam blockage of the terrain around the radar site and estimate the beam blockage fraction (BBF) along the beam propagation path by using the DEM data, under the assumption of standard atmospheric conditions. However, in the observation experiments, 1) the gradient distribution of atmospheric refractive along the height will change with the temperature, humidity, pressure and other factors, especially in heavy rainfall or in the case of abnormal propagation of radar beam. Thus, standard atmospheric refraction assumption could lead to computational error when calculating the BBF. 2) New urban buildings, limited DEM data resolution and other factors also make the ground features around the radar site hard to be described accurately by DEM data. This could affect the accuracy of BBF. The second class of algorithm, which has less dependence on high resolution terrain information and standard atmospheric refraction assumption, is to identify and estimate the beam blockage area by using the characteristics of observation data. However, it essentially is an ex-post evaluation method which have high requirement on radar data quality. Generally, KDP increase with the dielectric constant and ellipticity. The measurements are insensitive to antenna beamfilling and partial beam blockage effect. The specific attenuation (α) obtained by the KDP-α relationship is very suitable for estimating the BBF and correcting the reflectivity factor in partial beam blockage area. However, for x-band weather radar, when the rayleigh scattering can not be satisfied in the heavy precipitation, the estimation of KDP will be noisy, and the error of measurement accuracy of KDP will increase rapidly with the improvement of the distance resolution. All these factors will affect the quality of KDP data and have a significant impact on the correction results of partial beam blockage.
In this paper, with the advantage of multi-view in an X-band networked radar environment, an algorithm dynamically estimated the BBF and corrected the reflectivity factor in partial beam blockage area is proposed. A series of experiments show that the new method reduces the uncertainty of KDP estimation, improves the accuracy and stability of BBF estimation, and helps to improve the quality of mosaic and the accuracy of precipitation estimation in the X-band radar network.

Keywords: X-band Networked Radar, Partial Beam Blockage, Identification and Estimation