

Shortening the update time of a phased array weather radar

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Tornados and microbursts develop so fast that the radar update time should be of order 15-20 seconds. Such an update time can be achieved with a phased array radars (PAR). By applying adaptive scanning and decorrelating estimates via range oversampling, the update time has been reduced to about 1 min on the NSSL's weather PAR. Faster update can be achieved by transmitting few pulses into different directions and simultaneously receiving the returns. This approach is considered in the presentation. To separate signals transmitted to and received from different directions, frequency shifting (hoping) or phase coding of transmit pulses can be employed. At S band, the frequency constraint is so tight that agile frequency technique has little chance to be allowed. The pulse to pulse phase coding is already in use in the WSR-88Ds for resolving range ambiguities and most likely this coding will migrate to a future weather PAR and therefore could not be used for the multiplexed radar beams.

A new method of the multiple beam technique (MBT) for a weather PAR that transmits few radar pulses into different directions and simultaneously receives returns from those directions is described. The time delay between transmit pulses should be of a few microseconds. To separate returns from different directions, features of the antenna pattern are used. The MBT is described in terms of the theoretical and measured antenna patterns of the WSR-88D, which is the benchmark for a weather PAR. It is shown that the technique is capable of separating returned voltages from different directions with relative signal powers of 93 dB, which is sufficient for all weather applications. For a weather PAR, the MBT technique allows sharp shortening of the update time by a factor of three or four that depends on the duty circle of transmitting antenna modules. By using four sequential transmit pulses, the update time can be reduced to 15 seconds. The technique is demonstrated by using signals collected with the WSR-88D radar and simulating the PAR operations.