Strobe Waveform for Rapid Scanning Polarimetric Weather Radars

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A stepped-frequency pulse-pair technique, called Strobe mode was developed and tested with the University of Oklahoma Rapid scanning X-band polarimetric Doppler weather radar (RaXpol) to effectively eliminate beam-smearing during high speed scanning. The dwell (aka. integration) time of weather radars with conventional transmit waveforms is proportional to the desired number of independent samples and Pulse Repetition Interval (PRI). In order to maintain an angular resolution comparable to the antenna beam-width, the dwell time has to be limited to the ratio of the antenna beamwidth and scan rate. However, at very high scan rates with narrow antenna beams, this dwell time limit is insufficient to provide adequate range coverage while collecting enough samples for the precise estimation of the radar parameters. Strobe mode decouples the dwell time from independent sample count by transmitting a series of frequency shifted sub- pulses within a single radar waveform. The sub-pulses, which contain independent estimates of the weather echo, are processed separately using a bank of digital filters, then averaged. This technique opens up the possibility of developing narrow-beam mechanically-scanned weather radars with very high scan rates.

This paper will outline the fundamental limitations of using conventional transmit waveforms with rapid scanning weather radars, describe strobe mode, analyze the benefits and drawbacks of the technique and will compare the angular resolution of RaXPol data collected in conventional and strobe rapid scan from thunderstorms.