1 BACKGROUND

Pulse Compression capability has been incorporated into the Vaisala RVP8 and RVP900 meteorological radar signal processors for more than ten years having been used in over 60 weather radar systems. Pulse widths up to 50 microseconds in the RVP8 and 100 microseconds in the RVP900 are possible while retaining sub-microsecond resolution, down to 5 meter gates spacing (10 range steps). The processing gain associated with such compression results in sensitivity improvement on the order of 20 dB as compared with the corresponding uncompressed performance. The processing gain from such compression is suppressed by more than 50 dB as compared to the main lobe over the full range of Doppler velocity expected to be measured by the meteorological radar. Non Linear Frequency Modulation (NLFM), a time domain convolution filter and careful tapering of the pulse envelope is used to achieve this performance. A graphical user interface optimizer tool is used on the processor to allow the user to set the pulse characteristics and see the resulting waveform and ambiguity diagram in real-time.

2 PROBLEM STATEMENT

A drawback to the pulse compression is that reception was not possible until full duration of the transmitted pulse was completed, thus limiting the start range of data processing. This problem is illustrated in Figure 1.

The goal of this work was to overcome this problem by developing a Time Frequency Modulated Pulse Compression Meteorological Radars

3 METHODOLOGY

The Time Frequency Modulated (TFM) waveform by:

- Two consecutive pulses, the second immediately following the first in time. The first pulse is a long NLFM pulse and the second is a traditional short pulse without frequency modulation. See figure 2.
- Two parallel downconversion filters, one filter is the corresponding matched filter to the short non-frequency modulated pulse. See figure 3.

Through the experimental design, the NLFM is modulated to the second filter is the corresponding matched filter to the short non-frequency modulated pulse. See figure 3.

C. The two parallel IQ data streams are then merged together in the downstream processing at the autocorrelation stage. The merging is done over a range of the IQ samples where the results are valid for both the long and short pulses to avoid transition artifacts. And thus the result is data of improved sensitivity and range resolution from nearly range zero, to the full range based of the dwell. Figures 4 and 5.

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4 EXAMPLE AND MERGING INFORMATION

The problem of sampling the short range when using pulse compression techniques has been overcome. This work illustrates that two pulses can be used successfully achieving greater than 60 dB isolation between the two downconversion filters. Little discrepancy in the data values are apparent in the overlapping ranges when using the TFM waveform.

4.2 Merged IQ data stream. Overlapping and blending for duration of Long Pulse.

5 CONCLUSION

Example showing an echo overlapping merge range.

References:

3) Wideband waveform design principles for solid-state weather radars. JAOT 39 (1), 14-31. N. Bharadwaj and V. Chandrasekar

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Time Frequency Modulated Pulse for improving capabilities of Pulse Compression Meteorological Radars

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