P1.6

EVALUATION OF THE SZ(8/64) PHASE CODE ALGORITHM: SOME OPERATIONAL CONSIDERATIONS

Gregory Meymaris, John Hubbert, Scott Ellis, and Mike Dixon

NCAR, Boulder, Colorado

The range-velocity ambiguity problem can severely degrade the spatial coverage of the reflectivity, mean radial velocity, and spectrum width estimates from the WSR-88D weather radars. Because the maximum unambiguous range and unambiguous velocity (Nyquist velocity) are inversely proportional, increasing one necessarily decreases the other, causing the choice between range folding and velocity folding. For good radial velocity and spectrum width estimates, velocity folding is deleterious, making short PRT's preferable even though it results in range folding and thus censorship of overlaid echoes. One solution is to phase shift the transmitted pulses using a predetermined pattern called the SZ(8/64) phase code, which allows for the recovery of some weak trip spectral moment estimates (reflectivity, radial velocity, and spectrum width). In this paper, we present a quantitative analysis, comparing legacy WSR-88D spectral moments with those computed using the SZ(8/64) phase code and associated algorithm. The impacts from decreasing the number of pulses per beam, phase noise and phase stability, on the estimators' performance will also be shown.

For the analysis in this paper, pairs of experimentally-obtained I&Q time series radar data were phase-coded and added, emulating overlaid echoes when the radar is transmitting the SZ(8/64) phase code. By artificially, overlaying the I&Q data, it is possible to perform a quantitative analysis by comparing the recovered spectral moments (power, as a proxy to reflectivity, radial velocity and spectrum width) to those computed from the time series before the overlay process. Because the "truth" here are statistical estimators themselves, it should be noted that the biases and standard errors describe the effects induced from the overlay process and the SZ moment recovery algorithm, and that they do not include biases and errors in the estimators themselves.

From several PPI scans, about 5000 64-pulse beams were collected. Data that was contaminated by ground clutter, that was multi-modal, or that the signal to noise ratio was less than 20 dB was excluded. The Nyquist velocity of the collected data was about 24 m/sec. For the analysis, the Nyquist velocity was artificially set to about 32 m/sec.

In Figure 1, the mean bias the weak trip velocity is shown. The data in this figure is limited to those cases in which the weak trip spectrum width is between 1.75 and 2.25 m/sec. The x-axis corresponds to the strong trip spectrum width, and the y-axis to the strong trip to weak trip power ratio. It is clear that there is no bias for the weak trip velocity.

In Figure 2, the standard deviation of the errors for the recovered weak trip velocity are shown. Again, the weak trip spectrum width is between 1.75 and 2.25 m/sec. We see that the errors gradually increase as the power ratio increases. It is important to note that in the current legacy processing for the WSR-88D weak trip velocities, and sometimes strong trip velocities, are not recoverable.

Figure 3 shows the same type of plot as Figure 2, except that the weak trip spectrum width is between 2.75 and 3.25 m/sec.

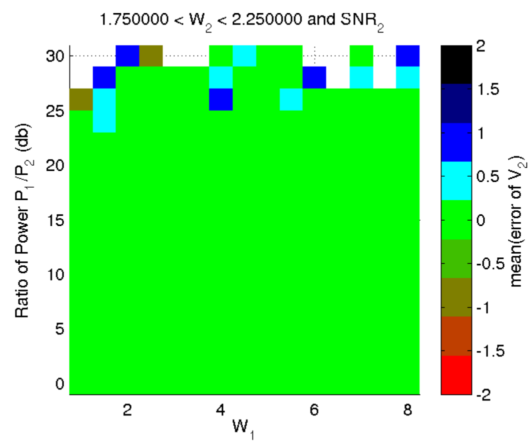

Figure 1: Mean bias of recovered weak trip velocity. The x-axis is the strong trip spectrum width in m/sec, the y-axis is the power ratio of the strong trip to weak trip power in dB, and the color axis is the mean bias of the recovered weak trip velocity. The weak trip spectrum widths are limited to values between 1.75 and 2.25 m/sec.

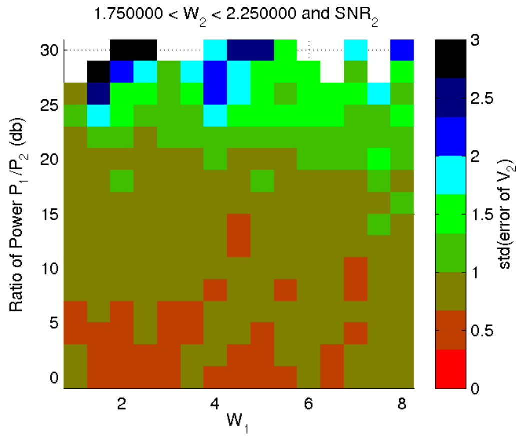

Figure 2: Standard error of recovered weak trip velocity. The x-axis is the strong trip spectrum width in m/sec, the y-axis is the power ratio of the strong trip to weak trip power in dB, and the color axis is the standard error of the recovered weak trip velocity. The weak trip spectrum widths are limited to values between 1.75 and 2.25 m/sec.

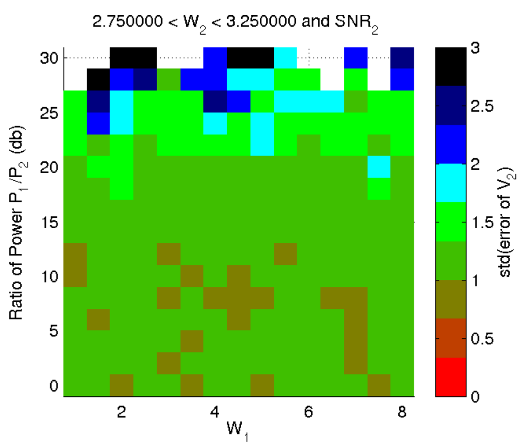

Figure 3: Standard error of recovered weak trip velocity. The x-axis is the strong trip spectrum width in m/sec, the y-axis is the power ratio of the strong trip to weak trip power in dB, and the color axis is the standard error of the recovered weak trip velocity. The weak trip spectrum widths are limited to values between 2.75 and 3.25 m/sec.