2.4C PULSE STUTTERING AS A REMEDY FOR ALIASED GROUND BACKSCATTER

S. A. Bowhill

Aeronomy Laboratory, Department of Electrical Engineering
University of Illinois
Urbana, IL 61801

The Urbana MST rdar operates at a prf of 400 Hz, with a frequency of 40.92 MHz. This frequency is in fact the lowest of the operating MST radars. As a result, at times of high sunspot activity and under winter daytime conditions, when the critical frequency of the F2 layer is at its greatest, sidelobes of the antenna can provide energy which is reflected by the F2 layer. This energy can then be backscattered from the ground and reradiated into the same antenna sidelobe.

Although the antenna directivity will attenuate this signal by approximately 40 or 50 dB, it nevertheless represents a troublesome source of interference. Ranges of 1000 to 3000 km, with time delays of 7 to 20 msec, will alias the scattered energy over several transmitted pulses (at 2.5 msec intervals). Examples of this effect are shown in Figure 1, compared to a normal 2-hour period at the same season in Figure 2.

The unwanted ground scatter is shown as a sequence of velocity plots which are almost typical at the various altitudes. The reason for this is that gravity waves produce changes in the height of the F layer, thereby giving a change in range of time that falls in the same general range as that from the mesosphere. Also, the ground forms a soft target similar to mesospheric turbulence, thereby producing a fade rate which is similar to that for mesospheric echoes.

One possibility would be to reduce the transmitter prf to a value such that the ground backscatter from one pulse had completely died out before another pulse is transmitted. However, this would require a decrease of a factor of 10 in the prf, with a resulting degradation of radar performance.

A second possibility, which we have implemented successfully, is to change the interpulse period in a cyclic way, thereby destroying the coherence of the unwanted signal. To accomplish this, the interpulse period must be changed by an amount at least equal to the transmiitted pulse width, and optimum performance is obtained when the number of different interpulse periods occupies a time span greater than the coherence time of the unwanted signal. Since a 20-msec pulse width is used, it was found convenient to cycle through 50 pulses, the interpulse period changing from 2 msec to 3 msec during the 1/8-second time. This particular pattern of interpulse periods was provided by a software radar controller, using an Apple II microcomputer with the timing program written in FORTH. With application of this algorithm, the unwanted scatter signal becomes incoherent from one pulse to the next, and therefore is perceived as noise by the coherent integrator and correlator.
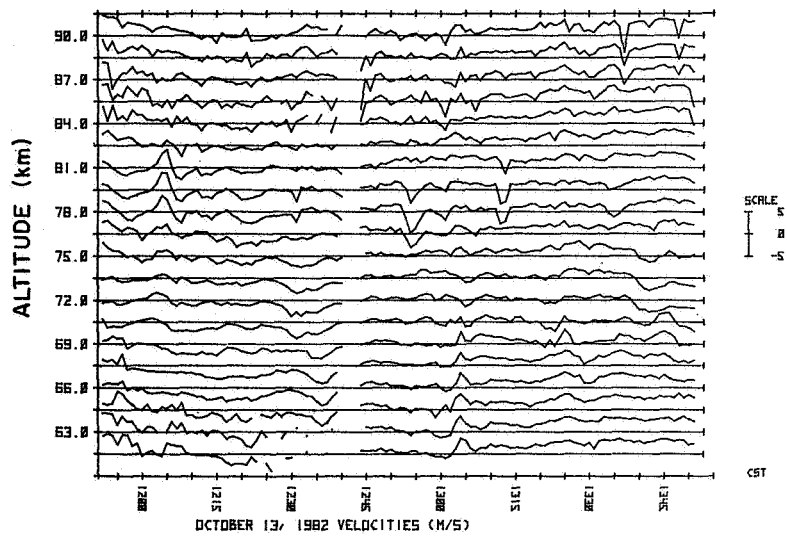
ACKNOWLEDGMENTS

Figure 1. Typical velocity record in the presence of aliased ground backscatter.
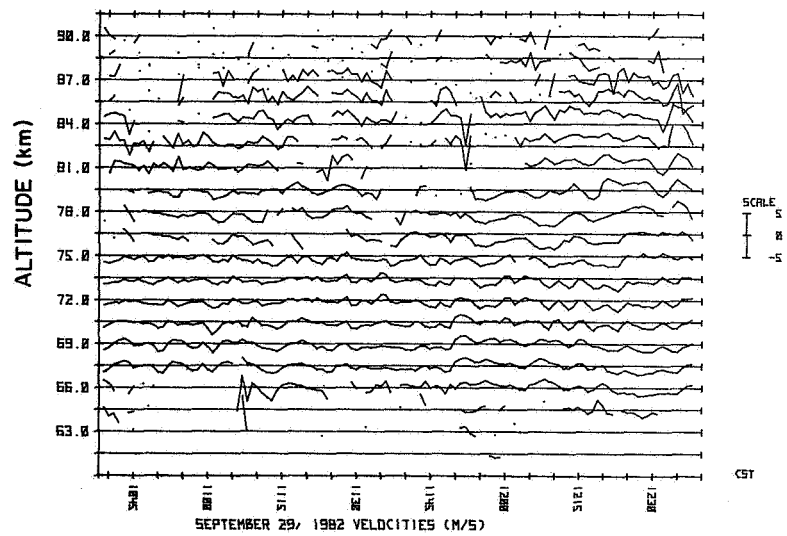

Figure 2. Typical velocity record in the absence of aliased ground backscatter.