Western Region Technical Attachment
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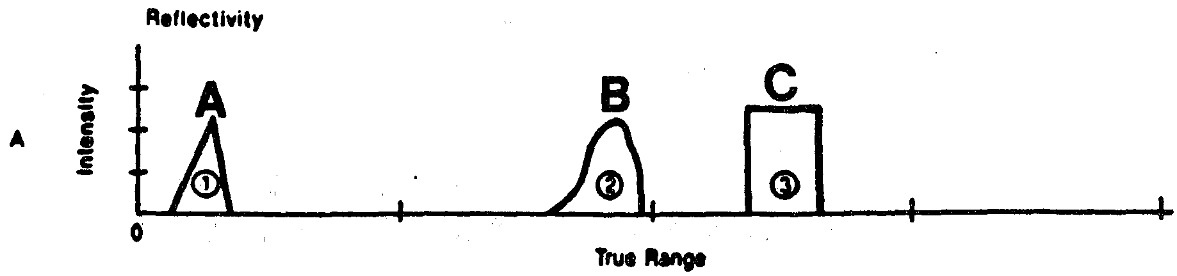
A SIMPLIFIED DESCRIPTION OF NEXRAD RANGE FOLDING AND VELOCITY ALIASING

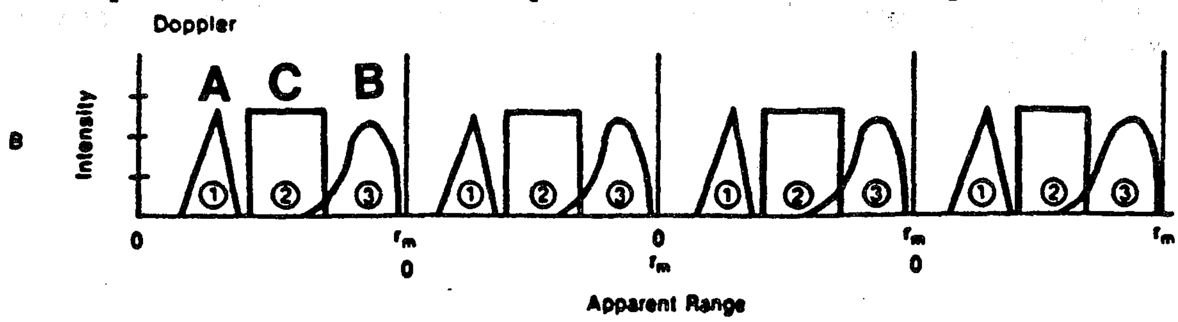
[Editor's Note: The following is a reproduction of an attachment to the Southern Region Staff Notes. The article does an excellent job of describing what range folding and velocity aliasing are and how NEXRAD handles the phenomena. Some of the figures are reproduced from the <u>*Federal Meteorological Handbook No. 11*</u> *(Part B, Doppler Radar Theory and Meteorology).]*

NEXRAD

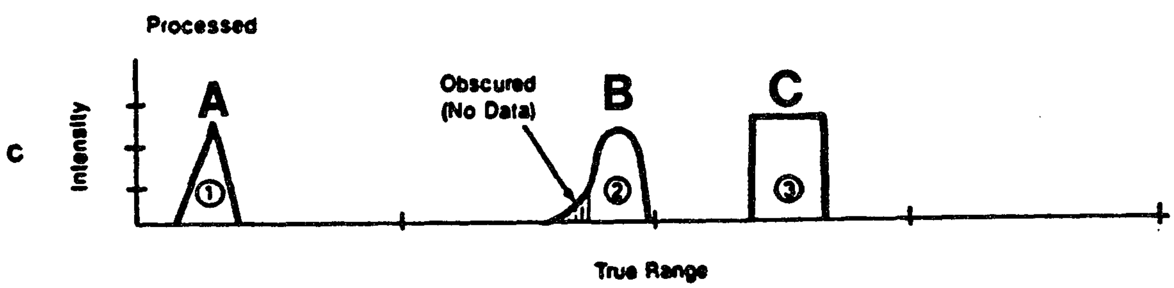
Range Folding is a characteristic of NEXRAD that all users must be aware of. The figures and text below describe the phenomenon.



This is a display of the true range of three storms. The distance between the origin and the first tic mark along the horizontal axis indicates the distance an energy pulse can go out and come back before another pulse is started. This distance is known as the unambiguous range or first trip. Storm B is in the second trip and Storm C is in the third trip.



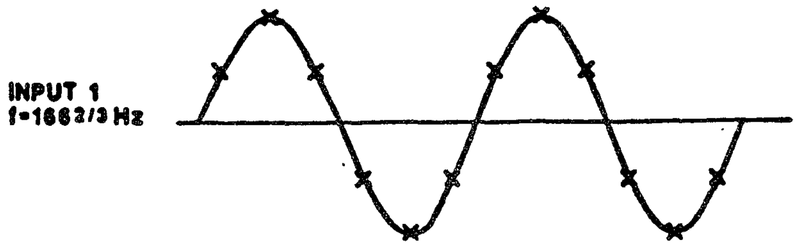
This is how NEXRAD "sees" the storms. Notice the reordering of storms A, B, and C. This compositing of multiple trip echoes is due to the fact that once a pulse leaves the radar, it can keep going. If that pulse impacts a storm in the second trip, an echo will be returned. By the time that echo reaches the antenna, a second pulse will have been started. The radar will then place the second trip echo in the first trip since it will assume the second pulse caused the echo. The same principle applies to the third trip echo.



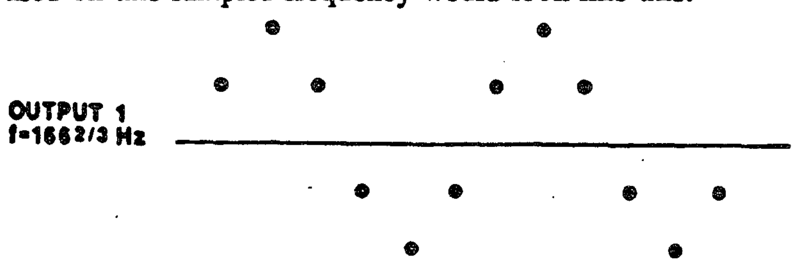
This is how NEXRAD displays the storms after the data have been processed. Notice that the storms are placed back in their proper order and range. Of critical importance is the obscured area which will be displayed as "Range Folding" on all NEXRAD products. This is the area where echoes from two or more trips were overlapped in the composite (see second figure above). The only way to remove this range folding is to change the Pulse Repetition Frequency (PRF).

Velocity Aliasing is another characteristic of any Doppler radar. It occurs when the input frequency is greater than half the sampling frequency. Say, for example, that NEXRAD is sampling the frequencies of the return echoes at a rate of 1000 samples per second (1000 Hz) as shown below.

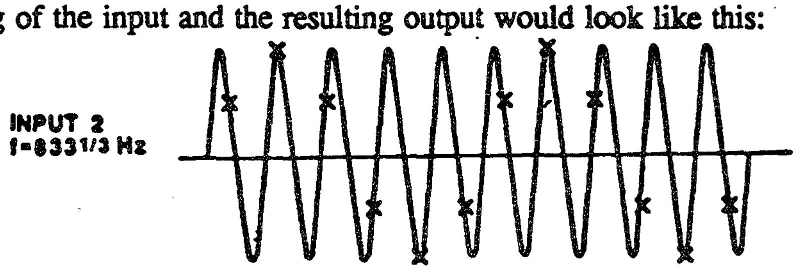
Given this sampling frequency, each *x in the* next figure shows a point (time) at which the returning (input) signal of 166.66 Hz will be sampled. The frequency of the input signal corresponds to the motion of particles toward or away from the radar.

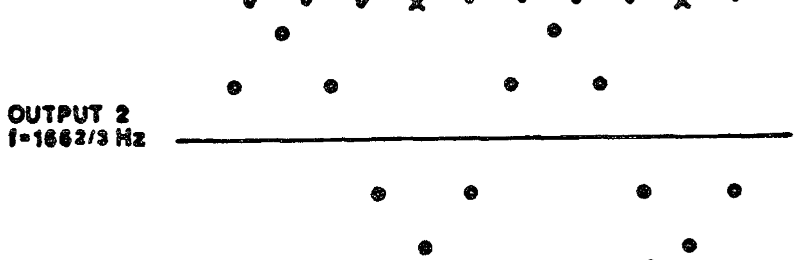


The output based on this sampled frequency would look like this:



But, if the returning (input) frequency is five times the example shown above (833.33 Hz), the sampling of the input and the resulting output would look like this:





Notice that the output for both cases show a frequency of 166.66 Hz despite the fact that the frequency of the latter case was five times that of the former (i.e., a significantly stronger radial component). These aliased data would be displayed identically with no indication that the two velocities were different. NEXRAD has algorithms that de-alias the velocity data automatically so that this is not a problem.