DETECTION AND MITIGATION OF POOR SELF AMBIGUITY TO MAINTAIN RESOLUTION IN PASSIVE RADAR.

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Passive radar systems systems are completely reliant upon uncooperative source for illumination. Commercial FM broadcasts have proven to be very useful to collect superb interferometric range-Doppler distributions of auroral E region irregularities. However, the range and Doppler resolution is occasionally poor due to features of FM modulation. In particular, speech contains many periods of silence, during which the effective bandwidth of FM modulation is low. During such periods, the range resolution degrades from its typical value of 1 km to as much as 1000 km — effectively ruining the range-Doppler distributions.

Upon detailed examination of the transmitter waveforms we see that the periods of ambiguity are actually quite brief, lasting tens of milliseconds, and rarely occupying more than ten percent of the time series. A variety of mitigation strategies have been considered. One of the more elaborate would involve computing an optimal "mismatched filter" that would at least partially correct the ambiguity. This approach has a number of serious difficulties, not the least of which is the enormous processing which would be needed to determine the filter coefficients. Furthermore, because the matched filter is provides optimal SNR (in certain conditions which are approximately relevant here), it is guaranteed that the SNR of the result will be inferior to that of a "better" waveform.

A far simpler approach is to rely upon the fact that the periods of poor ambiguity may be frequent, but are sparse. A simplified "mismatched" filter can then operate by simply discarding the transmitter signal when it has poor ambiguity. If ten percent of the signal is discarded, then the net impact upon the SNR of incoherently detected power is of the order 1 dB — usually quite tolerable.

In this report we provide a statistical study of the occurance of "bad ambiguity" in real broadcasts. We also describe a very computationally simple technique to dramatically reduce the deleterious effects of poor ambiguity, and illustrate its effect on data taken by observations of electrojet irregularities with the Manastash Ridge Radar.

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