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9.8A THE SONDRESTROM RADAR: PROGRESS AND PROPOSED UPGRADES FOR ST WORK

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At the first Workshop on Technical Aspects of MST Radar, the capabilities and limitations of the Sondrestrom Radar for ST observations was presented (WATKINS, 1983). Therefore this paper will only summarize recent progress and proposed upgrades.

During the first year of operation (April 1983 to April 1984) there was only one ST experiment, mainly with the objective of evaluating the site and determining that the hardware and software were still operational after the radar's move from Alaska. The Sondrestrom site has about the same degree of ground clutter as the former Chatanika site and the data appear to be similar. The radar's operation continues to be managed by SRII with its primary use being incoherent-scatter observations of the ionosphere. The main radar parameters are summarized in Table 1.

The major limitations of the radar still exist, i.e. low average power, poor range resolution (750 m), and inadequate computer/signal processing hardware. The upgrades required to meet these deficiencies would jointly benefit the incoherent-scatter operations, therefore we are hopeful that the necessary improvements will be possible in the near future.

It is unlikely that the system could ever be operated in a continuous ST mode because of high operational costs and competition from other incoherent-scatter work. Currently there is a total of about 100 hours per month radar operation funded. Therefore any future ST experiments must be of the short campaign nature.

The radar is potentially unique because of its high operating frequency and fast fully steerable dish antenna. Although the high frequency limits the maximum attainable height to about 20 km, the time to acquire a spectrum is very short compared to a 50-MHz radar. For example, with the current maximum PRF, the time to acquire one record with no incoherent spectral averaging is 1/2 sec for a 128-point spectrum. This, coupled with the fast fully steerable dish antenna is an ideal system for studying spatial variations of turbulence structures, short-period gravity waves, etc.

Unfortunately these types of experiments have been severely compromised by the inadequate data processing system. It is not possible for the data processing to keep up with the data input in real time. Therefore a critical upgrade item is at least an array processor for enhancing the data acquisition system.

The second upgrade needed is to implement phase coding that will effectively increase the average transmitter power and therefore system sensitivity. At present the transmitter is operating at 0.13% duty cycle with 5 μs uncoded pulses. The maximum permissible transmitter duty cycle is 3%. Therefore the opportunity exists to either enhance the average power with phase coding and/or increase the resolution. So far we have not attempted to use pulses shorter that 5 μs because of weak signal returns. Although uncoded pulses longer than 5 μs do enhance the signal/noise ratio they have not been used because of the resulting loss in range resolution.

Table 1

Location	67°N 51°W
Frequency	1290 MHz
Peak Pulse Power*	3 MW
Max. Pulse Repetition Frequency*	250 Hz
Pulse Lengths*	5-10 μs
Max. Duty Cycle	3%
Antenna - Fully Steerable Dish	
Antenna Diameter	32 m
Antenna Gain	49.6 dB
Antenna Efficiency	52%
Polarization	Circular
System Temperature	100°K

*Typical values for ST observations

A third, but not as critical, need is for a higher transmitter maximum PRF, at present this is 250 Hz. The spectral folding frequency converted to an equivalent doppler velocity $\delta\mu$ is given by

$$\delta\mu = \text{PRF}\ \lambda/2$$

$$= 28.8 \text{ m/s} \qquad \text{for PRF} = 250 \text{ Hz}$$

$$\lambda = 0.23 \text{ m}$$

When the antenna is directed off-vertical in the azimuth of the wind direction the horizontal wind speed is often large enough ($\gtrsim$ 28 m/s) to produce aliassing. A maximum PRF of about 1000 Hz would be optimum.

REFERENCE

Watkins, B. J. (1983), Capabilities and limitations of the Sondrestrom radar for ST observations, Handbook for MAP, Vol. 9, SCOSTEP Secretariat, Dep. Elec. Eng., Univ. Il, Urbana, 375-380.