Solar Radar?

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The prospect of probing the solar corona, solar prominences, and coronal mass ejections (CMEs) from the ground with a large radar system will be evaluated. A solar radar would exploit direct reflection from the solar plasma and possibly also coherent scatter from Langmuir waves in coronal arcs and CMEs. Active sounding could provide unambiguous information about the range, bearing, and speed of CMEs. crucial information for initial-value and assimilative models and operational space-weather forecasting.

For a solar radar, the radar wavelength must be longer than the plasma Debye length. This places a premium on low radar frequencies which overrides the penalty of increased sky and solar noise. However, the radar frequency should not fall below the maximum usable frequency (MUF) since that would invite radar clutter from sky waves. The most important performance metric is the transmitter power-aperture product which sets the flux delivered to the Sun. To optimize this flux, the antenna for transmission should be a steerable aperture or filled array with about a 1-degree half-power beamwidth. The receive array meanwhile must be large enough that most of the noise it receives comes from the solar disk and not from the galactic background. However, one must consider that the main source of noise in solar radar experiments will be type III radio bursts. System performance will therefore depend on discriminating solar echoes from radio bursts through adaptive beam-forming. All things considered, a facility comparable in size and power to the existing NSF Geospace Facilties but operating at VHF and incorporating spaced-receiver capabilities should be able to detect solar echoes.

Attempts have already been made to detect solar echoes. The historical record is mixed and inconsistent, and so the plausibility of the concept remains somewhat mysterious. Recent and ongoing attempts to receive solar echoes at The Jicamarca Radio Observatory near Lima, Peru, will be discussed.