Characterization & Mitigation of L-Band Ground-Based Aviation Radars

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The 1100–1400 MHz band is important for spectroscopy of HI at high redshift, pulsar work, and SETI. Observations at these frequencies are complicated by pulsed interference from ground-based aviation radars. These radars typically transmit pulsed fixed-frequency or chirped sinusoidal waveforms with pulse lengths of 5–75 μs, 1–27 ms between transmitted pulses, and bandwidths on the order of 1 MHz. Transmit powers range from 10^3 W to 10^6 W into a highly-directional antenna which rotates in azimuth with period on the order of 10 s. Pulses are easily detected through the sidelobes of radio telescopes at least 100 km away, and further when the radar beam is directly pointed at the receiving site or a reflecting object, such as an aircraft. The carrier frequency separation between radars detected at any given site can be 10 MHz or less, making observations in larger bandwidths (desirable for pulsar work, for example) a challenge. The spectrum between carrier frequencies is also corrupted to some degree due to the extended sidelobes associated with the pulse edges, which distorts noise baselines and overwrites spectral features. Pulsar surveys are affected because radar pulses tend to saturate dedispersion/periodicity searches (especially at low dispersion measures), masking pulsar candidates.

We have analyzed several radars received at the Arecibo Observatory using datasets obtained during recent observations. These datasets reveal information about the waveforms and propagation characteristics that can be exploited for mitigation purposes. Using this data, we discuss some simple methods for detection and removal of the radar pulses. Also, we present a coherent subtraction technique that has not previously been applied to the radar problem. This new technique provides an alternative to blanking, which is undesirable in pulsar and SETI work. Using a very crude implementation of the coherent subtraction approach, we show that a radar can be suppressed by at least 16 dB in integrated spectra, and that the maximum single-pulse power observed at the output of the canceler is $\sim$ 15 dB less. We find that the primary limitation is the performance of the pulse *detector*, not that of the canceler. As a result, the performance using blanking turns out to be about the same. Also, we demonstrate that the matched detector for pulses from this radar is relatively insensitive to astronomical transients (e.g., giant pulses), and quantify the risk of such transients being falsely identified as radar pulses.