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HF Signal Geolocation versus Ionospheric Structure: An Engineering Solution Approach

Abstract:
It is well known that the behavior of short and long range propagation at high frequencies (3 - 30MHz) are controlled by the ionosphere, the dilute plasma that exists above about 100 km altitude. The very practical problem of determining the location of HF transmitters from the angle of arrival of received signals is one with a rich history extending back to World War II.

In HF geolocation there are open questions about ionospheric variations and how closely nearby bistatic ray paths are correlated. We experimentally investigate the possibility that dense networks of known transmitters might provide ionospheric corrections to unknown nearby HF signals of interest. We refer to this approach as the “engineering solution.” As part of an experiment conducted in January 2014 at White Sands Missile Range (WSMR), we established a fixed network of transmitters and receivers that were used to investigate correlations in angles-of-arrival at a central receive site. This configuration provided multiple sites specifically chosen so that the known and “unknown” transmitters of varying distances (from 10 to 1000s of kilometers) were available.

We will describe the configuration and test signals used to test the engineering solution. We will then show the received data for all transmitters processed to Angle-of-Arrival (AoA), and the data for the “unknown” transmitter when corrected by the “known” transmitter(s). We assess the limits to this configuration (< 10 km baselines) and a discussion of the remaining ionospheric biases. In addition, we will show an analysis of the ionospheric bias as a Kolmogorov spectrum.