Passive Radar Interferometry of Meteor Trails

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We discuss the development of single site passive radar interferometry for the RAPID (Radio Array of Portable Interferometric Detectors) project and its application to the detection of meteor trails. We utilize antennas developed for the low frequency portion of the square kilometer array (SKALA) which are zenith pointing and cover the FM band.

Near earth space contains small pieces of matter known as meteoroids, some of which intersect the earth's orbit are then called meteors. The larger meteoroids produce a visible emission, a meteor. Meteors have a plasma trail that can be detected by radar. Interferometry and imaging can provide measurements which help to understand details of the plasma trail's structure and evolution.

For our measurements we have applied multi-static passive radar techniques where a single site is used for collection of the reference and scattered signal. Multiple antennas are used to measure the scattered signal over interferometric baselines with a separate horizon pointed antenna to measure the transmitter signal. Adaptive filtering is applied to the interferometric antennas to remove the direct transmitter signal and ground clutter signature. We then form a detected signal for each antenna and produce an interferometric cross ambiguity function to measure coherence and phase as a function of range and doppler shift. The detection of meteor trails using this methodology is an important step towards radar imaging of coherent plasma scatters in the ionosphere which is a key goal for the RAPID project.

Concepts explored in the project include passive radar, adaptive filtering, radar interferometry, and correlation. The software implemented to support the needed mathematical analysis techniques will be described. An overview of the experimental system, data collection, and the results of the radar analysis will be presented.