

Technical Exhibit for Experimental Licensee Application
Application #: 002-EX-PN-2020
Submitted: January 6, 2020

Overview

The Johns Hopkins University Applied Physics Laboratory, located in Laurel MD, is conducting experiments into the calibration of receive antenna arrays using a newly developed minimum shift key waveform. The experiments are to demonstrate the waveform and resulting signal processing to calibrate the center of rotation (CoR) of a parabolic reflector antenna. The transmitted waveform is reflected from a 1m diameter calibration sphere, currently in orbit. The calibration sphere is called Ridgesphere II or LCS4 NORAD 05398.

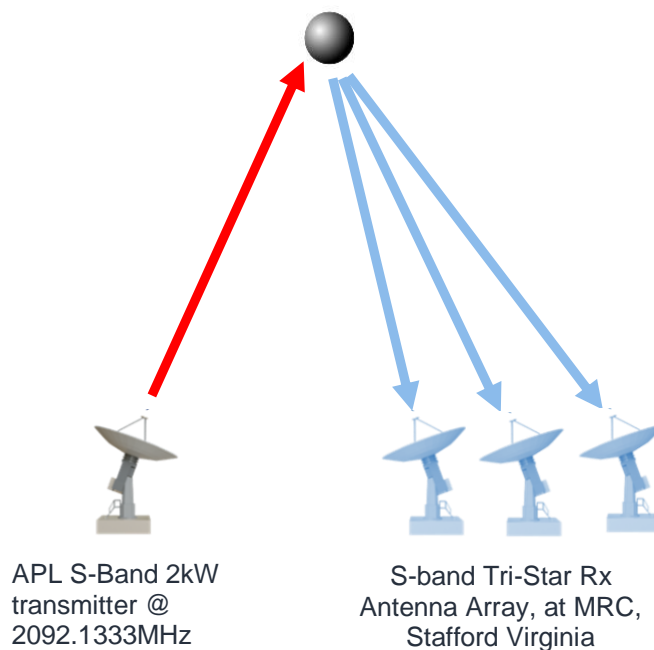


Figure 1 Experimental Overview for the Calibration of Receive Antenna Arrays—Red indicates the Space-to-Earth signal will originate from APL's existing S-Band ground station and the reflected signal is in Blue. The signal will be reflected isotropically from the calibration sphere.

These experiments are not operational in nature but are intended to prove the calibration concept using existing resources to are readily available. The antennas that are to be calibrated are located in Stafford VA at the Midway Research Center operated by the Navy Research Laboratory.

Description of DARC Calibration System

The purpose of the experiments is to demonstrate, in an operational environment, the signal processing needed to located the center of rotation of each antenna. That information will be

used to allow the antennas to be coherently summed that will enable coherent gain to be realized.

JHU/APL is requesting the use an uplink frequency of 2092.1333MHz, this frequency is the uplink frequency of the RBSP spacecraft operated by JHU/APL. The spacecraft are no longer operational and have been decommissioned, yet remain in low Earth Orbit. The total signal occupied bandwidth is 7MHz and is a minimum shift key signal. The main purpose of the waveform is that it does not go through zero amplitude, making it compatible with high power transit tubes. APL plans to use the filtered version of the waveform for the proposed demonstrations. This is a very short duration test that is planned for less than five demonstrations.

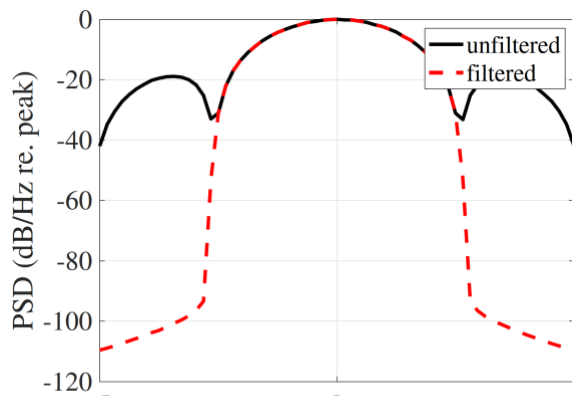


Figure 2 Power Spectrum Density of the Transmitted Waveform showing the filter and unfiltered spectrum. APL plans to use only the filtered spectrum.

Research and Experimental Equipment

APL will use an existing 18.3 meter ground antenna used to support spacecraft operations at a total EIRP of 80 dBW at a requested transmit frequency of 2093.1333MHz with an occupied bandwidth of 7MHz. Receive antennas will be located in Stafford VA at Midway Research Center.



Figure 3 Left is the APL 18.3 Meter S-Band Ground Station Located in Laurel, MD Center: 1m Aluminum Sphere in low Earth Orbit Right: Three receive only antennas located on Stafford, VA

General Research and Experimental Objectives

- 1) Demonstrate a new waveform to perform compatibility with high power transmit tubes
- 2) Demonstration calibration of the center of rotation of parabolic apertures.