Phoenix - A Study of Heat Islands Through Infrared Remote Sensing

Project Overview

Phoenix is a 3U CubeSat which will measure the effects of Urban Heat Islands in selected US cities through infrared remote sensing. Images will be taken from a Low Earth Orbit of 400 km and a 51.6° inclination of the following cities: *Phoenix, Chicago, Los Angeles, Baltimore, Houston, Minneapolis, and Atlanta*. The desired mission lifetime is one year, to allow for the Urban Heat Island Effect to be studied during all four seasons. Images will be taken of the selected target cities throughout the day, to return a projected total of 2500 images over the duration of the mission lifetime. *Phoenix* is supported through a cooperative agreement under the NASA USIP Program, and the satellite is owned and will be operated by a student team at Arizona State University.

The satellite is currently scheduled for a launch readiness date of March 8, 2018, and is projected to launch in the 2018 summer season (May - June) to optimize the mission performance. *Phoenix* will be assigned to a suborbital carrier through the courtesy of the NASA CSLI, and launched from the ISS. The launch application was submitted to the CSLI in November of 2016, and official launch information has not yet been coordinated. However, it is expected that the suborbital carrier information will be known by May of 2017.

Communications

Satellite communications will be performed through UHF (in a frequency range of 430-440 MHz) and S-Band (2.0-2.45 GHz) frequencies in order to optimize performance. The UHF band will be used for regularly transmitting satellite health data (power consumption, satellite location, and hardware performance) as well as receiving all operation schedules for the satellite which will be uplinked from the ground station. S-Band transmission will be used for downlinking all captured images as well as the associated orbital information (time of image, location, and date taken). For these purposes, a frequency in the range of 2.4-2.45 GHz is being requested to perform operations in the S-Band amateur frequency. All downlinks will be encrypted, per the regulations of NOAA in applying for a remote sensing license to support operations.

Satellite flight hardware will be comprised primarily of commercial off-the-shelf components, in order to reduce risk and ensure performance. This includes: the UHF receiver (NanoCom AX-100 from GomSpace), S-Band transmitter (CPUT s-band transmitter, selected from Clyde Space), and S-Band antenna (Clyde Space CPUT S-Band antenna). The antenna which will provide transmission and reception over UHF frequency, however, will be developed from a standard tape measure by the student team, and designed to operate in the wavelength range selected by the FCC. The design of a tape measure antenna has been successfully demonstrated on previous CubeSat missions conducted by the University of CalPoly as well as JPL, and the student team plans to utilize resources from these institutions in ensuring that the design successfully performs during operations.

Ground Station

The ground station located at Arizona State University will serve as the primary and sole base of operations for all uplink and downlinks of data. For this, the 2.4-2.45 GHz frequency for S-Band communications is requested, as this range will allow for the student team to utilize the ground station for all operations. While the ground station is not yet registered with the FCC, this will be submitted in tandem with the licensing request for *Phoenix*. In addition, the Mission Control Center located at ASU will facilitate mission operations procedures throughout the satellite's lifetime.