SPACE HAUC

Sim Dy, PM | 13 May 2019

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Description:

The SPACE-HAUC (Science Program Around Communication Engineering with High Achieving Undergraduate Cadres Project) is a 3U CubeSat mission comprised of two objectives: technology demonstration and educational experience for undergraduates. The first objective is to demonstrate X-band beam steering on a CubeSat platform using a novel design. The second objective is as a hands-on student training mission.

The need for high bandwidth communication from CubeSat missions cannot be overstated. As increasingly larger number of imaging and other data-intensive CubeSat missions are conceived and deployed, the demand for reliable, low-cost, and high-efficiency communication systems have increased.

A phased array antenna consists of multiple antenna elements, whose placements create a beam-forming network. Electronically phasing the radiation from each element can be used to steer the beam in different directions at high speed. Such a steerable beam provides a key advantage of use aboard Low Earth Orbiting (LEO) spacecraft to communicate with a ground station over slow-moving, mechanically-gimbaled systems, which are prohibitively expensive for nanosatellite missions.

Beam steering has been incorporated in spaceflight systems including the NASA Messenger mission. The student team will challenge themselves to demonstrate X-band beam steering aboard a CubeSat. Our CubeSat is designed to demonstrate this key enabling technology that will find applications in future missions.

SPACE HAUC leverages on-going research efforts at the university to provide an opportunity for undergraduate students to develop and flight demonstrate a state-of-the-art, low-cost phased array antenna. Already more than 100 undergraduate students with different backgrounds (e.g., science and engineering) have teamed up and are participating in this research and development effort. Graduate students involved in on-going spaceflight missions for their Ph.D. dissertation work serve as mentors to the student teams. SPACE HAUC enjoys a strong support from professionals at local aerospace industries and research laboratories.

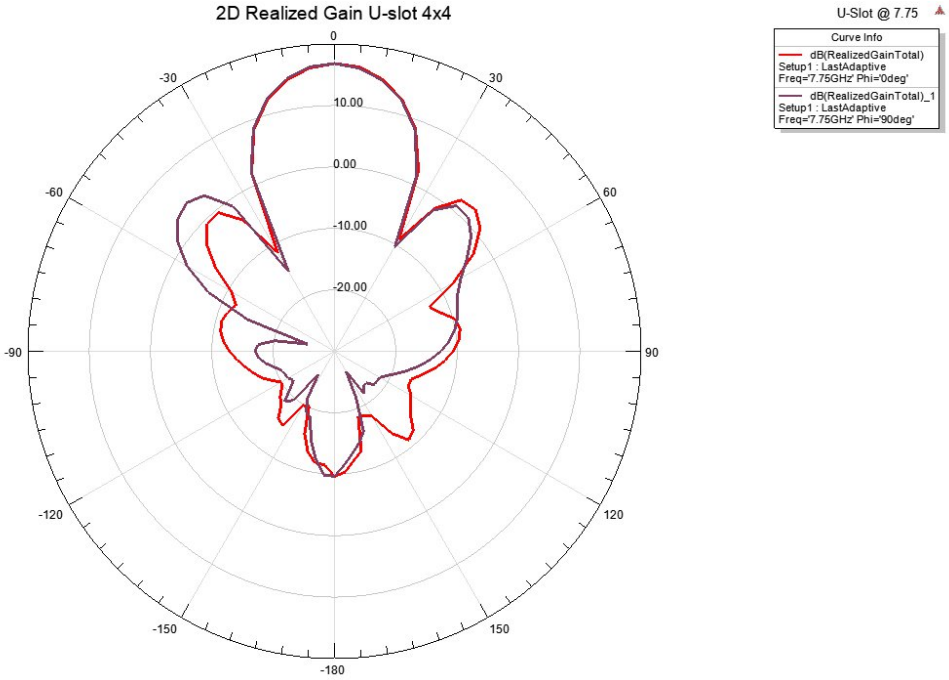
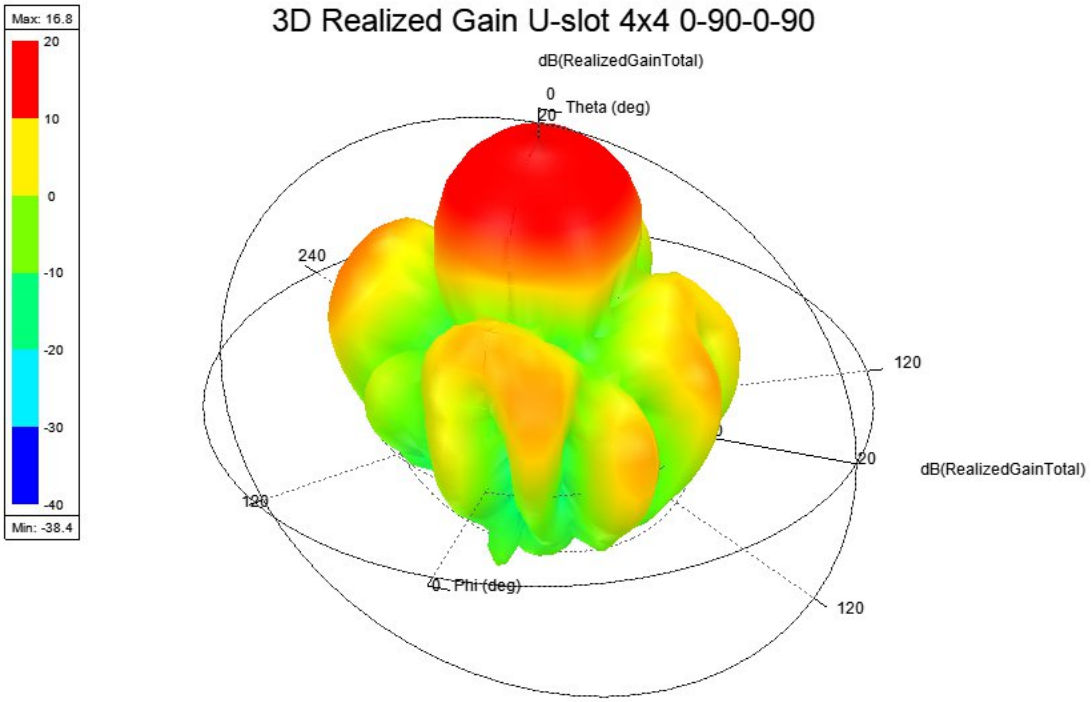
Amateur Band Technical Information:

- Earth Station Uplink:
  - Radio: Analog Device AD9361
  - Output Power: 35W
  - Frequency: 435 – 438 MHz
  - Modulation: 2GFSK
  - Emission Designator: 2K40F1D
  - Antenna: Half Duplex
- Satellite Downlink:
  - Radio: EnduroSat UHF Transceiver Type II
  - Output Power: 1 W
  - Frequency: 435 – 438 MHz
  - Modulation: 2GFSK
  - Emission Designator: 2K40F1D
  - Antenna: Half Duplex

X-Band Technical Information

- Earth Station Uplink:
  - Transceiver: Analog Device AD9361
  - Output Power: 15W
  - Frequency: 7.2 GHz
  - Modulation: QPSK
  - Emission Designator: 2M00G1D
  - Antenna: Half Duplex
- Satellite Downlink:
  - Transceiver: Analog Device AD9364
  - Output Power: 1.6 W
  - Frequency: 8.35 GHz
  - Modulation: QPSK
  - Emission Designator: 56M0G1D
  - Antenna: Half Duplex

Orbital Parameters

- Space Segment
  - The range of orbits and altitudes;
    - Orbit is about 400 km circular
    - Perigee: 400 km
    - Apogee: 405-410 km
  - Inclination angle
    - 51.6°
  - Orbital period
    - 91 minutes

X-Band Phased Array Polarization Results