Modular Dual-band Ku/Ka Antenna Tile with Digital Calibration

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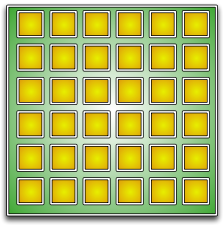
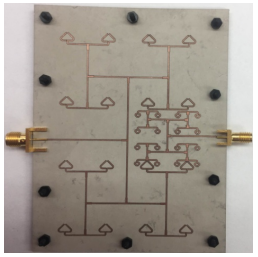
Objective

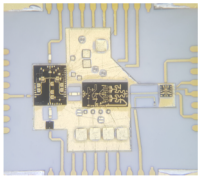
- Develop a low-cost, compact, modular Ku/Ka-band antenna array tile with integrated digital calibration architecture to enable scalable antenna apertures for a variety of airborne platforms, from small unmanned airborne systems (UASs) to aircraft wing pods, with targeted applications in precipitation monitoring and snowpack measurements. Specifically,
  - Develop at least two 10x10cm (CubeSat form factor) active dual-frequency antenna tiles (a.k.a. K-tiles)
  - Demonstrate the performance is within 0.1 dB in amplitude difference and 1 deg in phase difference between channels on multiple K-tiles after digital combination and calibration

K-tile (active Ku/Ka dual-pol, modular tile with digital calibration)

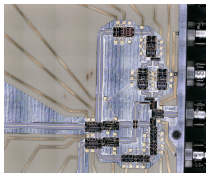




4x4 Ku/Ka-band antenna array prototype

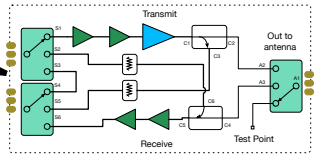


Ku-band TRM (transmit side)



Ka-band TRM frontend

CubeSat form factor tile with direct-write printed antenna



GaN MMIC TRM with digital calibration architecture

Accomplishments

- Designed and prototyped a Ku/Ka-band passive antenna array using multi-layer printed circuit boards and demonstrated satisfactory performance characteristics:
  - Ku/Ka-band antenna gain: 13.85/12.93 dB (measured); 15.84/15.89 dB (modeled)
  - Ku/Ka-band return loss: -27.9/-44.7 dB (measured); -26.9/-42.3 dB (modeled)
- Developed a Ku-band transmit/received module (TRM) using COTS MMICs and multi-chip module (MCM) technique whose architecture included digital calibration interfaces
- Designed and fabricated Ka-band GaN MMIC devices, including low noise amplifiers, power amplifiers, RF switches, and attenuators, for the development of Ka-band transmit/receive modules

Co-Is/Partners:
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$TRL_{in} = 3$ $TRL_{out} = 4$