Research Highlights from Prof. Satish K. Sharma's Antenna and Microwave Lab (AML) Group

AML – SDSU
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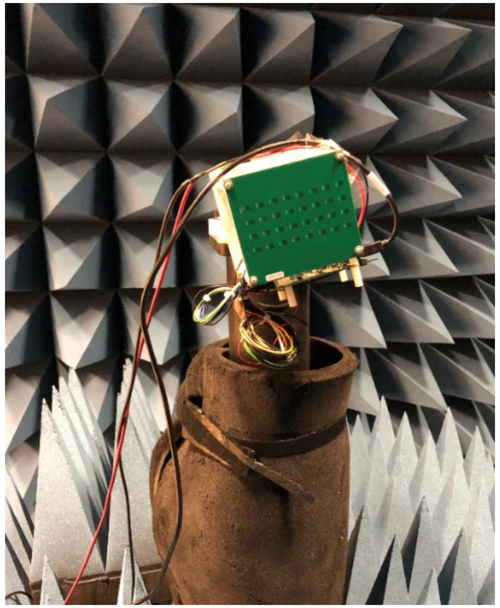
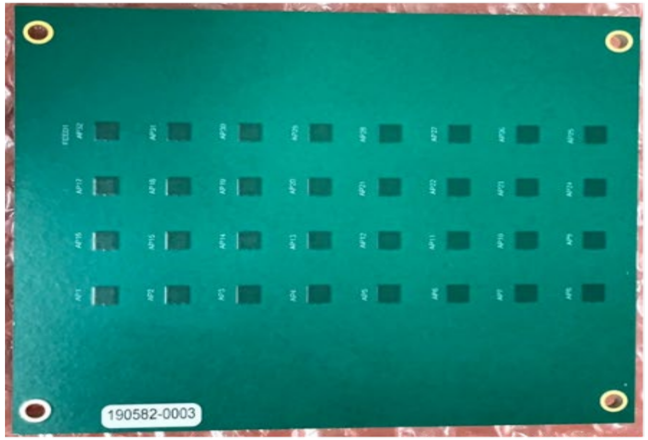
Current/Future Research Activities

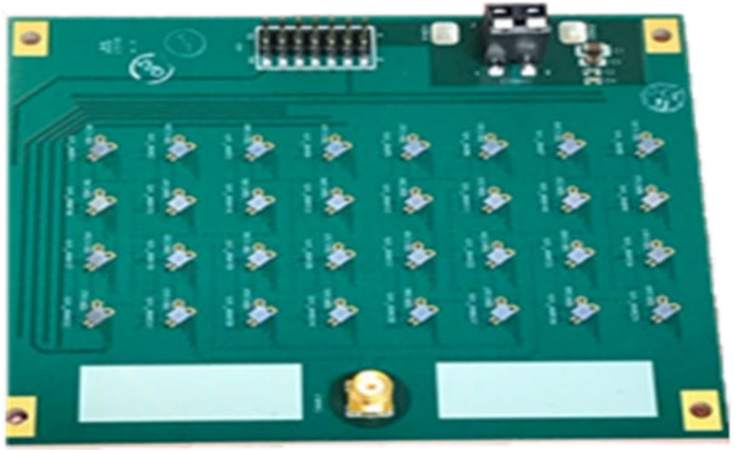
- 5G Technology and Massive MIMO Antennas
- LTCC and HTCC based Antennas
- Feed Systems and Reflector Antennas
- CubeSat Antennas
- Deployable antennas
- Analog Beamforming based Phased Array Antennas
- Digital Beamforming and Hybrid Beamforming based Multiple Beam Antennas
- Conformal Antennas for Curved Surfaces
- Reconfigurable and Tunable Antennas
- Ink-jet Printer based Flexible Antennas
- 3D Printer based Antennas
- Antennas for Handheld and Portable Devices including MIMO antennas
- Internet of Things (IoT) Antennas
- Waveguide Polarizers
- 5G Silicon RFICs based Electronically Scanned Arrays

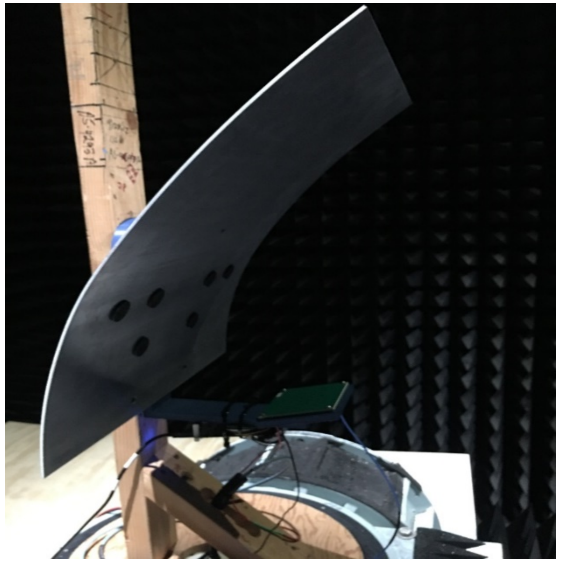
Wide Angle Beam Steering Cylindrical Parabolic Reflector with Phased Array as a Feed Source for Ku-Band Applications



Ku-band (10.5-16 GHz, Anokiwave RFIC: AWMF-0117)

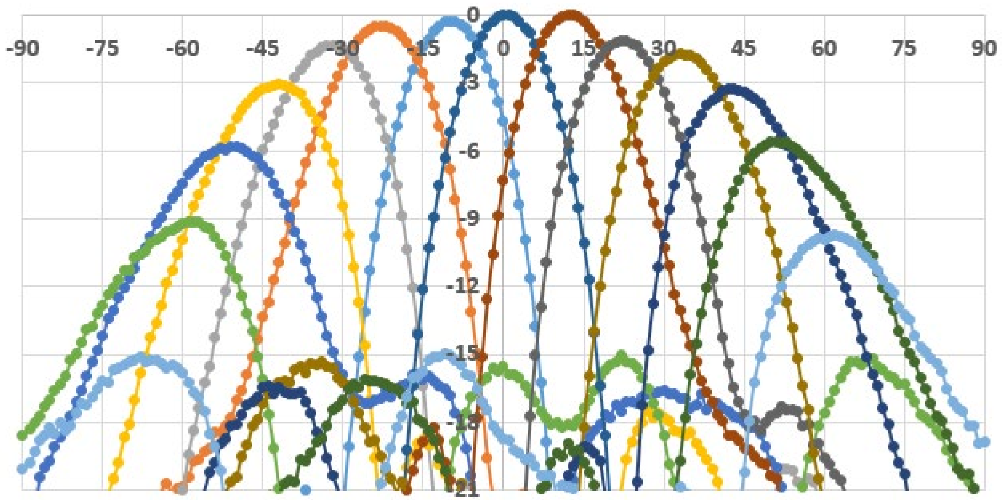






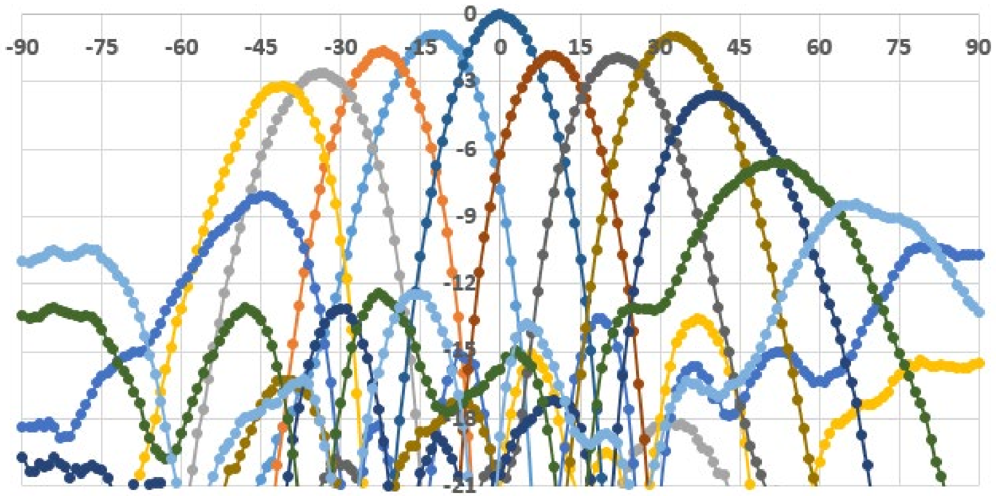
Vertical polarization

12.5 GHz Beam Steering



Horizontal polarization

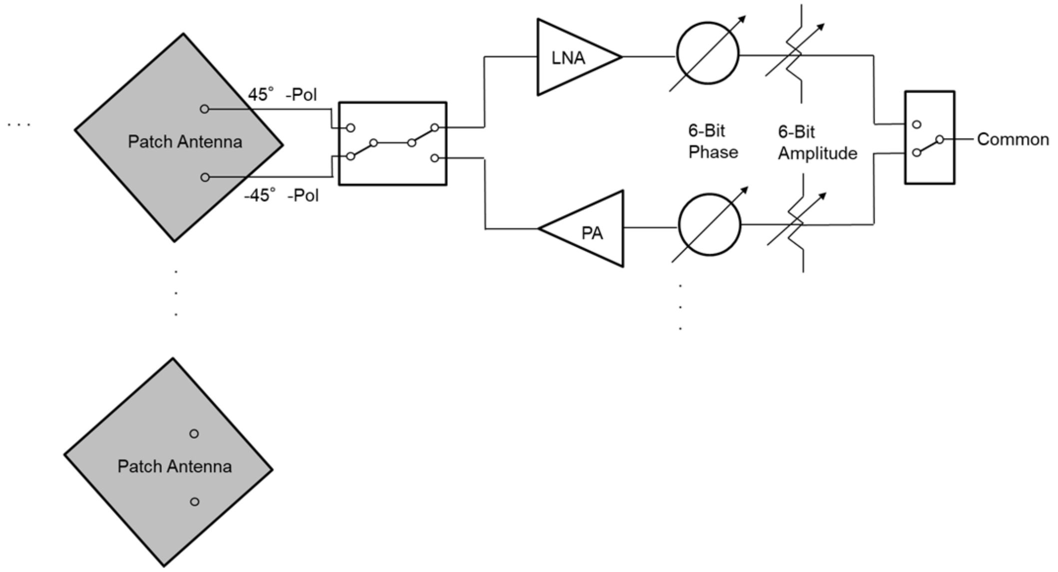
12.5 GHz Beam Steering

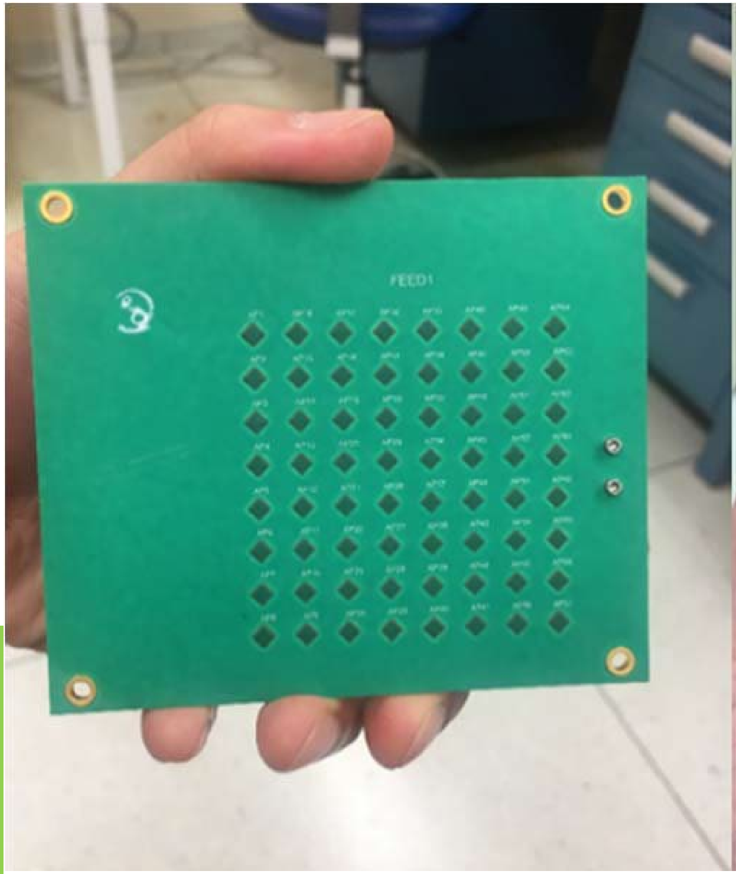


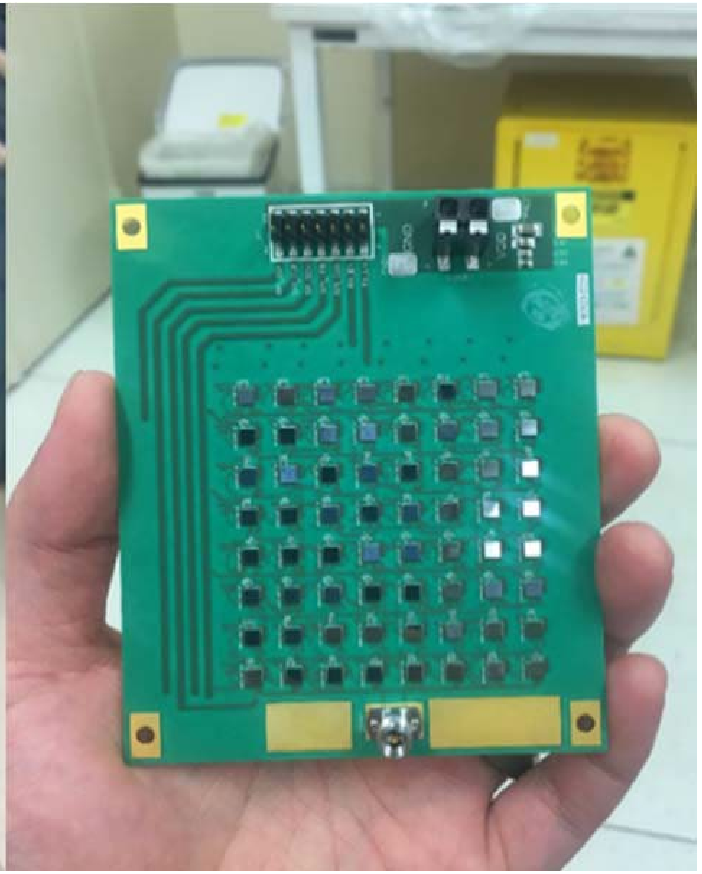
G. Mishra, **S. K. Sharma**, J. S. Chieh and R. B. Olsen, "Ku-Band Dual Linear-Polarized 1-D Beam Steering Antenna Using Parabolic-Cylindrical Reflector Fed by a Phased Array Antenna," ***IEEE Open Journal of Antennas and Propagation***, vol. 1, pp. 57-70, 2020.

Ka-band Phased Array Antennas using 5G Silicon RFICs

A flat panel dual slant linear polarized (±45°) transmit and receive (T/R) phased array antenna (PAA), that operates in the Ka-Band, which covers the millimeter-wave 5G band (27.5 – 28.35 GHz).

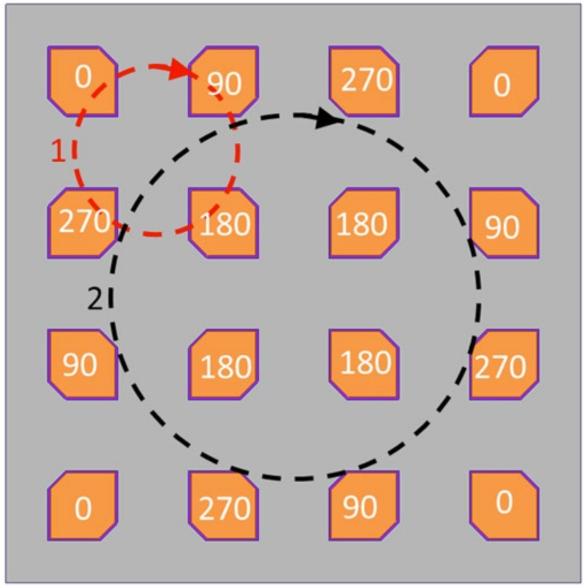


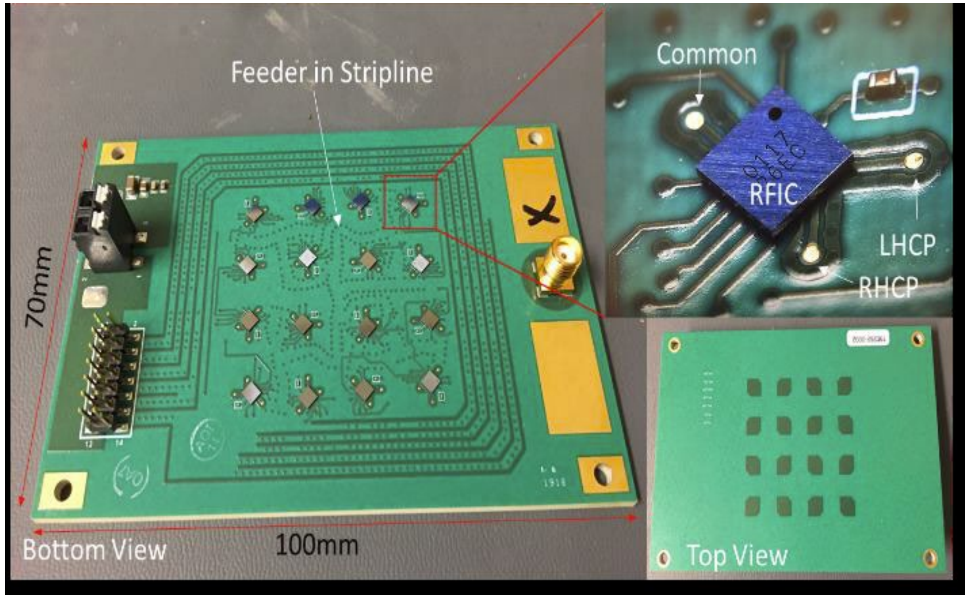




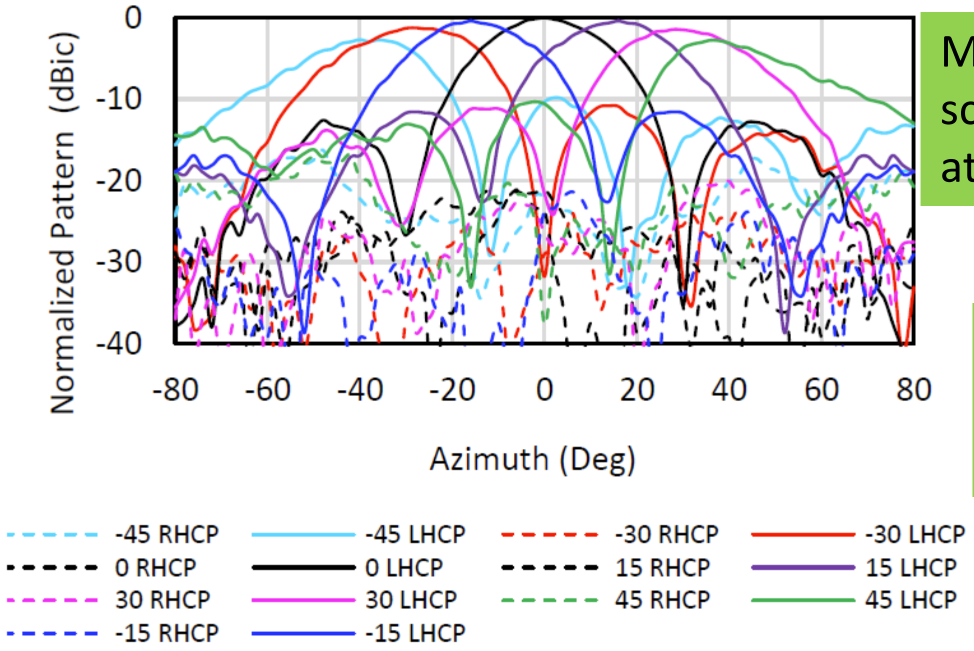
J-C. Chieh, E. Yeo, R. Farkouh, A. Castro, M. Kerber, R. Olsen, E. Merulla, and **S. K. Sharma**, “Development of Flat Panel Active Phased Array Antennas using 5G Silicon RFICs at Ku- and Ka-Bands”, ***IEEE ACCESS***, Vol. 8, Oct 2020.

Ku-band Dual Circular Polarized Phased Array Antenna



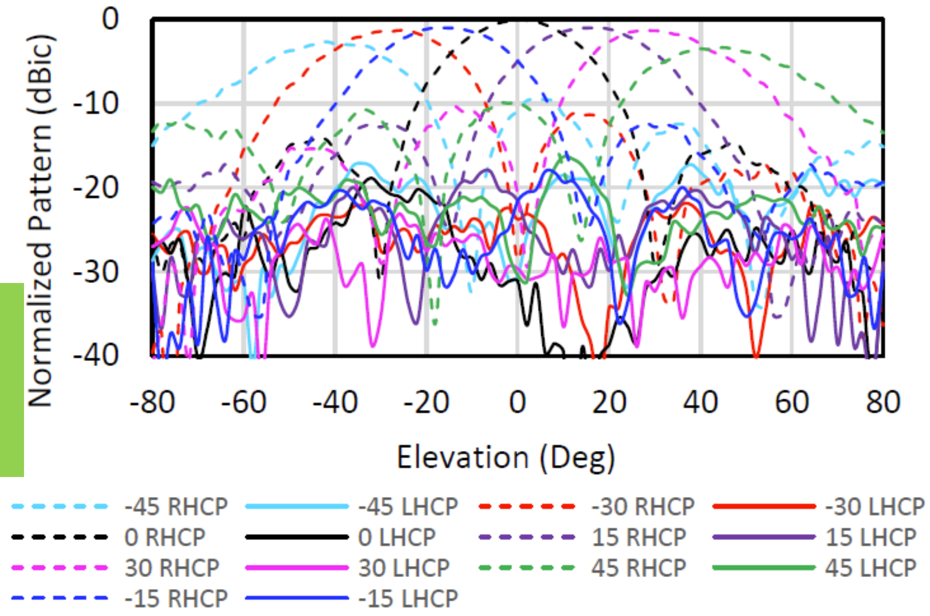


J-C. Chieh, E. Yeo, R. Farkouh, A. Castro, M. Kerber, R. Olsen, E. Merulla, and **S. K. Sharma**, "Development of Flat Panel Active Phased Array Antennas using 5G Silicon RFICs at Ku- and Ka-Bands", ***IEEE ACCESS***, Vol. 8, Oct 2020.

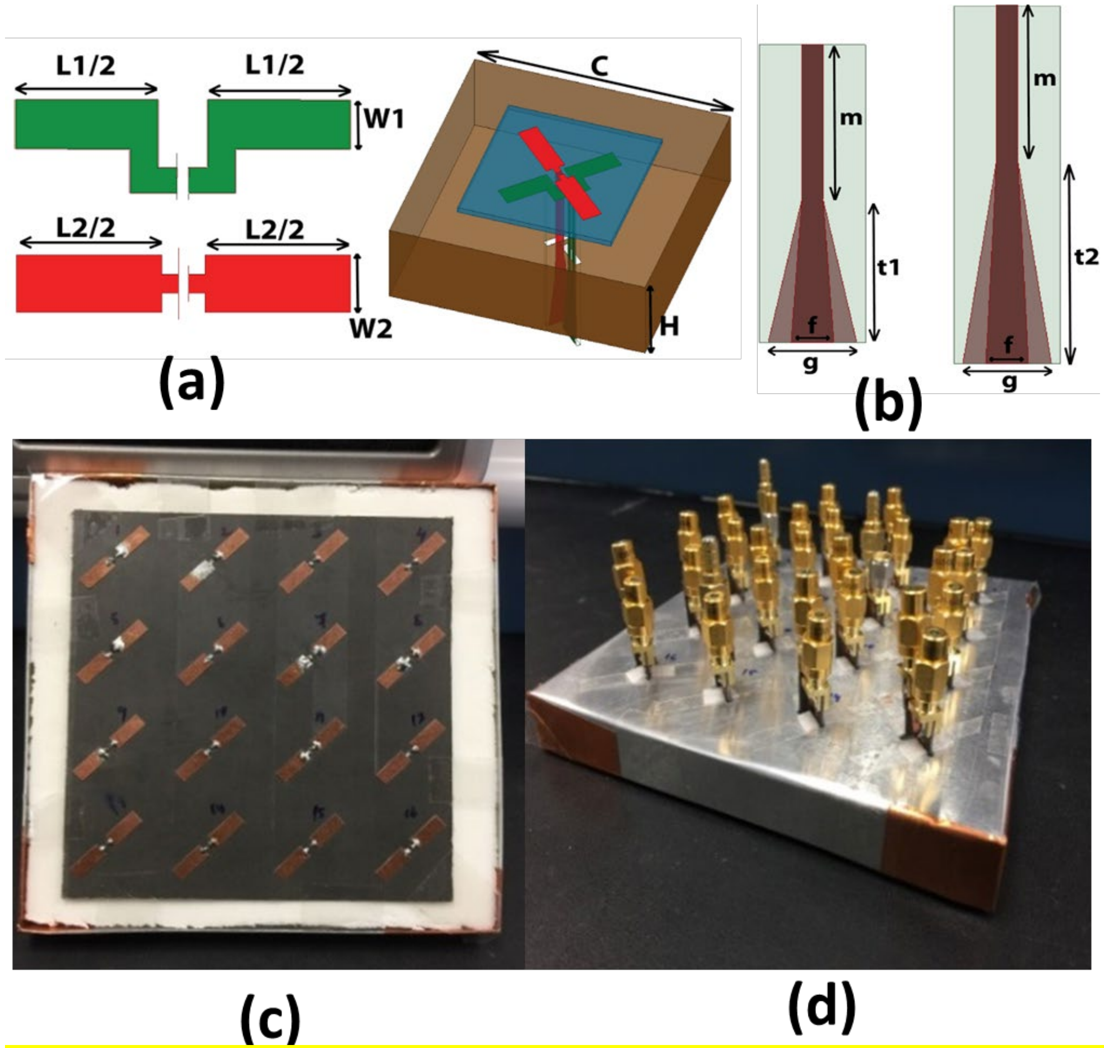


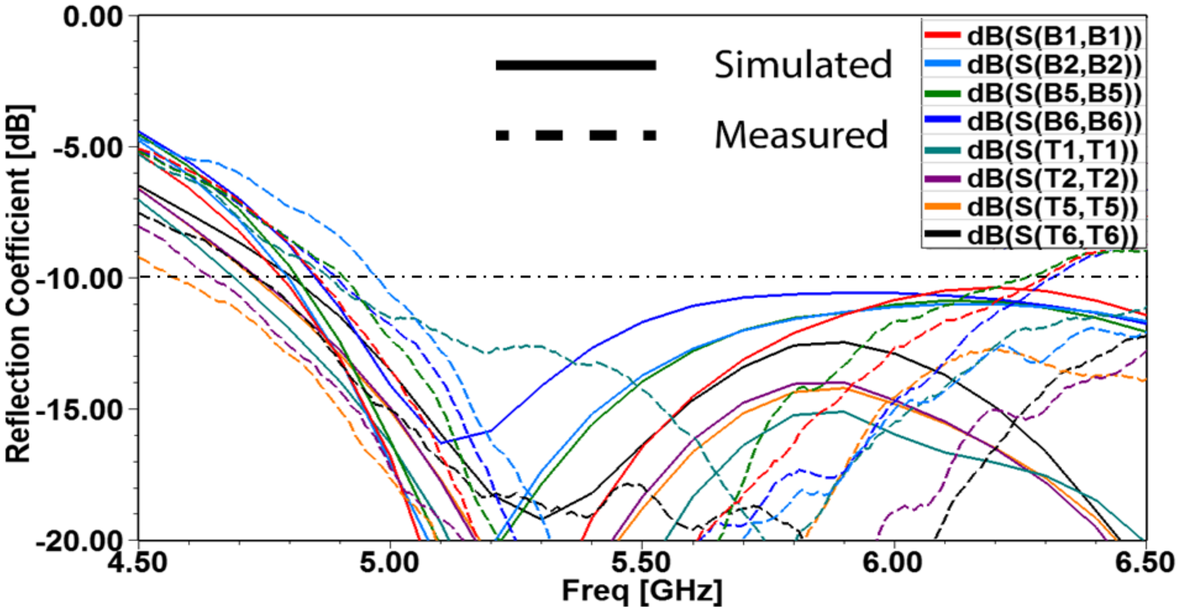
Measured LHCP beam scan patterns for Azimuth at 12.5 GHz

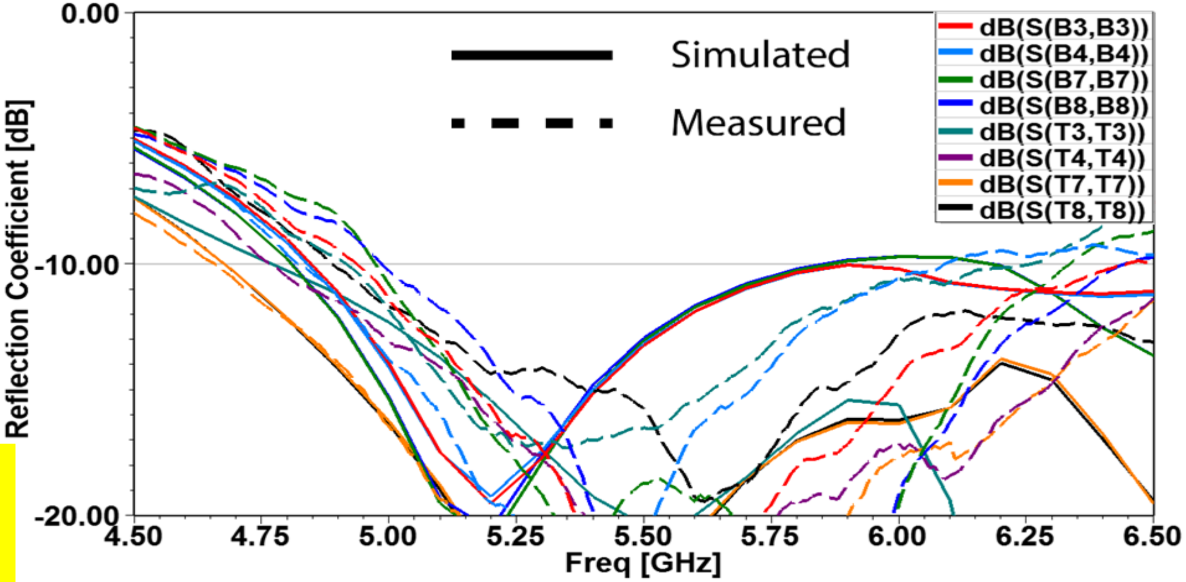
Measured RHCP beam scan patterns for Elevation at 12.5 GHz.



MASSIVE MIMO Antenna Panel Array at 5-6 GHz

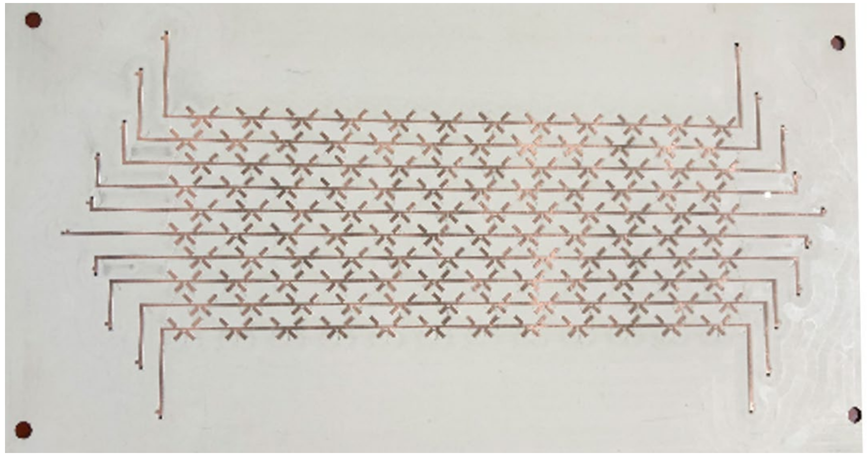


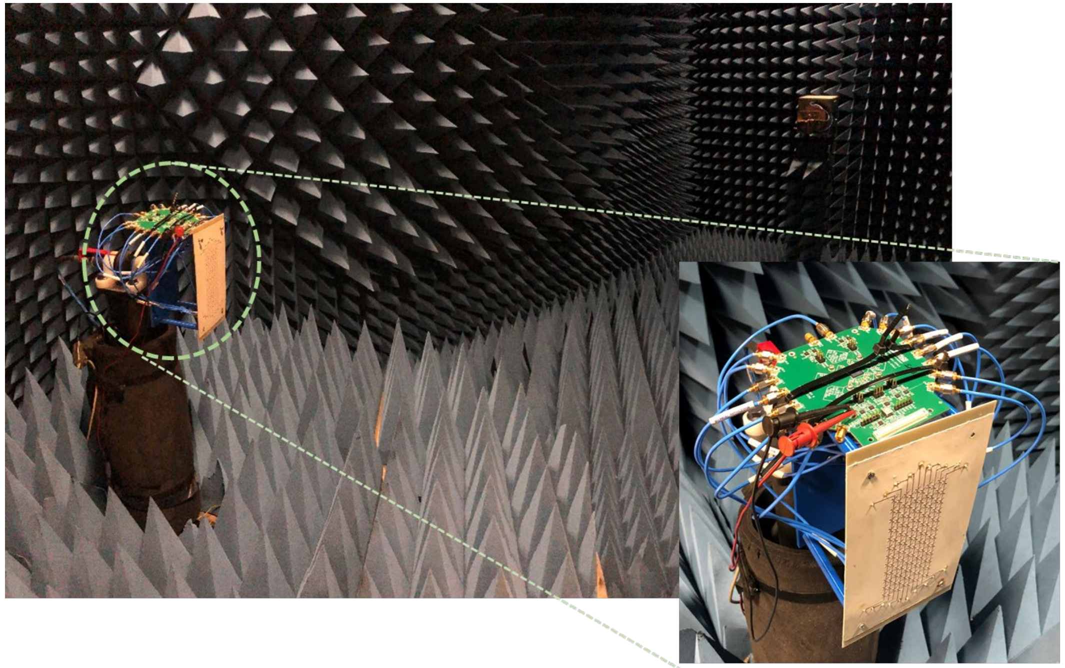




M. Komandla, G. Mishra and **S. K. Sharma**, “Investigations on Dual Slant Polarized Cavity Backed Massive MIMO Antenna Panel with Beamforming”, **IEEE Trans Antennas and Propagation, Dec 2017**.

Ka-band Multi-functional 1D-Beam Steering Staggered Phased Array Antenna

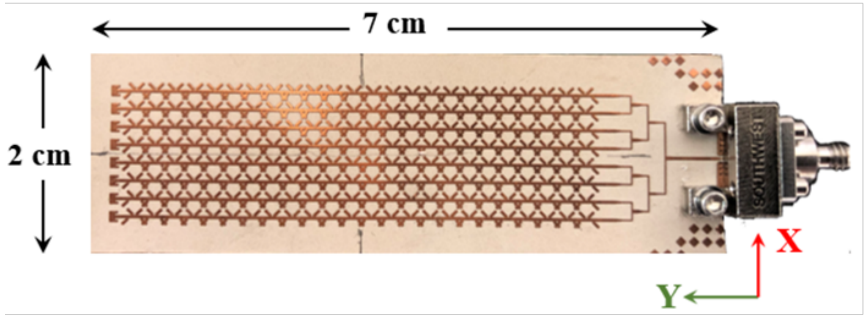


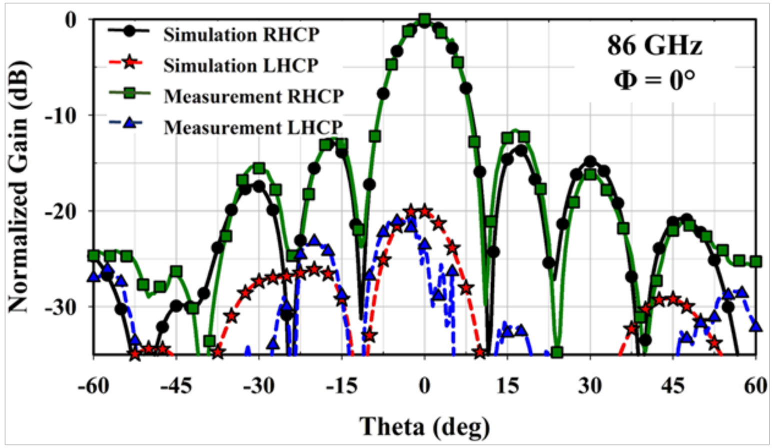


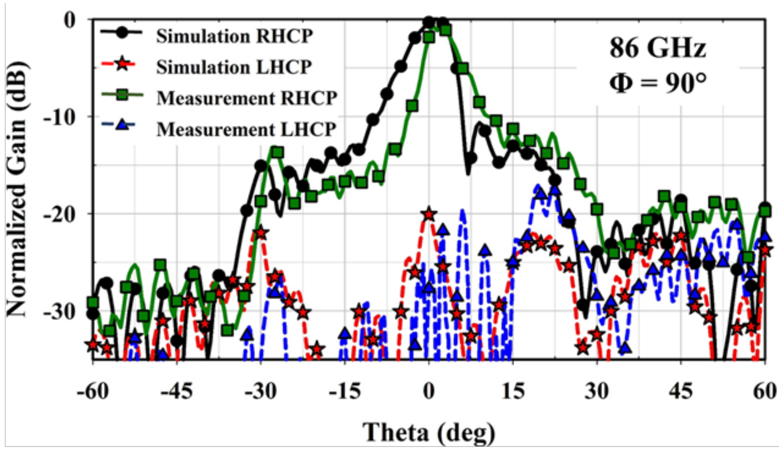
The radiation characteristics of the Butterfly staggered array antenna integrated with the Analog Devices ADMV4821 beamformer board is measured in the far-field anechoic chamber facility at the Antenna and Microwave Laboratory (AML) at San Diego State University (SDSU)

G. Mishra and **S. K. Sharma**, "A Multi-Functional Full-Polarization Reconfigurable 28 GHz Staggered Butterfly 1D-Beam Steering Antenna," **IEEE Transactions on Antennas and Propagation**, Volume: 69, Issue: 10, Oct. 2021, pp. 6468 - 6479.

High Gain Antennas at Millimeter Wave Frequencies for CubeSat Communications

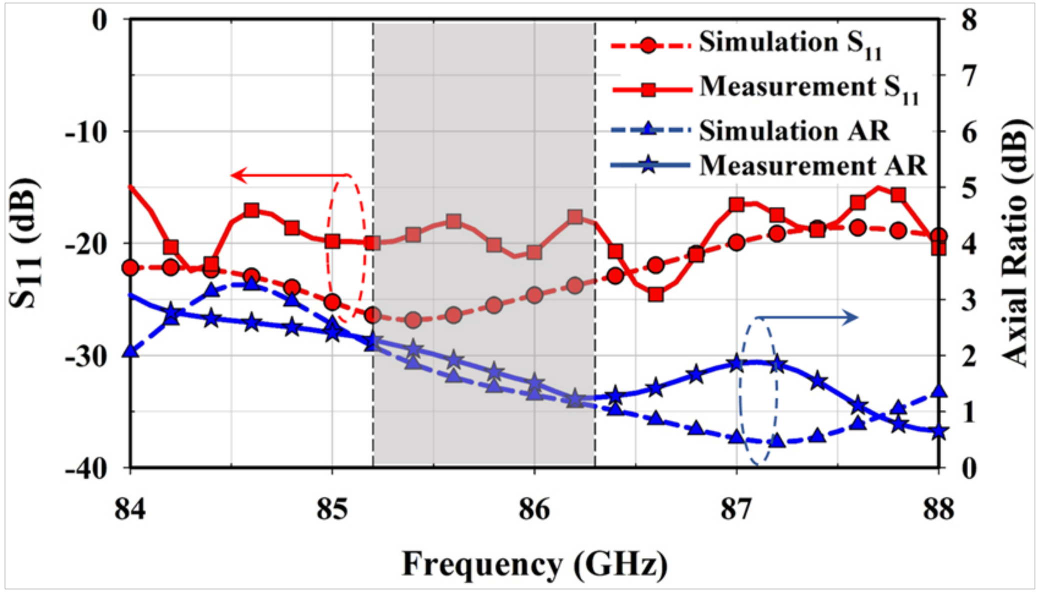


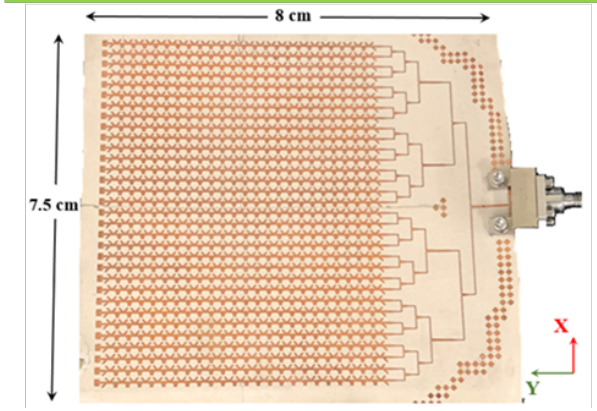


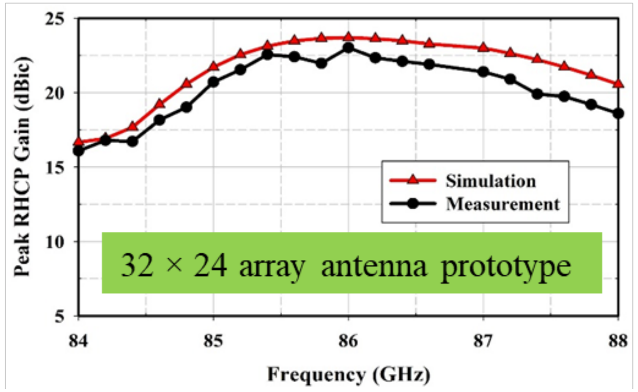


Acceptable squint bandwidth is from 85.2 GHz to 86.3 GHz

- The measured fixed beam array has an average 3 dB gain beamwidth of 9.5° and 6° in φ = 0° and 90°, respectively.
- The measured RHCP gain is 19.9 dBic with peak cross polarization separation of 21 dB at 86 GHz.
- The average simulated total antenna efficiency is 51% within the desired acceptable squint bandwidth from 85.2 – 86.3 GHz.





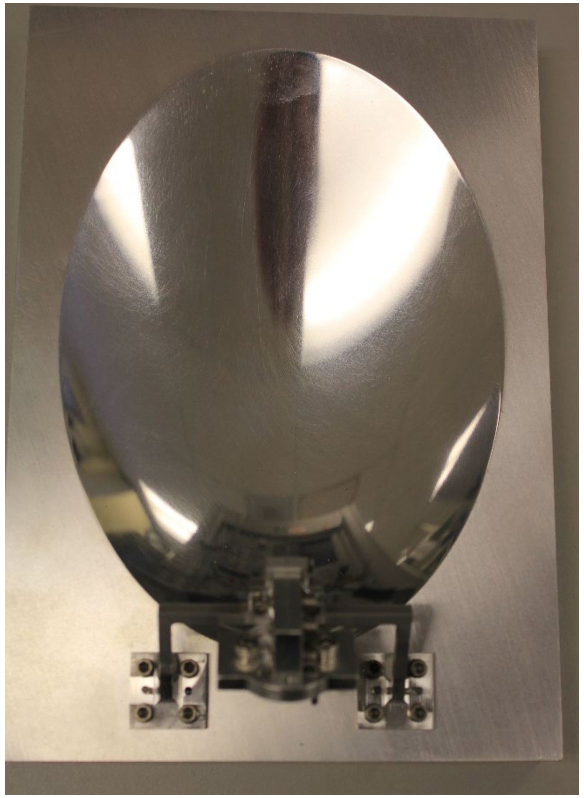


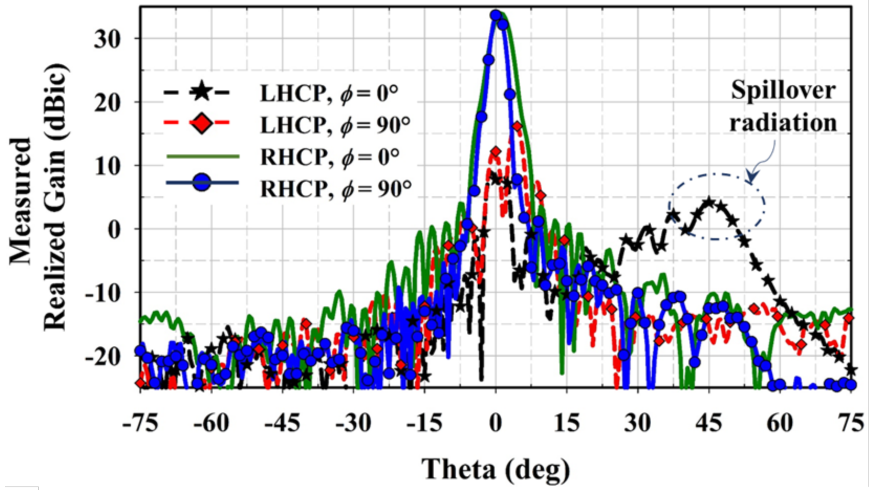
32 × 24 array antenna prototype

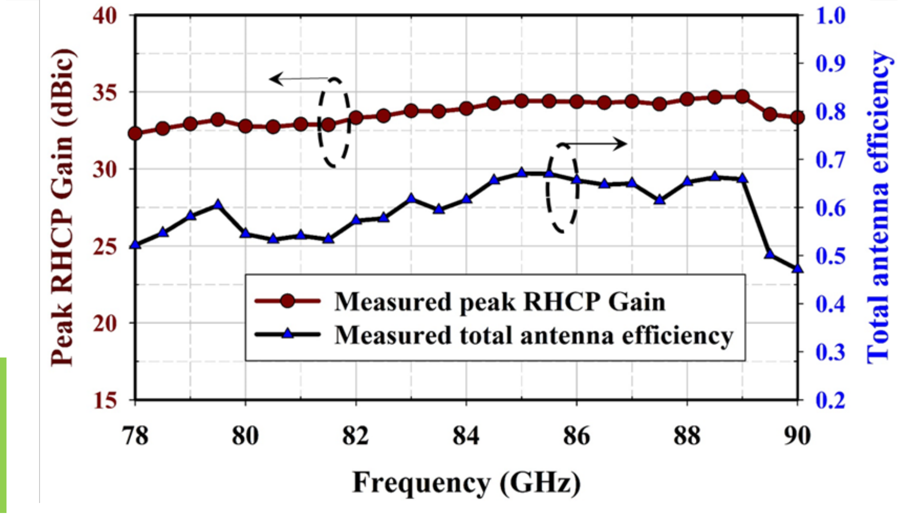
G. Mishra, **S. K. Sharma** and J. S. Chieh, "A High Gain Series-fed Circularly Polarized Traveling-Wave Antenna at W- band using a New Butterfly Radiating Element," **IEEE Transactions on Antennas and Propagation**, vol. 68, No. 12, December 2020, pp. 7947-7957.

W-Band Circular Polarized Horn Antenna with Inbuilt Polarizer as a Feed Source for a Reflector Antenna

A W-band Left hand circular polarization (LHCP) feed horn with wide bandwidth performance is designed and integrated with an offset parabolic reflector antenna of *f/D = 0.25* to achieve a minimum Right hand circular polarization (RHCP) gain of 34 dBic to maintain the data link.

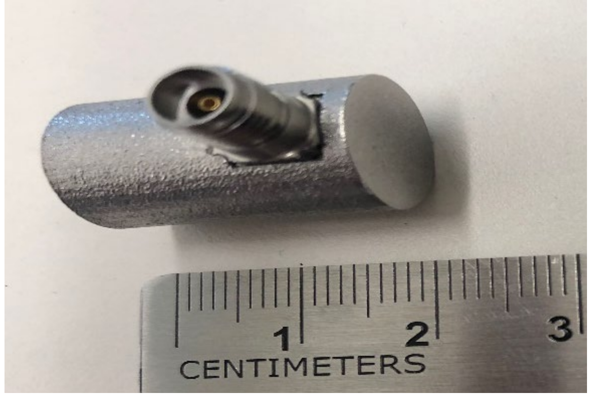






G. Mishra, **S. K. Sharma** and J. S. Chieh, "A Circular Polarized Feed Horn With Inbuilt Polarizer for Offset Reflector Antenna for W -Band CubeSat Applications," in *IEEE Transactions on Antennas and Propagation*, vol. 67, no. 3, pp. 1904-1909, March 2019.

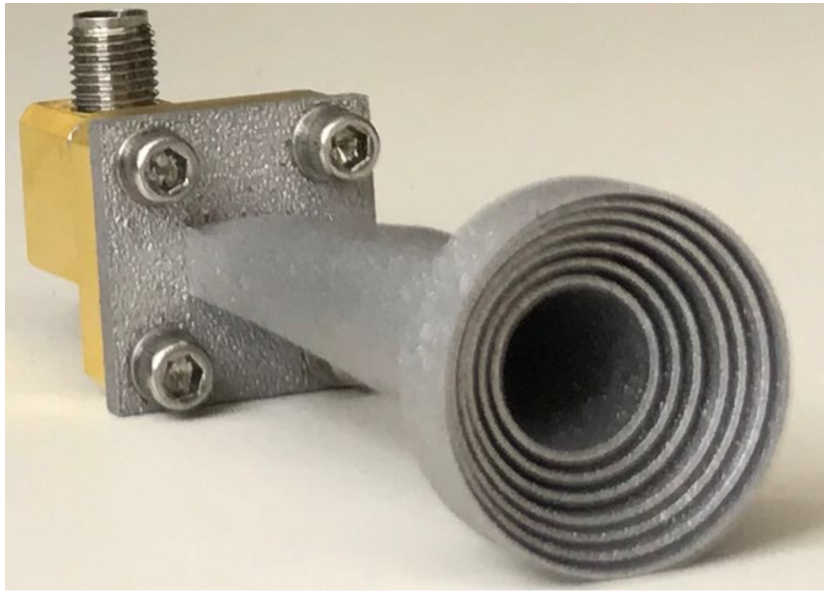
3D Metal/Dielectric and Ink-Jet Printed Antennas and Polarizers



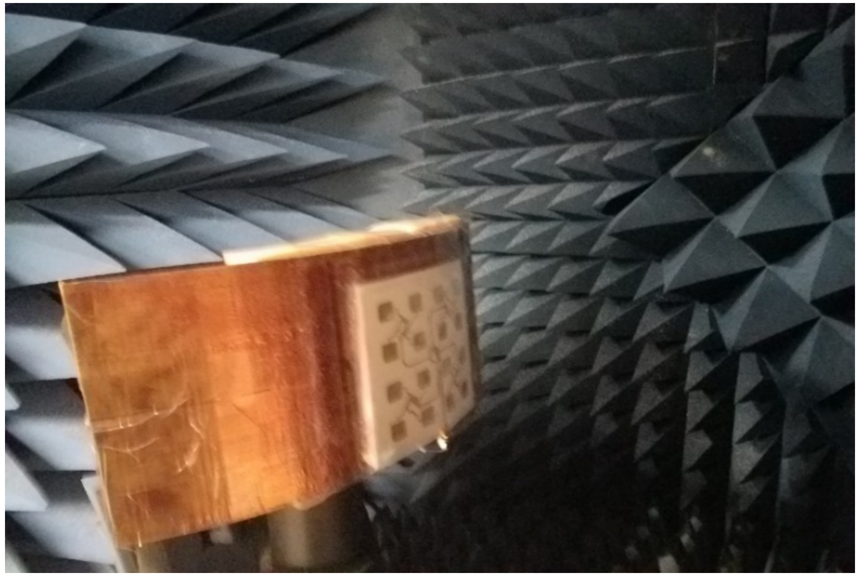
Ka-band polarizer: 3 D Metal

Ka-band dual circular polarized feed horn (26.50 to 29.50 GHz): 3D Metal

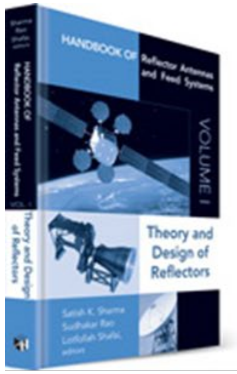
X-band Triple mode horn antenna: 3D Dielectric printed with Silver Coating



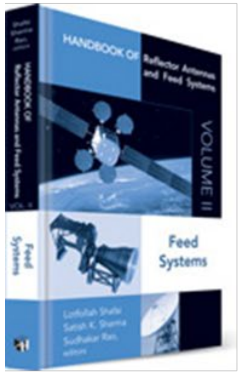
Ka-band axial corrugated horn (26.50 GHz to 40 GHz): 3D Metal



Ink-jet printed circular polarized microstrip patch array antenna on conformal surface



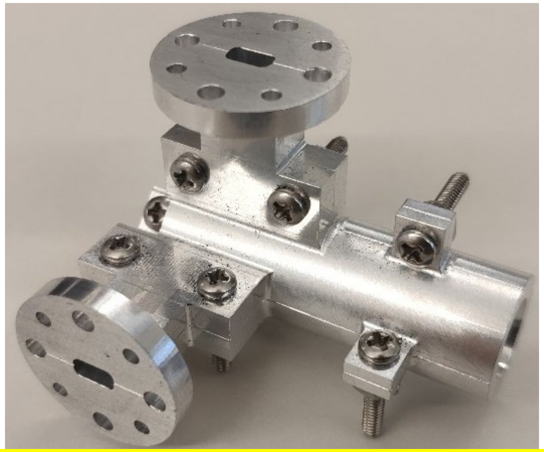
Handbook of Reflector Antennas and Feed Systems Volume 1:
Theory and Design of Reflectors
Satish K. Sharma, Sudhakar Rao, and Lotfollah Shafai, Editors
Copyright: 2013
Pages: Approx 350
ISBN: 978-1-60807-515-7



Handbook of Reflector Antennas and Feed Systems Volume 2:
Feed Systems
Lotfollah Shafai, **Satish K. Sharma**, and Sudhakar Rao, Editors
Copyright: 2013
Pages: Approx 450
ISBN: 978-1-60807-517-1

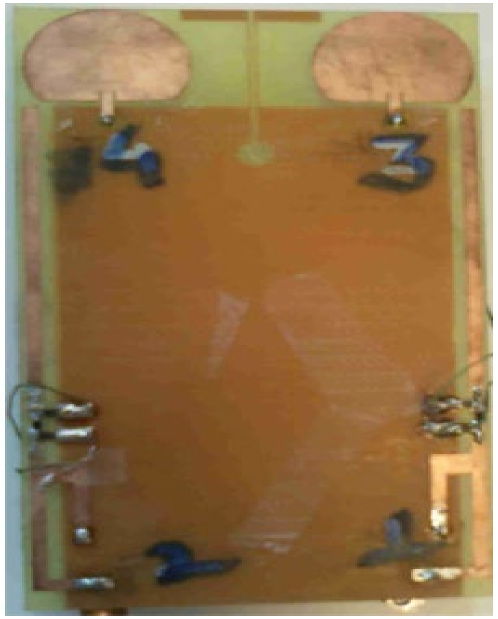
Handbook of Reflector Antennas and Feed Systems Volume 3:
Applications of Reflectors
Sudhakar Rao, Lotfollah Shafai and **Satish K. Sharma**, Editors
Copyright: 2013
Pages: Approx 450
ISBN: 978-1-60807-519-5

"Multiple Phase Center Feedhorn for Reflector Antennas" US Patent # 7,180,459, February 20, 2007

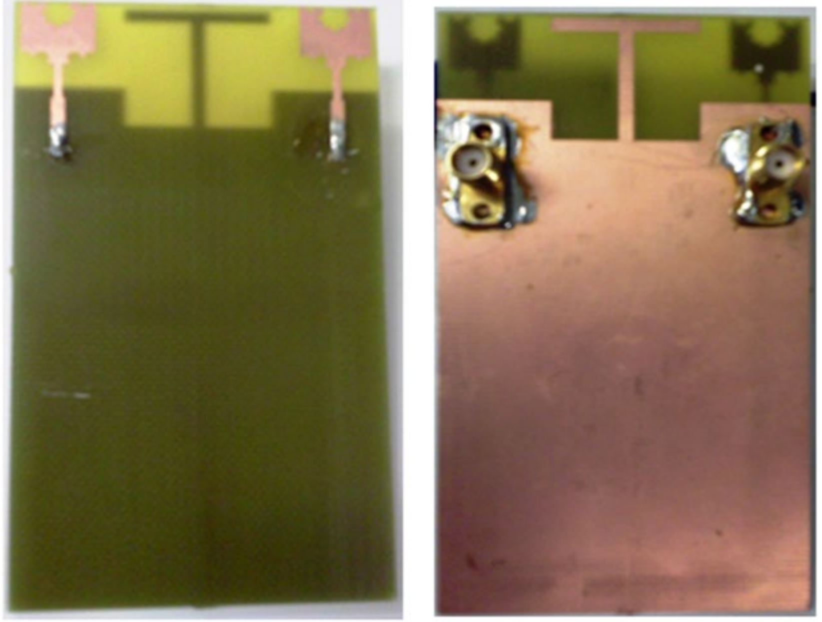


V-band dual circular polarized horn

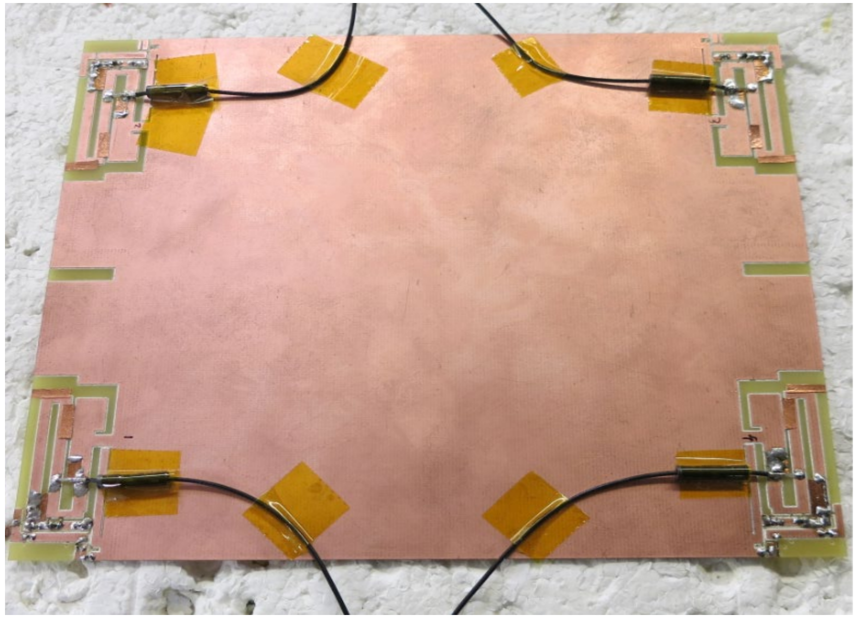
Frequency Agile Antenna with MIMO

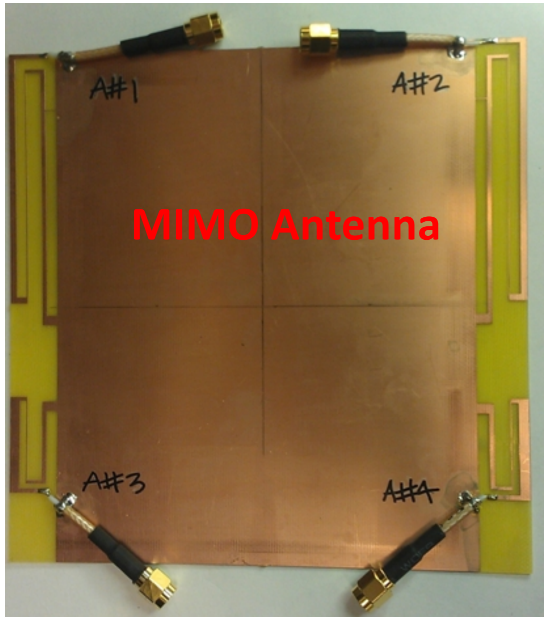


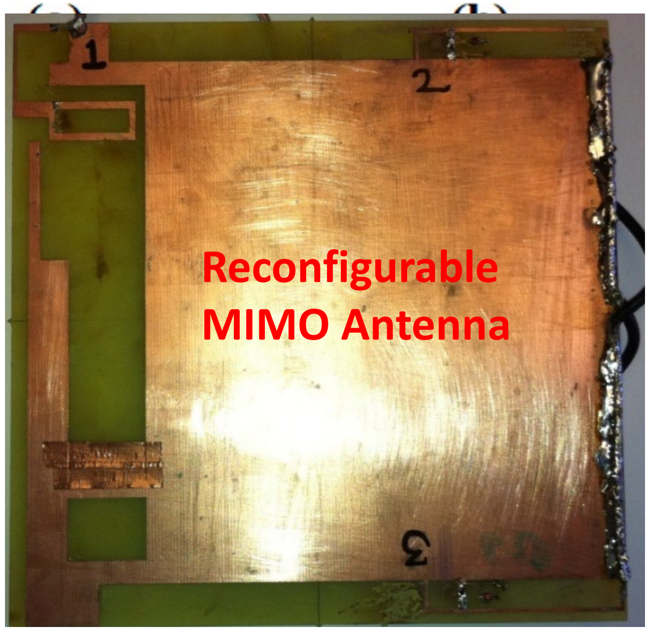
MIMO Antenna with Isolation Technique



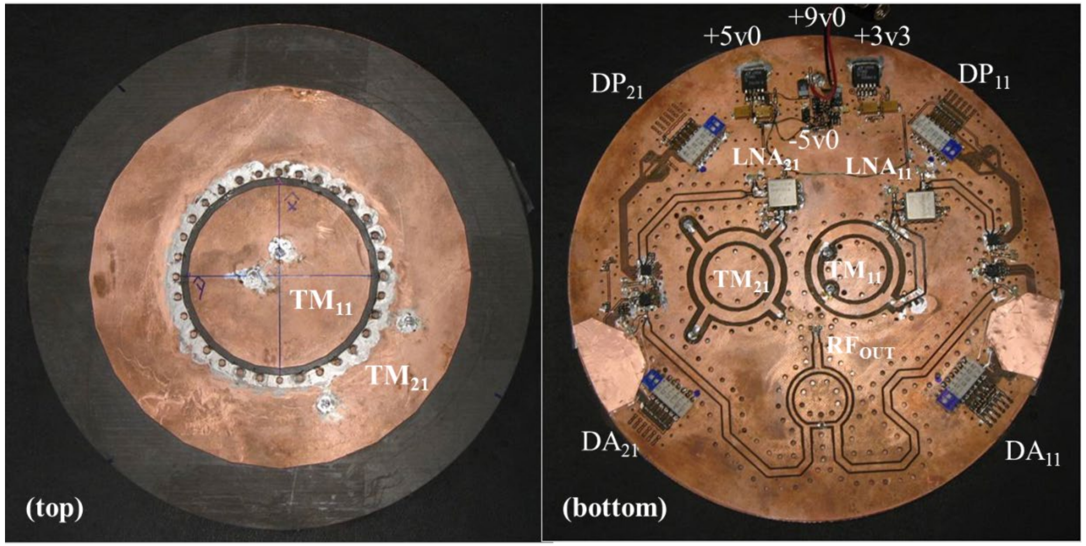
Reconfigurable MIMO Antenna for Tablet







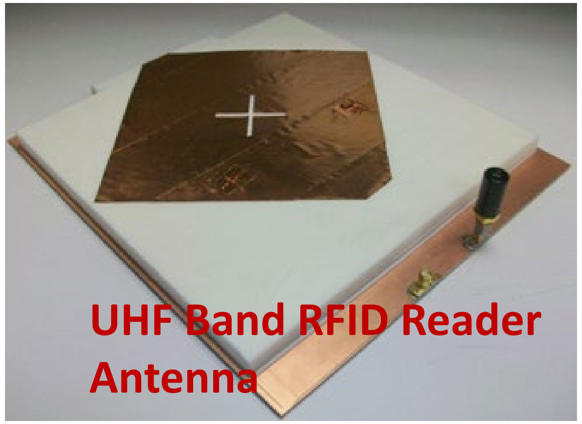
Beam Peak and Null Steering Antenna for GPS Receivers

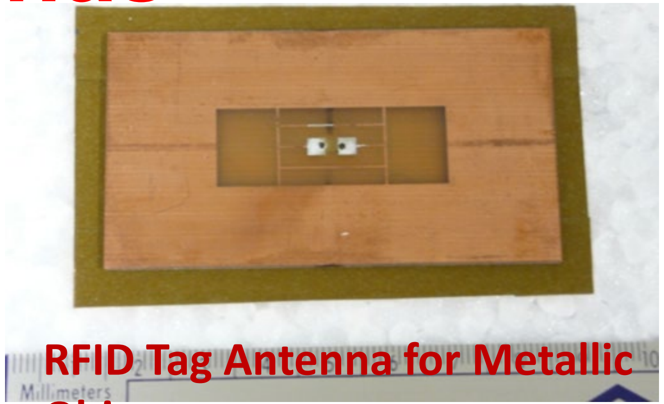


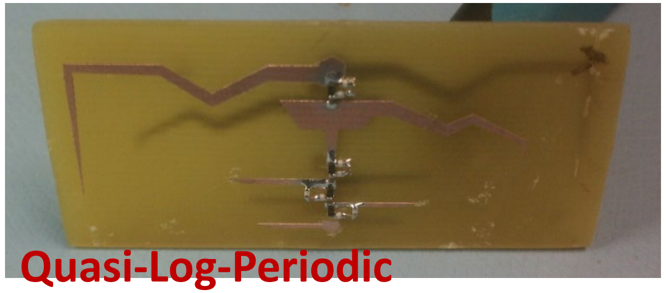
- DP (Digital phase shifter), DA (Digital attenuator)

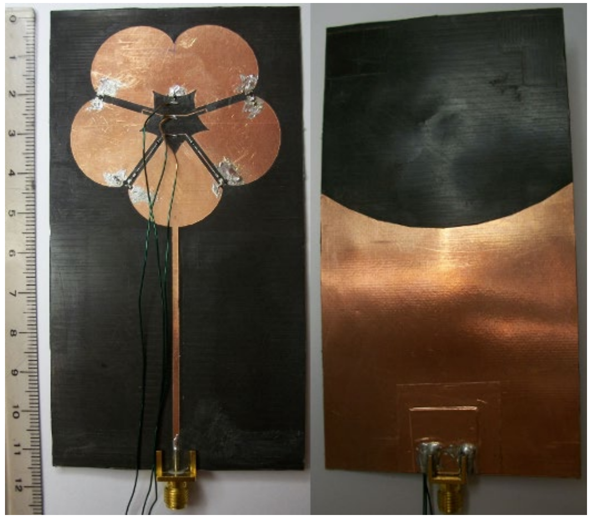
Some Funded Project Antennas

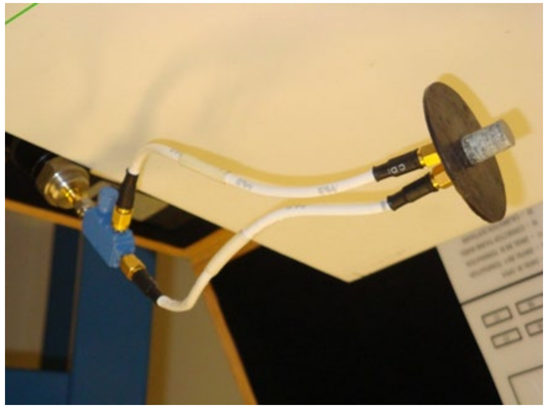

DF Antenna (100MHz to 1.3GHz)

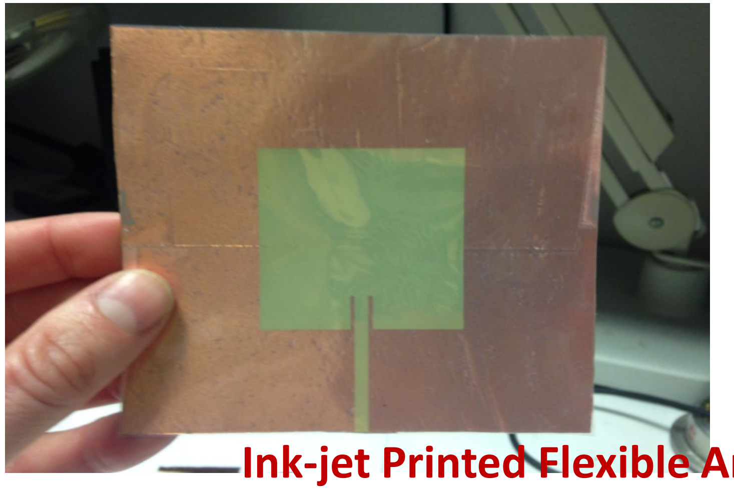

UHF Band RFID Reader Antenna

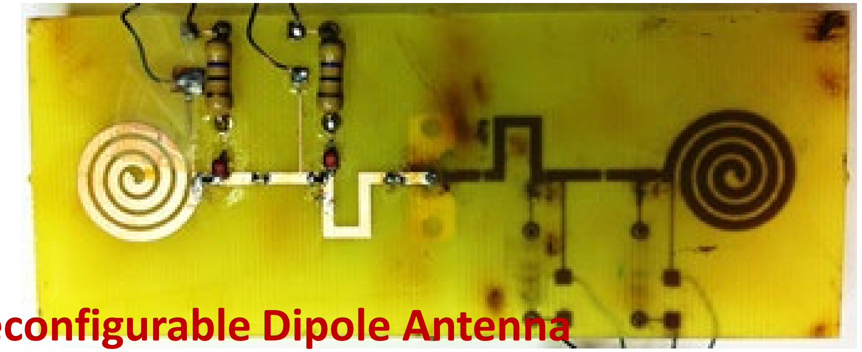

RFID Tag Antenna for Metallic Objects


Quasi-Log-Periodic Reconfigurable Antenna

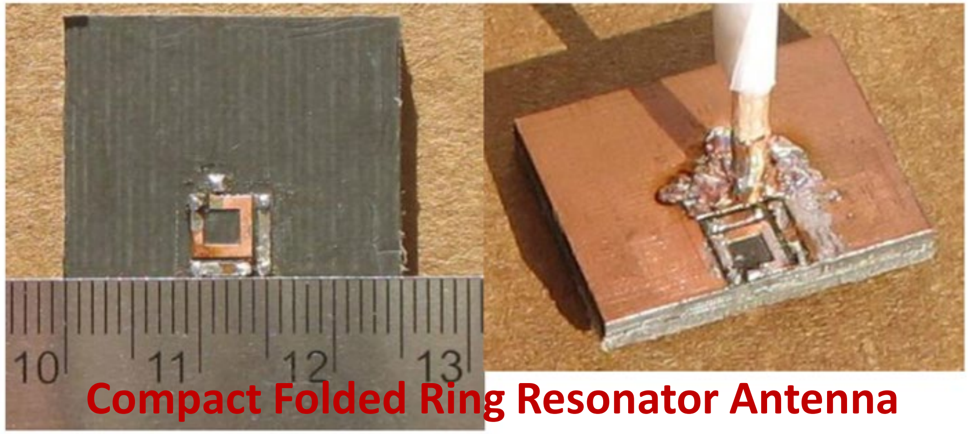

Wideband Reconfigurable Antenna (3:1 Bandwidth)


Wideband Low Cross-Pol DRA

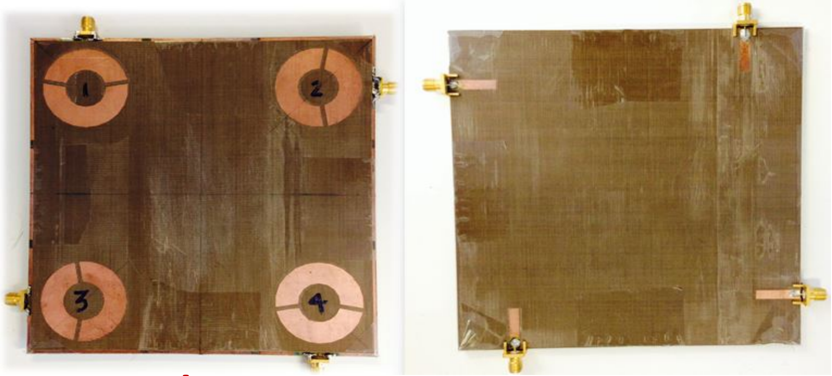

Ink-jet Printed Flexible Antenna


Compact Reconfigurable Dipole Antenna

Some Funded Project Antennas



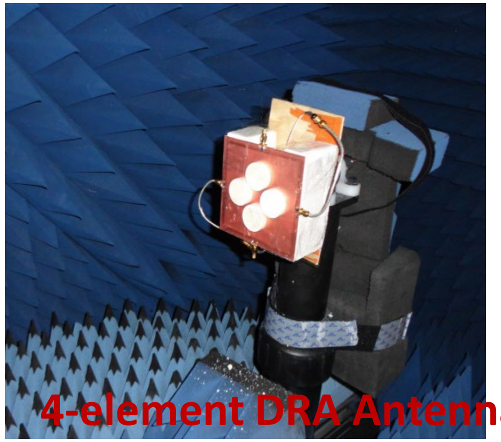
Compact Folded Ring Resonator Antenna



4 Element MIMO Antenna

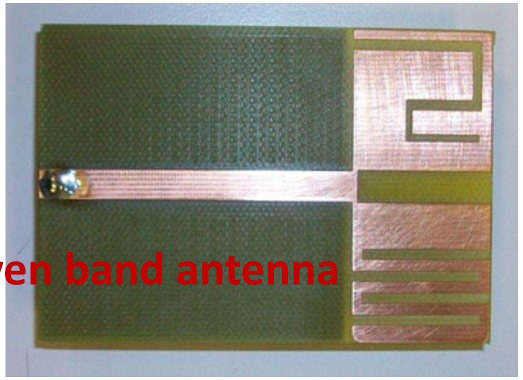
Fractal Antenna

Triple mode patch antenna



4-element DRA Antenna

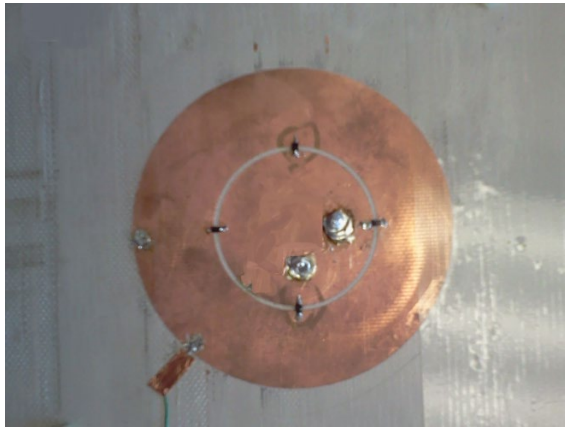
USB Dongle MIMO Antenna

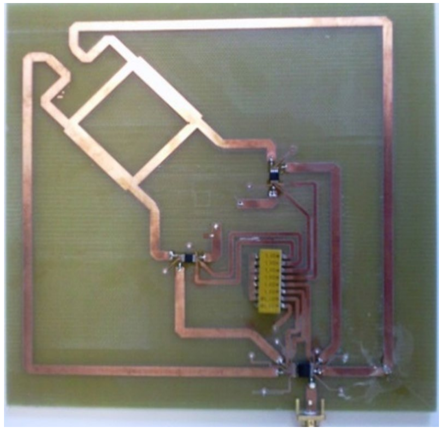


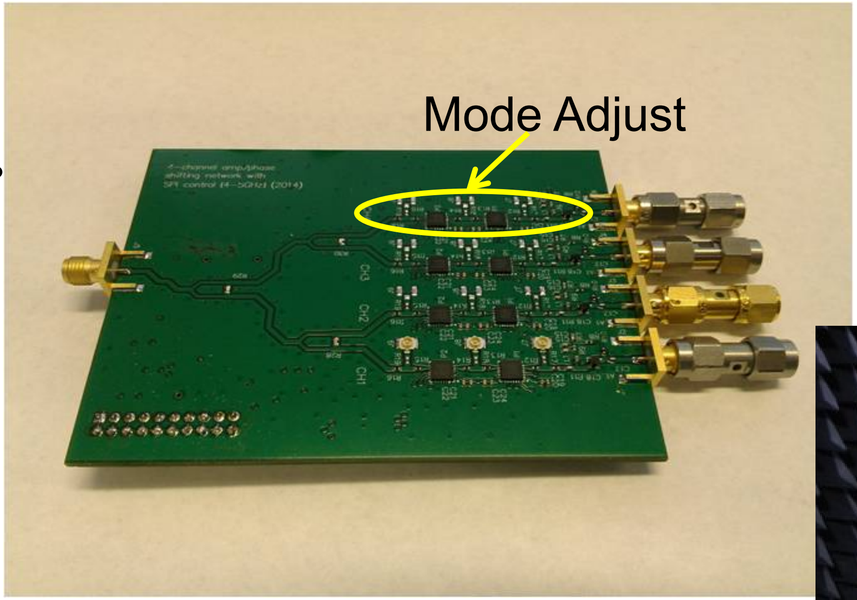
Eleven band antenna

Spiral Antenna

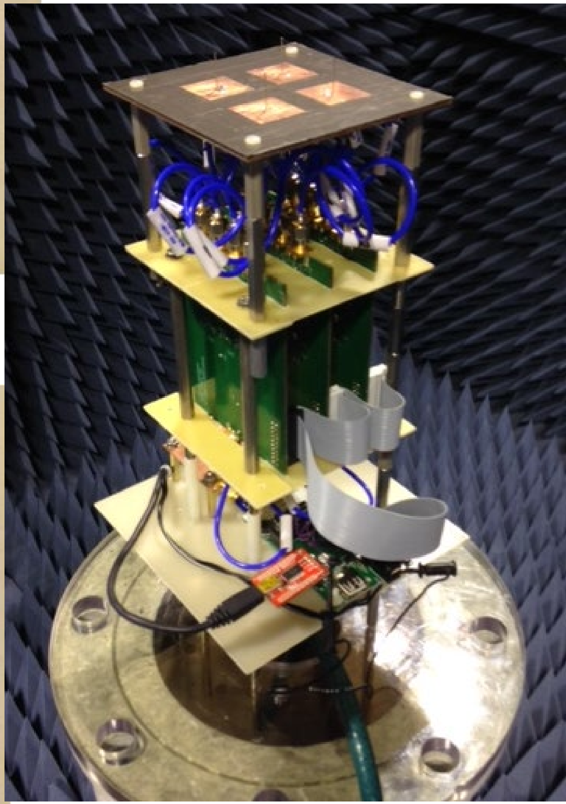
Frequency Tunable Polarization Reconfigurable Antenna



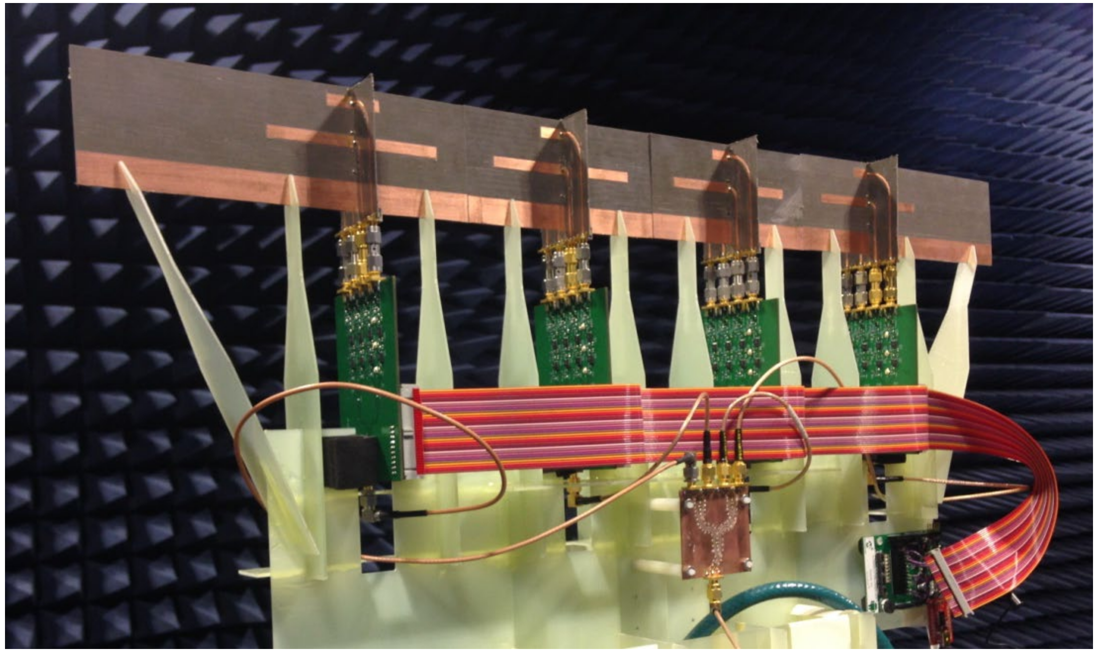


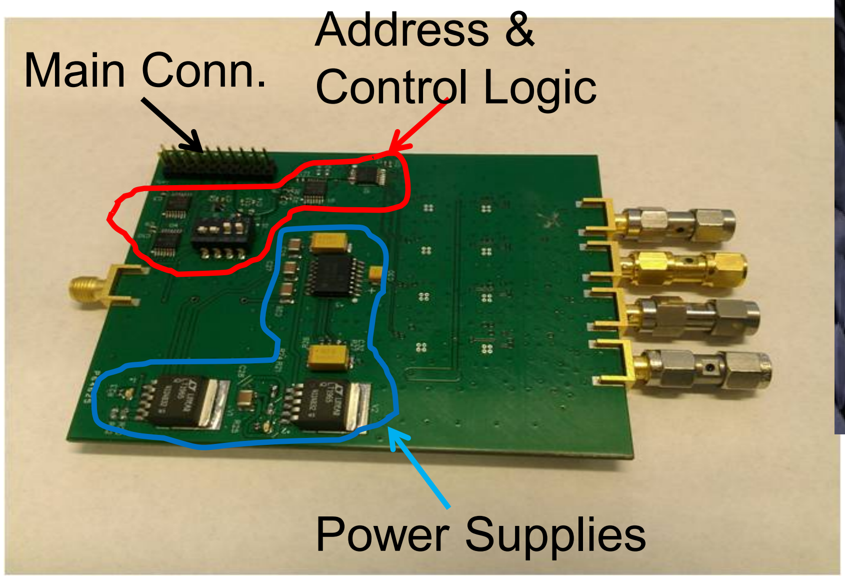


Multiple Modes Based 2D Beam Steering Antenna

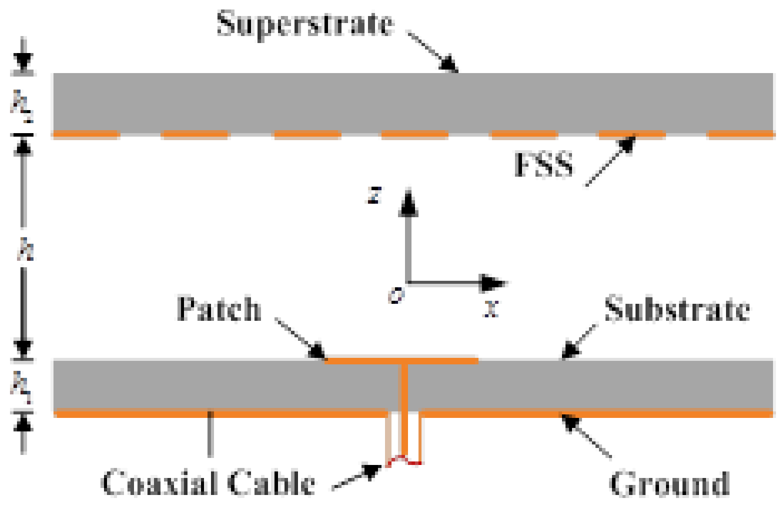


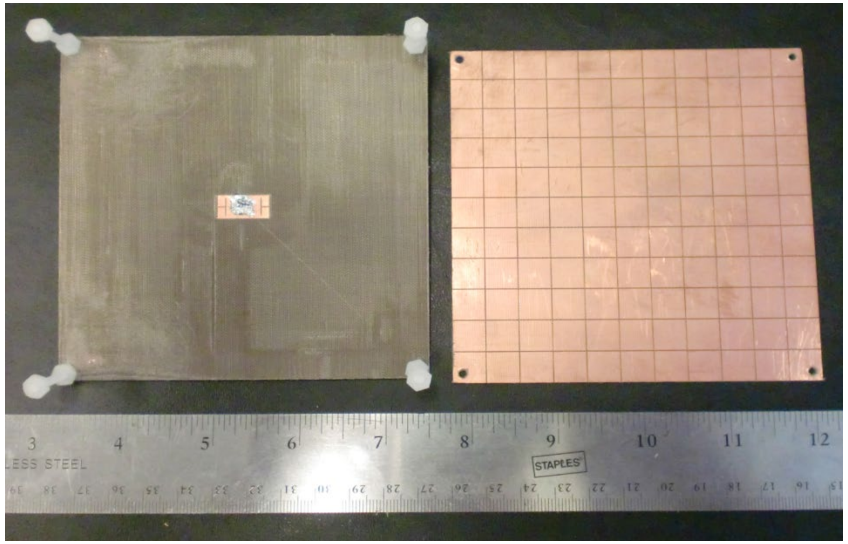
Wide-Scan Linear Phased Array Antenna

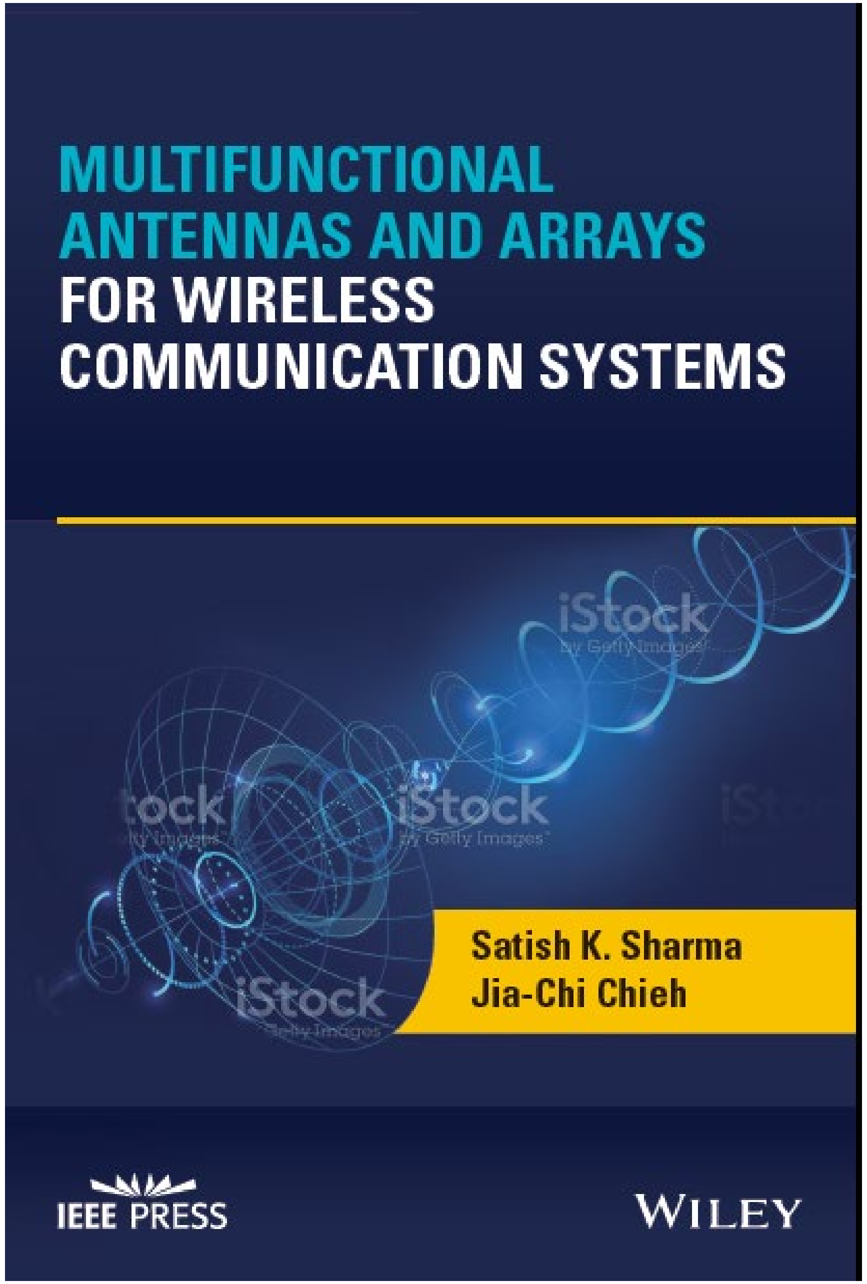




A Dual Band High Gain Resonant Cavity Antenna with A Single Layer Superstrate







F. Meng and **S. K. Sharma**, "A Dual Band High Gain Resonant Cavity Antenna with A Single Layer Superstrate", **IEEE Trans Antennas and Propagation** , May 2015