



Overview of ARRC Facilities

Shared Facilities for Effective Operations

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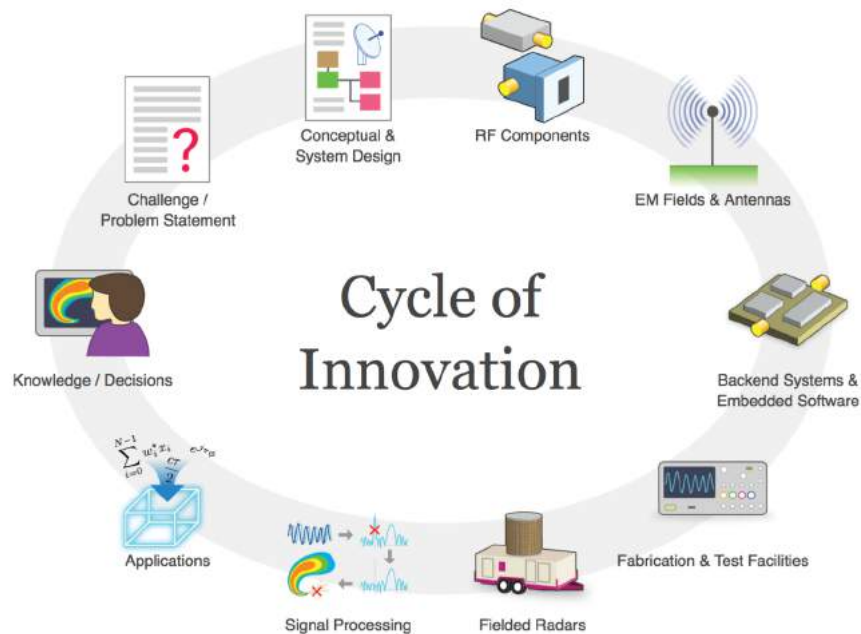
Adjunct Professor, School of Meteorology

University of Oklahoma

Present at CFE/ARRC event, October 5, 2021



Research and Education



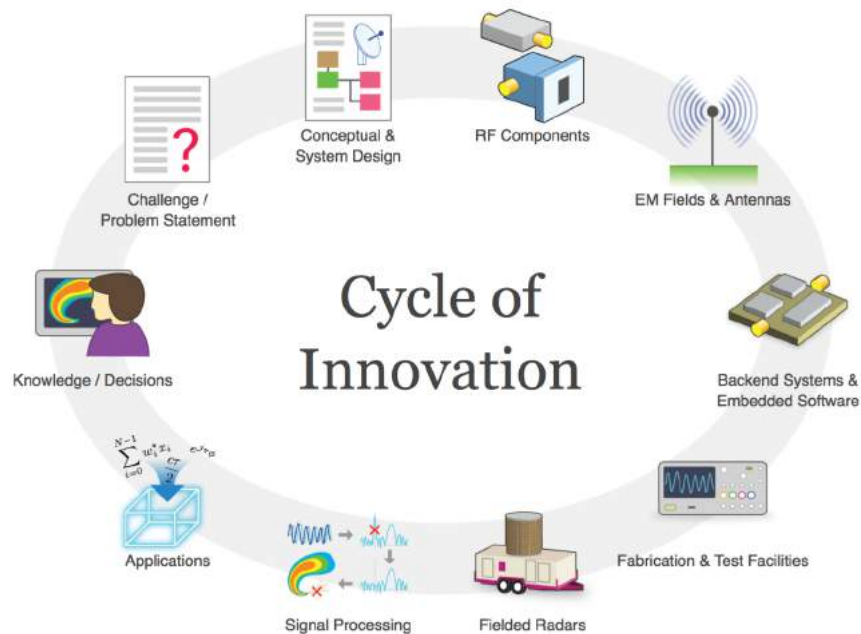
Formal ECE/SoM Courses

- Propagating Waves
- Advanced & Computational EM
- Antennas
- Phased Array Antennas
- RF & Microwave Filter Design
- Microwave Systems & Components
- RF & Microwave Engineering
- RF & Microwave Circuits
- Radar Signal Processing
- Radar Hydrometeorology
- Weather Radar Theory
- Radar Engineering
- Digital Radar Systems
- Weather Radar Applications
- Weather Radar Polarimetry
- Radar Imaging & Array Processing

We are very proud of our ability to contribute at many levels of the R&D process, from theory & concepts, to simulation, to prototypes, to field testing and scientific discovery



Research and Education



Formal ECE/SoM Courses

- Propagating Waves
- Advanced & Computational EM
- Antennas
- Phased Array Antennas
- RF & Microwave Filter Design

- Providing a fundamental *hands-on education* in radar, from EM theory, system design/fabrication, signal processing, to science and applications
- Interdisciplinary between engineering and meteorology
- OU's *Strategic Tuition Waivers* targeted to US military officers and civilian employees at government laboratories – levels the playing field
- Industry-sponsored *fellowships* – Cobham, Raytheon, Weathernews

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Current ARRC Facilities

Radar Innovations Laboratory 1.0 + Annex



RIL 1.0

- 35,000 square feet
- Completed in 2014
- Limited ITAR-controlled space



RIL Annex

- 6,000 square feet
- Completed in 2021
- Entirely ITAR-controlled space



RIL 1.0 - 1st Floor

• **ITAR-controlled space extremely limited**
 • **Engineering space is full**
 • **Expanding need for ITAR student space**





Current ARRC Facilities



RIL 1.0

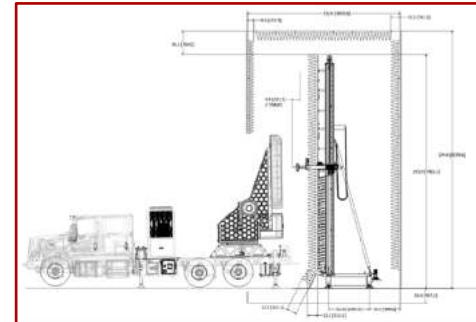


- Two anechoic chambers
- micro-fabrication lab
- machine shop
- high-bay
- large microwave lab
- mmWave/subTera Hz Lab
- Large experimental roof deck

RIL Annex



- Entirely ITAR-controlled space
- large near-field scanner
- high-bay





ARRC Radars



	Feq	Pol.	Transmitter	DC	BW	Platform	Status
CPPAR	S	PPAR	SSPA (1.5 KW)	10%	4.5°	Portable	Operational
Horus	S	PPAR	SSPA (10 W/ele/pol)	10%	4.4°	Mobile	2021
SMART-Rs	C	P-dish	Magnetron (250 KW)	0.1%	1.5°	Mobile	Operational
PAIR	C	PPAR	SSPA (5 W/ele/pol)	10%	1.6°	Mobile	2022
RaXPol	X	P-Dish	TWT (20 KW)	1%	1.0°	Mobile	Operational
PX-1000	X	P-dish	SSPA (200 W/pol)	14%	1.8°	Portable	Operational
PX-10000	X	P-dish	SSPA (200 W/pol)	10%	1.4°	Portable	Operational
WNIRefl	X	PAR*	SSPA (150 W)	10%	4.0°	Fix	Operational
Geofence	X	PAR*	SSPA (100 W)	10%	Fanbeam	Fix	Operational



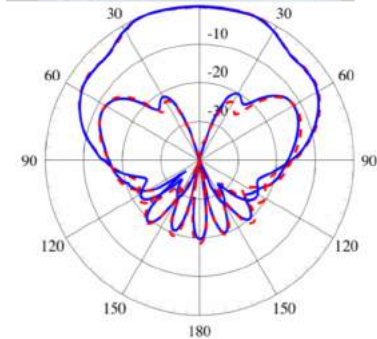
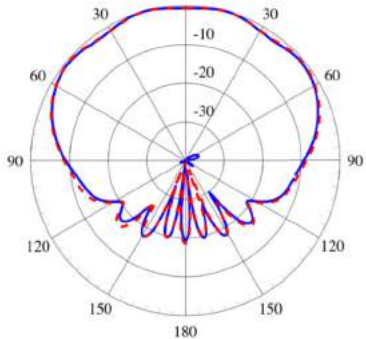
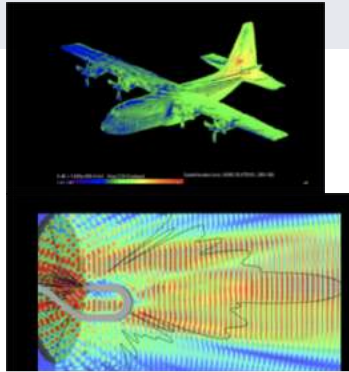
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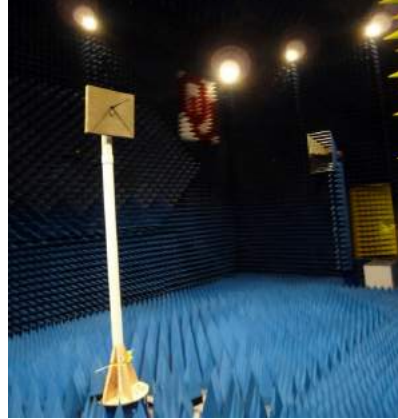
Anechoic Chambers



- Antenna performance measurements and characterization
- EMI/EMC measurements
- Radar Cross Section (RCS) measurements

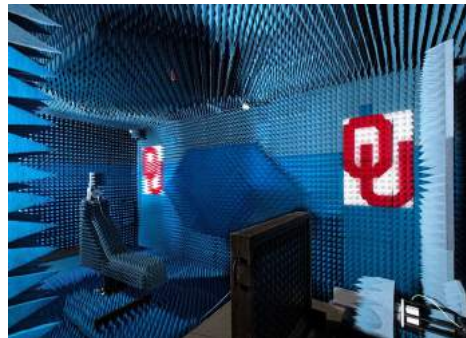


Far-field chamber



Frequency Range: 0.3 - 18 GHz
Size: 26' x 26' x 38'
 (7.9 m x 7.9 m x 11.6 m)
PNA: N5222A (10 MHz - 26.5 GHz)
Range: 24' (7.2 m)
Quiet zone: -24 dB @ 300 MHz
 -45 dB @ 4 GHz
 -50 dB @ 18 GHz

Near-field chamber



Frequency Range: 1.7- 40 GHz
Size: 11' x 11' x 26'
 (3.4 m x 3.4 m x 7.9 m)
PNA: E8364B (10 MHz- 50 GHz)
Measurement Mode:
 Planar
 Cylindrical
 Spherical

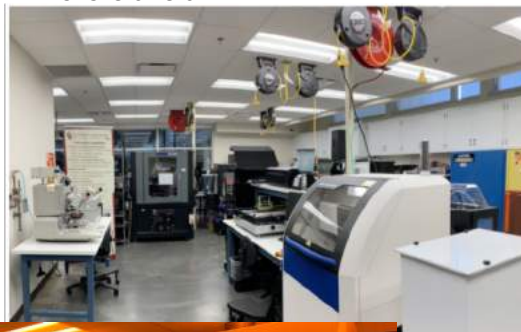


Fabrication Lab

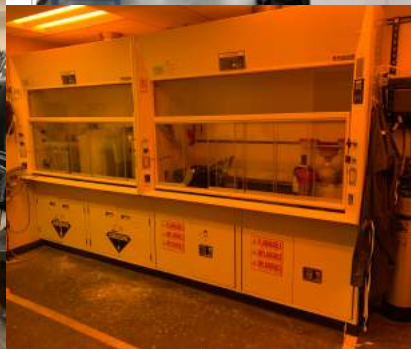


- Printed Circuit Board (PCB)
- Electroless- and electro-plating setup
- Board assembly
- A variety of 3D printers
- Wet bench chemical processing

Microfab lab



Machine shop





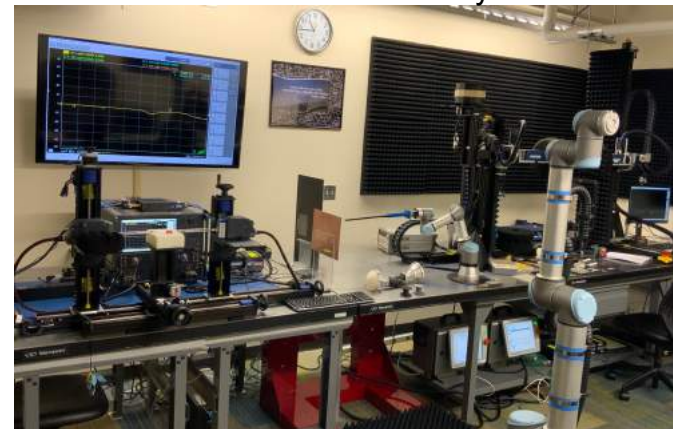
mmWave/Sub-Terahertz Lab



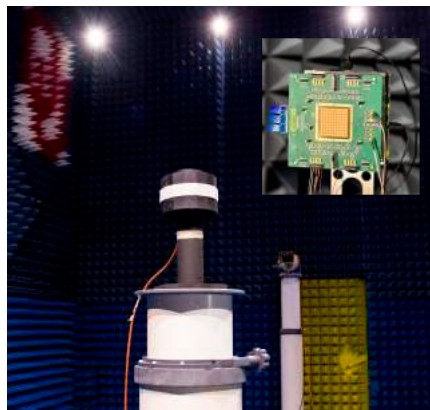
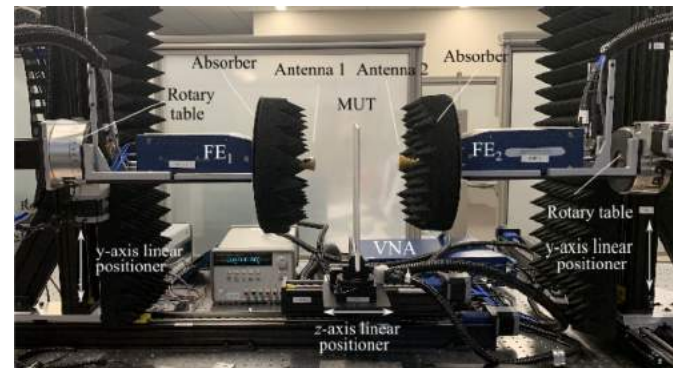
- Design and test capabilities for 30-330 GHz
- Material test characterization
- Scattering parameters measurements
- Near-field focused beam measurements
- Near-field antenna measurements
- Far-Field antenna measurements



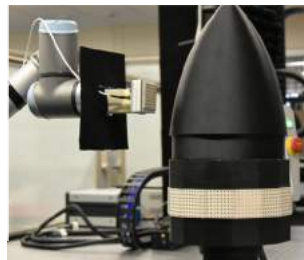
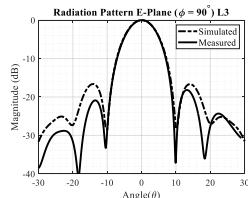
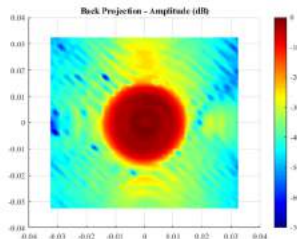
mmWave/Sub-Terahertz Test System



mmWave/Sub-Terahertz Material Test System



Massive MIMO (5G)



Cylindrical Ka-band Array & Radome

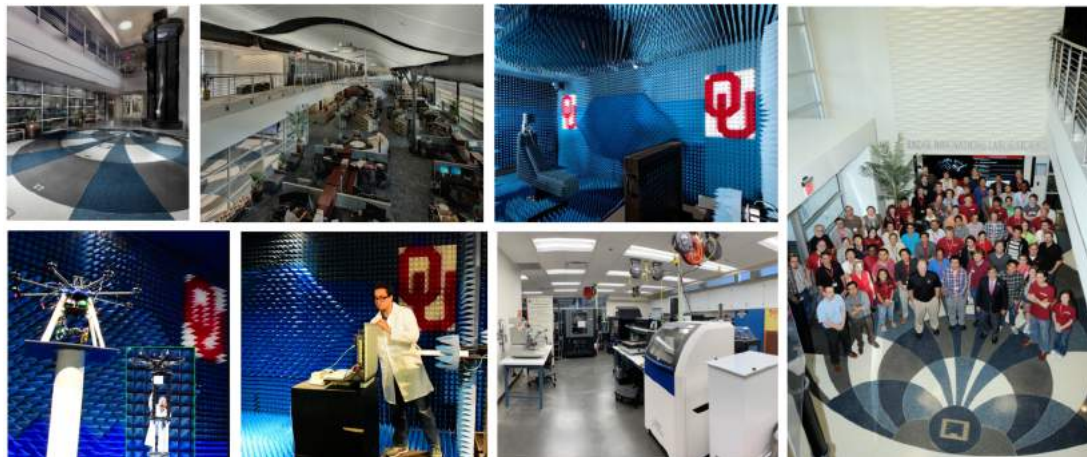
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Major Test Equipment



- Keysight PNA (N5225B), and Frequency Extenders from 65 GHz to 0.5 THz.
- VNA Copper Mountain Planar C4209 with RF front extender CobaltFx FEV-10 Frequency Extension System, 75 to 110 GHz.
- Agilent PNA and PNA-X Network Analyzers (up to 50 GHz for two ports, 26.5 GHz for 16-port analysis) with an electronic calibration module
- Agilent PSA and EXA Spectrum Analyzers with Phase Noise and Noise Figure Personalities (up to 50 GHz)
- Tektronix Real-Time Spectrum Analyzer with 110 MHz of instantaneous bandwidth (up to 14 GHz)
- Agilent PSG Vector Signal Generator (up to 31.8-50 GHz)
- Agilent Peak Power Meter (50 GHz)
- Agilent Oscilloscope (8 GHz)
- Anritsu Portable Spectrum Analyzer (13 GHz)
- Agilent Arbitrary Waveform Generator (125 MHz)
- Agilent Multi-channel data logger



Massive MIMO (5G)

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Rapid Polarimetric X-band Radar



- The Rapid X-band Polarimetric Radar (RaXPo) is a mobile radar designed to produce the **fast scans of severe thunderstorms with a dish antenna (2 sec for one PPI)**
- TWT-based transmitter, pulse compression, frequency hopping
- Recently was funded by NSF CIF program to broaden its access for research and education

