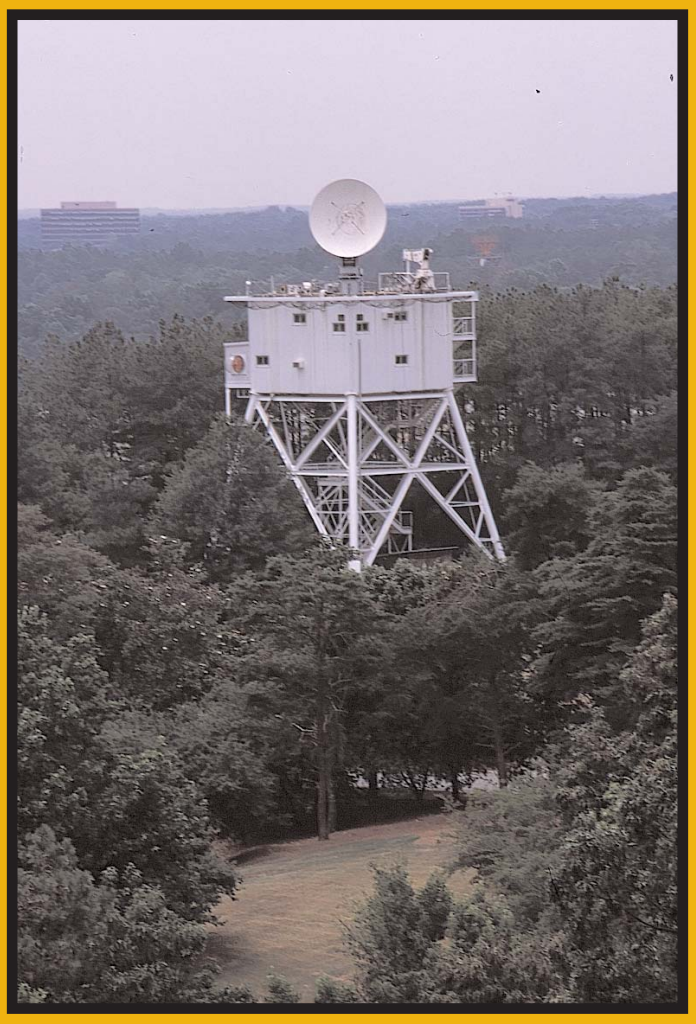
Georgia Tech Research Institute

Creating Solutions through Innovation

Electromagnetic Test and Evaluation Facility



Small- to large-scale structures.
Low to high frequencies.
Cellular to satellite.

The wideband, multi-purpose Electromagnetic Test and Evaluation Facility (EMTEF) at the Georgia Tech Research Institute (GTRI) covers the full spectrum of electromagnetic test and evaluation research conducted today. Configurable for industry, commercial and military needs, the facility offers flexibility for testing everything from cellular telephone and PCS base station antennas to antennas and arrays for tanks and aircraft.
Additional uses include:

- electromagnetic compatibility (EMC) research
- testing and evaluation of telecommunications, computer and military hardware
- radar cross-section (RCS) research, including target image generation, verification of predictions and evaluation of reduction techniques.

GTRI's EMTEF is housed at our Cobb County Research Facility, located about 40 minutes northwest of Atlanta near air and rail transportation. Available facilities include a shielded anechoic chamber and near-field, far-field and radar cross-section ranges.

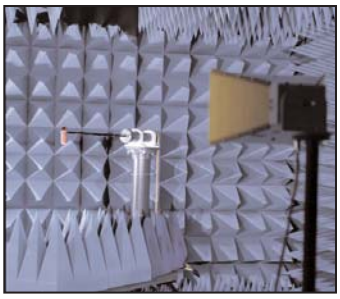
Anechoic Chamber and Shielded Room

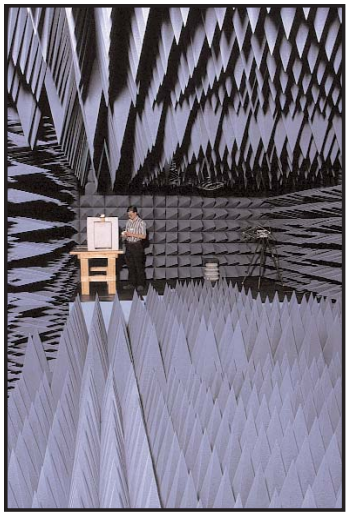
GTRI's new multipurpose anechoic chamber and shielded room are adaptable to an array of requirements including EMC testing in accordance with military and commercial standards; antenna measurements; and experimental developments, studies and investigations. Tests and measurements that can be performed in these facilities are:

- EMC testing in accordance with RF emissions and immunity standards including MIL-STD-461 E (military) and IEC 61000-4-3 (European Union). The chamber may be used for pre-compliance testing in accordance with ANSI C63.4-1992 (FCC) at distances of 3 and 5 meters.

- Accurate antenna pattern measurement from 27 to 100 MHz at low frequencies and up to 18 to 40 GHz at higher frequencies, depending on the antenna characteristics and required performance.

- Experimental developments, studies and investigations include cable coupling, shielding effectiveness, E/H field measurements in or around structures and validation measurements. Experimental work can be performed from 27 MHz to 40 GHz, depending on the required performance.





The anechoic chamber is multi-functional in design and configurable for many types of tests.

The anechoic chamber's dimensions are 36 feet long, 20 feet wide and 12 feet high with a full working length of 30 feet. Half the chamber is lined with 36-inch-high performance absorbers; the other half is lined with 24-inch-high absorbers. The floor absorbers are removable for configuration as a full or semi-anechoic chamber. The 36-inch absorber portion of the chamber has a ferrite patch 11 feet long and 10 feet wide on the floor to control reflections at the low frequencies, thus extending performance down to 27 MHz.

The shielded room can be configured as one large room or as two smaller shielded rooms by installing a shielded, removable partition. The two smaller rooms allow equipment-under-test (EUT) to be placed in one room, and control interface equipment to be placed in the other. This isolates the EUT from the interface equipment that, in turn, is isolated from the ambient environments. The room also features 36-inch absorbers on each end wall; these help damp out room resonances, improving field uniformity at lower frequencies. The shielded room's dimensions are 24 feet long, 12 feet wide and 8 feet high; wide shielded doors offer easy access. This room can be used for testing and measurements over the 9 kHz to 40 GHz frequency range, depending on the required shielding.

Far-Field Range

The high-precision, far-field antenna test range at GTRI can be used to test large and small antennas up to 40,000 lbs. It includes source and receive signal towers positioned 1,300 feet apart. The range features a heavy-duty, three-axis positioner capable of handling antennas up to 30 feet in diameter. Extremely precise polarization and millimeter wave pattern measurements are possible thanks to the exceptionally massive towers and stable platforms at both ends. The range's length may be extended using remote transmitting sites. The midpoint of the line-of-sight between the two towers is more than 110 feet above ground, thanks to natural terrain.

GTRI's high-precision, far-field antenna test range includes receive and source (pictured) signal towers 1,300 feet apart.

The range itself was designed to minimize any reflections from surrounding objects. A combination of tower rigidity and low reflection levels results in a very "clean" range for collecting low-sidelobe measurements, determining accurate cross-polarization and measuring millimeter-wave antennas with narrow beamwidths.

The 91-foot source tower offers applications for systems tests of radars, direction-finding systems and radar-warning receivers. It also is useful for boresight testing of precision-tracking radar systems through the millimeter wave region. In addition, the tower control room is a good location for testing direction-finding systems, especially in the millimeter wave region, where vibrational stability is a necessity.

The antenna range receiver provides frequency coverage from 20 MHz to 107 GHz using an assortment of mixers and down converters. The receiver can perform high-speed phase and amplitude measurements over a 90 dB dynamic range with a maximum sensitivity of -120 dBm. Programmable pre- and post-detection bandwidth selection allows compromise between measurement speed and sensitivity.

The standard antenna range signal source provides frequencies from 10 MHz to 26.5 GHz, with an output level of at least +1.0 dBm at 26.5 GHz, and up to 16 dBm for lower frequency ranges. Accuracy is exceptional, with an aging rate of less than 1x10-9/day and 2.5x10-7/year. Accuracy is enhanced by an onsite calibration facility capable of precision on the order of 1x10-12. Other capabilities include pulse and amplitude modulation, swept frequency, fast CW switching and IEEE-488 programmability. Remote source control from the receiver site is accomplished via IEEE-488.

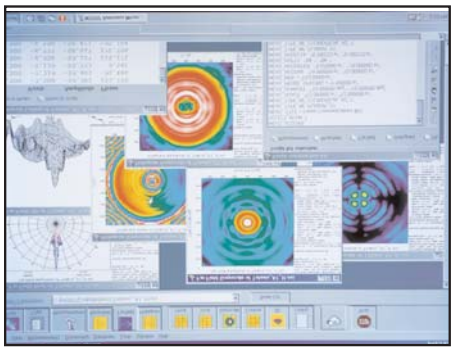
Near-Field Range

GTRI's planar/cylindrical near-field range (PCNFAR) can be used to test directive and non-directive antennas in cylindrical mode. The scanner sweeps an approximately 10-foot-long by 20-foot-wide planar area, or a 10-foot vertical plane in conjunction with a +/- 180-degree azimuth scan when using cylindrical mode. The range features a precision stepper motor control with a Z-plane laser sensor for post-data-processing correction of planarity errors.

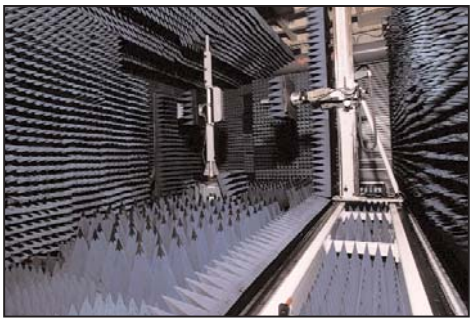
The PCNFAR is a 21-foot-long , 21-foot-high and 21-foot-wide anechoic chamber conveniently accessed via a 10-foot-long by 12-foot-high roll-up overhead door. The chamber is covered in 12- and 24-inch pyramidal absorber, with several roll-around panels for measurement-specific placement requirements.

The scanner features a 120-inch-long by 240-inch-wide working area that allows Z-axis post-processing correction via laser plane mapping during measurement. In addition, the scanner performs near-field, far-field and holographic processing using commercial software. Its positioning accuracy is +/-0.002 inches in all three planes. Additional azimuth axis positioners, software control and processing are available for cylindrical near-field measurements. Particularly useful is the PCNFAR's ability to use aperture holography for diagnosing antenna problems not easily detected on a far-field range.

Local and automatic control options are available for engineering/development requirements, or for programmed extensive measurements for planar and cylindrical near-field tests. Even the probe polarization rotator on the scanner may be controlled manually or



The PCNFAR software also allows data processing during acquisition.



The near-field chamber is covered in pyramidal absorber, with roll-around panels for measurement-specific placement requirements.

The RCS turntable range allows collection of target RCS data that can be used to produce target images, verify predictions and evaluate reduction techniques.

automatically during measurements. An auxiliary computer is available for processing previous measurements during later data acquisitions.

Radar Cross-Section Range

The RCS turntable range allows collection of target RCS data, which can be processed to produce target images, verify predictions of target RCS and evaluate RCS reduction techniques. The range includes an equipment elevator attached to the side of the source tower of the range, as well as a heavy-duty turntable about 150 feet away from and 3 feet below the base of the range's tower. The platform can be elevated over a distance of about 90 feet above the tower base, thereby providing a maximum height above the turntable of 93 feet. This range of travel permits RCS backscatter measurements on tank-sized targets at elevation angles up to 32 degrees.

The turntable area is clear of any protrusions that might produce extraneous backscatter signals or multiple reflections that could corrupt the accurate measurement of target characteristics. The ground also gradually slopes away from the turntable, directing principal ground surface scattering away from the measurement system. The sloping ground also minimizes groundwater collection near the turntable, avoiding enhanced backscatter and/or reflection. Absorbing panels can be placed in calculated locations around the target to minimize extraneous reflections from the turntable support surface. The turntable's flat surface can also be covered with sod or foliage to simulate the typical surface found around a target in a realistic scenario.

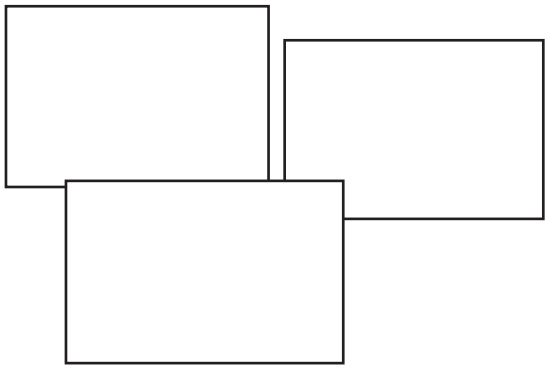
The turntable can support a vertical load in excess of 100 tons. A controller system allows rotational speeds varying from 1.0 and 0.1 degrees per second, corresponding to 10 and 1.0 revolutions in 60 minutes, respectively. The target support structure atop the turntable is level to within +/-0.1 degree, allowing for very accurate elevation angle pattern cuts.

The RCS measurement range is supported by a variety of instrumentation radars at frequencies from 5 GHz to 140 GHz. These radars support multiple polarizations for measurement of the full polarization scattering matrix and wide-band frequency agility for determination of high-resolution range profiles.

Range Calculators and Schedule Information

These are available at our website:

- Range Calculator: http://seal.gatech.edu/EAD/testfacilities/rangecalculator.htm
- Schedule Information: http://seal.gatech.edu/EAD/testfacilities/reservations.htm



The EMTEF website provides a range calculator, as well as scheduling and technical information.

Contact Information

To learn more, visit the EMTEF web pages at http://seal.gatech.edu/EAD/testfacilities/index.htm. Or, contact:

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Learn more about GTRI research at www.gtri.gatech.edu.

On the cover, clockwise from top left:
1. and 2. The far-field range receive tower provides frequency coverage from 20 MHz to 107 GHz.
3. GTRI's near-field range can be used to test directive and non-directive antennas in cylindrical mode.