

Overview of the RF, Communications and Intelligent Systems



Bringing Innovative Engineering Solutions to Challenging Problems

Mission: Strive to bring innovative solutions to challenging and nationally important engineering problems.

Capabilities:

- Custom electronics
- Software-defined radio platforms
- Model-based waveforms
- System architecture
- Advanced coding
- Novel antennas
- Hardware-in-the-loop simulations

Sponsors: Sponsors include the Departments of Defense, Energy, and Homeland Security; the U.S. Nuclear Regulatory Commission; the Defense Logistics Agency; the National Geospatial Information Agency; universities; and various industry partners.

Group Members:

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The RF, Communications and Intelligent Systems (RFCIS) Group strives to provide innovative engineering solutions to demanding and nationally important problems by integrating advanced concepts and new developments into custom radio-frequency (RF) and microwave systems. The focus of the RFCIS Group is research and development (R&D) geared toward supplying robust communications for extreme environments; global tagging, tracking, and locating (TTL) systems; and RF- and microwave-based measurement and processing systems. Diverse capabilities and top-notch facilities are two solid attributes of the RFCIS Group that make this type of R&D possible. Additional attributes that set the RFCIS Group apart from other organizations performing similar R&D are its rapid development and prototyping capability, the depth and breadth of staff experience, and its cache of internally developed intellectual property (IP).

Robust Communications in Extreme Environments

Conventional communications are often limited in extreme environments because of their high power consumption, short operating life, and susceptibility to multipath and interference. Extreme environments can include any situation where a clear path for communication signals is absent (e.g., where manmade features such as metal structures and buildings interrupt or interfere with signal propagation). RFCIS is developing wireless communications technologies capable of supplying robust wireless communications in these environments. These robust communications technologies are opening a whole new world of

wireless applications in extreme environments, including remote measurement and condition monitoring, efficient video and data transfer, and secure asset tagging and tracking.



ORNL Robust Wireless Communications Technologies Team—Winner of 2004 Project of the Year Award from Federal Laboratory Consortium for Technology Transfer.

Tagging, Tracking, and Locating Systems

TTL technologies are on the verge of revolutionizing how the world approaches real-time asset management. Essentially, they offer the opportunity to know the status of assets at all times: where they are, whether they are moving, how fast they are moving, and in which direction they are moving. "Assets" could include military cargo, consumer goods, scientific infrastructure, and people. The RFCIS Group is currently applying existing TTL technologies to global applications, while also addressing the technical challenges of new positioning, navigation, and timing techniques. Target applications include all of the major sectors of society (government, commercial, industrial, and military), as well as personal applications. TTL technologies have the ability to reduce manufacturing costs, increase efficiency in supply chains, automate



inventories, track assets from the point of departure to their final destination, and locate lost assets.



ORNL-developed tracking hardware installed on a shipping container in Charleston, South Carolina.

RF- and Microwave-Based Systems

RF- and microwave-based measurement and processing systems have been developed by the RFCIS Group for a number of applications, including plasma diagnostics, material moisture and density measurements, material processing and characterization, electromagnetic emissions measurements, and electromagnetic characterizations. RFCIS R&D in this area has been primarily focused on magnetic fusion energy research, materials science research, environmental cleanup, and energy efficiency applications. The advantages that can be attributed to these RF and microwave systems include energy savings, labor savings, consistent product quality, reduced waste, and material performance enhancement.



Microwave moisture measurement system for lumber drying.

Capabilities

- Custom RF and microwave electronics/systems.
- Software-defined and cognitive radio platforms.

- Model-based waveform development.
- System architecture design.
- Advanced coding techniques.
- Novel antenna design.
- Hardware-in-the-loop simulations.
- Radiolocation tracking and locating techniques.
- RF- and microwave-based diagnostics and measurements.
- RF- and microwave-based material processing and characterization.
- Electromagnetic characterization.



Millimeter-wave radiometer for measuring plasma electron temperature.

Facilities

The RFCIS Group has research facilities that include RF and microwave laboratories, shielded enclosures, an antenna farm, and open area test sites. Equipment in these facilities includes spectrum analyzers, network analyzers, logic analyzers, waveform generators, microcomponent assembly stations, environmental test equipment, and electromagnetic modeling tools (MatLab, Simulink, Sysgen, Rhapsody, etc.). The RFCIS Group's IP portfolio includes more than 40 patents and invention disclosures.

Contact Information

To learn more about our capabilities and how you can partner with us, please contact Paul Ewing (ewingpd@ornl.gov) at 865-576-5019.