

Technology **Today**

HIGHLIGHTING RAYTHEON'S TECHNOLOGY

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Raytheon's Culture of Innovation Providing Leading-Edge Customer Solutions



Raytheon

Customer Success Is Our Mission

Raytheon's Innovation Partnerships

Cultivating External Sources of Innovation

Part of Raytheon's technology strategy incorporates external sources of innovation as a complement to its internal and contracted research and development efforts. Raytheon invests and teams on applied research that supports the company's core and growth market pursuits. Collaborating with universities, federally funded research and development centers, and other companies helps ensure Raytheon remains a leader in integrated technology solutions. Here are several examples of the hundreds of initiatives Raytheon supports.

UNIVERSITY RESEARCH

Universities are at the forefront of basic and applied research in the United States and abroad. Raytheon taps this source by sponsoring research through its University Program in areas that align to business needs, build awareness of important innovations, and enable the company's growth strategy. In the current academic year, Raytheon is sponsoring more than 35 university-directed research projects (see table on page 24 for some highlights).

Solving the Indoor Positioning Problem

One of the most-requested capabilities of first responders and dismounted soldiers is the ability to track users in indoor and underground situations. There is little to no GPS coverage in environments such as residential buildings; warehouses; parking garages; heavily forested areas; and underground tunnels, caves and mines. No single technology exists that effectively solves this problem.

Seeking a solution, Raytheon is supporting directed research projects in the area of indoor positioning/precision personnel location, including one with Worcester Polytechnic Institute (WPI).

The university is conducting research into the performance of Raytheon's



Worcester Polytechnic Institute's personnel location research workshop

MicroLight™ handheld network radio system for indoor positioning and robustness. One of the goals is to construct and demonstrate a prototype system that integrates the MicroLight tactical radio with existing WPI beacon technology.

For nearly a decade, WPI's Precision Personnel Location (PPL) research group has been a leader in researching solutions to the problems of precision first-responder indoor location. The PPL group's collaboration with Raytheon aims to configure a loosely coupled (federated) solution based on information generated by both the Raytheon MicroLight system and the WPI radio frequency PPL technology. The objective is to obtain improved performance of both systems by fusing location information. The research will also evaluate the coupled system and document the cooperative benefits derived from the diversity of location technologies these two systems represent.

The research has the potential to greatly enhance the viability of MicroLight as a source of position location information, maintain market-entry barriers to other communications providers, and support growth in commercial markets such as public safety, public utilities and communications for mining safety.

Sensing and Responding to Explosive Threats

In October 2008, Raytheon joined the new U.S. Department of Homeland Security (DHS)-funded Center of Excellence for Awareness and Localization of Explosive Related Threats (ALERT).

Co-led by Northeastern University and the University of Rhode Island, ALERT is a partnership among leaders in academia, industry and laboratories that are collaborating on research projects that will lead to the development of cutting-edge technology to protect the United States from explosive-related threats.

As an ALERT industrial partner, Raytheon will collaborate on research that focuses on the long-range needs of homeland security. These include developing an ultra-reliable passenger and cargo screening method, the neutralization of newly improved explosives, and the detection of suicide bombers at a safe distance.

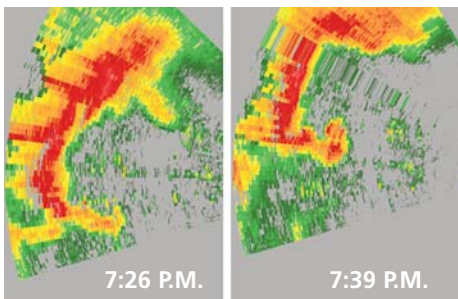
Advancing Networks of Low-Cost Radars

Since 2002, Raytheon has been the lead industry partner in CASA (the Center for Collaborative Adaptive Sensing of the Atmosphere), a National Science Foundation Engineering Center multidisciplinary partnership. Its vision is to advance mankind's ability to observe, understand, predict and respond to hazards through fundamental inquiry, new technology, and systems integration, while providing education opportunities for tomorrow's leaders. CASA builds upon a relationship between University of Massachusetts Amherst and Raytheon that began more than 25 years ago with the establishment of an Advanced Study Program. CASA now consists of five government, 10 industry, and seven academic partners.

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The CASA system promises to revolutionize our ability to observe, understand, predict and respond to weather hazards by creating distributed collaborative adaptive sensing (DCAS) networks that sample the atmosphere where and when end-user needs are greatest. One critical element of the partnership is Raytheon's collaboration with the center's lead institution, the University of Massachusetts Amherst, to study and develop very low-cost radar concepts and designs. These radars use low-cost silicon-based technologies, and will be designed to minimize manufacturing and assembly costs while maximizing radar performance.



Scan of Oklahoma severe thunderstorm by CASA weather radar testbed on May 8-9, 2007, showing development of the "hook" where tornadoes typically form.

The resulting radars will be less expensive and inexpensive enough for widespread commercial use. This especially impacts CASA, as the economics of the DCAS system depends on networks of very low-cost reliable radar systems.

As a CASA industry partner, Raytheon also participates in providing strategic planning, internships and employment opportunities for student researchers, as well as advanced study for Raytheon employees. CASA is a model for how industry, government and academia can collaborate to provide innovative, leading-edge solutions.

Reliable and Affordable Nuclear Detection Technology

Raytheon recently received a contract from the DHS to develop a Stand-Off Warning Against Radiological Materials (SWARM) technology.

DHS' Domestic Nuclear Detection Office under the Exploratory Research in Nuclear Detection Technology Program is funding the research, which Raytheon is leading using its OpenAIR™ business model to leverage the best talents and capabilities of academia and large and small businesses to provide the best value solution for the customer. The company is teaming with

experts from Los Alamos National Laboratory, ORTEC, the Massachusetts Institute of Technology and Boston University.

The transportation of nuclear material into and within the United States and allied countries is a serious security threat. SWARM will develop a radiation detection and localization approach that uses multiple, mobile and highly distributed sensors. This approach will enable first responders to accurately evaluate a situation and take swift action in the event of a threat to our national security. ●

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A Sampling of Raytheon's Current University Directed Research Projects

	University
Indoor Navigation	Air Force Institute of Technology
Flexible Electronics	Arizona State University
SAR ATR	California Polytechnic State University
High Resolution Processing for Radar	California Polytechnic State University, Pomona
Advanced Algorithms for ATR	Carnegie Mellon University
New Class of Infrared Fibers	Clemson University
mm-Wave 0.20-0.25 Micron Al(In,Ga)N HEMTs with >10-dB Gain	Cornell University
Cyber Battle Management Language	George Mason University
Collaborative Solutions Development Environment ET	Georgia Institute of Technology
Cyber Battle Management Language	Massachusetts Institute of technology
Lateral Wave Ground Penetrating Radar	Ohio State
3-D Immersive Visualization Environment Development	Penn State
TruST for Semantic Data Association and Correlation Across Knowledge Stores	University at Buffalo
Terahertz Spectroscopy and Radar Imagery	University of Arizona
Development of Microwave High Efficiency Power Amps	University of California, Davis
Tunable Organic Filters for IR Applications	University of California, Santa Barbara
Public Land Mobile Network Modeling and Simulation	University of Illinois
Probabilistic Evaluation of Computer Security Based on Experimental Data	University of Maryland
Multiagent Approach for Heterogeneous Persistent Surveillance	UMass Amherst
uFrame System Enhancement	University of Nebraska-Omaha
3-D Modeling of Semi-Guiding Fiber	University of Rochester
Delay/Disruption Tolerant Networks	University of Southern California
KM/KD Enabling Technologies	University of Texas at Dallas
Mathematical Framework for Saliency Analysis	University of Wisconsin-Madison
Improving IA and Reliability with Fast Event Notification	Vanderbilt University
MicroLight Indoor Positioning Performance Evaluation	Worcester Polytechnic Institute
System-on-Chip; Silicon Back-End Chip Development	Wright State University

