OAK RIDGE NATIONAL LABORATORY
MANAGED BY UT-BATTELLE FOR THE DEPARTMENT OF ENERGY
FACT SHEET

ESTD
Engineering Science & Technology Division

Sensor-Based Tagging and Tracking System

Next-Generation Time, Space, and Position Information System

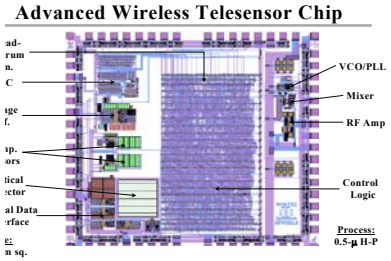
Executive Summary

ORNL is conferring with the U.S. Army test and training community on the development of a next-generation time, space, and position information (TSPI) system capable of identifying (tagging) assets and tracking their movements along both the linear and rotational axes. This system will address the critical need in TSPI platforms to know where assets (personnel and platforms) are at all times, if they are moving, how fast they are moving, and in which direction they are moving. The technical foundation of the system will be six-dimensional (6-D) gyroscopic sensor technology, advanced radiolocation tracking technology, and robust communications techniques to ensure operation in difficult radio frequency (RF) environments. The next-generation TSPI system will combine the requirements of multiple TSPI users into a universal tagging and tracking platform, hence providing the potential to reduce life cycle costs.

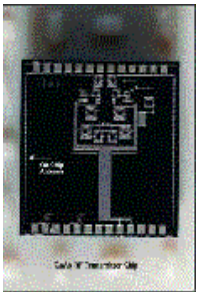
Background

ORNL is a multiprogram science and technology laboratory managed for the U.S. Department of Energy by UT-Battelle, LLC. ORNL is a leader in instrumentation science and technology research and has extensive RF tagging and tracking expertise. For this development effort, ORNL is also partnering with a developer and producer of measurement sensors and control subsystems that combines the latest in gyroscopes and other magnetic technologies. The expertise of ORNL and its strategic partner includes:

- Robust communications in difficult RF environments;
- Advanced spread-spectrum modulation and radiolocation tracking techniques (10 patents issued and pending);
- 6-D gyroscopic sensor technology (1 patent issued);
- Low-power analog, digital, and RF electronics (Si, Si-Ge, GaAs, InP);
- Smart RF network configurations;
- Microminiature sensor arrays; and
- Custom antenna design and fabrication.



Microtransmitter


Antenna on Substrate

Development Plan

The next-generation TSPI system will be capable of tagging assets (personnel and platforms) and tracking their movements along both the linear axes (X, Y, and Z) and rotational axes (roll, pitch, and yaw). The system will receive global positioning system (GPS) coordinates when available and then transfer to local position system (LPS) coordinates (generated with radiolocation tracking and gyroscopic sensor technologies) when GPS is denied. The technical foundation of the system is a microminiature 6-D gyroscopic sensor, advanced radiolocation tracking techniques, and robust communications capable of operating in difficult RF environments.

UT-BATTELLE

A revolutionary 6-D sensor, capable of making both linear and angular acceleration measurements, will be integrated with digital signal processing to develop an inertial navigation unit that can locally track both the linear and angular movements of personnel and platforms. In addition, radiolocation tracking techniques will be used to provide the accurate location of these assets on a larger local scale. This will be done through the strategic placement of receiving antennas and optimization of previously-developed algorithms to process tracking-related information in radio signals transmitted by the tagging and tracking devices located on assets. The initial coordinates for the local system will be based on GPS settings. Robust communications will be achieved with a new approach developed by ORNL utilizing a special patent-pending hybrid spread-spectrum (direct-sequence/frequency-hopping) transmission technique that simultaneously improves the communications performance of the tagging and tracking devices and reduces the generation of RF interference that could hinder system operations.

Applications

- Movement tracking during combat training maneuvers;
- Soldier/dismounted troop tracking;
- Platform tagging and tracking (ground and air);
- Logistics container tagging and tracking;
- Airdrop package tracking;
- Missile monitoring and tracking;
- Vibration and tilt monitors;
- Awareness enhancement in all environments—e.g., Joint Readiness Training Center (JRTC), Maneuver Combat Training Center (MCTC), Military Operations on Urbanized Terrain (MOUT), National training Center (NTC), and Virtual Targets Center (VTC); and
- "Virtual reality" glove or body suit implant—support total immersion into a virtual reality scene and interaction with human characteristics.

System Characteristics

- Asset handling capability—up to 9,000 assets (scalable to meet needs)
- Operating range—greater than 10 sq km (typical training site area)
- Communications capability—robust, reliable, secure hybrid spread-spectrum communications
- Spectrum usage—NTIA license-free bands (902-928 MHz, 2.40-2.4835 GHz, 5.15-5.35 GHz and 5.725-5.85 GHz bands); others as required
- Accuracy—1 to 2 ft typically, but can easily be lowered to a range of a few centimeters (at lower read rates)
- Size—microminiature (scalable to meet customer needs)
- Security—low-probability-of-intercept / low-probability-of-detection (LPI/LPD) signals
- Power requirement—low (battery operated with long life)
- Adaptability—capable of simultaneously accommodating individual soldier in MOUT environment and missile being shot down range
- Robustness—military environment
- Applicability—live, virtual, and constructive scenarios

Point of Contact:

Paul Ewing
Leader, RF & Microwave Systems
Oak Ridge National Laboratory
P.O. Box 2008
Oak Ridge, TN 37831-6006
Phone: 865-576-5019
FAX: 865-576-2813
E-mail: ewingpd@ornl.gov