

**Summary of the April Forum
for the Center for BioEnergy Sustainability
March 19, 2009**

The Center for BioEnergy Sustainability holds a forum on topics related to bioenergy sustainability R&D at 3:30 p.m. on the third Thursday of each month at the Environmental Sciences Division, Room 189, Bldg. 1505 at Oak Ridge National Laboratory.

The first seminar in this series was presented on March 19, 2009, by Kenneth Tobin, Director of the Measurement Science and Systems Engineering Division of ORNL. His Division deals with

Electronics	Sensor science
Photonics	Integrated circuit design
Image science	Robotics
Analog and digital systems	Radio-frequency and
Machine vision	microwave systems

The 133 staff members of the Division, most of them electrical and electronic engineers, specialize in unique R&D related to the creation, testing, integration, and application of science and technology to the production and analysis of measurements through electronics, sensors, and systems for the U.S. DOE, other federal agencies, and U.S. industries and in collaboration with other research divisions of ORNL. . They provide an important pathway for the translation of basic science to engineering and technology applications. Their primary capabilities include:

- design and fabrication of custom electronics
- development of unique MEMS and NEMS devices, sensors for multiple measurement modalities, and sensor systems
- implementation of multidimensional signal-processing and pattern-recognition methods
- real-time computing, networking, and other communication architectures that support measurement and control systems
- wireless communication technologies for remote measurement and situational-awareness environments
- sensor-based robotics, human-assist systems, power-transfer devices, and energy-transformation systems
- systems engineering and integrated systems
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Their tasks include building measuring systems, taking measurements, and analyzing what those measurements mean to interpret data, provide understanding, and impart control..

Tobin described a large number of projects that the Division was involved in, focusing mainly on satellite-image analysis for nonproliferation and monitoring applications. Such

systems are now used to characterize ground cover (forest, agriculture, urban, etc.) but could be extended to discriminate crop cover. Other systems developed by the Division include sensors for water quality and fuel quality.

Discussions during the presentation expressed the need for extending sensing and analysis from the plot to the regional scale. Specific sensors that would be helpful include those that could produce medium- to high-resolution regional data for soil organic carbon, moisture, reflectance, soil respiration rate, nitrous oxide, carbon dioxide, and other variables indicative of conditions related to biofuel production.

Tobin responded that some of these systems would be similar to one that the Division developed for the textile industry. There, the sensors scanned the width of a textile as it went through numerous printing processes that produced intricately interwoven and superimposed patterns on the cloth. The task was to monitor the color, intensity, and placement of the imprinted images in real time as the web of fabric whizzed through the printing process. The key technology area that applies to remote sensing of agriculture is the idea of calibrating the spectral reflectance of crops, forest lands, and other ground cover to produce precise estimates of cover type and content with geo-spatial data collected from multiband satellite or aircraft imaging systems.

Work that the Division was doing for DOE's Office of Biological and Environmental Research is moving away from small-animal imaging and moving toward gamma-imaging devices for plants and tree saplings. These new sensors are being designed to be moved up the plant to measure plant functions, record the uptake of radionuclides in real time, perform longitudinal studies on plants as they are growing, and track growth.

[Presentation Slides](#)