

Section 2 Project Summary

The Center for Subsurface Sensing and Imaging Systems (CenSSIS)

The CenSSIS mission is to revolutionize the existing technology for detecting and imaging biomedical and environmental-civil objects or conditions that are underground, underwater, or embedded in the human body. Multi-disciplinary resources to accomplish this mission are drawn from a team of four core academic partners (Northeastern University - lead, Boston University, University of Puerto Rico at Mayagüez and Rensselaer Polytechnic Institute) and five strategic affiliates (Massachusetts General Hospital, Memorial Sloan-Kettering Cancer Center, Idaho National Engineering and Environmental Laboratory, Lawrence Livermore National Laboratory and Woods Hole Oceanographic Institution). A key element of the CenSSIS mission is to immerse students in efforts to solve important real-world problems such as noninvasive breast cancer detection or underground pollution assessment.

“Diverse Problems – Similar Solutions.” The CenSSIS strategic plan aims to develop a unifying framework that encompasses a broad range of sensing and imaging applications. **The ERC’s technical merit** stems from three fundamental research thrusts: R1: Subsurface Sensing and Modeling, R2: Physics-Based Signal Processing and Image Understanding, and R3: Data and Image Information Management. These thrusts incorporate the essential elements of a generic sensing and imaging “end-to-end” system. A unifying approach requires the seamless integration of the multi-disciplinary thrusts.

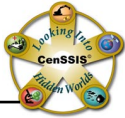
Four CenSSIS testbeds are used to validate research results by generating data on well-characterized “ground-truth” targets and backgrounds. Testbeds have been established for medical ultrasonic imaging (MedBED), underground cross-well radar imaging (SoilBED), and an autonomous underwater vehicle to image coral reefs (SeaBED). Moreover, external funding was obtained from

the Keck Foundation for instrumentation of a 3D fusion microscopy biological testbed (BioBED). This will be used initially for studies of cell evolution and structure.

The CenSSIS engineered system, I-PLUS (Integrated Process for Looking Under Surfaces), is a key long-range product. Development of this system will enable rapid prototyping of advanced subsurface instruments. **Broader impact of the ERC** is achieved through application of these new instruments to important real world problem areas. Initially these areas include breast tumor detection, image guided radiotherapy, assessment of embryo viability, monitoring of coral reef health, and underground pollution detection. Future efforts will be launched in new problem domains such as homeland security.

CenSSIS Corporate and government partners currently include a mix of large and small companies and US government agencies: US Department of Energy, Raytheon Corp., Mercury Computer Systems, Inc., Analogic, Lockheed Martin Corp., Textron Systems, National Geospatial-Intelligence Agency, National Center for Physical Acoustics, Digitome, US Air Force, Siemens, Bubble Technologies, Inc., American Science and Engineering, TransTech Systems Inc., CardioMag Imaging Inc., and Zomega Technology Corp.

The CenSSIS education program includes the development of undergraduate “High Tech Tools and Toys” laboratories and Subsurface Sensing and Imaging technical elective courses at each university. Distance-education graduate courses are tying the CenSSIS institutions together into a “distributed university.” Outreach programs include women’s and minority colleges and to K-12 teachers and children. This provides an ERC broader impact by enhancing the pipeline for and diversity of students entering CenSSIS graduate and undergraduate programs.



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