An Overview of CenSSIS Testbed Facilities

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The CenSSIS Family of Testbeds

- Versatile, Multi-Use Experimental Platforms for...
  - Validating engineered system concepts
  - Testing new research concepts
    - new sensors and measurement techniques
    - forward and inverse models
    - multi-sensor & multi-wave techniques
  - Calibration & operational evaluation
  - Generation of baseline data

- Support for R1 Research Activities

- Distributed Facilities Provide Linkage Across Partner Institutions & Thrusts
So... How Are We Making This Happen?

- Investments in physical space
- Investments in new equipment
- Personnel to construct & run the labs
- It’s a dynamic process
  - Coordination with Research & Educational Prog.

Four BED’s
(largely under construction)
Provide Service to the Various Thrust Areas
The CenSSIS TestBED Network

BioBED
MedBED
SoilBED
SeaBED

Industries

BioBED
MedBED
SoilBED
SeaBED

Partners

NU
BU
UPRM
RPI
BWH
MGH
WHOI
LLNL
SoilBED Infrastructure

- Northeastern University (Main Campus)

- Develop a controlled facility for understanding and validation of physics based models and sensors for detection of contaminants in groundwater and soil

- 740 sq ft in Room 058, Snell Engineering Bldg.

- 4’x5’x(6-12)’ sand-filled underground enclosure

- Support multiple modalities

- C. Rappaport, A. Alshawabkeh et al.
Functional Plan for SoilBED Controlled Test Facility

Soil Bed Dimensions (below ground level)
- cross section 4 ft depth x 5 ft wide
- Adjustable length: 6 ft, 9 ft or 12 ft
SoilBED: Strategic Affiliate Facility

- Lawrence Livermore National Lab
- Cross-well tomography for monitoring pollution plumes in the Vadose zone
SoilBED: Closely Related Project

- Northeastern University Dedham Campus
- Detection of buried landmines (funded by ARO)
- Different Sensing Modalities
  - G.P.R.
  - Opto-acoustic

Locating Mines with G.P.R.
Carey Rappaport
Northeastern U.
SeaBED Infrastructure

- WHOI, RPI
- Underlying physics of high-resolution optical and acoustical sensing
- Multi-sensor fusion, photomosaics, image registration, 3-D Image reconstruction
- SeaBED AUV as test platform (project leveraged by ONR)
The SeaBED Autonomous Underwater Vehicle (AUV)

- Flotation
- Electronics
- Sidescan
- Strobe
- Doppler
- Battery
- Camera

SeaBED AUV Internal View
SeaBED Infrastructure

- UPRM, Northeastern Univ.
- Multilayer Hyperspectral Imaging
- Detection and classification of objects imbedded in multi-layer complex media
- Multilayer = atmosphere + air/sea interface + shallow water column + sea floor
- Testbed is a controlled environment
- L. Jimenez, C. DiMarzio, et al.
SeaBED In A Controlled Environment

Camera & Filters

2’ or 8”

Object to be detected
SeaBED In A Controlled Environment
BioBED Infrastructure

- Northeastern University
- Testbed for Biological Imaging Systems
- Broad Capability Under One Roof
  - Biology Lab, Engineering Lab, Data Collection
- Egan Research Center, HMS, MGH
- Develop a 3D Fusion Microscope Facility
- C. DiMarzio, C. Warner, D. Golan et al.
BioBED... What’s In It?

- **Commercial Microscopes**
- **Novel Sensors**
  - QTM (NU Year 2)
  - Confocal/High-Speed Imaging (NU)
  - Entangled States Microscope (BU)
  - Reflectance Confocal Microscope (MGH/Lucid)
  - Single-Particle Tracking Microscope (HMS)
  - Optical Tweezers (HMS)
  - FRET Microscopy (HMS)
- **Multi-Use Instruments**
  - All staring & scanning microscopes: 1 body?
- **Phantom Objects**
- **Computer Models (MGH)**
MedBED Infrastructure

- Boston University

- General Purpose Ultrasound Test Facility
  - Tomography, forward propagation, complex tissue mimicking media, dual wave, nonlinear imaging, propagation in a controlled environment

- 2 Wet Labs + 4 Instrumented Test Tanks

- Facilities for Tissue Phantom Development and Characterization

- Supports Several R-1 projects

- R. Roy, T. Szabo. R. Cleveland et al.
MedBED: Room 409, BU AeroMech Dept.

Scan Tank

Nonlinear Imaging

 Therapeutic Ultrasound

Acousto-Photonic Imaging

API Tank

Sink    Hood    Fridge

approx 500 sq ft.
MedBED: Room B1, BU AeroMech Dept.

- Underwater Acoustics
- Wet Lab
- Multi-Use Ultrasound Test Facility
- Redwood Tank
- Large Scan Tank

approx 1500 sq ft.
MedBED: Tanks and Instruments

“Small” US Scan Tank

Analogic Ultrasound Engine

“Large” US Scan Tank
MedBED: Other Facilities & Projects

- Electrical Impedance Tomography (RPI)
- Diffraction Tomography for Classifying Intravascular Vulnerable Plaque (BU, NU, MGH)
- Multi-Spectral Optical Sub-Retinal Imaging (RPI)
- DOT and API Imaging (NU, MGH, BU)

DOT Array
David A. Boas
MGH NMR Center