Education Program

Education Team
Goals
Program Components
1) Undergraduate Research
2) Curricular Innovation
3) The Distributed University
4) K-12 Programs
5) Dissemination

Diverse Problems – Similar Solutions

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The CenSSIS Education Team

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- Member, Engineering Curriculum/ABET Committee

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- Member, ECE Curriculum Revision Committee
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- PI, NSF Research Curriculum Grant on Photonics

Prof. Gary Saulnier, RPI
- Chair, ECSE Curriculum Committee
Do We Miss the Forest for the Trees?

Building competence in engineering practice

Diagram: Electrical circuit with symbols for resistance (R), reference current (I_ref), output current (I_o), and voltage (-10 V). There is also a symbol for a medical heart monitor.
Goals of CenSSIS Education Program

1) Engage undergraduates in inspiring cross-disciplinary research
2) Implement curricular innovations that integrate systems concepts
3) Create a cross-university research/educational program
4) Create K-12 pathways into engineering, particularly for women and minorities
5) Evaluate and disseminate results
1. Engage Undergraduates in Cross-Disciplinary Research

CenSSIS solution: Industry/Undergraduate Research Opportunities (I/UROPs)

- Connects classroom, research, and application
- Integrates faculty teaching and research missions
- Students become vehicles for technology transfer
NU I/UROP Pilot

- On-campus research experience linked with employment
  - Research topic tied to employment (eg., Co-Op)
  - Company-supported stipend = $5K/year
  - Credit through “Independent Study” electives
- Pilot program involves 16 students
  - 3 students finished projects
  - 13 projects in progress
- Industry I-UROP funding pledged for 40+ students per year
I/UROPs Engage Undergraduates in CenSSIS Technology
## 2. Curricular Innovations: Linking Education to Research

### Research achievement

<table>
<thead>
<tr>
<th>SoilBED web access</th>
<th>SolutionWare modules</th>
<th>Web control of BED’s</th>
<th>I-PLUS integration</th>
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<tr>
<th>Years:</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
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<tbody>
<tr>
<td>Education application</td>
<td>Graduate classes</td>
<td>Undergraduate course/modules</td>
<td>K-12 Competitions/activities/training</td>
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Creating a Three-Course SSI Concentration

SSI-Theme
Capstone Design

New Course
SSI 101: Intro to Subsurface Sensing and Imaging Systems

Existing Elective
(e.g., BMED4470: Signals and Images)

100+ Grad/yr w/ SSI Conc.
Initial Undergraduate Module Development

- **RPI: BMED4470: Signals and Images: Subretinal Imaging module (Roysam)**
- **BU: EK130 Introduction to Engineering: Subsurface Sensing and Imaging module (Saleh)**
  - Piloted
- **BU: EK200 Technology and Society: Societal Impacts of SSI module (Ruane)**
- **NU: GE1103 Engineering Design: Subsurface Applications using LLNL MIR (Rappaport)**
  - Piloted
- **UPRM: INEL 4995 Intro to Remote Sensing: Hyperspectral Undersea Analysis module**
Graduate Courses

- **Specialized graduate courses on SSI topics**
  - (Example: UPRM INEL 6995 Advanced Topics in Remote and Subsurface Sensing)

- **Interdisciplinary learning courses**
  - BU Pilot Course AM503 (Sp ’00): “Diagnostic Ultrasound Medical Imaging: Inside/Out”
    - Dr. Tom Szabo, Agilent Medical Instruments Division
Curriculum Innovations: Bringing Research and Real World Experiences into the Classroom

- Systems Experts
  - Non-Invasive Med. Imaging
- Researchers
  - Processing Algorithms
- Industry Professionals
- Hospital
- Interdisciplinary Team-Based Graduate Course
Curricular Innovations: CenSSIS
Education Works at All Levels

Engineering Profession

Continuing Ed.

Grad. Interdisc. Learning SSI Topics

Jr./Sr. 3-Course SSI Conc. Undergrad. Modules

Fresh./Soph. Hi-Tech Tools & Toys

K-12 Outreach

K-12
3. How Do We Bring It All Together?

Inter-institutional Pathways

Goal:
- Distributed university

Strategies:
- Faculty exchanges
- Graduate thesis committees
- Remote testbed access
- Student leadership council
- Dissemination
The Student Council Links the Partners

- Local and center-wide councils
- Well defined roles: strategic plans
- Meetings via videoconference
4. How Can We Bring CenSSIS to K-12?

K-12 Pathways

Goals:

- Stimulate K-12 interest in science, math, and engineering through sub-surface sensing and imaging activities.
- Provide engineering students with a community service learning opportunity.

Strategies:

- Pre-college summer programs
- Teacher training programs
- K-12 educational modules
- Design competitions
Web Educational Modules

Dive and Discover
Expeditions to the Seafloor

Join scientists as they dive to the mid-ocean ridge thousands of meters deep. Explore towering underwater volcanoes, black smokers, and bizarre creatures that live there.

Click Here

Dive and Discover is funded by Woods Hole Oceanographic Institution and the National Science Foundation.
The “Hidden Worlds” K-12 Design Challenge

- Local design competitions using current infrastructure
- Model for National Science Olympiad Competition
5. CenSSIS Dissemination Strategies
Evaluation and Assessment

- **ABET 2000 assessment infrastructure**
  - Educational objectives system processes
  - Learning outcomes system processes
- Center-wide student tracking system

**ABET 2000 Criterion 3:**

Engineering programs must demonstrate that their graduates have:

- an ability to apply knowledge of mathematics, science, and engineering;
- an ability to design and conduct experiments as well as to analyze and interpret data;
- an ability to design a system, component, or process to meet desired needs;
- an ability to function on multidisciplinary teams;
- an ability to identify, formulate, and solve engineering problems;
- an understanding of professional and ethical responsibility;
- an ability to communicate effectively;
- the broad education necessary to understand the impact of engineering solutions in a global/societal context;
- a recognition of the need for and an ability to engage in lifelong learning;
- a knowledge of contemporary issues; and,
- an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.
How Will We Work to Increase the Number of Women and Minorities Entering into Engineering?

The CenSSIS Academic Partners together account for 2.5% (1 in 40) of the Total US Engineering BS Graduates

<table>
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<tr>
<th>Minority Students</th>
<th>Female Students</th>
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<td>National = 12%</td>
<td>National = 19%</td>
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<tr>
<td>CenSSIS = 40%</td>
<td>CenSSIS = 26%</td>
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Our Strategy

- Research-Teaching Mentors
- Student Mentors
- Industry Mentors
- K-12 Mentors and Programs
- Education Advisory Board Focus
Conclusions

- Inter-institutional strategies
- Systems level, interdisciplinary education
- K-12 pipeline development