MIT Lincoln Laboratory
MQP Project Center
Information Session
(U.S. Citizenship Required)

A tradition of excellence …

… a history of innovation

Slides Provided by Lincoln Laboratory

www.ll.mit.edu/WPI/2011
http://www.wpi.edu/academics/GPP/Centers/mitlin729.html
http://ece.wpi.edu/~ted/lincoln_mqp_center/index.html
Agenda

• About the Laboratory
  – Overview
  – Research Areas
  – Demographics

• The MQP program
  – Logistics
  – Admission
  – Summer & Full-time Employment

• Past Projects
• Fundamental Mission — Apply science and advanced technology to critical problems of national security

• Conduct research and development pertinent to national defense with emphasis on advanced electronics
  
  – Carry out field experiments to understand problems, formulate solutions and develop components
  
  – Fabricate one-of-a-kind systems and demonstrate concepts in the field
  
  – Provide technical advice and consultation to the military services and other defense and government agencies
Purpose

Technology in Support of National Security

Core Work Areas

Sensors → Information Extraction → Communications
Integrated Sensing and Decision Support
(Secure – Countermeasure Resistant)

Current Mission Areas

- Communications and Information Technology
- Space Control
- Advanced Electronics Technology
- Air and Missile Defense Technology
- Non-DoD Air Traffic Control, NASA, NOAA
- Intelligence, Surveillance, and Reconnaissance Systems & Technology
- Homeland Protection and Tactical Systems
Example Research Areas

- Radar for ballistic missile defense and FAA
- Advanced lithography and microelectronics fabrication
- High Performance & Embedded Computing
- Bio-Defense
- Tactical Communication
- Asteroid Detection
- Wideband Networking
- Space Surveillance
Primary Field Sites

White Sands Missile Range
Socorro, New Mexico

Pacific Missile Range
Kauai, Hawaii

Reagan Test Site
Kwajalein, Marshall Islands

Millstone Hill Field Station
Westford, Massachusetts

Flight & Antenna Test Facility
Bedford, Massachusetts
Composition of Professional Staff

Degrees

- No Degree
- Master’s
- Bachelor’s
- Doctorate

Academic Disciplines

- Computer Science
- No Degree
- Other
- Mathematics
- Mechanical Engineering
- Electrical Engineering

Professional Staff: 1500
Total Employees: 2532
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• Past Projects
• 1-Term, off-campus Major Qualifying Project
  – Typically, teams of 2–3 students each (10–20 students total)
  – 9 week program (no separate PQP), start 2 weeks prior to A-term
  – Advised by a WPI Prof.; Supervised by Lincoln staff
  – Double-majors complete extra 1/3-unit on-campus B-term

• U.S. Citizenship is REQUIRED
  – Generally, no dual citizens (and some limits on prior non-US citizenship)
  – DoD classified research & development environment
  – Commercial Background Investigation required
  – Students will be given “unescorted” badges
  – Security clearances generally not required

• WPI Project Directors: Professors Brown, Clancy (ECE)

• Students reside at home or on campus
  – Bus provided daily between WPI and MIT LL (43 miles)

• Projects for 2016 being finalized
  – Opportunities for CS, ECE, MA, ME/AE, PH, RBE

**No extra cost for participating students**
($3,000 – $6,000 at other sites)
• Selection is competitive — academic standing is strong factor
  – Performed by WPI professors, with input from Lincoln Laboratory
  – Lincoln Lab will request additional information directly
    Resume, transcript, C/D term courses, project preferences

• Timeline
  – Projects Fair
    2 September, Campus Center
  – Information Sessions
    5 November, FL320
  – Applications due (apply early!)
    10 November (on-line)
  – Interview (with a professor)
    Early November
  – Decision letters mailed
    December 2013
Summer & Full-time Employment

- Accepted MQP students may be offered summer internships
  - Competitive salary
  - Housing available
  - Get well-acquainted with Laboratory environment prior to MQP

- Standard application procedures
  - Submission of resume and transcript
  - Recommendations from WPI faculty
  - On-site interviews

- Majority of accepted MQP students are offered summer employment

- Excellent track record of MQP students being hired full-time after graduation
  - 20+ over previous 6 years
  - MQP and summer internship is an excellent opportunity for a “full duplex” interview
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- Past Projects
Past Projects

• 2011 MQPs
  – [CS, MA] Evaluating the Robustness and Feasibility of Integer Programming and Dynamic Programming in Aircraft Sequencing Optimization
  – [ECE, RBE] Automated Refueling for Hovering Robots
  – [CS, ECE] Software Defined Radar

• Other Year’s MQPs
  – [CS] - Configuration and Control of Real-Time Mission Data and Analysis
  – [AERO/ME] - Evaluation of Mounting Techniques for Optical Elements
  – [ECE, PH, MA] - Geiger-Mode Avalanche Photodiode (APD) Optimization Study
  – [ECE, PH] - Design of a Wideband Circular Array

• Please see http://www.ll.mit.edu/WPI/2011 for full project descriptions
  • And, http://ece.wpi.edu/~ted/lincoln_mqp_center/index.html
Growing Cyber/Security Interests

• **Cyber Systems and Technology**
  - Cyber Reasoning, Response: risk assessment, decision support, modeling and simulation, metrics
  - Cyber Security Infrastructures: secure data, services, applied crypto protocols
  - Secure Tactical and Embedded Platforms: open anti-tamper architectures, trusted hardware

• **Cyber Systems and Operations**
  - Cyber situational awareness, cyber command and control
  - Cyber sensors, analytics and visualization
  - Net-centric architectures

• **Cyber System Assessments**
  - Cyber range design and tools
  - Reverse engineering
  - Cyber test and evaluation
  - Malicious software analysis
Past Projects: **Computer Science**

**Configuration and Control of a Real-Time Mission Data Processor.**

Michael J. Molignano (CS), Timothy T. Navien (CS) and Steven Shidlovsky (CS).

Example Mission Data Processing Pipeline using SLIQUE
A Service-Oriented Approach to Application Development.

Robert Darneille (CS) and Gary C. Schorer (CS).

Proposed Architecture

Apache Tomcat

Acegi

Services | Service Framework | Java

- Required development
- Provided by users
Past Projects: Computer Science

**Distributed Virtual Environment for Radar Testing.**
Matthew R. Lyon (CS), James B. Montgomery (ECE) and Lucas M. Scotta (CS).

Designed Real-Time Radar Simulator
**Sparse Matrix Multiplication on a Field-Programmable Gate Array.**

Ryan Kendrick (ECE) and Michael A. Moukarzel (ECE).

![Graph showing efficiency of sparse multiplication methods versus full matrix multiplication for matrices 1-5% density.](image)
**Holographic Optical Beam Steering Demonstration.**
Gabriel J. Ayers (ECE), Michael A. Ciampa (ECE) and Nicholas A. Vranos (ECE).

![Diffraction Grating](image)
**Software Defined Radar.**
Shahil Kantesaria (ECE) and Nathan Olivarez (ECE).

Designed phased array radar receiver using commercial software radios.
Multiple Target Tracking.
Matthew J. Connor (ECE), Kathleen Haas (MA) and Alexander Volfson (MA).

One target (black) splitting into two (red, blue)
**Design and Analysis of Vibration Test Fixtures for Payloads.**

Kara Buckley (ME) and Lee T. Chiang (ME).

- Finite element analysis of a rocket/payload.

![Screenshot of Displacement in the Z Direction due to Vibration in the Z Direction.](image)
**Past Projects: Aero/ME**

**Thermal and Structural Analysis of a Rocketborne Experiment.**

Thomas H Huynh (ME) and Krystal L. Parker (AE).

Thermal profile of aluminum skins after aerodynamic heating.
Past Projects: Physics


Steven P. Rose (PH) and Bradley A. Scoville (ECE).

Prototype Lasercom Terminal
Past Projects: **RBE**

**Marsupial Unmanned Aerial Vehicle**

From Berard, Petrie, Smith 2010 Lincoln Lab MQP
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Steven Rose and Bradley Scoville
PH/ECE MQP, 2008

Thomas Huynh and Krystal Parker
ME/Aero MQP, 2007