Introduction to MIT Lincoln Laboratory

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MIT ILP R&D Conference

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Who Are We – A Little History

• MIT Radiation Laboratory: October 1940 – December 1945

  Mission: Development of radar systems and technology
  
  Main projects: Surveillance radar
  Fire control radar
  Navigation systems

  4000 employees
  Designed half of all US WWII radars

• MIT Lincoln Laboratory in the 1950s

  Established 1951: Air defense and technology development

  Main projects: Semi-Automatic Ground Environment (SAGE)
  - Spun-off Mitre in 1958 to operate SAGE

  Major Innovations:
  - Real-Time Computing
  - Magnetic-core Memory
  - Light-pen CRT Interface
MIT Lincoln Laboratory Today

Shared Values –
Technical excellence
Integrity
Meritocracy

DoD Federally Funded Research and Development Center
Systems architecture engineering
Long-term technology development  ~4000 employees
Rapid system prototyping and transition  ~$1B in FY19

MIT: Cambridge, MA
Lexington, MA
Westford, MA
Albuquerque, NM
Kwajalein, Marshall Islands

MIT: Cambridge, MA
Westford, MA
Albuquerque, NM
Kwajalein, Marshall Islands
Lexington, MA
Socorro, NM
Technology in Support of National Security

MIT Lincoln Laboratory Division Structure

Mission-specific technology focus
- Air, Missile and Maritime Defense Technology
- Homeland Protection
- Air Traffic Control
- Communication Systems
- Space Systems and Technology
- ISR Systems & Technology
- Tactical Systems

Broad-application technology focus
- Advanced Technology
- Cyber Security
- Engineering

Advanced Technologies
- Cryogenic Yb:YAG Lasers
- Decision Architectures
- Quantum Bits
- APD Arrays
- Advanced Focal Planes

System Prototypes
- XTR-1 radar
- Haystack Ultra-wideband
- Lunar Laser Comm Demo
- Space Surveillance Telescope

Microchip Technologies
- Miniature Low-Power Transceivers

Advanced Technologies
Advanced Technology Development and Transition

National Security Challenge

User Input

Analyses & Architectures

Technology Awareness and Innovation

Academia
Basic and Applied Research

Lincoln
Core S&T Competencies

Small/Med Business
Advanced Commercial Capabilities

Testing / User feedback

Operational systems, Subsystems, Methodologies

User Community

Industry
R&D Tools, Components, Software and Manufacturing

Technology Transfer

Prototyping:
Components, Subsystems, Evaluation Systems
68 Years of Impact for the Nation

<table>
<thead>
<tr>
<th>Event</th>
<th>Description</th>
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<tr>
<td>First RADAR-based Satellite Imaging</td>
<td>ALCOR radar located at Kwajalein</td>
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<tr>
<td>First Transmission of Packetized Speech</td>
<td>Forerunner of voice over internet protocol (VoIP)</td>
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<td>3-D Laser Imaging</td>
<td>Permits airborne 3D imaging through trees</td>
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<td>First Prototypes for All Military Comm. Satellites</td>
<td>DSCS, MILSTAR, WGS, AEHF, MUOS</td>
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<td>Digital Signal Processing &amp; Error-Correcting Codes</td>
<td>Inventions of recursive digital filters and Reed-Solomon codes</td>
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<td>First Fully-Transistorized Real-Time Computer</td>
<td>Spawned commercial mini-computer industry</td>
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<td>First Transmission of Packetized Speech</td>
<td>Installed on all planes with &gt;19 passenger seats</td>
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<td>First Television Picture Transmission via Satellite</td>
<td>Used NASA’S Echo I Satellite</td>
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<td>First Burst Mode Satellite Imaging</td>
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<td>First Airborne Collision Avoidance System</td>
<td>Instructs the optimal avoidance direction based on radio waves received</td>
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Transiting Exoplanet Survey Satellite (TESS)

All-sky, two-year photometric exoplanet discovery mission

Launched 18 April 2018
Final Lunar Resonant Orbit: 30 May 2018

First Light 26 April 2018
(1/4th of FOV Displayed)
MIT Lincoln Laboratory rapidly deployed advanced ladar system and analytics to support FEMA and the National Guard with Texas Hurricane Harvey recovery.
Lincoln Beaver Works Activities

- Lincoln Beaver Works capstone projects (Lincoln funding and/or mentors)
  - Persistent USV for ionosphere measurement (2.013/2.014)
  - Carbon neutral cooling (2.013/2.014)
  - SVTOL aircraft design (16.82)

- Lincoln funded research projects / research assistants
  - Two UAV-related research projects
  - Cyber research focusing on software analysis and vulnerability discovery

- Beaver Works Summer Institute (BWSI)
  - Elite summer program for rising high school senior ~ 200 participants summer 2018
  - Hands-on courses with a focus on robotics and AI

- Other activities
  - Cyber Capture the Flag (university teams)
  - Cyber Patriot Teams (high school teams)
  - Assistive Technology Hackathon
  - LL IAP courses
  - Lincoln seminar series
Air Force AI Accelerator (New 2019)

**Program Name:** AI Accelerator
- 5 year MIT program sponsored by Air Force

**Goal:** MIT to conduct open, fundamental research to advance AI including applications of new results to national security
MIT Center for Quantum Engineering

Objectives

• Define the emerging discipline of quantum engineering
• Educate and train tomorrow’s quantum engineers
• Partner with academia, government, and industry
• Advance the nation’s leading role in QIS and Engineering
• Stepping stone to a future center with expanded participation

quantumcurriculum.mit.edu
Notable Lincoln Laboratory Spin-Offs

1955
Amtron Technology, Inc.

1960
Saperix, Inc.

1980
Bouton Office

2000
Optim Microwave

1995
Fast Efficient 3D Imaging

2010
Butterfly Network, Inc.

1985
M&I Research

2015
Copious Imaging

2019
Jetcool Technologies