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ABSTRACT

This series of presentation will be given at the 2nd workshop of Engineering Institute Korea. The brief introduction of Los Alamos National Laboratory will be presented. After then, the activities of Engineering Institute (EI) in both research and education, including Los Alamos Dynamic Summer School will be presented. Finally the recent SHM research of EI will be followed.

Engineering Institute of Los Alamos National Laboratory

GyuHae Park, Ph.D.

Los Alamos National Laboratory

Los Alamos National Laboratory (LANL)

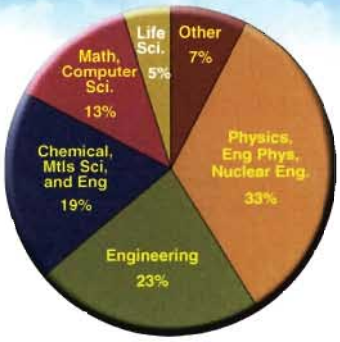
- Established in 1943 as part of Manhattan project.
- Maintain a safe, secure, and reliable US nuclear stockpile.
- Solve problems related to energy, environments, bio-technologies, materials, and infrastructures.

Los Alamos National Laboratory (LANL)

- Lab Budget approximately $2.2 billion
  - 67% : Weapons program
  - 20%: DOE science, environment, energy
  - 13%: WFO (National Security, Science)
- ~ 40 square miles
- 1,280 buildings with 9.0M gross sq. feet
  - 11 nuclear facilities
  - 40% are more than 40 years old
- 268 miles of roads (100 miles paved)
- 1M sq. feet of footprint reduction

LANL Workforce

11,463 - Current Work Force



4,709 Technical Staff
(Scientists & Engineers)
2,300 Technicians
3,105 Operational/Admin./
Specialist Support
371 Post-Docs
1,068 Students (HS, UGS, GRA)
429 Limited Term

LANL is: **Broad and deep science**

- Drawn from across the nation
- 2,211 PhDs
- 40% of career workforce started as students or post docs

Engineering Mission: Stockpile Stewardship

- Responsible for over 80% of the US nuclear weapons stockpile
  - Safety, reliability, surveillance, design technology, upgrades, dismantlement, annual assessments
- Confidence without nuclear testing is based on a more fundamental science and engineering understanding

LANL capabilities support multiple missions

Meeting vital national security challenges

Stockpile Stewardship

Global Security

- Advances in nuclear detection technology
- Imagery analysis and exploitation technology

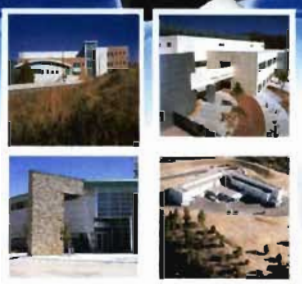
Energy Security

- Impacts of Energy Demand Growth
- Sustainable Nuclear Energy
- Concepts and Materials for Clean Energy

Los Alamos NATIONAL LABORATORY

Unique facilities of LANL

- Nuclear facilities address critical stockpile stewardship challenges
- Supercomputing facilities
- DARHT allows researchers to study weapons performance
- CINT: Nanotechnology center drives critical research programs
- NHMFL, LANSCE draws international scientists studying materials



Engineering Institute Korea

The Engineering Institute (EI)

- **A research and education collaboration between LANL and UCSD's Jacobs School of Engineering.**
  - **Support LANL's engineering research**
  - **Recruitment Pipeline**

- **High-Fidelity Predictive Simulation**
- **Advanced Sensing**
- **Novel Data Interrogation**

- **Validated Simulations with Quantified Uncertainty**
- **Structural Health Monitoring (SHM) /Damage Prognosis**

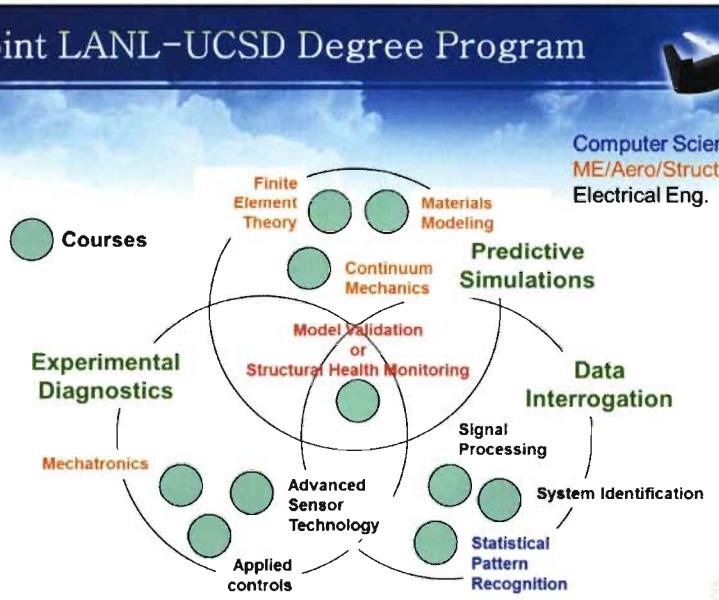
Intelligent, Adaptive Engineering Structures

Engineering Institute Korea

The EI Components

- Multi-Disciplinary Graduate Degree Program
- Collaborative Research with UCSD
- Los Alamos Dynamics Summer School
- Industry Short Courses
  - SHM
  - Model Validation and Uncertainty quantification
- Annual Workshops
  - Produce summary report on state-of-the-art in the respective topics and identify outstanding research issues.

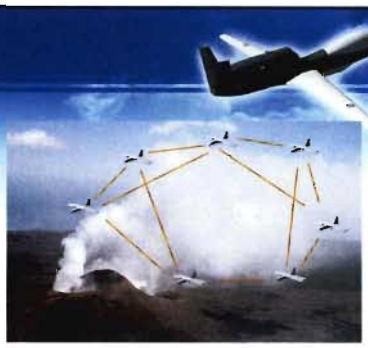
Joint LANL-UCSD Degree Program

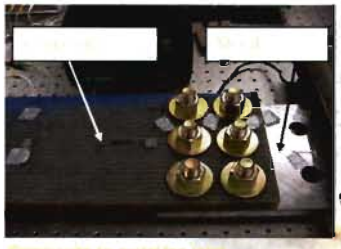


- 3 LANL staff members received MS, 5 currently enrolled in graduate program.
- More than 120 LANL Staff members taken at least 1 class offered by EI

Collaborative Research

- NW-related projects
  - –Residual stresses in beryllium welds (with Univ. of Texas)
  - –Design code for composite springs
  - –Crack detection in gas bottles
  - –Adaptive sensing and control of time variant systems
  - –Passive Vibration Sensor
- TR-related projects
  - –Plume detection and forecasting with swarming UAVs
- DoD-related projects
  - –Coupling UAVs and RF sensing for rapid damage assessment of structures
- Other
  - –Signal Processing and control of pulsed power systems
  - –Commercialization Advisement
- Total of 25+ Grad Students and 7+ more students supported by NSF & NDSEG fellowships



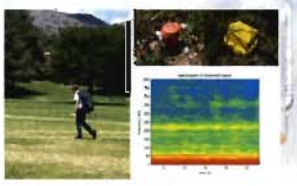


Composite-to-metal lap joint

Engineering Institute Korea

Los Alamos Dynamic Summer School

- Proactive approach to recruitment of top students through an intense 9-week summer school program.
- Program goal: Get top US-citizen engineering undergraduates enrolled in graduate school.
  - Average GPA of these students: 3.8
  - Approx. 85% have gone on to grad school
  - 21 have completed their Ph.D.s
- Summer School Activities
  - Week–long tutorials & Guest lectures
  - Summer long 3-person research project
  - Each group produces a conference paper by the end of the summer



Engineering Institute Korea

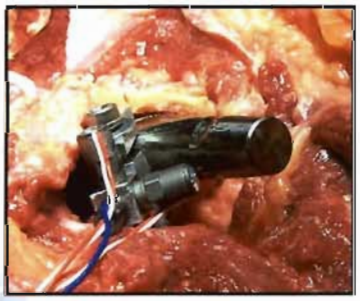
Los Alamos Dynamic Summer School

- To date, LANL has hired 16 Staff Members from this program
- 16 former LADSS alumni at enrolled in graduate school at UCSD.
- Our students have been very successful in obtaining competitive fellowships:
  - NSF Graduate fellowships: 14, (5 honorable mentions)
  - National Defense Science and Engineering Fellowships: 6
  - Graduate Education for Minorities (GEM): 2
  - NASA Graduate Fellowships: 4



Sensing System added to Femoral Component

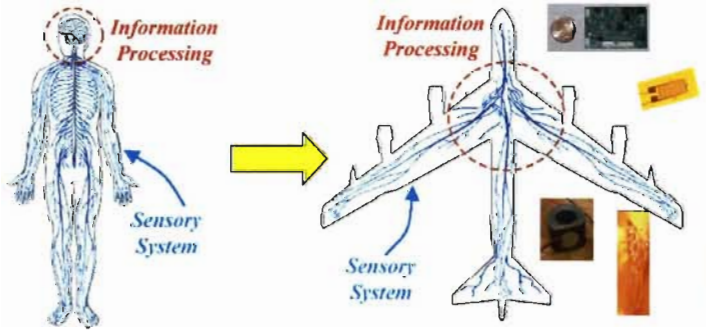


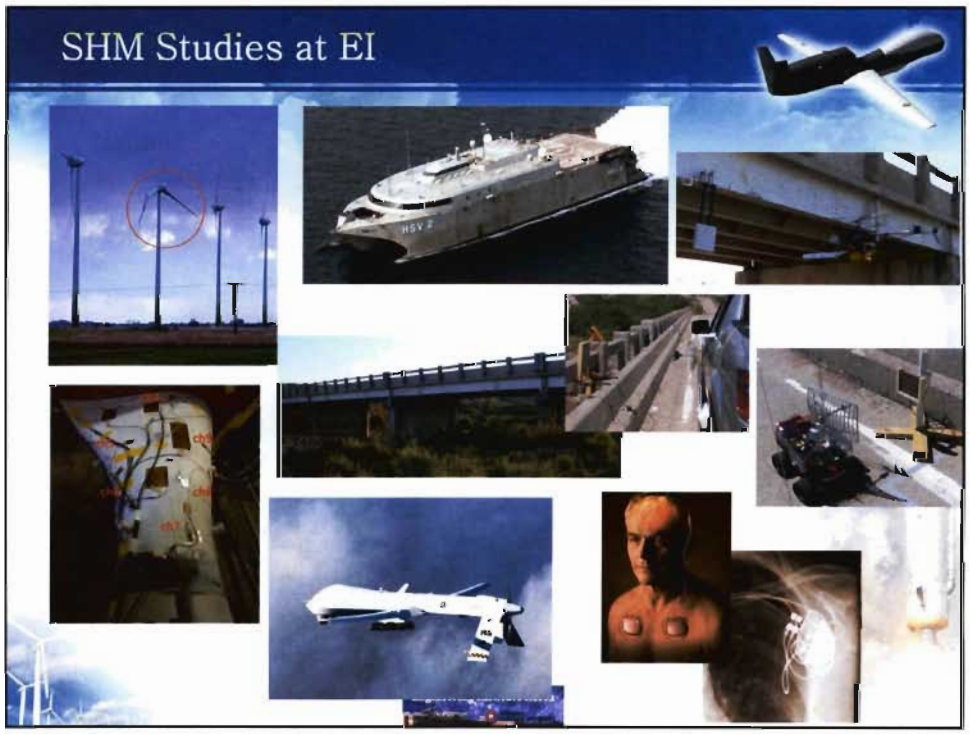

Sensing System added to Femoral Component

Structural Health Monitoring

- Structural Health Monitoring (SHM) is the process of developing a damage assessment capability for aerospace, civil and mechanical infrastructure
- The goal of SHM
  - To improve the safety
  - To reduce the maintenance cost
- A systems level approach
  - Hardware & software Integration
  - Long term reliability of sensing systems.
  - Power constraints




SHM requires both software and hardware development
Sensor node 1
Sensor node 2
Sensor node 3
Sensor node
Mobile Host
Engineering Institute Korea


SHM Studies at EI

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