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Title: National Security Education Center: Update on Engineering Institute Activities

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National Security Education Center: Update on Engineering Institute Activities

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The Engineering Institute

- **THE ENGINEERING INSTITUTE(EI)** is a research and education collaboration between LANL and the University of California San Diego (UCSD) Jacobs School of Engineering started in 2003.
- **MISSION:** Develop a comprehensive and coordinated approach for
 - conducting mission-driven, multidisciplinary engineering research and
 - recruiting, revitalization and retention of the current and future staff necessary to support LANL's diverse technology portfolio.
- **TECHNICAL FOCUS:** multidisciplinary engineering science that integrates advanced **predictive modeling, novel sensing systems and new developments in information technology.**



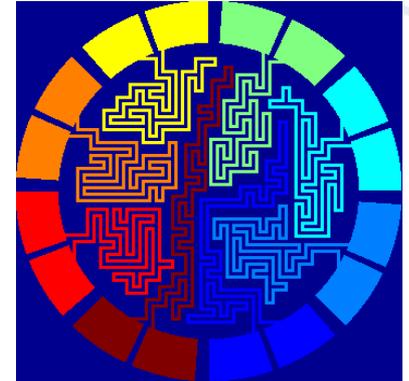
Summarize Various Engineering Institute (EI) activities since last update to the Engineering Council (Dec., 2013):

- **Los Alamos Dynamic Summer School (LADSS),**
- **Science of Signatures Advanced Study Institute**
- **Judge's Science School**
- **International collaborations**
- **Recruits & Pipeline**
- **Capabilities Reviews**
- **New research activities**
- **Support of Weapons Environmental Testing**
- **R&D 100 Award**
- **Fellowship pilot program with Univ. of California Office of the President**
- **Univ. of California President Napolitano Visit**

The Los Alamos Dynamics Summer School

21 top undergraduate engineering students from around the U.S. (juniors, seniors, 1st year grad)

- **Continuing with our new focus on cyber-physical systems (CPS)!**
 - Broader LANL mission relevance,
 - Aligned with the **National Science Foundation's** new research thrust in CPS. Integrate sensing, embedded processing, controls and information technology to improve performance of engineered systems
- Mean undergrad GPA approx. **3.8/4.0**,
- **11/21** of the students were from under-represented groups
- **4/6** women engineers asked to return as either post-BS or post-MS students.
- **How can you engage?**
 - **Line organizations need to hire students that want to return**
 - **Need mentors and projects for next year (I can support up to 5 mentors at \$10K/mentor).**
 - **Need women mentors!**



Graphene-Oxide Tamper Resistant Seals



**Acoustic Wavenumber Spectroscopy
identifying damage in 737 fuselage**

MENTORS

- **Student are assigned to 3-person project teams with LANL staff members or postdocs acting as a mentor.**
- **2014 Projects and Mentors**
 - **Dr. Stuart Taylor***, **Dr. Kendra Van Buren** (Mechanical shock environment synthesis and testing)
 - **Dr. Eric Flynn***, **Will Warren*** (Hybrid Structural Health Monitoring)
 - **Dr. Alex Scheinker**, **Dr. Eric Schmeirer**, (Drill vibration suppression)
 - **Dr. Alessandro Cattaneo** (Graphene tamper resistant seal)
 - **Dustin Harvey ***, (Structural Health Monitoring of UAV systems)
 - **Dr. David Mascarenas***, (Glovebox control system)
 - **Dr. David Mascarenas***, (Detecting transparent barriers for UAV flight control)
- ***Former LADSS participants**

Science of Signatures Advanced Study Institute

The Eng. Institute hosted the 2nd SoS Forward Deployment Advanced Study Institute for Ph.D. students and postdocs (external or internal to LANL)

Projects:

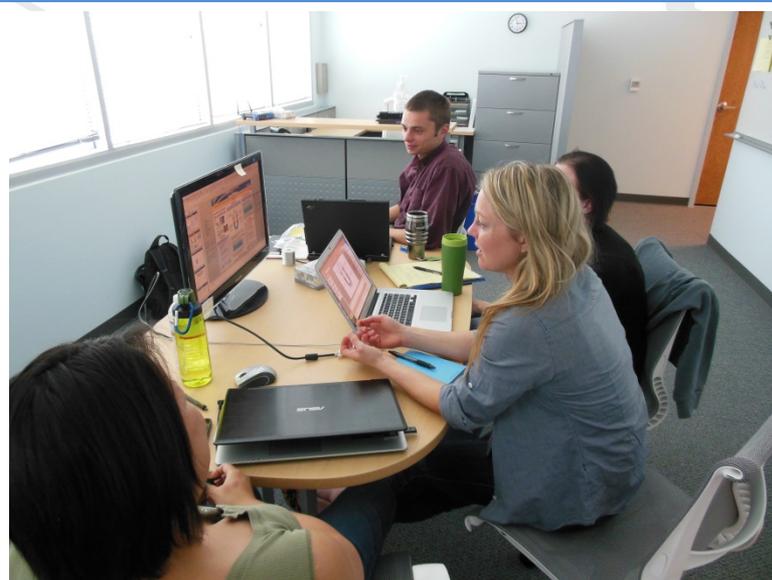
Development of Novel Human-Computer Interfaces for an Interactive Electronic Work Control System (IEWCS) for Glovebox Operations Mentor: Ross Muenchausen, MST-7

Development of Optical Pathogen Detection for Field Diagnosis of Infection Mentor: Basil Swanson, B-10

Development of the Next Generation of IAEA Tamper-Evident Seals for Nuclear Safeguards Mentor: Karen Miller, NEN-1

Novel Methods for Remotely Detecting the Energized state of DC-to-DC converters Mentor: James Ten Cate, EES-17

Gamma Ray Flux Uncertainty Quantification for Emergency Response Mentor: Peter Karpus, NEN-2



Judge's Science School

- National Security Education Center hosted 8 judges and one faculty member from UNM law school for 1-week Science School
- Goal is to help judges better assess the science and technology they see in their courts
- Lecture Series (main educational component)
- Guest Speakers (talks on current science research)
- Doing and Presenting Science (hand-on activity – estimating lift capacity of quadrotor)
- Judging Science (mock Daubert hearing)
- Science in the field and in the lab (tours)
- **Request from National Courts and Science Initiative to provide training for 500 more judges nationwide!**



Judges do experiments to estimate lift vs RPM of quadrotor motor and propeller



LANL scientist lectures on “The Art of Approximation”

International Collaborations

- Korean National Research Federation is funding the **Engineering Institute-Korea (EI-K)** at Chonbuk National Univ., which is modeled after LANL's EI.
- **The EI-K provides funding for research visits by LANL students, postdocs and staff**
- International Collaborations
 - Formal collaborations with **Univ. of Sheffield** and **Univ. of Bristol** in the UK and **AGH Univ. of Science and Technology** in Poland.
 - Institutions from around the world send their graduate students and postdocs to the EI at their expense!
 - Japan, Portugal, Italy, Poland, Ireland, Greece, Turkey, Spain, UK



EI-K Building Dedication, August, 2014

- **Atomic Weapons Establishment** in the UK sends new hires to the Dynamics Summer School

Engineering Pipeline at LANL

Staff Hired (4)

- **Stuart Taylor**, Ph.D. Structures, **UCSD**, AET-1, (**NSF Graduate Fellowship**)
- **Colin Haynes**, Ph.D. Structures, **UCSD**, WX-14 (**NSF Graduate Fellowship**)
- **John Heit**, MS Mechanical, Utah, WX-14 (2013 LADSS)
- **Dustin Harvey**, Ph.D. Structures, **UCSD**, AET-1 (**National Defense Graduate Fellowship**) sent for LISC approval last week



Stuart Taylor



Dustin Harvey

Postdocs (1)

- **Alessandro Cattaneo**, Ph.D. Civil Eng., Politecnico di Milano, NSEC working on graphene oxide tamper resistant seals



Alessandro Cattaneo



Colin Haynes



John Heit

CAPABILITIES REVIEWS

- The Engineering Institute participated in:
 - The Engineering capabilities review
 - The Information Science and Technology (IS&T) Capabilities review
- Both reviews focused on the EI's structural health monitoring research

- **Engineering capabilities review report quote:**

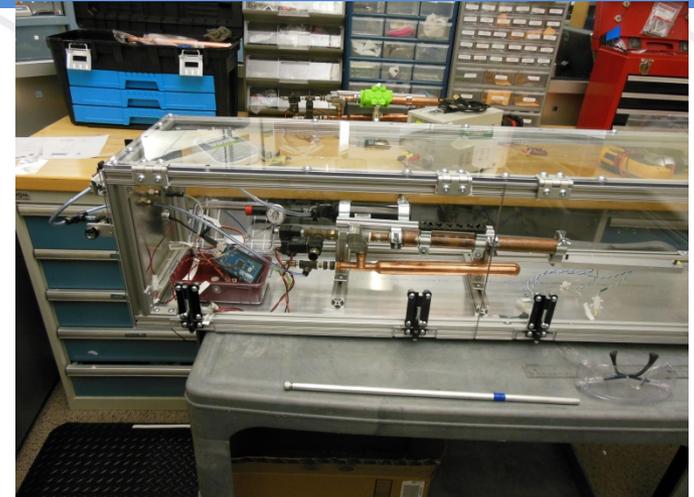
“Results - The return of investment and value of the Engineering Institute to LANL, the University of California system and the scientific and engineering community as a whole is significant. It provides a workforce pipeline of leaders and innovators for LANL and a cadre of devoted and loyal alumni of those that do not remain at LANL.”

- **IS&T capabilities review report quote:**

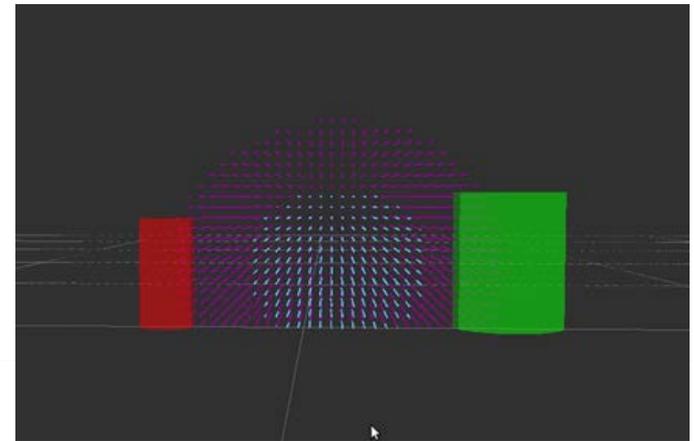
“The structural health effort is innovative, high impact, generating substantial scientific and engineering output, and an excellent mechanism for recruiting and retaining outstanding research staff. LANL asserts that it is considered one of the leaders in structural health monitoring (SHM) worldwide and the committee wholeheartedly concurs.”

New Research Activities

- Remote Sensor Placement (LDRD early career award, D. Mascarenas)
- Interactive electronic work control system for high performance glovebox operations and documentation (D. Mascarenas)
- Multi-intelligence data analysis (follow-on to Advanced Studies Institute, Eric Flynn)
- Structural health monitoring technology adapted to security applications (A. Cattaneo)



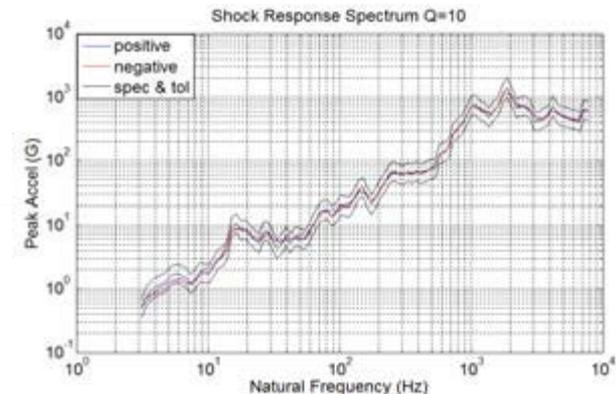
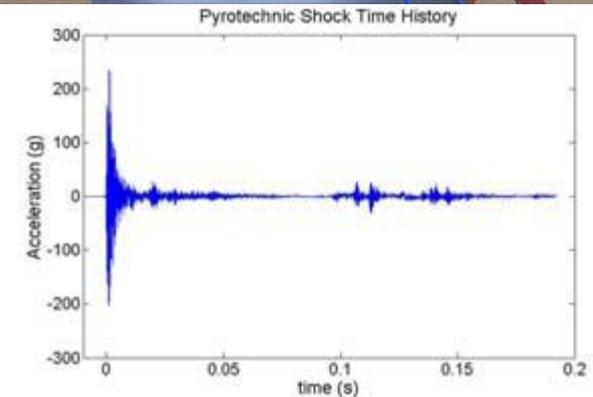
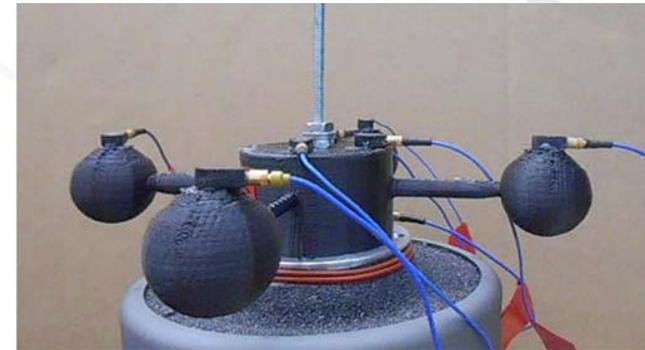
Gas gun for remote sensor placement that will be mounted on small quadcopter



Computer vision-based warning of criticality accidents in glove boxes

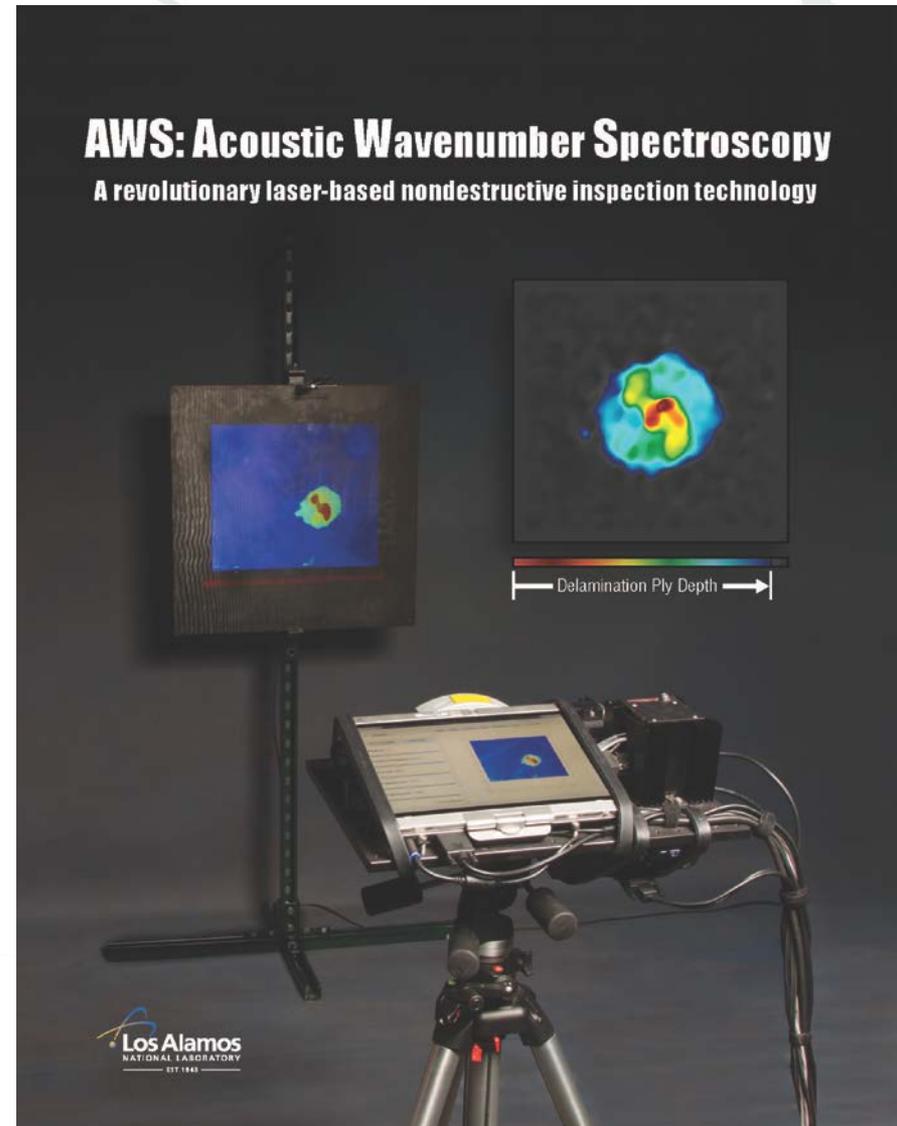
Support of Weapons Environmental Testing

- The Eng. Institute is working with Stuart Taylor (AET-1) and Steve Ellis (W-1) to support weapons testing
 - Develop new data analysis tools for system-to component-level testing
 - Provide place with lab space to house new hires waiting for their clearance.
 - Provide unclassified research/projects for these new hires.
 - Eric Flynn (Eng. Institute) working ½ time.
 - Provide student pipeline to weapons program.
 - Address weapons program research needs as identified from testing (e.g. acoustic emissions, non-contact displacement measures)



Eric Flynn's R&D 100 Award

- Eric Flynn's Acoustic Wavenumber Spectroscopy system won 2014 R&D 100 Award
 - Order of magnitude faster than current laser scanning systems used for NDE.
 - Dense measurements of large areas.
 - Extremely portable and fast to setup.
 - He will doing demonstrations for Chevron in Texas.
 - See: <http://www.rdmag.com/award-winners/2014/08/faster-aircraft-defect-analysis>



Fellowship pilot program with Univ. of California Office of the President

- Currently Univ. of California fee money* (approx. \$15 million/yr) is awarded to UC faculty based on an open proposal process. Most of this funding goes to grad student fellowships.
- There are concerns about the alignment of these research activities with Lab mission and Lab recruiting from this program.
- LANL National Security Education Center (Clark, Farrar) has been working with Univ. of California Office of the President (UCOP) Associate Vice President Laboratory Programs (D. McCallen) to propose a fellowship program where Labs define research areas and fellowship recipient spend defined time at Laboratories.
- Pilot program “strawman” is currently being socialized at UCOP and with Laboratory management.

* Funds the Univ. of California receives for managing Los Alamos, Lawrence Livermore and Lawrence Berkeley National Labs

Univ. of California President Napolitano Visit

The Engineering Institute is LANL's primary formal collaboration with the University of California

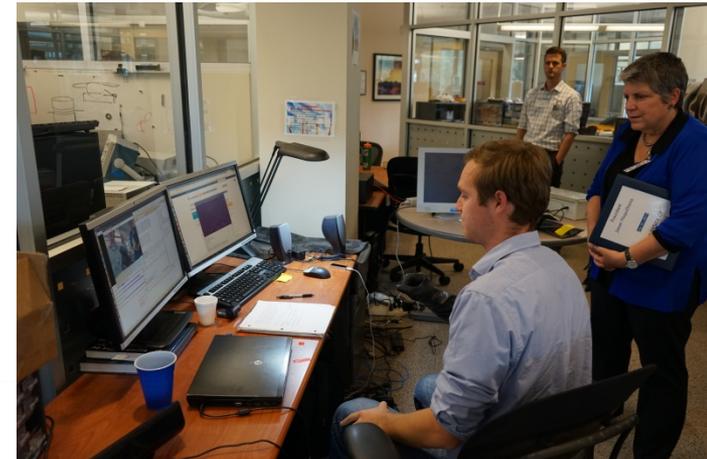
In July, 2014 The Engineering Institute hosted the new University of California President, Janet Napolitano and new Vice-President for Laboratory Management, Kim Budil.

They spent 1 hr+ meeting with students and touring the Los Alamos Dynamics Summer School labs

Compliment from Kim Budil "I'd like to see Livermore create an Engineering Institute"



UC President Napolitano observing quadcopter flight demo



UC President Napolitano discusses computer vision research with grad student