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Title: An Introduction to the 2021 Los Alamos Dynamics Summer School

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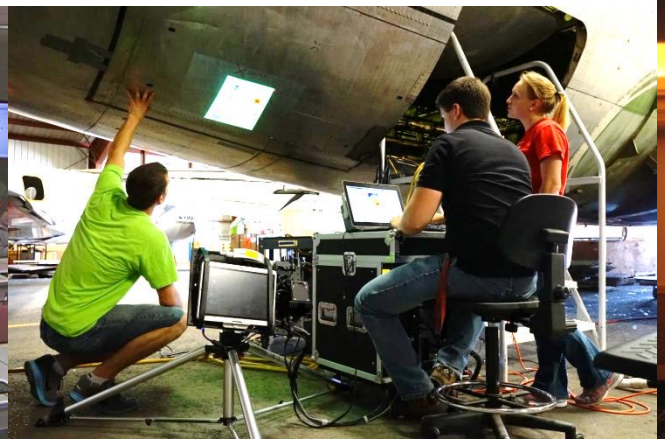
An Introduction to the 2021 Los Alamos Dynamics Summer School



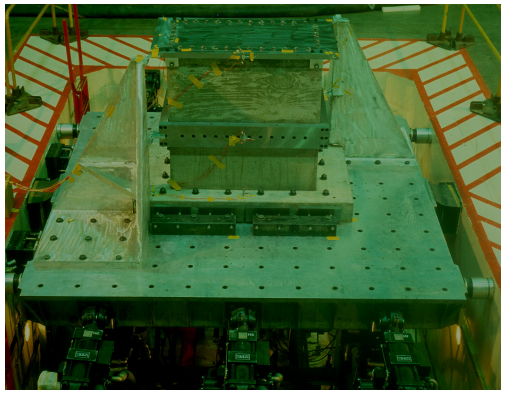
Lectures & Classes **Research** **Student Presentations**

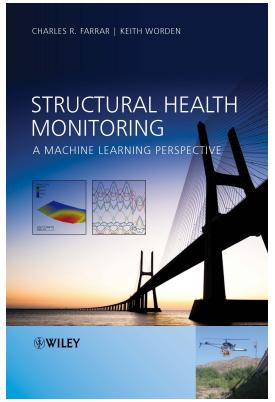
Charles R. Farrar
Engineering Institute Leader

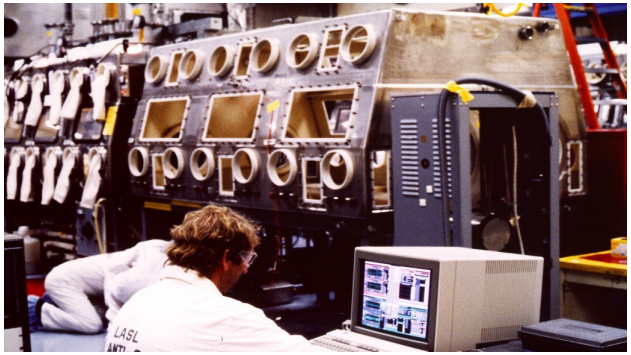
My Background

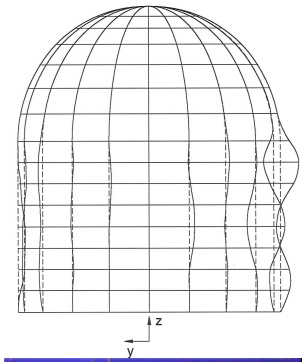
- From a Maryland suburb of Washington DC
- BS Civil Engineering, Michigan Technological University (decision to go there was based on basketball)
- Two years doing repair and maintenance of nuclear reactors on guided missile cruisers and aircraft carriers at Norfolk Naval Shipyard
- MS Civil Engineering, University of New Mexico (decision to go there was based on a backpacking trip in the Pecos Wilderness)
- Started at LANL as a GRA in 1983 and converted to staff within a year.
- Ph.D. Civil Engineering, University of New Mexico while working at LANL.
- Primarily involved in analytical and experimental structural dynamics my entire LANL career.
- Founded LADSS in 2000.
- Engineering Institute Leader since 2003.

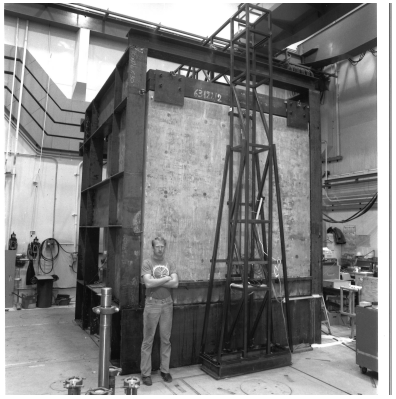
My Background

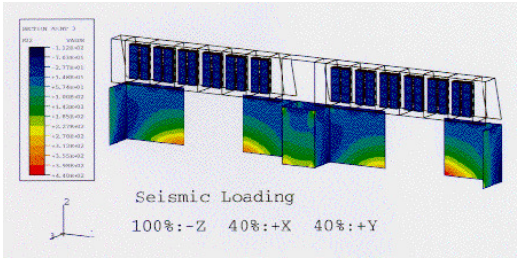


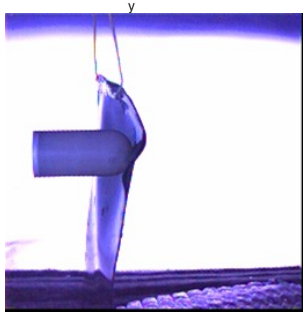












Los Alamos Dynamics Summer School

Los Alamos
NATIONAL LABORATORY

The LADSS is part of the Engineering Institute

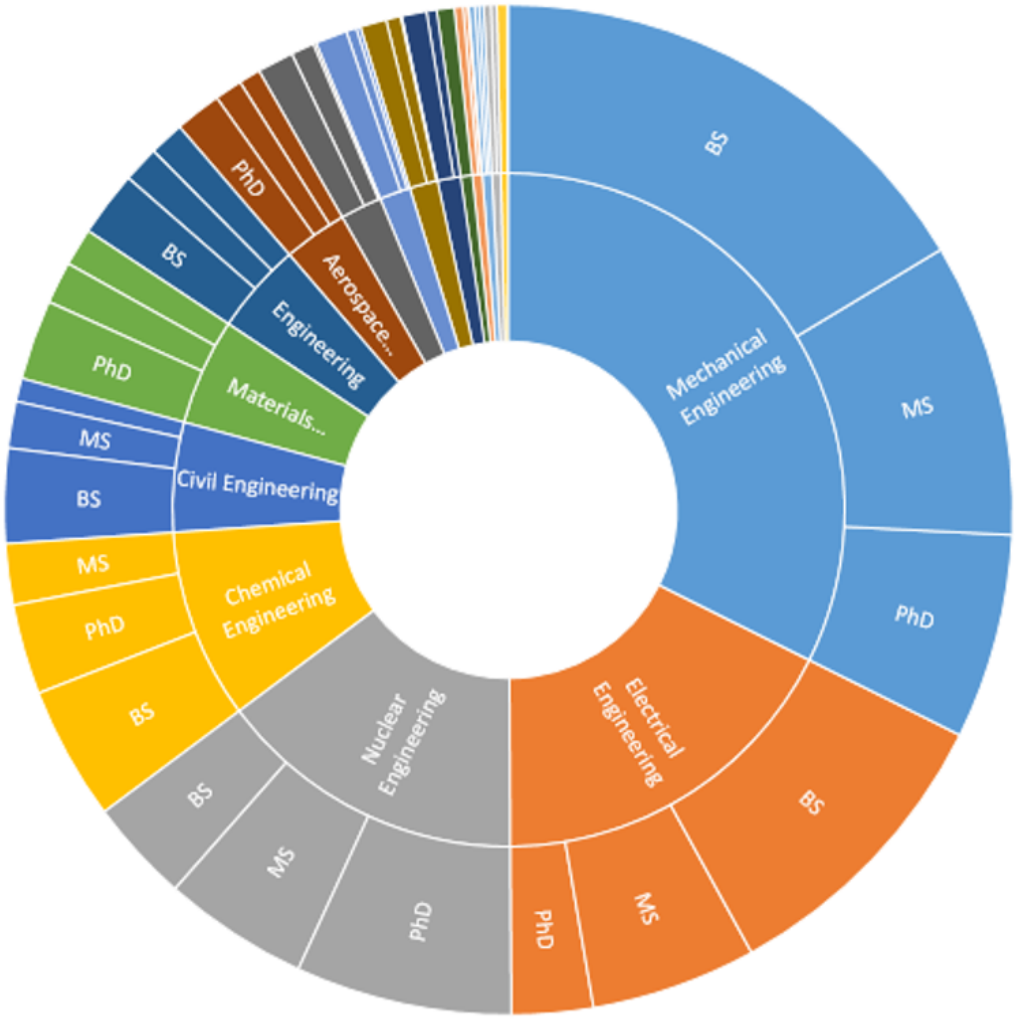
- **THE ENGINEERING INSTITUTE(EI)** is a research and education collaboration between LANL and the University of California San Diego (UCSD) Jacobs School of Engineering started in 2003.

- **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.**

The LANL Engineering Enterprise: Capabilities

Prototype Manufacturing	Continuum Mechanics & Structural Analysis	Electrical Systems Design – Digital	Software Engineering
Chemical Systems Engineering and Design	Robotics, Mechatronics and Automation	Imaging -- High Speed Digital	Systems Engineering
Mechanical Systems Design	Actinide Chemical Processing	Power Systems	Systems Analysis
Weapons Engineering	Dynamic Material Response	Thermodynamic Systems	Electromagnetics
Specialized Nuclear Explosives Package Materials Characterization and Manufacturing	Nondestructive Testing and Evaluation	Reactor Systems & Modeling, Criticality Safety	Accelerator Operations and Maintenance
Specialized Handling of Nuclear Materials	Electrical Systems Design -- Analog	Radiation Detection & Applications	Imaging -- Radiographic

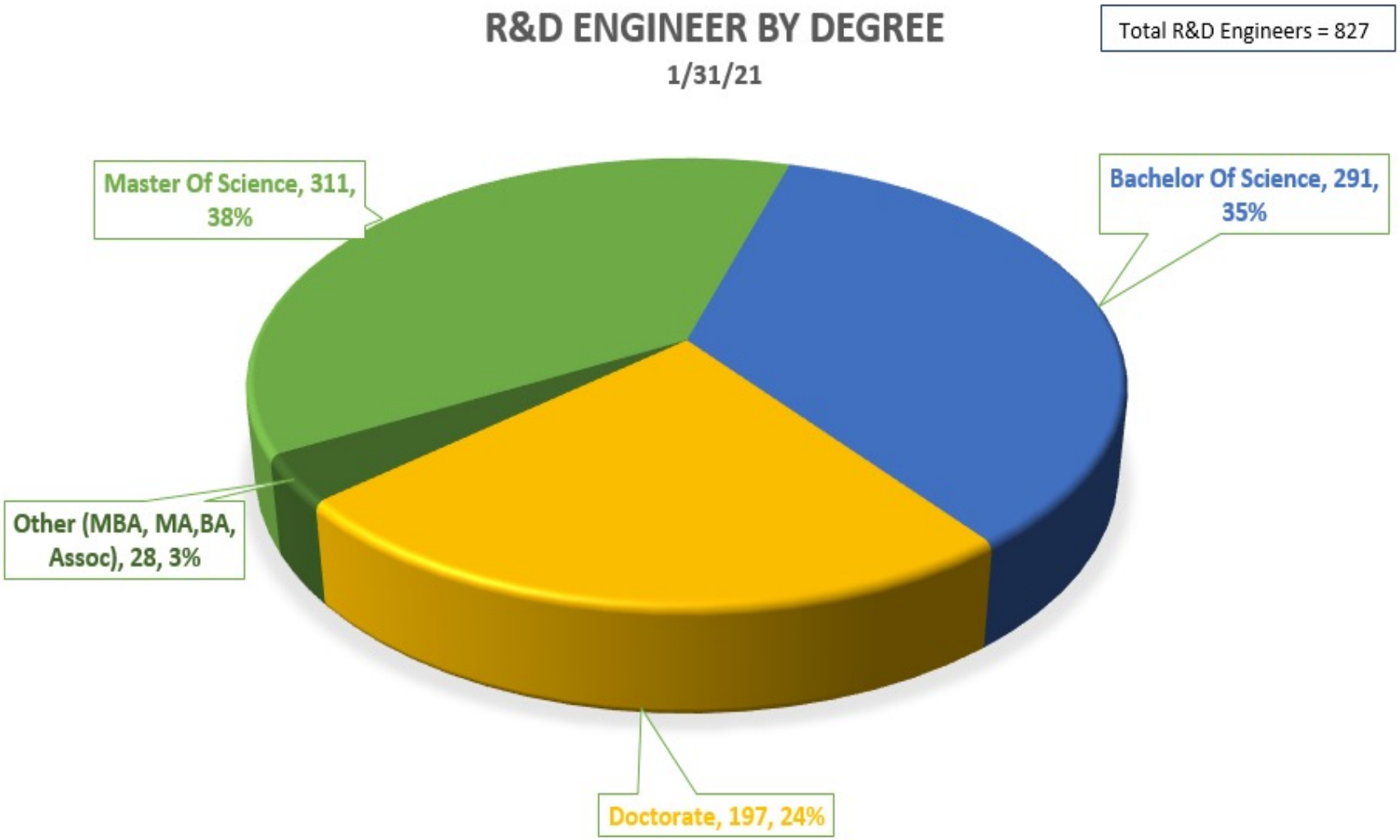
The LANL Engineering Enterprise: Demographics



Job Function	1	2	3	4	5	6	Total
R&D Engineer	94	279	241	180	27	3	824
Scientist	33	491	438	387	141	16	1,506
Total	127	770	679	567	168	19	2,330

Los Alamos NATIONAL LABORATORY

The LANL Engineering Enterprise: Demographics



LANL Projected Engineering Needs 2020-2024

Job Group	Job Subgroup	Current Population	Total Estimated Need	Distribution of Degrees Among Current Employees				
				Other	Associates	Bachelors	Masters	Doctorate
LANL Total		9,385	7,054					
R&D		2,420	972					
	R&D Engineer	736	365	1%	0%	34%	40%	24%
	R&D Manager	241	97	2%	0%	12%	20%	66%
	Scientist	1,443	510	1%	0%	7%	11%	81%
Science & Engineering Support		1,445	1,198					
	Draft Design	51	30	29%	65%	6%	0%	0%
	Facilities Engineers	209	141	40%	26%	29%	5%	0%
	Mechanical Tecs	72	76	74%	24%	3%	0%	0%
	Research Technologist	262	169	23%	14%	32%	26%	5%
	Support Engineers	213	210	2%	0%	69%	28%	1%
	Support Tecs	638	572	53%	18%	20%	8%	2%
Operations		3,316	3,428					
	Craft	1,111	1,398	100%	0%	0%	0%	0%
	Env Safety Health	624	721	27%	10%	29%	29%	5%
	Facility	398	392	57%	10%	21%	12%	1%
	Operations Support	182	152	57%	5%	25%	8%	5%
	Project Mgmt	737	515	28%	4%	28%	27%	13%
	Security	224	197	32%	8%	28%	25%	6%
	Other	40	53	35%	13%	25%	28%	0%
Business Services		2,204	1,456					
	Admin Support	468	193	50%	11%	25%	14%	1%
	Finance & Accounting	236	89	13%	5%	33%	49%	0%
	Human Resources	102	42	23%	10%	32%	33%	2%
	Information Services	200	150	40%	11%	32%	17%	2%
	Information Technology	785	422	23%	11%	45%	19%	1%
	Market & Com	70	30	19%	6%	36%	31%	9%
	Procurement	134	213	36%	13%	36%	11%	4%
	Other	209	317	24%	8%	37%	27%	4%

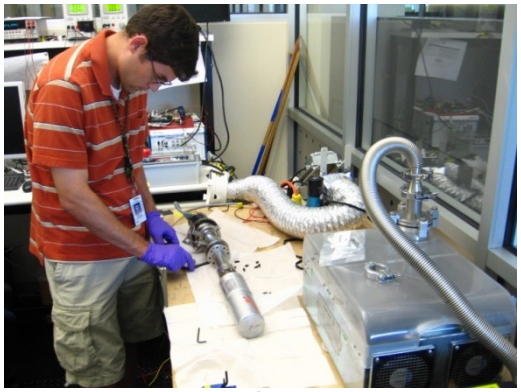
The EI Research and Education Components

- **Since 2003 LANL and UC have invested G&A, UC Fee and Programmatic funds in the Engineering Institute (EI) to support:**
- **Los Alamos Dynamic Summer School (LADSS),**
- Science of Signatures Advanced Study Institute (being re-worked)
- Judicial Science School (restarting)
- Athena Scholars Program
- A joint LANL/UCSD multi-disciplinary graduate degree program,
- TAMU distance-learning MS Engineering programs
- Joint LANL/UCSD multi-disciplinary research projects,
- Engineering research support to line organizations,
- Workshops (not recently),
- Industry short courses, (self-sufficient, no LANL or UC resources used to support this activity),
- **International collaborations (Profs. Nick Lieven, Nikos Dervilis)**

The Los Alamos Dynamics Summer School

Since 2000, 15-21 (24 in 2021) top-performing undergraduate engineering students from around the U.S. enter our program

- Mean undergrad GPA approx. **3.7/4.0, 70+ student have obtained NSF or NDESG grad fellowships**
- Week long (1-hr/day) lectures (e.g. signal processing), Guest seminars on various research topics, tours and field trip.
- Students work on team research projects, produce conference paper, present paper the following February at an International Conference.
- **Our Goal: Motivate students to attend graduate school**! Hopefully, some will return to LANL after they complete their graduate degrees.



Vibration control of mechanically-cooled germanium detector

Vibro-tactile, haptic human-computer interface for damage detection

Summer School Motivation

- Recruitment of talented young students into engineering and computer science fields was identified as a critical need for the economic competitiveness and national defense.
- Approx. 40% of graduate engineering degrees are awarded to foreign nationals (percentage is higher if you look at Ph.D. graduates). This demographic poses significant problem for U.S. defense industry.
- Proactive approach to recruiting for LANL and other DOE labs (Sandia and Lawrence Livermore)

Summer School Goals

- Students' goal is to produce conference paper at the end of the 10-week school.
- Motivate top U.S. citizen undergraduate students to attend engineering graduate school.
- Develop students oral and written communications skills.
- Expose students to interesting, multi-disciplinary, graduate-school-like research activities.
- Make students aware of graduate education opportunities with LANL/UCSD Eng. Institute (18 former LADSS students are/were grad students at UCSD)
- Make students aware career opportunities at LANL.
- Keep in mind that LANL hires BS, MS and Ph.D.-level engineers who are mostly US citizens
  - Most needs are at the M.S. level (ties back to second bullet).

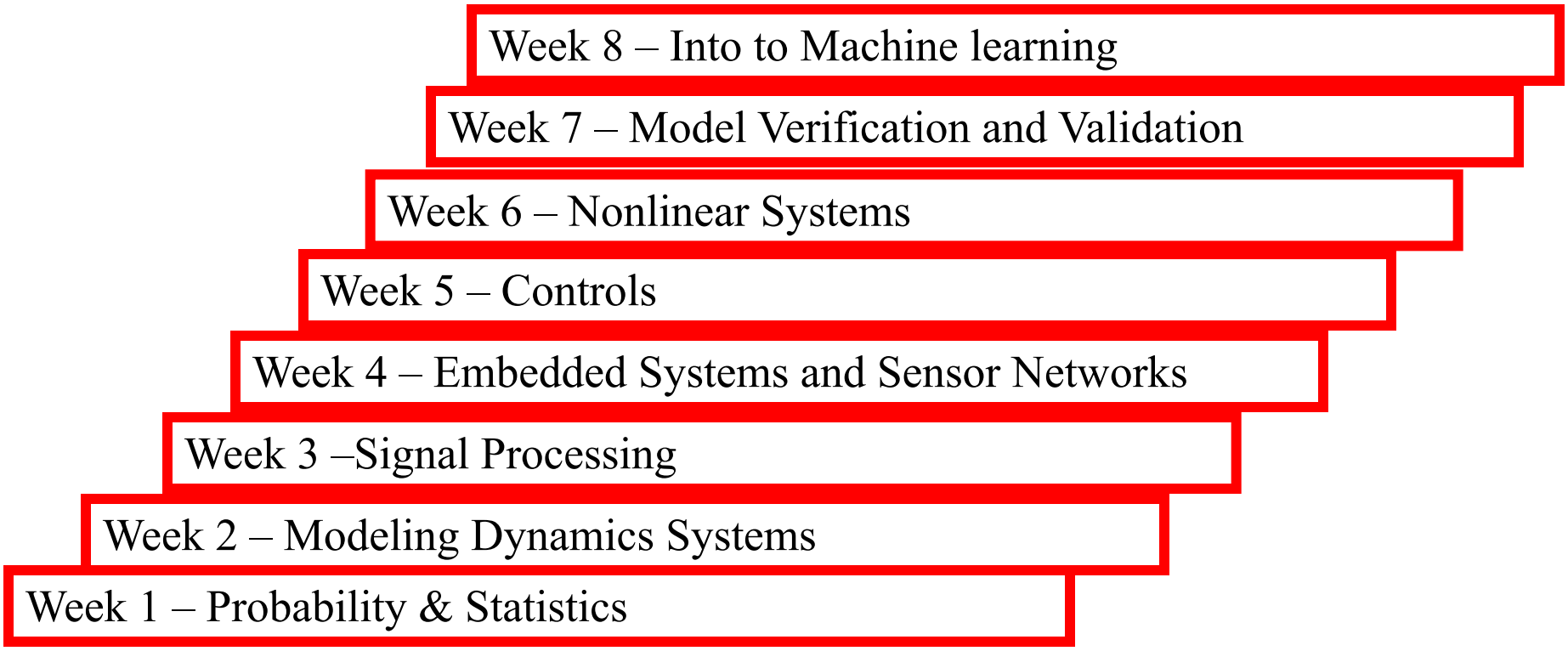
Mentors

- **Student are assigned to 3-person project teams with LANL staff members or visiting faculty member acting as a mentor.**
- **2021 Projects and Mentors**
  - **Scott Ouellette*,** and **Thomas Roberts*,** Simulating SDOF and MIMO Vibration Tests
  - **Garrison Stevens*** and **Chuck Farrar,** Environmental-Insensitive Damage Features Based on Output-to-Output Coherence
  - **Jeff Tippmann** and **Christian Ward,** Signature-driven adaptable collaborative sampling
  - **David Mascareñas*, Alessandro Cattaneo,** and **Fernando Moreu,** Estimation of Light Intensity Time Series from Event-Driven Imagery for Acoustic Measurements
  - **Adam Wachtor, Erica Jacobson*,** and **Nikolas Dervilis** Skin Deep: Multi-Layer Input Deep Learning
  - **Alex Scheinker** and **Alan Williams*** Deep Reinforcement Learning for Active Structure Stabilization
  - **David Mascareñas*, and Andrew Sornboger,** Estimation of Structural Vibration Modal Properties Using a Spike-Based Computing Paradigm
  - **Phil Cornwell,** and **Nick Lieven**, Data Challenges for Structural Health Monitoring of Electrical Machines
- **Note projects do not have a "known" outcome**
- ***Former LADSS participants**

Format

- Ten-week research project with experimental and analytical component
- Four-day lectures on various subjects related to dynamics and cyber-physical systems
- Guest seminars on various research and programmatic activities (mostly at LANL).
- A few professional development lectures(e.g. writing a conference paper, applying to grad school)
- Some guest seminar speakers will spend time reviewing projects with each group as their schedules permit.
- Virtual tours of some LANL facilities
- Prepare International Modal Analysis Conference (IMAC) papers
- Students present papers at IMAC in February 7-10, 2022.

Each week there is a lecture series first thing each morning (Wed. are off)



Most weeks there are two guest seminars (every student must ask a question!)

Satellite Engineering

Weapons Testing

Offshore Wind Turbines

Aerospace Structural Dynamics

The program has changed over the years

The program has been extended to 10 weeks!

New lab space!

New office space!

Some new lectures and tutorials!

Some new mentors!

New selection process for projects!

Virtual delivery!!

What is expected of the students?

- Treat other summer school students with courtesy and respect.
- Be supportive of your research team members and work as a **team!!**
- Take advantage of the people that will be presenting tutorials – ask lots of questions!!
- **Be on time for tutorials and guest lectures!**
- Promptly submit on-line reviews of speakers
- **DO NOT SLEEP** during talks – this is not school, you are being **paid** to attend and participate.
- **Professional conduct at work and responsible conduct in the community!**

Your deliverables/assignments

1. Safe conduct at all times!
2. Safety assessment
3. IMAC abstract
4. **Ask at least one question at every afternoon lecture**
5. Fill out very short surveys of each lecture and tutorial
6. Interim individual presentations of your project
7. Interim write-ups that will form your conference paper
8. Final team presentation
9. Final paper
10. Program review

We will provide a schedule and examples of these deliverables