NOMAD
RESEARCH INSTITUTE

CUTTING EDGE RESEARCH. COLLABORATION.
NETWORKING. SOUTHWEST CULTURE.

The Nonlinear Mechanics and Dynamics (NOMAD) Research Institute seeks to tackle research challenges in the field of nonlinear mechanics and dynamics by forming diverse teams of B.S., M.S., and Ph.D. students. The program is sponsored by Sandia National Laboratories and the University of New Mexico.

The Program.

- The program will run from **June 16 to August 8, 2025** at the University of New Mexico Campus in Albuquerque, NM
- You are matched with research projects based on your **research interests and skills**.
- **Internships available** to U.S. citizens, legal permanent residents, asylees or refugees in the U.S. (See job posting ID Grad #694701 & Undergrad #694700)

The Benefit.

- Meaningful work in your area of interest to improve understanding of cutting edge research and development
- Short-term position to accommodate the graduate research commitments of students
- An opportunity to present and publish novel research in nonlinear mechanics and dynamics

The Engineering Disciplines.

- Mechanical
- Civil
- Aerospace
- Engineering Mechanics
- Applied Mathematics
- Materials

The Contacts.

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PROJECTS SUMMER 2025

Quantifying the Effect of Non-Physical Parameters on the Nonlinear Dynamics of an Electromechanical Ratcheting Mechanism

Complex electromechanical mechanisms often have to account for a multitude of physics and nonlinear phenomena to operate properly. Previous work has demonstrated that the solutions obtained by FEMs of these assemblies are sensitive to small variations in non-physical parameters (such as the mesh discretization and FEM solver tolerances). This project intends to isolate and study the sensitivity of each non-linear interaction. The end goal is to develop an FEM model of an electro-mechanical mechanism that produces solutions that are insensitive to minor variations in non-physical parameters.

Modal Expansion of Nonlinear Vibration Response Using Neuromorphic Event-based Imaging Data

The emerging field of neuromorphic imaging applies computing techniques inspired by biological nervous systems to extract relevant data from image sensors in real-time for low-latency applications. This project will investigate the integration of neuromorphic imaging data with spatial expansion to improve the interpretation of full-field vibration response with a focus on nonlinear behavior. The students will acquire data from a nonlinear pylon using neuromorphic imaging techniques and combine it with accelerometer data from the main structure in an expansion procedure.

Verification and Convergence of the Method of Harmonic Balance within Sierra/SD FEA Code

The method of harmonic balance is a frequency-domain approach that efficiently computes the time-periodic, or steady-state, vibration response to a periodic input. It is widely used throughout the nonlinear structural dynamics R&D community to efficiently solve nonlinear vibrations problems, and it is beginning to be adopted into commercially available FEA codes. The proposed project seeks to investigate the current code implementation of the harmonic balance method in the Sierra/SD FEA codes developed at Sandia and perform verification studies to assess the state of the current implementation.

Electrical chatter and modal response of pin-receptacle contacts in oil

During severe mechanical environments, electromechanical switches are sometimes observed to chatter, which cause switches to fail to transmit intended electrical signals and/or corrupt the intended signals. This project intends to perform both modal analysis and chatter analysis of pin-receptacle contacts in air and in oil, as it is common for the switches in which these contacts are used to be fluid filled. The objective of this project is to collect high-quality experimental data, which will be leveraged to calibrate and validate two types of computational chatter models.

Investigating the Microstructure and Properties Relationship of Ta-alloy

Material strength models typically assume a homogenized material representation, where the impact of localized chemistry, grain shapes, crystallographic textures, impurity/defect densities and microstructure on mechanical properties are not fully considered. Previously collected data on the microstructure of a Ta-alloy will be used to inform a multi-scale modeling approach. The main objective of this project is to determine if we can predict the extent of reduction in ductility associated with a specific grain size and/or texture.

Bolted Joint Friction Modelling Under Shock Loading

This integrated project will focus on predicting the response of a 'single-joint' coupon to shock loading generated using a Hopkinson bar. Hopkinson bar experimental data over a range of shock amplitudes will be used to define input loading conditions and validate results against digital image correlation and laser vibrometer data. The students will explore the effects of various friction and contact modelling approaches, and use the model to evaluate friction forces and internal bolt stresses as a result of the applied shock loading.

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