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, as well as post-doctoral and early-career researchers. The program is sponsored by Sandia National Laboratories and the University of New Mexico.

The Program.

- Held from **June 14, 2021** to **July 29, 2021** 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

  Please refer to the website for current openings.

The Benefit.

- Meaningful work in your area of interest to improve understanding of **cutting edge research and development**
- Collaborate with researchers from around the world under the mentorship of the **professional community**
- **Short-term position** to accomodate 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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Visit NOMAD online at sandia.gov by visiting **http://tinyurl.com/gw8r5wf**

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2021 NOMAD PROJECT LIST

Nonlinear characterization of a joint exhibiting a reduction in damping at high energy

A simple exemplar structure with a single nonlinear joint has been shown, under certain loading conditions, to exhibit the softening behavior (i.e. decrease in natural frequency), but with an apparent decrease in damping. The resonant response resulted in a nearly 500% increase in amplification in the response at high forcing levels. The objective of this NOMAD project is to understand and characterize the nonlinear response of this exemplar structure through testing, modeling, and simulation.

Empirical models of puncture energy for metals

An empirical curve has been developed for the lower bound of energy dissipated by metal plates as they are punctured by cylindrical probes. This project will identify a series of lower-bound curves based on explicit dynamic finite element simulations that are tailored to a few specific tests given four key inputs: the material, thickness, probe size, and probe shape. Test results and validated finite element models will be provided for specimens of different materials and thicknesses that were punctured by probes of multiple sizes and shapes.

Mapping from low fidelity to high fidelity analysis for failure quantities of interest

Often in large numerical simulations decisions are made to reduce the fidelity of particular features in order to simulate the event duration. One common method is the application of shell formulations instead of 3D continuum, especially for objects with large aspect ratios of extent to thickness. This project seeks to examine the effect of various fidelity discretization on material failure quantities of interest and determine useful sub-modeling techniques to bridge the multiple fidelities.

Modeling rate dependent interface separation with cohesive zone models and bulk viscoelasticity

In complicated components and structures the interface between materials can play a large part in mechanical behavior and failure. Predicting failure at interfaces is often more complicated than in bulk materials but when one of the bonded materials is highly inelastic it is unclear how to partition energy dissipation between interface delamination and bulk inelastic processes. In this project we exercise existing capabilities to model interfacial separation and evaluate their effectiveness in delamination of metal/polymer interfaces by comparing to measured data.

Investigating electrical connection chatter induced by structural dynamics

Inherent in the design of circuits is the ability to maintain electrical continuity, which can rely on electromechanical features. One example of such a feature is a pin-receptacle connection. In a dynamic environment, the resistance between these two components can become sufficiently large such that electrical energy cannot be adequately transferred. This phenomenon is referred to as chatter. This project focuses on investigating the influences of the structural dynamics of the pin-receptacle connection on chatter through testing, modeling, and numerical analysis.

Nonlinear transient response of electromechanical assemblies

This project focuses on non-linear electromechanical systems whose sources of nonlinearity come from contact impacts between piece parts, which invalidate the assumptions needed to apply linear modal analysis. The NOMAD team will perform a systematic exploration of a simplified example to understand how contact impacts lead to nonlinear coupling between elastic and rigid body modes. These discoveries will be supported with generation of both simulated and experimental data and leverage nonlinear modal analysis theory along with signal processing methods.

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