

# BYU Mechanical Engineering

## IRA A. FULTON COLLEGE OF ENGINEERING

### Research Projects by Professorial Faculty (A-Z)

#### **Brad Adams,** [brad.adams@byu.edu](mailto:brad.adams@byu.edu)

- Using CFD modeling of dust emissions and transport to predict air quality impacts of land use changes and climate change.
- Using urban canopy models to study impacts of urban growth and anthropogenic heating on urban meteorological conditions.
- Using chemical transport models to study impacts of NO<sub>x</sub> and VOC emissions on ground level ozone concentrations under different seasonal conditions.



#### **Matt Allen,** [matt.allen@byu.edu](mailto:matt.allen@byu.edu)

- Using multi-input-multi-output control to reproduce vibration environments experienced by components flying on rockets and other vehicles.
- Developing methods to predict the energy lost due to friction within bolted joints of aerospace vehicles, in order to more accurately predict their survivability in extreme environments.
- Using vibration measurements to infer the forces in tendons and ligaments during biomechanical activities such as walking and running.



#### **Jon Blotter,** [jblotter@byu.edu](mailto:jblotter@byu.edu)

- Vibrations and optical-based measurements
- Detection of external speech signals in noise and development of next-generation audio system
- eVTOL Aeroacoustic Design Framework Development
- Detection of external speech signals in noise and development of next-generation audio system



#### **Anton Bowden,** [abowden@byu.edu](mailto:abowden@byu.edu)

- Using wearable, nano composite sensors to measure spine biomechanics and phenotype underlying causes of chronic low back pain
- Designing artificial vertebral endplates using a novel carbon-infiltrated carbon nanotube material
- Designing a minimally invasive, expanding spinal surgical implant device



Spinal Technologies

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**Steven Charles**, [skcharles@byu.edu](mailto:skcharles@byu.edu)

- Predicting tremor: Developing a validated, subject-specific model of tremor
- Investigate how healthy humans control their movements
- Determine how movement disorders alter movement behavior
- Develop technology to evaluate, assist, and/or rehabilitate patients with movement disorders



**Douglas Cook**, [d.cook@byu.edu](mailto:d.cook@byu.edu)

- Agricultural Robotics: A hot new domain for robotics! Using robotics and machine learning to speed up and reduce the cost of performing agricultural tasks like weeding, harvesting, testing plants, etc.
- Plant Biomechanics: using experimental and computational principles from biomechanics and machine learning to understand how plants work and then "design" structurally optimal plants!



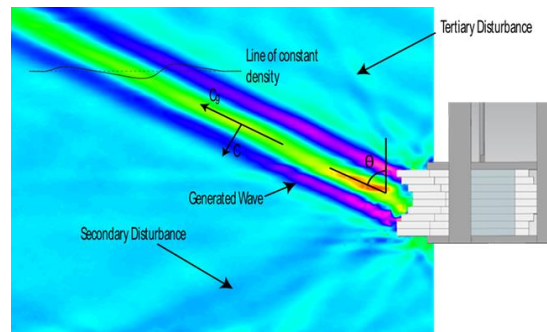
**Nathan Crane**, [nbcraane@byu.edu](mailto:nbcraane@byu.edu)

- Additive manufacturing (AM) of high performance fiber-reinforced composites using powder-based precursors.
- Improving quality of metal binder jetting AM through study of inkjet droplets impacting on rolled powder beds.
- In situ defect detection and process monitoring of additive manufacturing (AM) processes using thermal response to heat inputs.



**Julie Crockett**, [juliecrockett@byu.edu](mailto:juliecrockett@byu.edu)

- Droplet evaporation on superhydrophobic surfaces
- Stratified flow and internal ocean waves;
- Superhydrophobic fluid physics and thermal transport.

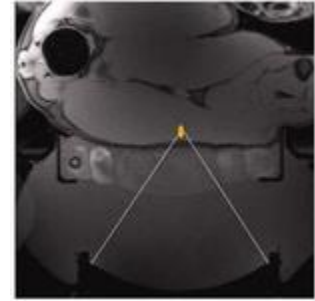


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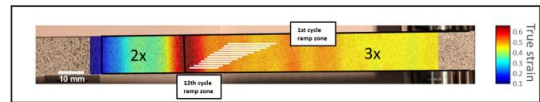
**Christopher Dillon**, [chris.dillon@byu.edu](mailto:chris.dillon@byu.edu)

- Measuring temperature-dependent fat tissue properties to improve computational models of magnetic resonance-guided focused ultrasound (MRgFUS) thermal therapies.
- Validating computational models that predict heating location and magnitude in MRgFUS therapies.
- Accelerating simulations of MRgFUS by means of reduced order modeling and machine learning.
- Building devices to measure Achilles tendon stress during dancing to assist in predicting Achilles tendinopathy injury.



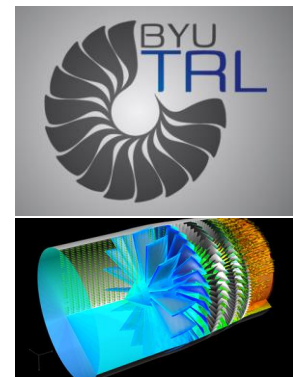
**David Fullwood**, [dfullwood@byu.edu](mailto:dfullwood@byu.edu)

- Characterizing geometrically necessary dislocations, and their influence on springback during forming of sheet metals.
- Understanding the extreme elongation arising during forming via continuous bending under tension: application to HCP metals
- Monitoring modified biomechanical motion in chronic lower back pain patients via high-elongation nano-composite strain sensors



**Steve Gorrell**, [sgorrell@byu.edu](mailto:sgorrell@byu.edu)

- Analysis of a large turbomachinery database using open source tool
- Computation fluid dynamics (CFD) study of a wide flow range turbocharger compressor
- Turbomachinery aerodynamics
- CFD modeling of inlet distortion



**Jeff Hill**, [dr.jeff.hill@byu.edu](mailto:dr.jeff.hill@byu.edu)

- Experimentally testing the use of small, micrometer size hard and soft beads to protect electronics in harsh mechanical environments of 100-10,000 g's of deceleration
- Modeling compliant tensegrity structures for rapid optimization of impact absorbing structures
- Exploring methods to manipulate tensegrity structures for locomotion
- Developing a bi-stable tensegrity structure to apply stiffness to a back support brace

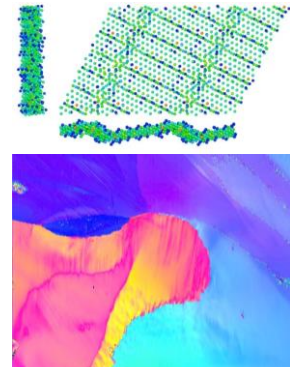


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**Eric Homer**, [eric.homer@byu.edu](mailto:eric.homer@byu.edu)

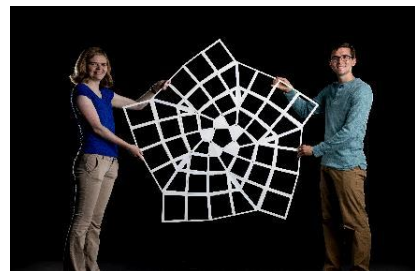
- Martensitic transformations in paraelectric shape memory ceramics activated by an electric field
- Computational and experimental investigation of cryogenic grain boundary motion for enhanced mechanical behavior and properties
- Computational materials modeling via molecular dynamics and machine learning
- Metallic grain boundaries
- Shape memory ceramics



**Larry Howell**, [lhowell@byu.edu](mailto:lhowell@byu.edu) & **Spencer Magleby**, [magleby@byu.edu](mailto:magleby@byu.edu)

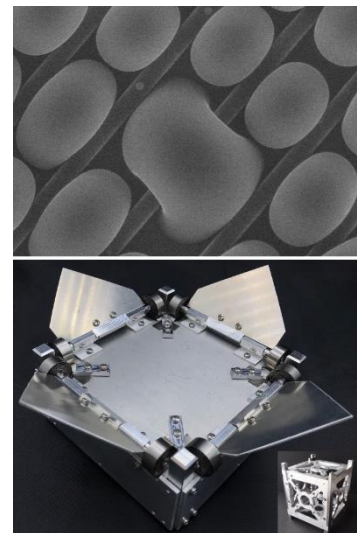
Compliant Mechanisms Research Group

- Using principles of compliant mechanisms & origami to design a deployable membrane telescope for NASA.
- Collaborating with Florida International University to design various configurations of foldable thin reflect-array antennas for space use by Air Force Research Labs.
- Researching origami patterns, membrane hinge designs, & methods of stabilization for a variety of foldable space array systems.
- Designing compliant mechanisms for a mixture of biomedical applications.
- Analyzing compliant mechanism designs to create robust systems.



**Brian Iverson**, [bdiverson@byu.edu](mailto:bdiverson@byu.edu)

- Wetting behavior and heat transfer: Phase change processes like boiling and condensation are drastically affected by how a liquid wets a surface. Wetting behavior can result in unique droplet and bubble dynamics. We seek to understand how micro/nanoscale surface texturing and surface chemistry can be used to inhibit or enhance heat transfer.
- Radiative cooling: Spacecraft and next generation indoor climate control utilize radiative cooling as a primary method of heat transport. We explore how surface structure and actuation can be used to dynamically control heat transfer for optimum thermal management.
- Energy systems: Solar power generation and many non-renewable energy sources are being considered for pairing with the highly efficient supercritical CO<sub>2</sub> Brayton cycle. We study ways to improve power plant cycle efficiency and unique combinations of technologies to reduce undesirable pollution.



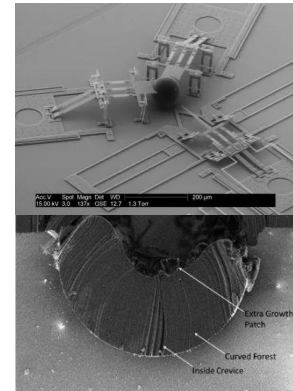


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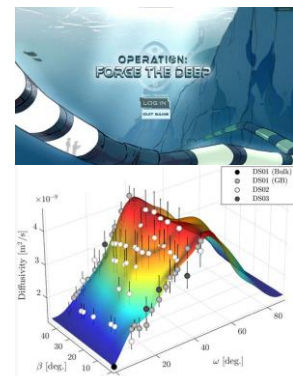
**Brian Jensen**, [bdjensen@byu.edu](mailto:bdjensen@byu.edu)

- TULA health - Non-Invasive health sensing
- Development and applications of carbon infiltrated carbon nano-tubes (CNT) for use in biological systems
- Micro-electromechanical systems (MEMS) development and design of mechanical systems



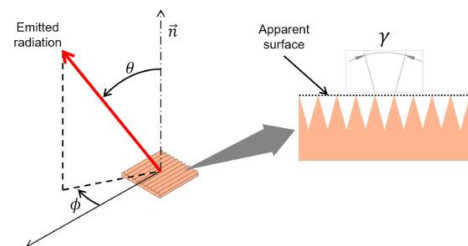
**Oliver Johnson**, [ojohnson@byu.edu](mailto:ojohnson@byu.edu)

- Quantifying & designing grain boundary network structure via spectral graph theory
- Design optimization and validation of robotic construction systems
- Bayesian inference & uncertainty quantification
- Material property homogenization and localization
- Microstructure design of materials and community science solutions to complex problems



**Matt Jones**, [mrjones@byu.edu](mailto:mrjones@byu.edu)

- Real-time additive manufacturing defect mitigation using pulsed thermography
- Reduced order modeling of thermal systems
- Energy transport, conversion, and harvesting



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**Marc Killpack**, [marc\\_killpack@byu.edu](mailto:marc_killpack@byu.edu)

- Design and adaptive control of soft robotics
- Physical human/robot interaction
- Design optimization and validation of robotic construction systems
- Tactile sensor development and using them to estimate the shape of an air filled and driven robot



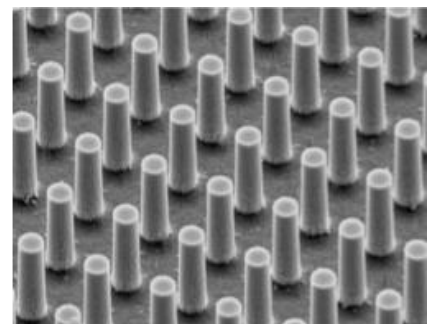
**Chris Mattson**, [mattson@byu.edu](mailto:mattson@byu.edu)

- Design theory
- Engineering for global development
- Effective Use of Product Architecture to Help Engineering Teams Manage Complexity in the Design Process
- Promoting Desirability and Transferability in Engineering Design through Customized Development Processes
- Effective Use of Product Architecture to Help Engineering Teams Manage Complexity in the Design Process



**Dan Maynes**, [maynes@byu.edu](mailto:maynes@byu.edu)

- Superhydrophobic surfaces: Experimental and analytical investigations of the fluid and thermal transport physics associated with liquids impacting superhydrophobic surfaces. Condensation on superhydrophobic surfaces.
- Turbomachinery: CD modeling of pumps operating in extreme environments. Development of predictive models for future turbomachine design.
- Propeller Aerodynamics: PIV measurements exploring the flow field of closely spaced propellers.



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**Tim McLain**, [mclain@byu.edu](mailto:mclain@byu.edu)

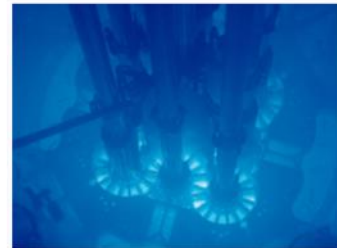
Research focus: Autonomous aircraft guidance, navigation, and control.

- Electric vertical take-off and landing (eVTOL): methods for aircraft localization for landing in urban environments where GPS is degraded or unavailable
- Unmanned aircraft navigation in challenging environments where GPS is jammed, degraded or unavailable.
- Autonomous shipboard landing of multirotor unmanned aircraft



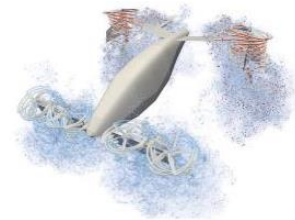
**Troy Munro**, [troy.munro@byu.edu](mailto:troy.munro@byu.edu)

- Using high resolution 3D printers to study how proteins and DNA unfold to understand their impact on human diseases
- Creating two devices and measuring the thermal conductivity of molten salts for safer nuclear power plants and for thermal energy storage
- Measuring the thermal environment between a friction stir welding tool and welded piece to reduce production costs and produce lightweight vehicles
- Creating a thermal properties microscope using lasers and projectors to shorten measurement times from 2 years to 1 week



**Andrew Ning**, [aning@byu.edu](mailto:aning@byu.edu)

- Multidisciplinary design optimization of electric vertical takeoff and landing aircraft
- Analysis and design of low-noise ducted propellers for small passenger aircraft
- Aerodynamic modeling of unsteady complex wakes with applications for wind farm analysis
- Optimization of wind turbines and wind farms
- Efficient ways to compute derivatives for optimization and machine learning
- Aerodynamics and applications of multirotor aircraft

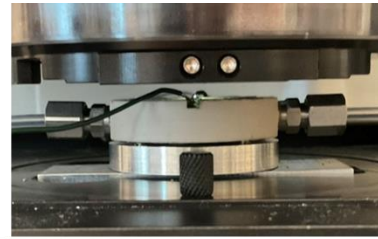


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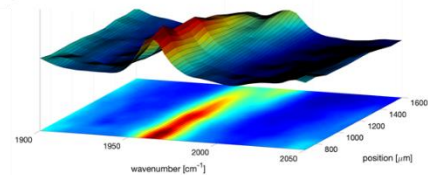
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**Jason Porter**, [jasonporter@byu.edu](mailto:jasonporter@byu.edu)

- Ion transport in battery electrolytes: measuring transport properties using infrared imaging (pictured)
- Lithium depletion during battery fast charging: measuring local ion concentrations in a battery during fast charging using infrared spectroscopy
- Polysulfide transport in lithium-sulfur batteries: Using infrared spectroscopy to identify and track sulfur species in operating batteries.

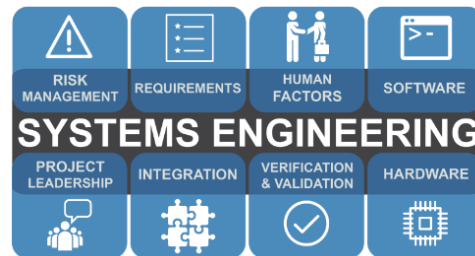


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**John Salmon**, [johnsalmon@byu.edu](mailto:johnsalmon@byu.edu)

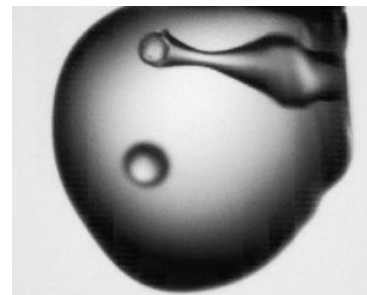
- Systems engineering of aerospace systems particularly UAVs and airport design
- Autonomous 4D flightpath based airborne separation assurance system
- Interdisciplinary studies of engineering system design
- Public sustainable design projects in California
- Alternative energy systems including solar electric and human-powered vehicles



[incose.org](http://incose.org)

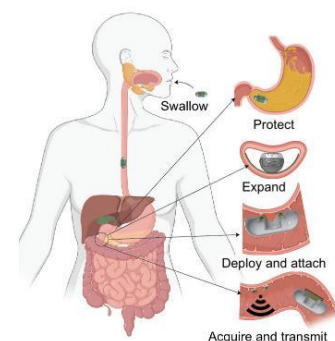
**Nathan Spiers**, [nathan\\_spiers@byu.edu](mailto:nathan_spiers@byu.edu)

- Entry of objects into a body of water and the associated forces and deformation of the air-water interface
- The inception of vaporous cavitation
- Collapse dynamics of cavitation bubbles
- Microscale interactions of particles and droplets in the atmosphere



**Benjamin Terry**, [ben\\_terry@byu.edu](mailto:ben_terry@byu.edu)

- Development of swallowable, retainable medical capsules for characterizing the impact of probiotics.
- Development of new surgical tools to facilitate minimally invasive access to the abdominal cavity.
- Quantification of value to the customer of human agents in the loop of driverless delivery robots.





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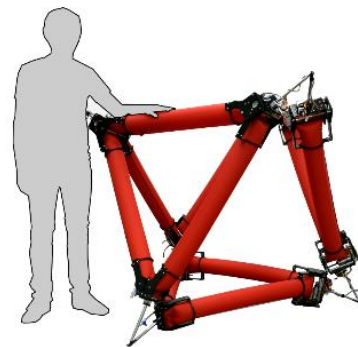
### Dale Tree, [treed@byu.edu](mailto:treed@byu.edu)

- Measuring the spectral emission of water vapor at high temperature and pressure
- Using water vapor emission to measure the inlet temperature of a gas turbine engine
- Biomass combustion for carbon capture and climate control



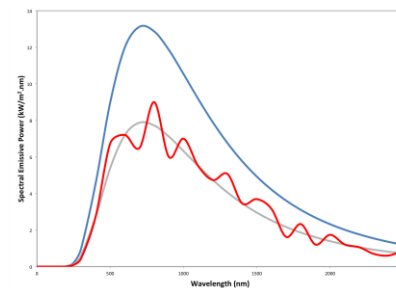
### Nathan Usevitch, [nathan\\_usevitch@byu.edu](mailto:nathan_usevitch@byu.edu)

- Mechanical design of novel robotic systems
- Design, modeling and control of soft robots
- Haptic device development for human/computer interaction
- Design of wearable and assistive devices using soft robotic technologies



### Brent Webb, [webb@byu.edu](mailto:webb@byu.edu)

- Advanced spectral models for predicting radiation heat transfer in high temperature gases
- Effect of real gas radiation in combined mode transport problems



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