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Faculty Project Supervisors 2024-25

	Professor	*Home department*	*Area / Projects*
1	Aluru, Narayana	Mechanical Engineering	Research in the Multiscale Nanotechnology Group focuses on the development of multiscale methods combining quantum, atomistic, mesoscale and continuum scales, and application of multiscale methods to study physics of nanofluidics, bionanotechnology, nanomaterials/nanoelectromechanical systems, and soft matter. Some of the applications currently pursued in the group include water desalination, nanopower generation, DNA sequencing, protein recognition, 2D materials-based chemical and biological sensing, CO2 reduction, energy storage, etc. Website: https://sites.utexas.edu/aluru/
2	Bajaj, Chandrajit	Computer Science	1) Deep Structured Inference Agents: Counterfactual Inference for Improved Outcomes from Multi-modal Patient Clinical and Imaging Observations (e.g. Combatting Parkinson’s disease) 2) Principled Learning to Model Stochastic Dynamical Environments (eg. POMDPs, PDEs, HJB, PMP) 3) Dynamic Belief Games (e.g. New Materials Discovery, Network Topology Optimization)
3	Baker, Aaron	Biomedical Engineering	We are creating computational models of the cell and the glycocalyx under mechanical forces. In particular, we are interested in modeling how mechanical forces are transmitted through cells and can cause changes in the chromatin or cell signaling. These studies aim to improve our understanding of cellular mechanism of mechanotransduction and gene regulation.
4	Bakolas, Efstathios	Aerospace Engineering & Engineering Mechanics	Interested students will have an informal interview to ensure background, experience, and interests match the project's expectations/requirements. 1) Decision making and control for spatially distributed multi-agent systems (algorithm design and simulation studies) 2) Local motion planning (collision avoidance) and path planning for autonomous robots in dynamic and uncertain environments (requirement: good familiarity with path / motion planning methods)
5	Baldea, Michael	Chemical Engineering	1) Mathematical modeling, optimization and control of process and energy systems. 2) Data visualization and analysis for manufacturing systems.
6	Becker, Thorsten	Geological Sciences	1) Earthquake dynamics 2) Thermo-chemical mantle convection models 3) Planetary evolution modeling
7	Biros, George	Mechanical Engineering	Parallel Algorithms for Data Analysis and Simulation Group. We are working on numerical methods for fundamental problems in computational physics & machine learning. Target applications include machine learning for medical imaging, computational fluid mechanics for blood flow & porous media flows, inverse problems, & uncertainty quantification. Website: https://padas.oden.utexas.edu/

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8	Bollapragada, Raghu	Mechanical Engineering	*Area:* Optimization for Machine Learning
			Description: We are developing nonlinear stochastic optimization algorithms for solving problems in training large-scale machine models with applications in science and engineering. Projects involve designing, analyzing, implementing, and testing optimization algorithms.
9	Bui, Tan	Aerospace Engineering & Engineering Mechanics	1) Inverse problems
			2) Uncertainty quantification
			3) Numerical analysis
			4) Numerical optimization
			5) Reduced-order modeling (model order reduction)
			6) Scientific computing
			7) Parallel computing
			8) Scientific machine learning
10	Burby, Joshua	Physics	General area of research: stellarator magnetic confinement fusion
			1) Isodrasticity metric for stellarators: Charged particles moving in stellarator fields come in two classes, bouncing and passing. Good stellarator confinement requires bouncing particles never suffer orbit-type transitions. Isodrasticity is the minimal condition on a magnetic field that ensures bouncers suffer no such orbit-type transitions. This project aims to develop the first computational metric for measuring the deviation of a given magnetic field from isodrasticity. This metric will ultimately be incorporated into stellarator design codes in order to expand the class of candidate stellarator reactors the design code searches through.
11	Castillo, Edward	Biomedical Engineering	The Dynamic Medical Image and Computing Lab develops medical image processing & analysis methods for clinical applications. This work is highly interdisciplinary, drawing on expertise in imaging, applied mathematics, medical physics, biomechanics, and medicine. Our current projects involve inferring patient-specific biomechanical properties from dynamic imaging for applications in radiation oncology, radiology, and pulmonology.
			Project: Standard image-guided radiotherapy (RT) planning for lung cancer delivers a prescribed dose to the tumor while satisfying safety constraints for critical organs. Current RT planning makes the simplifying assumption that lung function is spatially homogeneous. However, we recently showed that incorporating heterogenous function into RT planning reduces both the incidence of lung toxicity and the magnitude of post-RT pulmonary function loss. Using physical modeling and deep learning methods, we wish to develop an optimization framework for maximizing patient lung function post-RT.

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12	Chang, Joshua	Neurology	1) Developing a better understanding of how electrical stimulation therapy modulates neuronal behavior. We've developed techniques to find optimal stimulus waveforms for controlling neuronal systems, but more insight is needed to understand the mechanisms underlying such changes. This project will involve modeling more complicated neuronal systems, and then exploring the relationships between the optimal stimulus shape and the responses along different ionic channels.
			2) Optimizing and understanding the use of complex stimulus waveforms to construct spatially targeted stimulation in biological tissue. This project will involve complex spatial computational modeling of electric field propagation in tissue (e.g., brain) as well as experimental studies conducted on the effects of electrical stimulation of brain tissue.
			3) Analyzing physiological signals from the NICU in order to identify time-series driven signatures of critical adverse events in prematurely born infants (e.g., bradycardia, apneas and desaturations). Determining how these signatures may relate to longer term patient-specific outcomes (e.g., rehospitalization, neurological and cognitive performance metrics).
13	Chelikowsky, James	Physics / Chemistry / Chemical Engineering	Center for Computational Materials
			Student should have some modern physics
14	Chen, Jingyi Ann	Aerospace Engineering & Engineering Mechanics	Interested students must take one of following technical electives: - COE 379L, Numerical Methods - COE 379L, Imaging Radar Systems
			1) Interferometric Synthetic Aperture Radar (InSAR) image analysis
			2) InSAR-based earth observation applications
15	Cullinan, Michael *(cont'd next pg)*	Mechanical Engineering	1) <u>Computer Vision Processing of In-Line Photoelastic Image Capture for the Improvement of Roll-to-Roll Manufacturing Web Control</u> *Description:* This project will be operating in tandem with a photoelastic imaging tool used in roll-to-roll (R2R) micro/nano fabrication to build a computer vision tool and reference library for analyzing images taken by the tool as they are taken during the manufacturing process. By processing these images, it will be possible to provide real-time tension information to the R2R system and provide recommendations for improving web control and layer alignment to produce more high quality components at a high throughput.

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15	Culllinan, Michael *(con't from prev pg)*	Mechanical Engineering	2) <u>Image reconstruction using machine learning from sparce data</u> *Description:* Image reconstruction using machine learning is a widely applicable topic of research, and in the area of nanomanufacturing it presents a unique opportunity to optimize the feedback control process. Large area nanometrology is typically very slow because it requires physical interaction with the sample to take scans at such a small scale. Image reconstruction makes it possible to generate high quality metrology images using faster scan speeds and low density sampling, reducing overall tool time. This project is working to utilize machine learning to accomplish image error correction and reconstruction for nanometrology by adapting established reconstruction algorithms such as Noise2Noise and Intermediate Layer Optimization and applying them to atomic force microscopy data. 3) <u>Structural-Thermal Modeling of Hybrid Bonded Interfaces to Predict Bond Quality</u> *Description:* This project will focus on the development of a Finite Element (FE) model capable of simulating the hybrid bonding process used to package semiconductor devices with finely spaced interconnects. This model will simulate heating within the bonding materials to predict the relative thermal expansion of copper and silicon dioxide that facilitates bond formation. These simulations will eventually incorporate measured surface profiles (Atomic Force Microscopy) from real structures prior to bonding, simulate the bonding process, and predict both the structural integrity of the bond and its ability to conduct electricity.
16	Delshad, Mojdeh	Petroleum & Geosystems Engineering	1) Modeling Bench- and Field-Scale Hydrogen Storage in Geological Porous Media 2) Pilot- and Field-Scale Simulation and Optimization of Carbon Storage (CCS) and Co-optimization of CO2 Storage and Enhanced Oil Recovery Method (CCUS) 3) Modeling Enhanced Oil and Gas Recovery Methods
17	Demkowicz, Leszek	Aerospace Engineering & Engineering Mechanics	1) Study on Galerkin and Petrov Galerkin methods for 1D model problems 2) Numerical study on DPG and DPG* methods using 1D model problems 3) Study on minimum residual methods in Banach spaces
18	Dortdivanlioglu, Berkin	Civil, Architectural and Environmental Engineering	Develop and validate models using physics-based approaches—such as finite element, isogeometric, material point method, or machine-learning techniques—for applications in 3D bioprinting, active systems, and composites (e.g., tissue-like materials, smart fabrics, concrete).
19	Engquist, Bjorn	Mathematics	Numerical analysis of differential equations, optimization, multiscale modeling and seismic imaging.

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20	Ezekoye, Ofodike	Mechanical Engineering	UT Fire Research Group seeks to understand and characterize high temperature reacting systems with a focus on fire safety science. 1) Modeling and simulation of thermal runaway propagation, fire, and explosion dynamics for lithium-ion cells and battery arrays 2) Modeling and simulation of fire and smoke transport in rooms and buildings
21	Fomel, Sergey	Geological Sciences	Computational geophysics, including seismic imaging, wave propagation, inverse problems, and geophysical data analysis using machine learning
22	Foster, John	Petroleum & Geosystems Engr / Aerospace Engr & Engr Mechanics	Contact for project areas
23	Fridovich-Keil, David	Aerospace Engineering & Engineering Mechanics	Research is at the boundary of autonomous and multi-agent decision-making, machine learning, and control theory, and focuses on algorithmic development with validation on physical systems.
24	Ganesan, Venkat	Chemical Engineering	Research in our group uses computer simulations (primarily classical molecular dynamics) to address the structure and properties of a variety of soft matter systems such as polymers, colloids, biological membranes etc. Current interests relate to the design of polymer electrolytes for batteries, optimization of water purification and ion separation membranes, and the use of machine learning tools to address tradeoffs resulting in such systems.
25	Gilpin, William	Physics	Our group is interested in developing new computational tools for the analysis of nonlinear dynamical systems. 1) Automated discovery of rare dynamics in dynamical systems 2) Time series featurization with topological data analysis
26	Heimbach, Patrick	Geological Sciences	Computational ocean and ice forward & inverse modeling: As part of several NASA, NSF, & ONR-funded projects we are conducting forward & inverse modeling studies of the global and regional-scale ocean circulation. The projects seek to improve our understanding of climate dynamics and variability, improve ice-ocean interaction simulations at high latitudes, represent small-scale processes such as the internal wave field in the ocean, develop methods for uncertainty quantification, conduct formal observing system design studies, and improve the efficiency of adjoint-based optimization for coupled ocean-ice state and parameter estimation. Interested students would be involved in one of these subjects through model and algorithm development, conducting simulations, or developing quantitative analysis tools. The student should be familiar with Fortran, Linux, Matlab, Python, or Julia.

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27	Henkelman, Graeme	Chemistry	The primary focus of the Henkelman group is the development of algorithms and simulation methodology to study kinetic processes at the atomic scale. We are interested in surface chemistry for catalysis and diffusion in solids with application to battery materials. Electronic structure methods are used to model the atomic interactions. Although accurate, these calculations are expensive, so that computational efficiency is very important and the development of machine learning and surrogate models will be valuable. Using our computational methods, we strive to understand the dynamics of chemical systems over experimental time scales, and use this understanding to design new materials for energy applications.
28	Hesse, Marc	Geological Sciences	General Area: Geological Fluid Dynamics 1) Cryo-volcanism on icy dwarf planets 2) Mars global hydrology 3) Ice shell dynamics of tidally heated moons
29	Huang, Rui	Aerospace Engineering & Engineering Mechanics	1) Multiscale modeling of two-dimensional nanomaterials and mechanical interactions 2) Mechanics of bio-inspired soft active materials by molecular and continuum modeling
30	Jah, Moriba *(cont'd next pg)*	Aerospace Engineering & Engineering Mechanics	Research Interests: - Artificial Intelligence (AI) and Machine Learning (ML) - Data Science and Big Data Analytics - Cognitive Science and Human-AI Interaction - Operations Research and Systems Engineering - Space Law and Policy - Cybersecurity and Space Infrastructure Resilience - Environmental and Sustainability Science - Risk Analysis and Uncertainty Quantification - Ethics and Responsible Innovation 1) **Simulation of Orbital Debris Movement Using Numerical Methods** **- Objective:** Develop a computational model to simulate the movement of space debris, focusing on how factors like atmospheric drag, solar radiation pressure, and gravitational perturbations affect their trajectories. **- Skills Required:** Numerical simulation, computational mathematics, coding (Python/Matlab), orbital mechanics. **- Outcome:** A validated simulation of orbital debris paths, with visualizations showing how debris behaves over time and predictions for future collision probabilities.

	Professor	*Home department*	*Area / Projects*
30	Jah, Moriba *(cont'd from prev pg)*	Aerospace Engineering & Engineering Mechanics	2) **Trait-based Classification of Anthropogenic Space Objects (ASOs)** **- Objective:** Apply computational algorithms to classify space debris based on physical traits such as size, shape, and material properties using available datasets. **- Skills Required:** Data science, machine learning, classification algorithms, knowledge graph databases. **- Outcome:** A proof-of-concept classifier that groups ASOs into specific categories for future tracking and removal planning.
			3) **API Development for ASTRIAGraph Data Access** **- Objective:** Develop a set of public APIs that allow users to interact with ASTRIAGraph's database for querying space objects, tracking data, and orbital predictions. **- Skills:** API development (REST, GraphQL), Python, JavaScript, database query optimization. **- Deliverable**: A fully functional API that provides real-time access to data on Anthropogenic Space Objects (ASOs), including filtering by object type, orbit, and status.
			4) **Scalable Data Pipeline for ASTRIAGraph** **- Objective:** Create a scalable and efficient data pipeline to handle the ingestion of observational data from multiple telescopes and external sources into ASTRIAGraph. **- Skills:** Data engineering (ETL), cloud platforms (AWS, GCP), stream processing (Apache Kafka, Spark). **- Deliverable:** A robust pipeline that processes and ingests new data in real time, optimizing for performance and reliability.
			5) **Visualization Tools for ASO Data** **- Objective:** Build a dashboard that visualizes the space debris environment by pulling data from ASTRIAGraph APIs, showing real-time ASO positions, trajectories, and interactions. **- Skills:** Data visualization (D3.js, Plotly), front-end development, working with geospatial data. **- Deliverable:** A user-friendly web-based visualization tool for researchers and policymakers to analyze ASO data.
			6) **Enhancing ASTRIAGraph's Knowledge Graph for ASO Classification** **- Objective:** Extend ASTRIAGraph's knowledge graph capabilities by incorporating more detailed classifications of ASOs, integrating new sources of data to improve ASO behavior prediction. **- Skills:** Knowledge graph engineering, semantic web technologies (RDF, SPARQL), graph databases (Neo4j). **- Deliverable:** An updated version of ASTRIAGraph's knowledge graph with richer classifications and improved querying capabilities.

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31	John, Lizy Kurian	Electrical & Computer Engineering	My research is on computer architecture, performance evaluation and workload characterization. A few specific topics of interest are: 1) Hardware architectures for Machine Learning 2) FPGA, GPU, CPU and custom acceleration and optimization of Emerging Workloads 3) Weightless Neural Networks for Energy-Efficient Inference
32	Jones, Brandon	Aerospace Engineering & Engineering Mechanics	Our research focuses on the intersection of orbit propagation and advanced estimation to solve problems in astronautics. Applications of this work include space domain awareness, satellite navigation, and spacecraft systems. Specific projects vary with the semester and are designed to overlap with active research conducted by graduate students.
33	Kallivokas, Loukas	Civil, Architectural, & Environmental Engineering	We are working on wave propagation and wave-driven inverse problems. Applications include subsurface imaging, condition assessment, and metamaterials.
34	Keitt, Timonty	Integrative Biology	Our lab uses computation to better understand and manage ecological systems. We design and build autonomous sensing systems to monitor the environment and wildlife. We are seeking students that would like to conduct research using AI/ML methods to identify biodiversity in remotely sensed data, such as field sound recordings, as well as implement autonomous systems in support of this work. The work assumes a basic knowledge of electronics, robotics, and programming.
35	Kileel, Joseph	Mathematics	1) Reconstruction problems in imaging and computer vision 2) Higher-order tensor decompositions 3) Non-convex optimization landscapes
36	Kumar, Krishna *(cont'd next pg)*	Civil, Architectural, & Environmental Engineering	1) Accelerating Simulations using Graph Neural Networks: The Graph Network Simulator (GNS) https://github.com/geoelements/gns project provides a unique opportunity to gain hands-on experience in advanced machine learning techniques, specifically focusing on surrogate modeling. In this project, students will leverage the power of GNS for creating surrogate models that efficiently mimic complex physical phenomena. These models can significantly speed up computer simulations by bypassing the need to calculate detailed physics at every step. Furthermore, the project will delve into accelerating the GNS itself on multi-node architecture, enhancing its performance and efficiency for large-scale problems. The experience culminates with the implementation of a mesh network accelerating complex CFD and Finite Element solvers.

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36	Kumar, Krishna *(cont'd from prev pg)*	Civil, Architectural, & Environmental Engineering	2) Building next-generation simulators with Differentiable Programming: The Differentiable Simulations project is a cutting-edge research program focused on the integration of Automatic Differentiation (AD) and Gradient-based optimization, offering an innovative class of simulation tools that promises to transform the landscape of optimization, design, control and inverse problems. Leveraging AD, these tools provide a way to compute the derivatives of a function that can be represented as a computational graph, thereby enabling the efficient calculation of gradients necessary for optimization algorithms. This technology holds enormous potential for application, from optimizing complex systems and machine learning models, to advancing the field of robotics through more intelligent design and control mechanisms.
37	Laguna, Pablo	Physics	Numerical Relativity and Computational Astrophysics: 1) Binary black holes and black hole – neutron star binaries 2) Scalar-tensor alternative theories of gravity 3) Physics Informed neural networks applied to gravitational physics
38	Landis, Chad	Aerospace Engineering & Engineering Mechanics	Computational Mechanics Group
39	Lease, Matthew	School of Information	1) AI fairness and explainability (aka transparent & interpretable), especially for Natural Language Processing (NLP), such as large language models (LLMs) and generative AI 2) Human-AI hybrid systems (human-in-the-loop decision-making, decision support, human-AI teaming, human computation, crowd computing) 3) Applications to curbing dis- and mis-information to protect the information environment and defend against foreign influence operations and campaigns 4) Accelerating scientific discovery through generative AI / LLMs and LLM agents
40	Lu, Hannah	Aerospace Enginering & Engineering Mechanics	1) Reduced order modeling and Scientific Machine Learning: developing computationally cheap models for complex physical systems. 2) Uncertainty quantification and inverse problem: analyzing the uncertainties in modeling complex systems and reducing the uncertainties by data assimilation for decision-making. 3) Modeling and simulation for sustainable energy: topics include CO_2 sequestration, hydrogen storage, battery modeling and etc.

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41	Makarov, Dmitrii	Chemistry & Biochemistry	1) Biophysical Dynamics. We apply computer simulations and polymer theory to learn how biomolecules fold into biologically functional shapes and how they search for their targets. 2) Chemical rate theory with applications to mechanochemical phenomena. We develop theoretical models and computational algorithms to describe how mechanical forces affect the dynamics and pathways of chemical reactions. 3) Theory and interpretation of single-molecule experiments. We develop physical models and numerical tools to explain single-molecule observations.
42	Manuel, Lance	Civil, Architectural and Environmental Engineering	1) Uncovering patterns, anomalies, motifs and discords in time series databases. 2) Stochastic weather window analysis in planning of ocean-related operations and maintenance activities in support of a "blue economy". 3) Uncertainty quantification in long-term ocean climate trends and prediction of extreme waves.
43	Marcotte, Edward	Molecular Biosciences	Computational, systems, and synthetic biology. The Marcotte group studies the large-scale organization of proteins, reconstructing 'wiring diagrams' of cells by learning how the proteins encoded by a genome are associated into functional pathways, systems, and networks. Such models help determine the functions of genes and link genes to traits and diseases. Computational projects include 3D structural modeling of proteins and assemblies, graphical modeling of biological systems, and analysis of high-throughput functional genomics and proteomics approaches for studying thousands of genes/proteins in parallel.
44	Meyers, Lauren	Integrative Biology	Developing mathematical models of infectious disease dynamics to investigate outbreaks, forecast their spread, and design effective intervention strategies.
45	Morrison, Philip	Physics	Computation of low degree-of-freedom Hamiltonian/symplectic dynamical systems with applications in fluid mechanics, astrophysics, and plasma physics. Development of structure preserving algorithms for PDEs of kinetic theory and fluid mechanics.
46	Niyogi, Dev	Geological Sciences / Civil, Architechtural, and Environmental Engineering	If you have an interest to conduct cutting-edge research in using AI/ML approaches or numerical weather prediction modeling, environmental sustainability, climate, weather extremes, and satellite datasets our group will be the right fit. Examples of possible studies include working with (i) using AI/ML approaches for developing climate/weather digital twins especially for the Cities and US Gulf Coast region, (ii) satellite data assimilation techniques, (iii) data+model fusion to create synthetic datasets for applications ranging from urban fires, heat stress mapping, air quality, (iv) statistical downscaling climate information and evaluating different operators, (v) urban, coastal boundary layer and severe weather simulations using advanced weather research and forecasting models, and (vi) developing user interfaces and data portals for climate and environmental datasets using GIS. The work will be with the University of Texas Extreme Weather, Climate and Urban Sustainability (TExUS) Lab, which has a number of active and evolving projects. Website: https://Texuslab.org Email happy1@utexas.edu, dev.niyogi@jsg.utexas.edu

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47	Offner, Stella	Astronomy	Applying and improving neural networks to predict gas chemistry/abundances. This is a hybrid astronomy-chemistry project.
48	Ostling, Annette	Integrative Biology	1) Development and application of clustering and network analyses methods to detecting structure in ecological data related to mechanisms of niche differentiation/biodiversity maintenance 2) Development and application of numerical methods for partial differential equations to numerical analysis of models of competition between populations structured by size and patch aging (which describe competition between tree species, but also other ecological systems) 3) Stochastic community assembly simulations to study competitive coexistence and its influence on community structure
49	Pyrcz, Michael	Petroleum & Geosystems Engineering	Spatial and subsurface data analytics, geostatistics and machine learning
50	Rausch, Manuel	Aerospace Engineering & Engineering Mechanics / Biomedical Engineering	1) Mechanics of soft tissues using the finite relent method 2) Inverse material parameter identification 3) Automatic image segmentation 4) Automatic filtering, smoothing, and analysis of surgical data
51	Rylander, Marissa	Mechanical Engineering	Project will develop a computational model to accurately predict the evolving and complex nature of tumor growth and the response of tumors to candidate therapeutic regimens for treatment optimization. This model will be formulated, calibrated, and validated using a series of physiologically representative in vitro tumor platforms of varying complexity developed by our lab which have been shown to recapitulate the intricacies of the cancer microenvironment.
52	Sacks, Michael	Biomedical Engineering	1) Machine Learning methods in finite element modelling of the cardiovascular system 2) Diffeomorphic geometric modelling of cardiac structures
53	Sha, Zhenghui	Mechanical Engineering	Multidimensional Network Modeling and Analysis of Complex Sociotechnical Systems *Description:* Complex sociotechnical systems are constituted of multiple types of stakeholders from different levels who exhibit complex relations and make multiple types of decisions that are dependent on each other. Moreover, there might be a large number of stakeholders, each of which has different decision-making preferences, i.e., heterogeneity. These unique features call for modern computational methods and a systematic modeling framework for complex systems engineering. In this project, we leverage the advancement in network theory and design science to develop a multidimensional network-based approach to model, analyze and predict individual entities' decisions in supporting the study of emergent behaviors in complex systems and the design of complex sociotechnical systems.

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54	Shoemaker, Deirdre	Physics	1) Gravitational Wave Data Analysis in Python: work with gravitational wave data and numerical relativity waveforms to detect and interpret gravitational waves, could involve machine learning. 2) Numerical relativity: work to improve the efficiency of the code that solves Einstein's partial differential equations for black holes merging. Involves MPI, C, and could involve machine learning/AI
55	Siegel, Donald	Mechanical Engineering	1) Atomic scale simulation of materials for energy storage 2) High-throughput computational screening for new materials 3) Applications of machine learning to improve understanding and accelerate discovery of functional materials
56	Subramanian, Venkat	Mechanical Engineering; Texas Materials Institute	1) Real-time simulation and optimization of nonlinear differential-algebraic equations to enable fast charging of batteries in electric vehicles and cell phones 2) Model and data-driven estimation of capacity fade 3) Collocation methods - strong and weak forms for current and next-generation battery materials
57	Tamir, Jon	Electical & Computer Engineering	Computational Sensing and Imaging Lab 1) Medical image modeling through deep learning 2) Large-scale distributed optimization for MRI reconstruction 3) Joint system and reconstruction design for MRI
58	Topcu, Ufuk	Aerospace Engineering & Engineering Mechanics	Theoretical and algorithmic aspects of the design and verification of autonomous systems. Research is at the intersection of learning, controls, and formal methods with applications in robots and air and ground vehicles.
59	Torres-Verdin, Carlos	Petroleum & Geosystems Engineering	1) Large-scale inverse problems for subsurface geophysics 2) Machine-learning methods for expedient forward and inverse problems in subsurface geophysics 3) Machine-learning methods for the estimation of rock properties from multi-physics measurements 4) Estimation of uncertainty of results in inverse problems
60	Tsai, Yen-Hsi	Mathematics	1) Mathematical theory for deep learning 2) Machine learning approaches for games and navigation problems 3) Multiscale algorithms for wave propagation and highly oscillatory dynamical systems

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61	Varghese, Philip	Aerospace Engineering & Engineering Mechanics	1) Kinetic Equations – Extending the quasi-particle simulation method for the Boltzmann equation to cylindrical and spherical coordinates in velocity space, Incorporating the Boltzmann equation into a multi-dimensional flow solver like Open Foam. 2) Solving the Fokker-Planck equation using a quasi-particle method.
62	Villa, Umberto	Oden Institute for Computational Engineering and Sciences	My research interests and expertise are in computational engineering and imaging science. My work focuses on advancing emerging quantitative image modalities to help resolve major challenges in medicine and public health, including early detection of cancers and improved treatment outcomes. 1) Spatiotemporal image reconstruction algorithms for dynamic contrast enhanced imaging: In this project, we will use advanced numerical optimization method, including low-rank (non-negative) matrix factorization, tensor decomposition, etc to derive novel computationally and memory-efficient image reconstruction algorithms for large scale, multi-dimensional (three space dimensions, time, and optical wavelength) image reconstruction. 2) Task-based assessment of image quality: Medical images are taken for a specific clinical task (screening, diagnostics, monitoring). As such, physical measurements of image quality (such as mean square errors or structural similarity) do not always inform the clinical utility of the image. Task-based assessment of image quality, instead, use signal detection and numerical observer theory to measure the performance of a particular imaging system design or image reconstruction algorithm in performing a given clinically relevant task, e.g. detecting and/or segmenting a lesion, discriminating a benign lesion from a tumor. 3) Quantitative photoacoustic tomography: In this project, we will use partial differential equations to model light and sound propagation, large-scale optimization methods to reconstruct images of hemoglobin concentration, machine learning to further refine those images.
63	Virostko, Jack	Diagnostic Medicine	We are using machine learning to perform classification and segmentation tasks on medical images. Most of our projects employ abdominal MRI and CT images to identify image features indicative or predictive of disease.

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64	Wang, Wennie	Chemical Engineering	Defects in two-dimensional materials are promising materials platforms for memristors, the building block for a neuromorphic computer. However, very little is known about the defect chemistry in low-dimensional materials, which severely limits their application in next-generation computing devices. We use simulations and supercomputers to understand the atomic-level properties of materials. Our objective is to develop general physical models, defect engineering principles, and advanced computational tools of adsorption phenomena in discovering defects in 2D materials for resistive switching. For more information, see https://wangmaterialsgroup.com or our group wiki:https://wang-materials-group.gitbook.io/group-handbook. Interested students are welcome to attend our weekly group meetings; the latest schedule is posted on our group wiki.
65	Yang, Zong-Liang	Biomedical Engineering	Dr. Yang's research focuses on understanding and modeling land-atmosphere exchanges of energy, mass, and momentum, quantifying the strengths of land-climate interactions and feedbacks, and exploring their applications in predicting hydrological extremes (such as floods, droughts, heatwaves, wildfires, and severe storms). His approaches encompass theoretical work, data analysis, and numerical modeling. Dr. Yang has developed terrestrial hydrological parameterizations and land surface models (CLM and Noah-MP) that are utilized by major institutions worldwide, including the U.S. National Center for Atmospheric Research (within the Community Earth System Model and the Weather Research and Forecasting model), the U.S. National Centers for Environmental Prediction (the Climate Forecast System), and the U.S. National Water Center (the National Water Model). These models have proven critical for climate applications and the accurate forecasting of extreme weather and water events, such as Hurricane Harvey, and their associated impacts. Additionally, Dr. Yang develops innovative dynamic downscaling methods that produce high-resolution regional climate information, aiding impact assessments and resource decision-making.
66	Yankeelov, Thomas	Biomedical Engineering	Dr. Yankeelov's team develops tumor forecasting methods by employing patient-specific, quantitative imaging data to initialize and constrain predictive, multi-scale biophysical models of tumor growth with the purpose of optimizing therapies for the individual cancer patient. This is accomplished by dividing his efforts into approximately equal parts mathematical modeling, pre-clinical development and validation, and implementation in human studies.
67	Zanetti, Renato	Aerospace Engineering & Engineering Mechanics	Modeling and simulating aerospace vehicles with an emphasis on stochastic methods.
68	Zariphopoulou, Thaleia	Mathematics	1) Human-machine interaction systems and digital-twins 2) Inverse reinforcement learning, elicitation of risk preferences 3) Robo-advising and automated investment platforms 4) Information acquisition 5) Medical and health care, quantitative modeling and methods

List is not exhaustive. Students may select a project supervisor from any of the Oden Institute

GSC Faculty

or

Affiliated Faculty

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