University of Massachusetts Boston and Amherst

STEMPOWER FELLOWSHIP

Institute of Diversity Sciences

Funded by the Alfred P. Sloan Foundation

FACULTY BROCHURE

Fall 2025

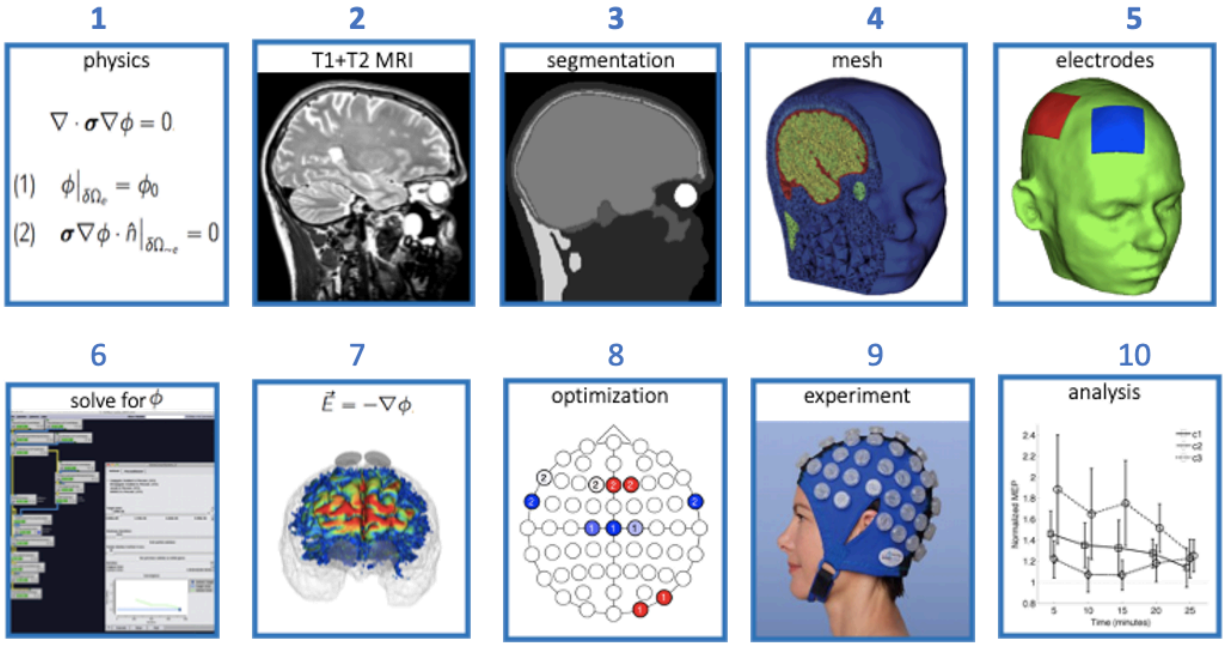
More Information: STEMPOWER.net

UMass Boston

Department: **Physics**

Sumientra Rampersad

I study electromagnetic brain stimulation through experiments and computational models. Experiments include neuroscientific and clinical trials that use electroencephalography, (f)MRI, and tests of memory, cognition and motor function, to study the effects of transcranial electromagnetic stimulation on the brain. Additionally, we build finite element head models from MRI scans to simulate and optimize electric fields in the brain. Existing projects involve topics including diabetes, epilepsy, cognitive decline, and brain tumors, where modeling is used to understand effects of past experiments or design new studies. We also work on algorithm and software development along the entire pipeline of head model construction.



Schematic of the steps involved in electromagnetic brain stimulation research, including the physics equations to solve (1), the process of building a finite element head model from MRI scans (2-5), calculation of the electric potential and field (6-7), computational optimization of currents to achieve a desired field (8), and testing the results in experiments with human volunteers (9-10).

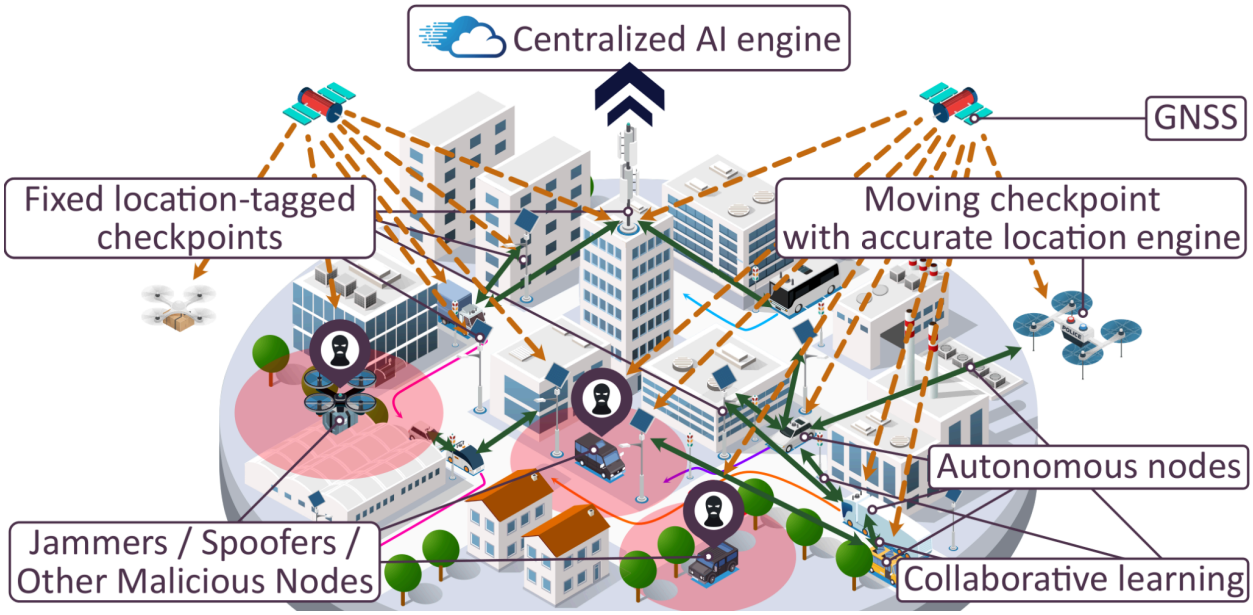
Website: https://www1.coe.neu.edu/~rampersad/

UMass Boston

Department: **Computer Science**

Tales Imbiriba

Distributed, privacy-aware jamming source localization:
We will focus on localizing and tracking GPS jamming sources based on received signal strength signals measured by user devices. The goal is to propose distributed data fusion techniques that can produce heat or interference probabilistic maps of threats over space, with the goal of localizing and tracking those. To cope with privacy constraints over user's data, we will leverage our expertise on FL, whereby a data-driven heat map model will be updated locally, thus preserving confidentiality of the users' position. We will also focus on improved FL-based localization through active learning.



Website: https://talesimbiriba.github.io/

UMass Boston

Department: **Biology**

Brook Moyers

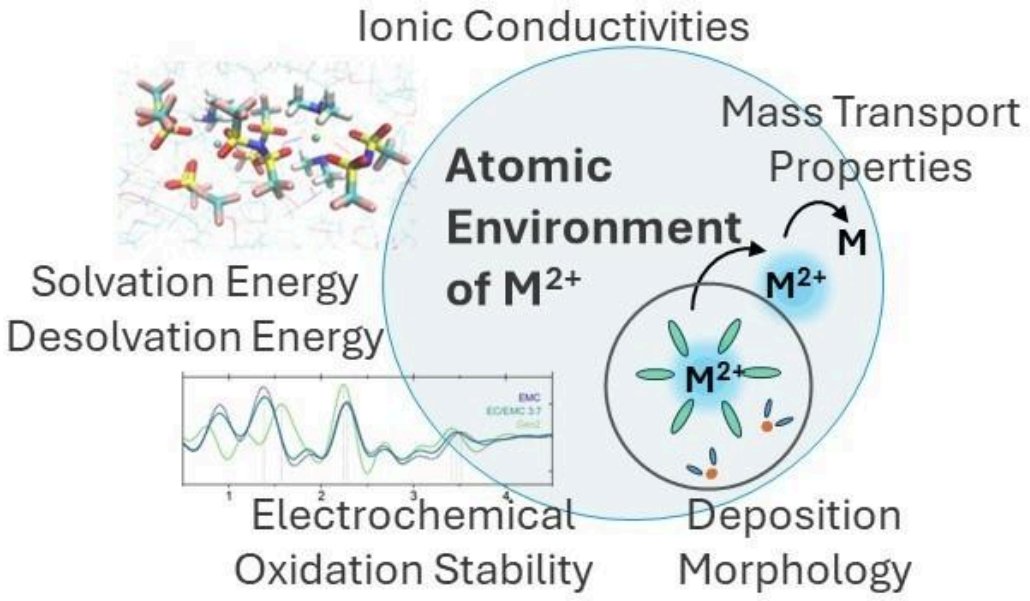
My lab studies trait variation in useful plants using tools from genetics, genomics, ecology, evolution, and computational biology. Our current main projects are on: (1) understanding adaptation heavy metal tolerance in a wild edible salt marsh plant (Salicornia depressa, American pickleweed) and (2) characterizing the genetic basis of abiotic stress tolerance in Asian rice (Oryza sativa).

Website: https://www.brookmoyers.com/

Department: **Chemistry**

Niya Sa

Clean energy is critical to address the biggest challenge that our society has been facing today. Driven by the fast adoption of electric vehicles, the next generation energy storage research is of the greatest importance to the development of sustainable energy systems. Among the most promising innovations in this domain are multivalent batteries, which are poised to revolutionize the field of energy storage by overcoming many of the limitations of conventional lithium-ion batteries. Multivalent batteries, which utilize multivalent metal ions such as magnesium (Mg), calcium (Ca), or aluminum (Al) as charge carriers, present significant advantages over traditional monovalent lithium ion systems. These metals are not only abundant and more environmentally friendly but also offer the potential for higher energy densities due to their ability to carry multiple charges per ion. This fundamental difference could translate into batteries with greater power output, longer operational life, and reduced reliance on rare or geopolitically constrained resources, such as lithium and cobalt. Our team seeks to address these challenges through a comprehensive investigation into the mechanisms governing ion transport, electrode-electrolyte interactions, and material stability in multivalent battery systems. This research, in particular, seeks to build a fundamental molecular-level understanding of the structure-property relationships for the multivalent electrolyte systems, which is a necessity for rational design of the beyond lithium-ion energy storage devices with enhanced functionality. The objective of this proposed research is to bridge the dynamic electrolyte structure at the atomic resolution with the electrochemical mechanisms to understand the non-aqueous multivalent electrolyte complex. The goal is to ultimately offer critical guidelines to molecular and solvent design approaches for multivalent systems. Graduate and undergraduate students trained through the project will learn hands-on experimental skills and techniques from the state-of-art beyond lithium-ion electrolyte designs and energy storage concepts.



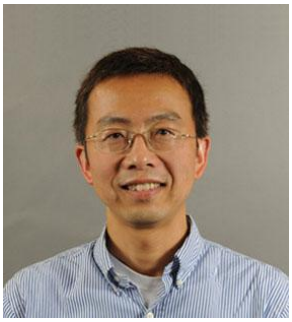
Website: https://saniyabnu.wixsite.com/niyasa

Department: **Mathematics**

David Degras

Statistics at large + mathematical optimization + applications to brain research. Examples of recent projects: joint tensor decomposition; penalized regression for brain encoding; brain computer interfaces; time series models with Markov switching; data deduplication.

Website: https://scholar.google.com/citations?user=CYLjVg4AAAAJ&hl=en



UMass Boston

Department: **Engineering**

Honggang Zhang

This project will develop a UAV exploring/sensing system based on mmWave radar and Deep Learning. The goal of the system is to conduct object localization and reconstruction in an unknown and low-visibility environment based on signals collected by mmWave radar sensors mounted on UAVs. The system utilizes deep learning neural network models to process raw low-resolution radar data and generate high-resolution point clouds or depth images of the environment. The computation jobs generated by the UAVs, including the learning/inference of the neural network models and the collaborative exploring and data collecting of UAVs, are executed by edge computing servers.

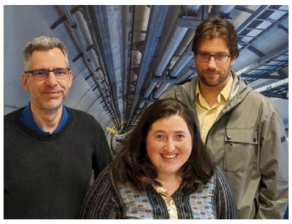
Website: https://scholar.google.com/citations?user=elPaEWUAAAAJ&hl=en

UMASS AMHERST

Department: **Physics**

Rafael Coelho Lopes de Sa

Particle Physics and High Performance Computing



A UMass, a large group of professors, scientist and students are concerned with discovering the most fundamental constituents of matter and the laws governing their behavior.

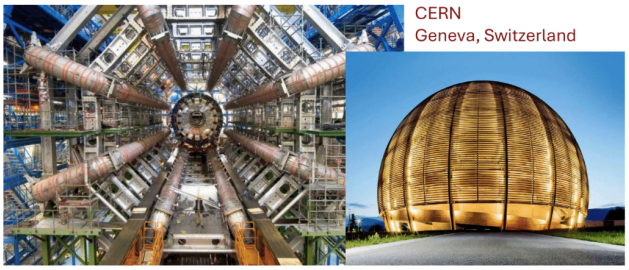
https://websites.umass.edu/eppex/

University of Massachusetts

ATLAS EXPERIMENT

Particle detectors build at UMass are installed in the ATLAS detector at CERN

Physical Sciences Building
Amherst, MA



CERN
Geneva, Switzerland

Data collected by the ATLAS experiment is analyzed with the NET2 cluster at the MGHPCC

Massachusetts Green High-Performance Computing Center
Holyoke, MA

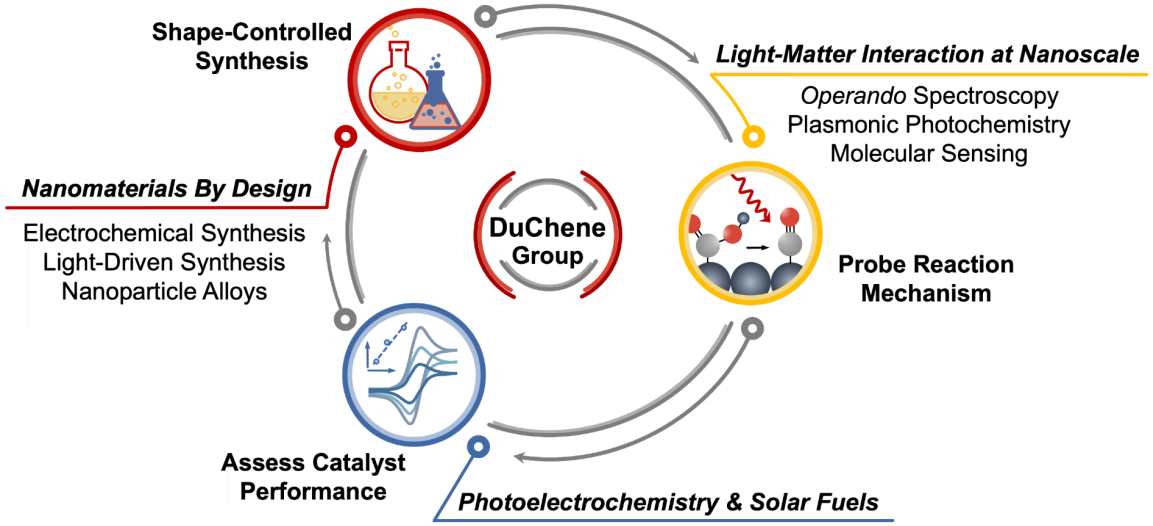
Website: https://websites.umass.edu/eppex/

UMASS AMHERST

Department: **Chemistry**

Joseph DuChene

Synthesis of nanostructured metal and metal oxide catalysts for photocatalytic, electrochemical, and photoelectrochemical transformations of small molecules into useful chemicals. We use carbon dioxide, water, and nitrate/nitrite as feedstocks for the synthesis of chemicals such as ethylene, hydrogen, and ammonia, respectively. We focus on the use of electrochemistry and photochemistry to synthesize the catalytic nanoparticles, its with emphasis on the controlling the shape and size of the nanostructures and elucidate structure-function relationships with catalytic studies.



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duchenelab.chem.umass.edu

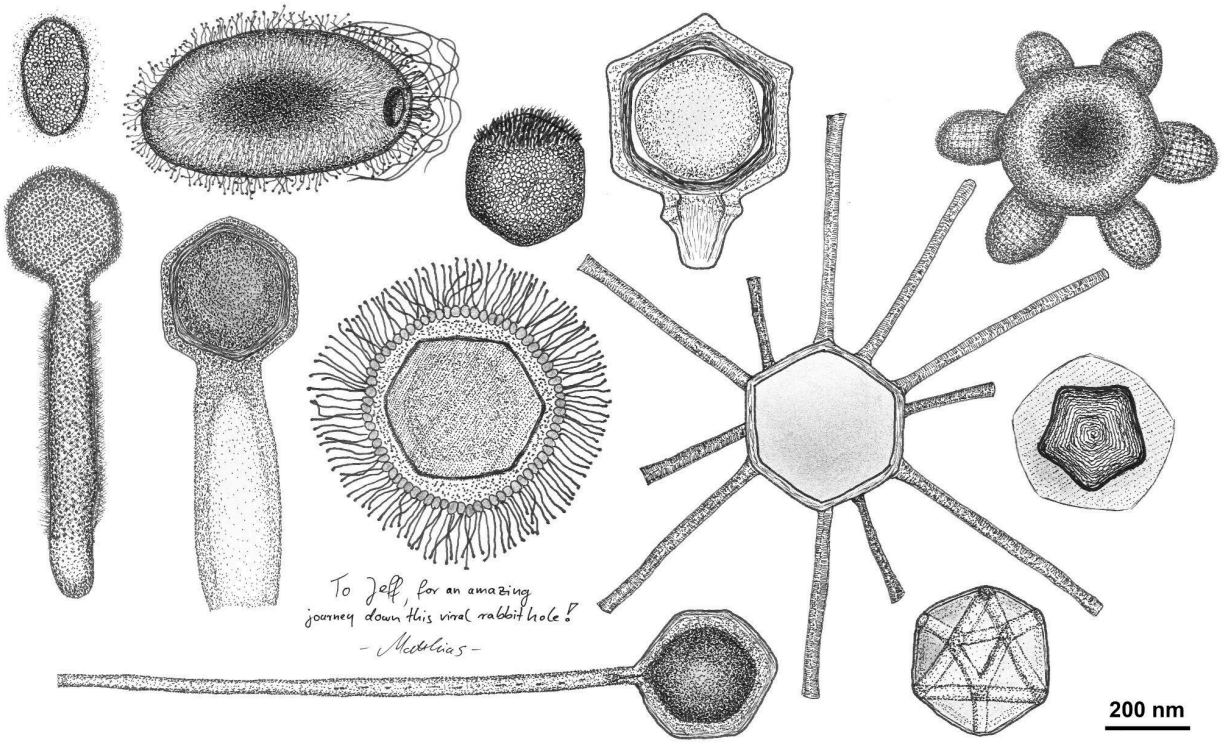
Website: https://duchenelab.chem.umass.edu/Team/

UMASS AMHERST

Department: **Biology**

Jeffrey Blanchard

Due to the COVID-19 pandemic we are now acutely aware there is a vast reservoir of unknown viruses in the environment. We discovered the world's second largest virus genome at the Harvard Forest in MA. More recently we have sequenced RNA from soil microbial communities and discovered novel RNA viruses and viroids. We have shown that soil warming results in changes in the abundances of RNA viruses that directly infect plants and plant-associated fungi and bacteria. We are testing new ideas from RNA viruses discovered in this project for biotechnology products with our collaborators at New England Biolabs.



Website: https://jeffreyblanchard.github.io/lab/

Department: **Engineering**

Jessica Boakye

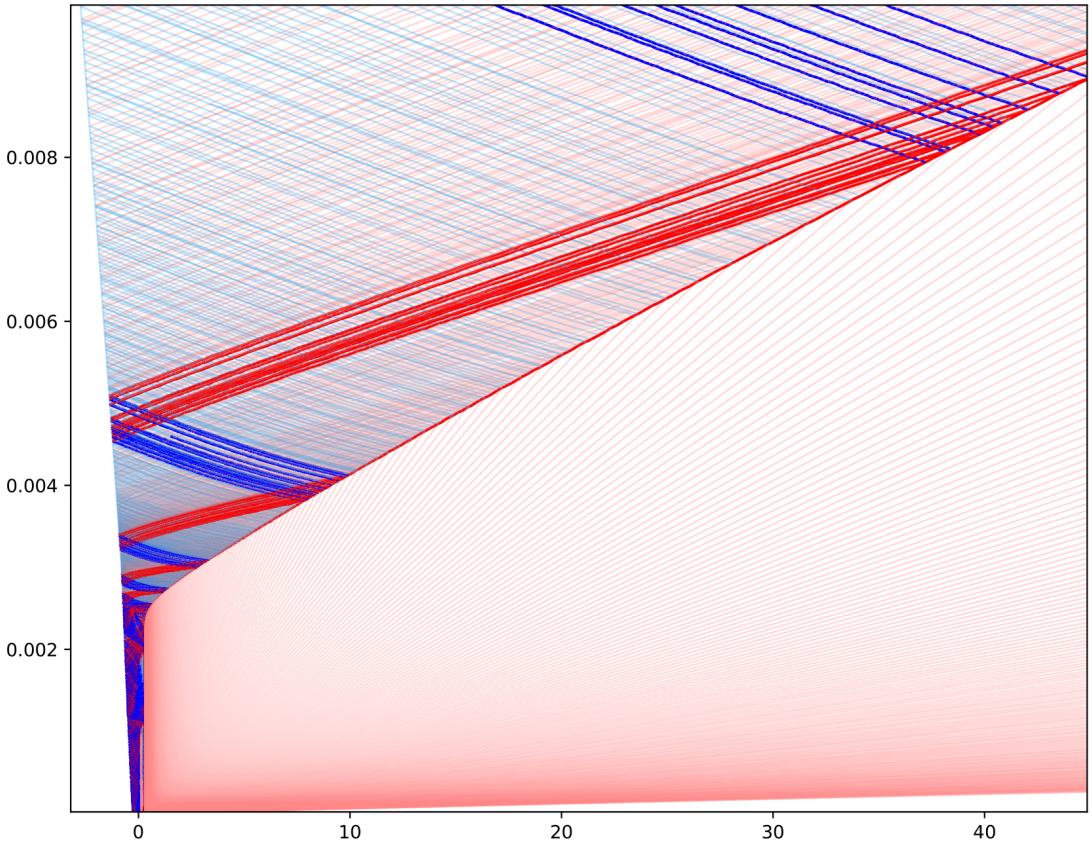
Pavement deterioration can lead to numerous societal consequences including increased emissions and costs. Past research has shown that this deterioration is not equally distributed across the population. Instead, socially vulnerable populations have been shown to have disproportionate amounts of deteriorated pavements in their communities and have higher fuel consumption during recurrent trips as a function of this damage. Pavement maintenance plans provide an opportunity to decrease these impacts through equity-informed policies. This research will investigate different maintenance strategies and examine the effects on societal consequences. These consequences will go beyond traditional pavement/structural factors focusing instead on well-being related indicators.

Website: https://www.drjessicaboakye.com/

Department: **Mathematics**

Robin Young

The project is to compute nonlinear sound waves. Although sound waves have been successfully modeled using the (linear) wave equation for two centuries, a paradox emerged early in the history of the subject: the nonlinear equations, which are ostensibly more accurate, appeared not to support such solutions. Recently we resolved this paradox theoretically by proving the existence of sustained nonlinear sound waves. This project will further develop code to compute and visualize these and related solutions. The project provides a bridge between several fields and has the potential to generate interest in STEM in the general public.



Website: https://people.math.umass.edu/~young/

UMASS AMHERST

Department: **Computer Science**

Pubali Datta

We are going to explore security and privacy concerns in modern cloud infrastructures. Explorations include investigation of current access control methods, and building prototype for a novel secure access control framework among other research topics in the broad domain of cloud security.

Website: https://people.cs.umass.edu/~pdatta/