DEPARTMENT OF BIOLOGICAL SCIENCES
SEMINARY SERIES

Kayla Coldsnow
Biology Graduate Student

Title: "The Unexpected Consequence of Calcium Chloride on Invasive Bivalves and Their Presence in Communities."

Alexandria Fischer
Biology Graduate Student

"Metabolic Complementation in Interspecies Pairs of Auxotrophic Bacteria"

Monday, October 1, 2018
12:00 Noon
CBIS, Bruggeman Room
Deciphering Heparan sulfate–protein interactions in bone remodeling and inflammation

The main interest of the Xu lab is to understand how proteins interact with heparan sulfate (HS), a highly negatively charged linear polysaccharide, and the physiological significance of the interactions in bone remodeling and inflammation. Universally expressed by all mammalian cells, HS is a major and often dominant component of the landscape at the cell surface and thus plays essential roles in cell signaling, cell-cell interactions and host-pathogen interactions. At the cell surface and in the extracellular matrix, HS interacts with hundreds of HS-binding proteins, many of which are important drug targets (such as RAGE, Cathepsin K and FGF receptors). The dependence of these proteins on HS for normal function suggests that disrupting HS-protein interaction could be an effective means to block the activity of these HS-binding proteins. The goal of the lab is to dissect the structural determinants of HS-protein interactions by characterizing structures of HS/protein complexes (using X-ray crystallography and small-angle scattering), and to use this information to develop and test the pre-clinical efficacy of novel therapeutic agents (including monoclonal antibodies, oligosaccharides) that target HS-protein interactions in cellular and animal models. The HS-binding proteins we are currently working on include inflammatory receptor RAGE (receptor for advanced glycation end products), danger associated molecular pattern protein HMGB1, osteoclastogenic negative regulator osteoprotegerin and bone remodeling protease cathepsin K.
Lecture One: Wednesday, October 3rd, at 9:15 am, Ricketts 211

Toward “Damascus yogurt”: developing thermal processing strategies for colloidal solids

Abstract: The use of thermal processing to control phase separation in atomic and molecular solids is a conserved motif for designing materials with tailored mechanical properties that spans antiquity, modern technology and the natural world. By contrast, thermal processing of colloidal solids poses significant challenges, including relatively slow dynamics and a lack of scalable materials in which colloidal interactions can be actively tuned and quenched. To overcome these challenges, we have developed a model thermally processable colloidal system based on nanoparticles in the presence of thermoresponsive polymers that allows for fine control over their interparticle attractions and resulting colloidal behavior. We show how this thermoreversible behavior allows access to a range of gelation mechanisms including dynamic percolation, arrested phase separation and glass formation, whose outcome can be selected through the path taken to the gelled state. In cases of arrested phase separation, we explore the analogy between thermal processing in colloids with that in atomic and molecular systems, including the kinetics and micromechanics of structural coarsening and the concept of a “time temperature transformation” diagram from which to design arrested morphologies. Ultimately, we show how the sophisticated control of gelation and arrested structure afforded by thermal processing can be used to tailor colloidal solids (and other materials from them) with widely varying and superior mechanical properties.
Abstract: Emulsions have long been a foundational technology for the solution-phase synthesis of functional particles and materials. More recently, methods to create emulsions with multi-phase droplet structure have opened up an entire new design space of complex droplets and particles with potential advantages for foods, consumer products, and medicine. These applications have yet to be realized due to significant challenges with current emulsification methods for multi-phase droplets, which are mostly limited to large sizes, poor stability and low throughput. Nanoemulsions – metastable suspensions of nanoscale droplets – overcome these limitations through their scalable processing and metastability. However, their engineering is complicated by emergent behavior when droplet sizes are driven to the nanoscale. In this seminar, I will summarize our recent efforts to understand this behavior, and exploit it for the creation of complex nanodroplets and nanoparticles using relatively simple design principles. In particular, we have demonstrated the synthesis of novel nanogel particles with independent control of particle size, internal composition, and mechanical properties that provide unique opportunities for nanoencapsulation and nanomedicine. As a demonstration of their utility, we show how nanoemulsion-templated complex nanogels can be used for a number of fundamental studies and functions in nanobiotechnology.

The Van Ness Award is made in recognition of the achievements of the late H.C. Van Ness, Institute Professor Emeritus at Rensselaer Polytechnic Institute. It is presented annually to honor a chemical engineer who has made seminal contributions to the profession. The Van Ness Award Lecture Series is sponsored by a generous endowment from Edward ’62 and Nancy Feltham.
“Intelligent Climate Adaptation and Resilient Engineering (I-CARE)”

Wednesday, October 03, 2018

JEC 3117

10:30 – 11:30

Dr. Auroop Ganguly
Professor
Northeastern University

ABSTRACT:
From buildings, warehouses, bridges, and factories, to networked lifelines related to communication systems, power grids, transport networks, and water distribution, critical infrastructures provide essential services such as food, energy, and water security, safety from natural and man-made hazards, as well as healthcare and economic growth. However, even as the stresses and disruptive events continue to evolve, and the vulnerabilities and exposures grow, the risk profiles change in time and space. Stresses may include climate change induced exacerbation of heat waves and heavy precipitation or technological failures related to cyberattacks that grow deadlier with each passing day. Vulnerability of infrastructures may increase owing to aging and inadequate design or maintenance, or because of mismanaged operations. Urban and rural planning, movement of people, and co-location of assets may lead to growing exposures. Balancing multi-stakeholder priorities and generating incentive schemes for preparedness may be challenging. Even relatively small perturbations may lead to cascading failures owing to feedback processes and nonlinear effects, while uncertainties may overwhelm the ability to generate predictive insights. However, the ability to design robust systems, characterize systemic strengths and points of failure, and design recovery plan in advance, remain important. This is where state of the art and novel tools, drawn from interdisciplinary areas such as network sciences, nonlinear dynamics, signal processing, machine learning, and probabilistic risk assessment, can come to the rescue, especially when combined with physical basis and process understanding where available. Case studies are presented where intelligent data interpretation and the intelligence embedded in physics and process understanding have led to research successes, and even in translation to practice. Outstanding gaps, and future directions, are discussed, with pointers to the emerging literature and best practices.
Auroop R. Ganguly is a Professor of Civil and Environmental Engineering at Northeastern University in Boston, MA, where he directs the Sustainability and Data Sciences Laboratory (SDS Lab), and has courtesy appointments in Computer and Information Science, Marine and Environmental Sciences, and Political Science. He has 20+ years professional experience spanning the private sector (including Oracle Corporation and multiple startups), government research (US DOE’s Oak Ridge National Laboratory), and academia. He has authored a textbook on Critical Infrastructures Resilience and an edited book entitled Knowledge Discovery from Sensor Data. He obtained a PhD from the Massachusetts Institute of Technology and a B. Tech. (Hons.) from the Indian Institute of Technology (IIT) at Kharagpur, both from the Civil (or Civil and Environmental) Engineering departments.
ABSTRACT: Gas turbine hot section components are being pushed to the limit with every increasing combustion firing temperatures and improved expectations of life and durability. Improved internal cooling of turbine blades is a critical need for the interest. With the advent of additive manufacturing, the designs of internal cooling feature options are unlimited. With that in mind, detailed heat transfer measurements are presented for complex internal cooling channels with and without rotation to evaluate performance and applicability of such cooling designs to turbine blade cooling. A transient liquid crystal technique is used to measure detailed heat transfer coefficient distributions inside these channels. The cooling channels have features such as ribs, dimples, impinging jets and a combination of these features. The challenge of making detailed measurements inside such rotating channels is displayed through the measurements. In addition, some examples of additively designed geometries are demonstrated.

BIO: Dr. S. V. Ekkad is the Department Head and RJ Reynolds Professor in the Mechanical & Aerospace Engineering Department at North Carolina State University since September 2017. He previously served as the Associate Vice President for Research Programs at Virginia Tech. He also held the title of Rolls-Royce Commonwealth Professor for Aerospace Propulsion Systems at Virginia Tech. He was also the Founder and Director of the Rolls-Royce University Technology Center for Advanced System Diagnostics at Virginia Tech, one of 30 centers around the world, prior to joining NC State. He was in the Mechanical Engineering department at Virginia Tech from August 2007 to September 2017 after 9 years at LSU and 2 years at Rolls-Royce Allison Engine Company in Indianapolis. He received his Ph.D. from Texas A&M University and M.S. from Arizona State University. He has over 25 years of experience in heat transfer related research. He has published over 230 journal & conference articles, three patents and co-authored a book and three book chapters. He currently has funding from Solar Turbines, Trillitus Aerospace Systems, and DOE. He has been working on gas turbine cooling and heat transfer issues since 1989 including a stint as a design engineer at Rolls-Royce, Indianapolis before his academic career. Dr. Ekkad has also served as a summer faculty fellow at AFRL, Dayton in 2003. He is well known for his contributions to heat transfer experimental methods. In 2004, he received the inaugural ASME Bergles/Rohsenow Young Investigator in Heat Transfer Award for significant contributions to the field of heat transfer by a researcher under the age of 36.
The unique properties of an important class of smart materials, the ferroics, originate from structural phase transformations with symmetry breaking that produce self-accommodating polydomain structures. Sensing and actuation can be realized simultaneously through domain switching under external fields. Even though the micro-domain structures in various ferroic systems have been studied for over a century, the properties of their nano-domain counterparts have not yet been explored until recently. In particular, the discovery of the strain glass state in shape memory alloys (SMAs) in parallel to relaxor and cluster spin glass has renewed the interest in nano-domain ferroics. In this presentation, using SMA and GUM metals as examples and with the aid of computer simulations, we demonstrate how to develop novel nanostructures with unprecedented properties, including nearly hysteresis-free and linear superelasticity, nearly zero thermal expansion (Invar anomaly), and ultra-low and temperature-independent elastic modulus (Elinvar anomaly) over a wide temperature range. Most of these new alloy design concepts demonstrated by the computer simulations have been realized in experiments and most of the simulation predictions have been confirmed by experimental characterization and testing. The findings have not only allowed us to solve some long-standing puzzles, but could also open a new avenue for the development of new concepts and design strategies for next generation of smart nano-structured materials for widespread technological applications.
Professor Wang received his B.S. (1982) in Metallurgy from Northeastern University of China and Ph.D. (1995) in Materials Science and Engineering from Rutgers University in the US. He joined the MSE Department at The Ohio State University (OSU) in 1996 as an assistant professor and became a full professor in 2005. His research interests are in the field of theoretical modeling and computer simulation of microstructure evolution during phase transformations and plastic deformation in high temperature Ni-base superalloys, Ti-, Al- and Mg-alloys, ferroic functional materials and metallic glasses. He has developed strong collaborations with many experimental groups to motivate and validate his modeling work. Prof. Wang has received numerous awards including NSF CAREER Award (1997), Hsun Lee Research Award (2006) from Institute of Metal Research, Chinese Academy of Science, ARC International Fellow (2009) from Australian Research Council, Harrison Faculty Award for Excellence in Engineering Education (2010) from OSU, Fraunhofer Bessel Research Award (2012) from Alexander von Humboldt Foundation of Germany, and Prof. Brahm Prakash Visiting Chair (2014) from Indian Institute of Science. Prof. Wang has published over 190 refereed journal articles (with over 90 in Acta Materialia)
significant research and development in the field of Si Photonics have been done in the past two decades leading to the worldwide establishment of Si Photonics foundry services. The technology advancement includes hybrid integration of III-V laser diodes on Si platform, micro-ring or disk resonators, integrated PN junction based Mach-Zehnder (MZ) light modulators, SiGe on Si photodetectors, SiN low-loss waveguides, integrated optical delay line, array waveguide gratings etc. In my group, the current focus of research is slow-light Bragg grating rib waveguides and slot waveguides on Si substrate. Slow-light waveguide has enhanced light-matter interaction so allowing significant size reduction in active photonic devices such as MZ light modulators. The MZ modulator is a basic building block for a large array of tunable optical interference units for the on-chip optical neuromorphic computing application in which the MZ interferometer serves as an arbitrary unitary matrix. The passive slow-light waveguide is also a key element for chip scale photonic system integration in many application areas. For example, the slow-light Bragg grating waveguide has been used to construct tunable optical delay lines for beamforming in phased array antennas. For on-chip optical reservoir computing, a dispersive Bragg grating is a critical element in obtaining nanoseconds of true-time delay for storage of memories.

Dr. Huang received her B.Sc. from Beijing Institute of Technology and her Ph.D. in Electrical Engineering from Georgia Institute of Technology. Prior to joining RPI, she worked as a postdoctoral fellow at the NSF Microsystem Packaging Center at Georgia Institute of Technology where she led the effort of end-to-end optical interconnects on printed circuit boards. Dr. Huang now is an Associate Professor at the Electrical, Computer, and System Engineering Department at RPI. She has co-authored more than 60 journal articles and conference proceedings. She received the Best Poster PRC Award (2nd place) in 1999, Outstanding Poster Paper Award of 53th ECTC in 2003, Commendable Paper Award of IEEE Transaction in Advanced Packaging in 2004, and NSF RampUp Award in 2010.