

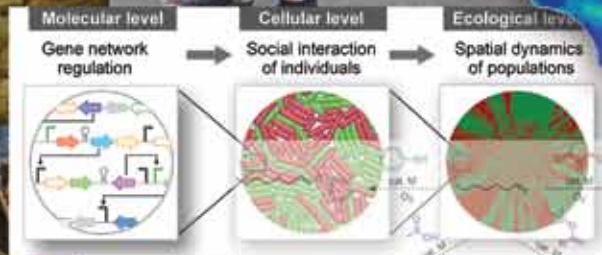
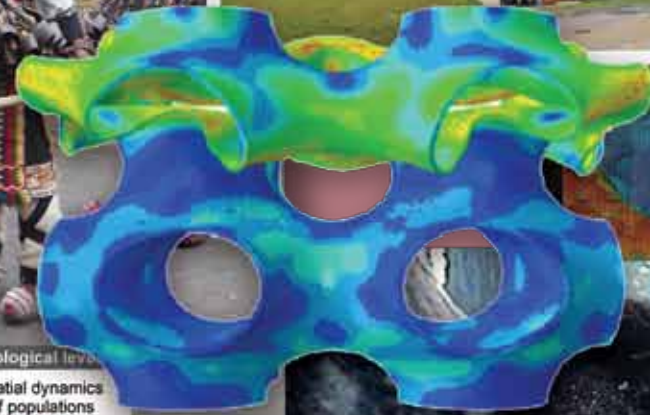
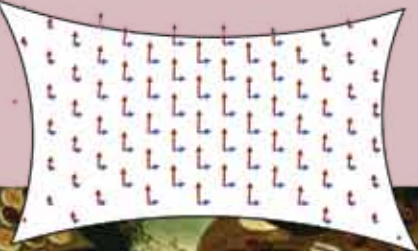
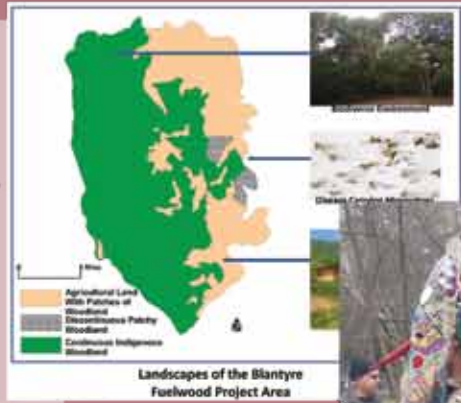
CAS

Center for
Advanced
Study

Research Appointments / Associates and Fellows 2017 - 18

I University of Illinois Urbana-Champaign

$$g | H_1(M; \mathbb{Z})_{\text{torsion}} | \text{vol}(M)$$



quod ab A. pollino Lyram antiperit
ut illius Pentu sylvas. saxunge move
spot se traxerit, forasq. ferocissimas
Domulfoxit
erit: Ho

Audible Cosmology: Engendered Bells in Bulgarian Belief • Visual Representation and Sensing from Mobile Cameras • The Linkage Between Topology and Geometry in Dimension • Multiscale Study of Bone Fracture, Adaptation, Regeneration and Bone-Inspired Materials • The Impact of Deforestation on Vector-borne Diseases in Southern Malawi: The Case of the Blantyre Fuelwood Project Area • Native Speakers, Interrupted: Agents of Change in Heritage Languages • Before Unemployment: Work, Idleness and the Uber-working Class • Tree of Pearls: The Extraordinary Architectural Patronage of the 13th-Century Egyptian Slave-Queen Shajar al-Durr • Mass Transport in Random Environments • Special Visual Effects: Digital Rendering in the Global Effects Industry • Coral Reef Restoration using Additive Manufacturing (3D Printing) • Orpheus Crosses the Atlantic: Greek and Latin Texts by Native Americans in Colonial New England • Justice at Work: The Expanding Politics of Urban Equity • Monitoring and Improving Positioning Integrity for Unmanned Aerial Vehicles (UAVs) • A General Framework for Analyzing the Sustainability of Resource Recovery from Bodily Waste • Selective Pd-Catalyzed Olefin Functionalization Reactions • A Systematic Search for Merging Black Holes in the Early Universe • Integrative Dissection of Bacterial Community Assembly • Materials with Strongly Coupled Order Parameters • The Genetic and Environmental Influences on Social Mobility



Research Appointments 2017-18

Each year, the tenured and untenured University of Illinois faculty are invited to submit scholarly/creative proposals for consideration by the Center's permanent Professors. Faculty members with winning proposals are appointed Associates and Fellows and awarded one semester of release time to pursue their projects in the coming academic year.

In accordance with the Center's mission, these appointments provide an incentive to pursue the highest level of scholarly achievement. They also provide faculty members with an unusual opportunity to explore new ideas and demonstrate early results.

Along with the Professors, Associates and Fellows form the intellectual core of the Center for Advanced Study community. They participate in a yearly roundtable discussion of research interests, are invited to participate in CAS events, and have opportunities to present their work to the CAS community. Thus, each year brings together the established and the new in an ever-changing flux of ideas and disciplines.

In this brochure we are pleased to introduce the projects of the 2017-18 CAS Associates and Fellows.

CAS

CAS Review Committee

The review committee for the Associates and Fellows program consists of the Center for Advanced Study Professors. These senior scholars represent a wide range of disciplines. Their permanent appointment to the Center is among the highest forms of campus recognition.

James D. Anderson

education policy, education desegregation, African-American public education

Renée L. Baillargeon

early conceptual development, infant cognition

Tamer Başar

distributed decision making, robust estimation and control, dynamic games, network economics

May R. Berenbaum

entomology, chemical ecology

Bruce C. Berndt

analytic number theory, Srinivasa Ramanujan

Antoinette Burton

British empire, colonial India, race and sexuality mobility

David M. Ceperley

quantum Monte Carlo methods, quantum many-body systems

Leon Dash

immersion journalism, domestic and international reporting

Gary S. Dell

Language production, speech errors

Eduardo H. Fradkin

Quantum field theory, condensed matter physics

Matthew W. Finkin

labor and employment law, legal issues in higher education

Martha U. Gillette

cellular neuroscience, circadian rhythm

Nigel Goldenfeld

condensed matter physics, evolution, microbial ecology, statistical mechanics

Martin Gruebele

computational modeling, laser techniques, complex molecular systems

Bruce Hajek

communications engineering, stochastic methods

Anthony James Leggett

low-temperature physics, superconductivity

Harry Liebersohn

music and globalization, transnational cultural encounters

Stephen P. Long

environmental physiology, global atmospheric change, C4 photosynthesis

Michael S. Moore

law and philosophy, jurisprudence, criminal law, ethics and meta-ethical philosophy, philosophy of punishment and responsibility, philosophical psychology

Catherine J. Murphy

Nanomaterials, cellular imaging, chemical sensing, photothermal therapy

Tere O'Connor

dance, choreography, consciousness

Gene E. Robinson

genomics, social behavior, social insects

Jay Rosenstein

journalism, film, documentaries

Sharon Hammes-Schiffer

proton-coupled electron transfer reactions, enzymatic processes, non-Born-Oppenheimer electronic structure models

Jonathan Sweedler

bioanalytical chemistry, peptide hormones, neurotransmitters, neuromodulatory agents

Maria Todorova

history, Balkans, nationalism

Lou van den Dries

model theory, o-minimality

Dale J. Van Harlingen

experimental low-temperature physics, superconductivity, microfabrication of superconductor devices, scanning probe microscopy, mesoscopic systems

Invitation to Apply

We invite the campus faculty to submit proposals for the 2018-19 academic year. For more information, please consult our website at www.cas.illinois.edu

**Application deadline:
October 2, 2017**

Contents

- 02 Musicology Division Audible Cosmology: Engendered Bells in Bulgarian Belief**
Donna A. Buchanan
Associate
- 03 Visual Representation and Sensing from Mobile Cameras**
Minh Do
Associate
- 04 Justice at Work: The Expanding Politics of Urban Equity**
Marc Doussard
Fellow
- 05 The Linkage Between Topology and Geometry in Dimension**
Nathan Dunfield
Associate
- 06 Monitoring and Improving Positioning Integrity for Unmanned Aerial Vehicles (UAVs)**
Grace Zingkin Gao
Beckman Fellow
- 07 A General Framework for Analyzing the Sustainability of Resource Recovery from Bodily Waste**
Jeremy Scott Guest
Beckman Fellow
- 08 Development of Anti-Markovnikov Selective Pd-Catalyzed Olefin Functionalization Reactions**
Kami Lee Hull
Beckman Fellow
- 09 Multiscale Study of Bone Fracture, Adaptation, Regeneration and Bone-Inspired Materials**
Iwona Jasiuk
Associate
- 10 The Impact of Deforestation on Vector-borne Diseases in Southern Malawi: The Case of the Blantyre Fuelwood Project Area**
Ezekiel Kalipeni
Associate
- 11 A Systematic Search for Merging Black Holes in the Early Universe**
Xin Liu
Beckman Fellow
- 12 Integrative Dissection of Bacterial Community Assembly**
Ting Lu
Fellow
- 13 Emergent Ground State Behavior in Materials with Strongly Coupled Order Parameters**
Gregory MacDougall
Fellow
- 14 Native Speakers, Interrupted: Agents of Change in Heritage Languages**
Silvina Montrul
Associate
- 15 Before Unemployment: Work, Idleness and the Uber-working Class**
Emanuel Rota
Associate
- 16 Tree of Pearls: The Extraordinary Architectural Patronage of the 13th-Century Egyptian Slave-Queen Shajar al-Durr**
D. Fairchild Ruggles
Associate
- 17 Mass Transport in Random Environments**
Dallas Trinkle
Associate
- 18 Special Visual Effects: Digital Rendering in the Global Effects Industry**
Julie Turnock
Associate
- 19 Coral Reef Restoration using Additive Manufacturing (3D Printing)**
Amy Jaye Wagoner Johnson
Associate
- 20 Orpheus Crosses the Atlantic: Greek and Latin Texts by Native Americans in Colonial New England**
Craig Williams
Associate
- 21 The Genetic and Environmental Influences on Social Mobility**
Yilan Xu
Beckman Fellow

Audible Cosmology: Engendered Bells in Bulgarian Belief

Donna A. Buchanan
Associate

Musicology Division



Mummets from eastern Bulgaria



Lyudmila Zhivkova,
The Bells, central
tower, Sofia

Throughout the world, belief systems are heard, apprehended, enacted, and perpetuated through musical and non-musical sounds endowed with uncommon power and meaning. This project will argue that in Bulgaria, the shimmering resonance of ringing metal is one such sonic phenomenon.

The Girl in the Bell: Audible Cosmologies of Bulgarian Belief will be Professor Buchanan's second ethnomusicological ethnography. Informed by 19 months of fieldwork with musicians, instrument craftsmen, and ritual practitioners conducted between 2007 and 2017, this book investigates the pivotal significance of bells in contemporary Bulgarian expression, whether as artistic and historical objects, gendered instruments of spirituality and politics, or sonic metaphors of musical beauty and world view.

The book's approach is acoustemological; that is, it assumes that we comprehend and experience the world not just visually, but aurally. Chapters locate this "aural sense" in bell craftsmanship; shepherding practices; men's instrumental tunes and women's vocal technique; multimedia folkloric productions on stage and screen; literary works; and architectural edifices, especially bellfries and monuments. Ultimately these findings illustrate that bells, both as sign-vehicles and when rung, as highly charged, environmentally saturating, surround-sound acoustic experiences, are profoundly evocative musical signifiers of Bulgarian subjectivity, lifeways, and belief; they represent multivalent, gendered, acoustemological indices weaving together sound, sentiment, and the sacred across the presocialist-postsocialist historical continuum.

Visual Representation and Sensing from Mobile Cameras

Minh Do
Associate

Department of Electrical &
Computer Engineering

Due to advancement in minimization and mass-production, cameras are ubiquitously embedded in most current mobile devices including smartphones, autonomous vehicles, robots, and body-worn devices. These mobile cameras are cheap and can gather, in real time, large amounts of visual data about the surrounding environments. Moreover, these mobile cameras are equipped with other sensing modalities like inertial and depth measurements, and even have active motion. Professor Do's research project will develop efficient visual representation and sensing schemes for mobile cameras using ideas from geometric vision,

plenoptic functions, information theory, sensor fusion, and bio-inspired algorithms. He will aim for a holistic approach for mobile vision that combines multi-modal sensing, geometric reconstruction, and semantic recognition for visual perception of dynamic environments. This approach will lead to a number of novel methods for extracting visual information from mobile devices including pose and location estimation, 3D environment mapping, object localization and recognition, and motion detection and recognition.



**Justice at Work:
The Expanding Politics of Urban Equity**

*Marc Doussard
Fellow*

Department of Urban & Regional Planning

Economic and social inequality stands as a defining problem of our time. It endures in substantial part because the national and global reforms necessary to contest it remain beyond the scope of political possibility. Out of necessity, the project of reversing inequality has moved to local venues. Relocating advocacy to cities has both strengthened anti-inequality movements, and changed their composition, strategies and goals.

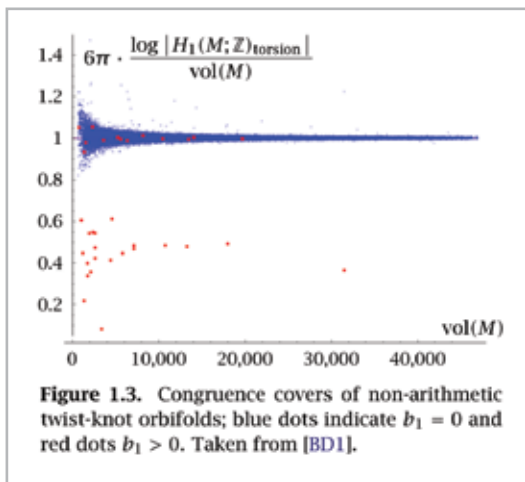
Justice at Work is a book that asks how U.S. cities became potent sites of economic reform and anti-inequality advocacy. The literature on cities and inequality remains insistent that urban-level equity reforms are at best unlikely – the result of individual instances of political luck or organizing skill. By contrast, *Justice at Work* will scrutinize

the systematic development of the social movement authoring these reforms. Informed by more than 200 interviews with organizers and activists campaigning for reform, Professor Doussard details the institutional changes that made cities meaningful cities of reform, and shows how the urbanization of advocacy changes activists' expectations about work, home and politics.

The Linkage Between Topology and Geometry in Dimension 3

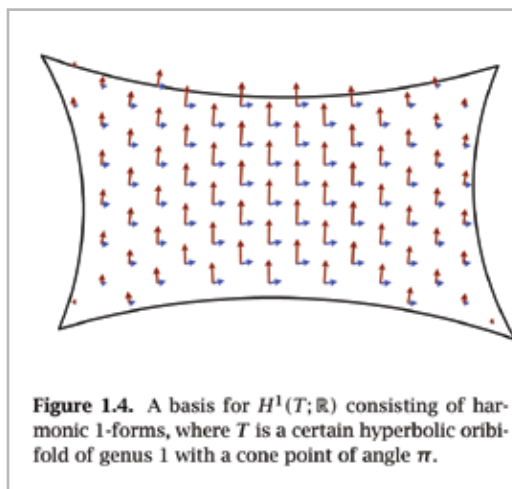
Nathan Dunfield
Associate

Department of Mathematics



In topology, a 2-manifold is an object that looks locally like a plane, for example a sphere or the surface of a doughnut. This research project studies 3-manifolds, which are objects that look locally like the ordinary 3-dimensional space we live in but whose global structure may be twisted up in complicated ways. Starting in the late 1970s, W. Thurston revolutionized the field by discovering that many 3-manifolds have homogeneous geometries, which include the round geometry of a 3-dimensional sphere, and that one can study the topology of a 3-manifold via this geometry. This profusion of geometry was confirmed by Grigori Perelman's stunning

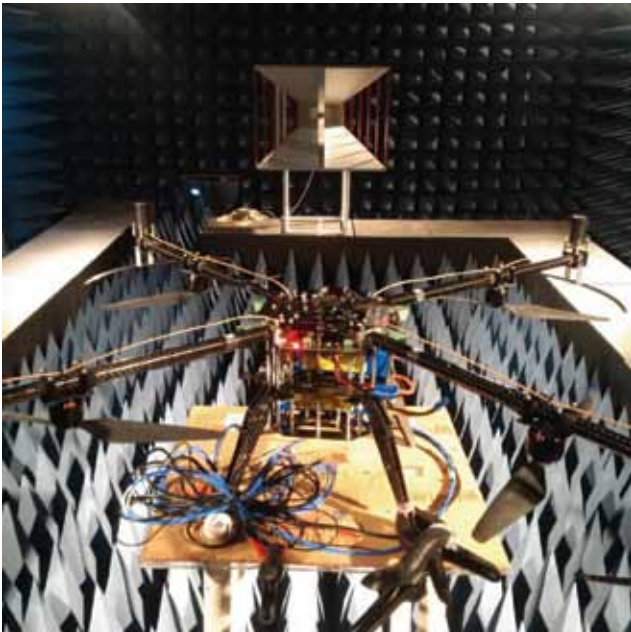
proof of Thurston's Geometrization Conjecture in the early 2000s. While this geometric perspective has been central to the solution of many long-standing problems, there are many facets of the theory where the precise relationship between different topological and geometric features of the same 3-manifold remains obscure. This project aims to better understand these relationships in the context of torsion growth in towers of covers of hyperbolic 3-manifolds, a question in part motivated by deep questions in number theory and geometric analysis.



Monitoring and Improving Positioning Integrity for Unmanned Aerial Vehicles (UAVs)

*Grace Zingkin Gao
Beckman Fellow*

Department of Aero and
Astronomical Engineering



To safely navigate in the coming age of autonomous systems, positioning is critical. The Global Positioning System (GPS), providing absolute position information, is a significant component of Unmanned Aerial Vehicles (UAVs). GPS operates via satellite signal reception and is thus susceptible to satellite and signal propagation errors. In urban environments, GPS signals can be blocked or reflected by buildings, leading to incorrect positioning, and thus resulting in potentially catastrophic failures of the autonomous platforms. To ensure safe and reliable positioning of autonomous systems, it is critical to address not only positioning accuracy, but also the confidence in accuracy, defined as integrity.

Professor Gao proposes a novel positioning integrity assessment and monitoring solution that is robust in GPS-challenged environments and is suitable for navigation sensor fusion.

1) She will develop a new algorithm to directly assess and monitor GPS integrity in urban environments; 2) she will develop an integrity-monitoring framework for GPS sensor fusion using camera vision, Lidar and inertial measurements; 3) she will further improve integrity by turning unwanted multipath signals into a useful navigational source. The proposed solutions will be assessed by conducting real-world flight tests using the UAV fleets in Professor Gao's lab.

A General Framework for Analyzing the Sustainability of Resource Recovery from Bodily Waste

*Jeremy Scott Guest
Beckman Fellow*

Department of Civil &
Environmental Engineering



Professor Guest's research project will advance the sustainability of sanitation in low-income communities by re-envisioning bodily waste (urine and feces) as a renewable resource from which nutrients (for agriculture) and energy can be recovered and reused locally. The objectives are 1) to characterize the potential for bodily waste to be a renewable resource for food production, energy production, and income generation in refugee settlements and 2) to develop an analytical framework to explicitly identify and navigate trade-offs in social-ecological systems (SEs) that leverage individually derived renewable resources (i.e., bodily waste).

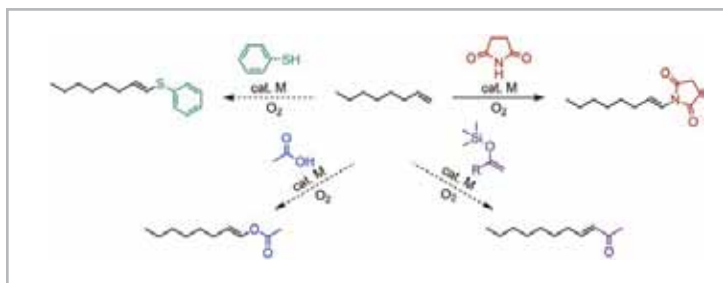
The research objectives will be accomplished through the quantification of resource flows (fuel, food, fertilizers) around a refugee settlement in Uganda, the development of a model to explore the complex social-ecological system in the Settlement, and participatory workshops with

stakeholders. The outcomes of this work will include a sanitation decision-making tool for the United Nations High Commissioner for Refugees (UNHCR) as well as an improved understanding of sanitation and food-energy systems by stakeholders in the refugee settlement. More fundamentally, the research will explore a novel conceptual framework for the management of resource systems in which human beings are a source (or, more accurately, part of a cycle) of renewable resource flows. This novel framework will represent a major shift in thinking related to coupled human-natural systems, and will provide an important tool for the pursuit of sustainable development to meet the needs of a growing global population in the 21st century.

Development of Anti-Markovnikov Selective Pd-Catalyzed Olefin Functionalization Reactions

*Kami Lee Hull
Beckman Fellow*

Department of Chemistry

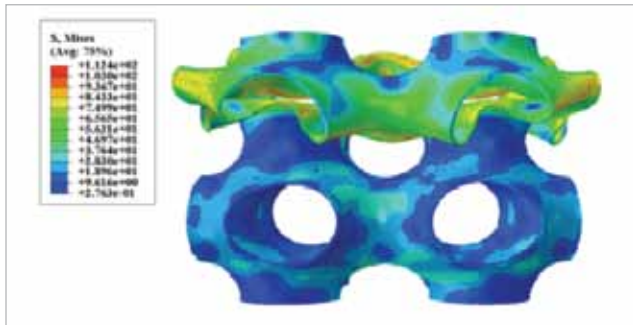


Carbon–nitrogen bonds are common functionalities found throughout organic molecules, including pharmaceuticals, agrochemicals, and organic materials. The selective amination—generation of carbon–nitrogen bonds—of hydrocarbons has been an ongoing challenge to synthetic organic chemists. Professor Hull proposes to develop catalysts that allow for the selective addition of nitrogen atoms to carbon–carbon double bonds such that a single isomeric product is generated. Further, she seeks to expand the methodology to the selective formation of carbon–carbon, carbon–oxygen, and carbon–sulfur bonds. The proposed work will be of great use to synthetic organic chemists by expediting the synthesis of target molecules, while reducing the generation of waste to a single molecule of water. Thus, the proposed research will have both economic and environmental benefits to the field of synthetic organic chemistry.

Multiscale Study of Bone Fracture, Adaptation, Regeneration and Bone-Inspired Materials

Iwona Jasiuk
Associate

Department of Mechanical Science
and Engineering



Finite element model of a TPMS (Primitive) structure loaded in compression

Bone is a living multi-functional material, optimized by nature and providing a playground for scientists to explore while addressing important scientific, clinical and technological problems. Professor Jasiuk's proposed research addresses four inter-related topics on bone which include:

1. Computational predictive multiscale model of bone fracture and strength

The experimentally-based computational analysis will span from nanoscale to macroscale, leading to the capture of bone weaknesses in disease and providing more accurate predictions of bone quality.

2. Bone adaptation: Multiscale biologically-based modeling of bone growth

The development of a numerical framework that can predict the bone growth for a wide variety of loading conditions will be useful in solving an inverse problem of identifying optimal loading conditions that can result in a desired growth. In addition, the local fields evaluated for a given loading condition will provide new insights on how cells react to mechanical stimuli.

3. Bone regeneration: Design of new scaffolds and modeling of bone ingrowth

Triply periodic minimal surfaces (TPMS) structures are infinitely extending, smooth, and continuous surfaces found in nature and in human bodies. TPMS minimize stress concentrations and provide an optimal template for bone cells to grow new bone tissue.

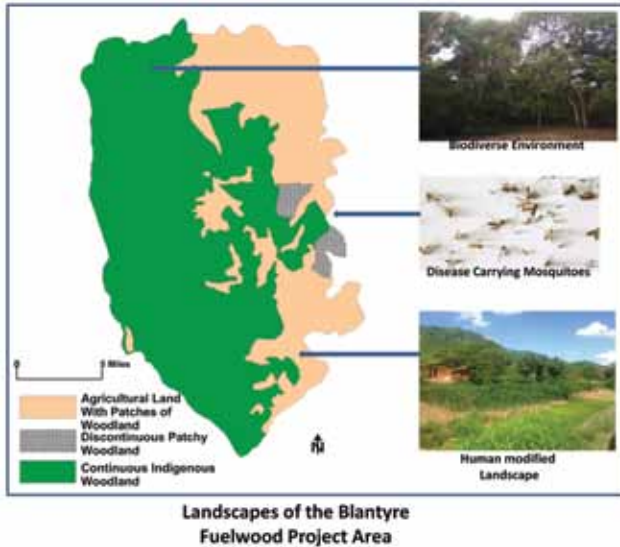
4. Bio-inspired Materials: Design of new bone inspired biomaterials and composites

Recent studies on demineralized, deproteinized and untreated bone showed that both the minerals and the proteins formed contiguous, stand-alone structures, capable of withstanding structural loads. The structural advantages of such bi-continuous phases will be incorporated in new designs.

The Impact of Deforestation on Vector-borne Diseases in Southern Malawi: The Case of the Blantyre Fuelwood Project Area

Ezekiel Kalipeni
Associate

Department of Geography



This proposed study will examine the link between biodiversity and disease dilution or amplification in the Blantyre City Fuelwood Project (BCFP) area of southern Malawi. It will shed light on the following two questions: 1) How do changes in biodiversity affect human health and/or the risk of a vector borne disease such as malaria transmission? 2) Can an interdisciplinary approach to studying the relationships among structural diversity, habitat availability, vector ecology, epidemiology, and human behavior be used to reduce the risk of malaria transmission in the BCFP area? As such the central goal of the study is to test the disease dilution hypothesis using malaria in southern Malawi as a case study.

The following specific objectives will be accomplished during the course of the study: (a) document the spatial pattern and extent of forest cover change in the BCFP area of southern Malawi between 1948 and 2010; (b) examine the presence and intensity of malaria carrying mosquitoes sampled on a forest and deforested transect with a gradient from heavily deforested, densely populated to heavily forested area with great biodiversity; and (c) conduct genotyping on the collected samples of mosquitoes to gauge the presence and genetic variation of malaria protozoa across the forest/deforestation transect.

Professor Kalipeni will travel to Malawi in order to work with colleagues at the College of Medicine in Blantyre. While in Malawi, he will also have the opportunity to analyze remotely sensed images that go back to the late 1940s obtained from the Department of Lands and Surveys of the Government of Malawi as well as to collect a sample of mosquitoes for genomic testing at the College of Medicine in Malawi and at the University of Illinois.

A Systematic Search for Merging Black Holes in the Early Universe

Xin Liu
Beckman Fellow

Department of Astronomy



Dual Active Galactic Nuclei (AGNs) are active supermassive black hole pairs co-rotating in merging galaxies. Despite decades of searching, and strong reasons to believe they exist, unambiguously confirmed dual AGNs are surprisingly scarce, which contradicts theoretical prediction. To date no confirmed case of dual AGNs is known at cosmic redshift $z > 2$.

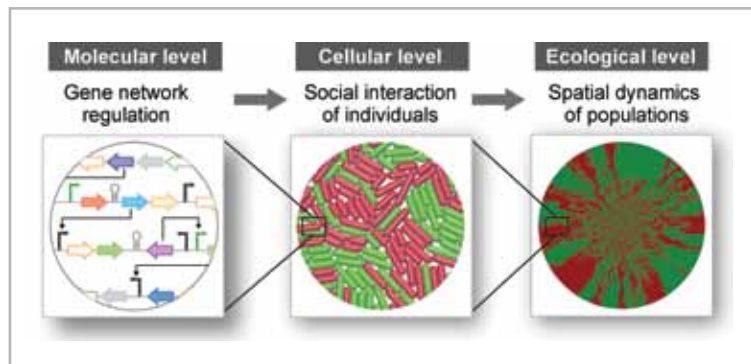
During her Center appointment, Professor Liu will employ a new technique to identify $z > 2$ dual AGNs to fill this gap. The technique makes use of variability of the AGN light curves, and searches for the centroid shift due to the non-synchronous variation of two closely separated AGNs. This technique will be applied to data from time-domain surveys such as the Dark Energy Survey. Higher resolution imaging and spectroscopic follow-up observations will be conducted to confirm the dual AGN candidates and to assess the efficiency and feasibility of the technique.

Preliminary results suggest that the technique is capable of identifying dual AGNs at redshifts up to $z > 2$ (i.e., probing the cosmic “high noon” when mergers should be most common), and can achieve an order-of-magnitude increase over the telescope angular resolution limit. If confirmed, this result would imply that hundreds and thousands of dual AGNs could be identified through most of the early cosmic history with ongoing and future surveys, thereby opening a new window onto the study of galaxy evolution, cosmology, and gravitational wave astronomy.

Integrative Dissection of Bacterial Community Assembly

Ting Lu
Fellow

Department of Bioengineering



Bacteria are single-celled organisms but known to form complex communities in space. Understanding how they assemble is fundamentally important, as the vital impacts of bacteria to the environment, agriculture as well as human health are all achieved through the form of communities. Despite significant advances over past decades, our understanding about bacterial communities remains limited, largely due to their intrinsic complex-system nature that integrates cellular processes across multiple scales.

Professor Lu's research program aims to discover the fundamental design principles of bacterial communities, by systematically dissecting and modeling the multiscale link among intracellular gene regulation, intercellular social interactions, and spatiotemporal dynamics of populations. To achieve the goal, a multidisciplinary approach that combines mathematical modeling with experimentation will be used in order to accomplish the following three aims:

(1) specifying how the architecture of molecular networks controls the mode of interaction and hence community organization; (2) quantifying how noise at the molecular level propagates to cellular interactions and further causes variability in community structure; and (3) determining how the metabolic cost of cellular interactions alters the outcome of community structure.

The proposed research promises an integrated understanding of the structure, dynamics and function of bacterial communities, thus providing new insights into microbial ecology and sociology. It may also yield new strategies for engineering synthetic consortia. More broadly, due to the intrinsic complexity of bacterial communities, the work will also deepen our fundamental understanding of complex systems sciences.

***Emergent Ground State Behavior in
Materials with Strongly Coupled
Order Parameters***

*Gregory MacDougall
Fellow*

Department of Physics

Professor MacDougall explores novel states of matter in quantum materials using advanced instrumentation housed at national laboratories to examine large single crystals grown in his labs. By using both neutron scattering and muon spin rotation (μ SR), his research group is able to study magnetic correlations, volume fractions, collective excitations and superconducting phases in materials of interest. He uses these techniques to identify and understand the origins of novel phases, in an effort to generalize to other material systems.

There are two parallel efforts: 1) the study of new magnetic phases seeded by strong spin-lattice coupling, and 2) the study of intertwined charge, spin and superconducting order parameters in correlated electron materials. A major example of the former is the observation of spontaneous phase separation in the material Mn_3O_4 at low temperatures into ordered and disordered volumes, and the ordering of order-disorder domain walls on an emergent length scale of $d \sim 100$ nm.

Professor MacDougall's research group is currently exploring the generality of this effect and the possibility of using it to control material properties in a way analogous to 'colossal' response functions in rare-earth manganates.

The group's studies of superconductivity focus on materials containing co-existing superconducting, spin and charge orders, and explore the possibility that phase-sensitive coupling terms in the free energy could seed novel 'pair density wave' (PDW) states. The existence of such a phase could explain key experimental observations in the high-temperature cuprate superconductors, and other materials, and could further stabilize other unconventional superconducting signatures such as half-quantized vortices. Professor MacDougall is part of a multi-investigator team which is seeking to experimentally verify these signatures in various PDW candidates and establish the veracity and generality of the theory.

Native Speakers, Interrupted: Agents of Change in Heritage Languages

Silvina Montrul
Associate

Department of Spanish & Portuguese

All spoken languages change over time. Some linguists have proposed that the monolingual child is the main agent of language change; others contend that adult second language learners and their imperfect language learning ability are the most obvious agents. Professor Montrul will argue that heritage speakers—bilingual native speakers—who combine some qualities of child monolingual speakers and adult second language speakers can also act as significant agents of language change. As young adults, the language skills of heritage speakers rarely mirror those of their parents in many grammatical areas, leading to the uneven transmission of the heritage language across generations. The special language learning situation of heritage speakers thus provides a unique testing ground for isolating those aspects of language that are more likely to simplify and change over time.

This comparative, transgenerational, and transnational study tells the linguistic story of first and second generation immigrants through an in-depth analysis of the special case marking of some direct objects and subjects, common to Spanish, Hindi, and Romanian, elicited through linguistic tasks. The results reveal a significant degree of language change among Spanish-speakers in the United States, but not among Hindi and Romanian speakers in the United States. These differences are related to the structures of these specific languages, to a certain extent, but also to the cultural specificities of each heritage community: its size, patterns of interaction, identity and attitudes toward the language. Using new empirical evidence, Professor Montrul will advance the hypothesis that the change in the Spanish of the United States is more likely transmitted from older children to their parents –and not from parents to the children, as some linguists have suggested.

Before Unemployment: Work, Idleness and the Uber-working Class

Emanuel Rota
Associate

Department of French & Italian



Pieter Bruegel the Elder, *The Land of Cockaigne* (1567), Alte Pinakothek, Munich

Professor Rota's project reconstructs Western attitudes toward idleness from the first to the third Industrial Revolution. By representing industriousness as a modern feature, the hegemonic Western narratives have portrayed the Western economic success as the result of its ability to break away from its past and from the rest of the world. By representing idleness as a permanent human vice, the same narratives have been able to close the imagination of an alternative future where labor could disappear from the human condition. In reconstructing how the question of idleness was thematized during each of the previous Industrial Revolutions, this project aims to debunk the use of narratives of idleness as a justification of the superiority of modernity over the past and as an explanation of the economic success of the West over the rest of the world.

Each chapter in the book resulting from this project will underline a transformation in the Western conception of idleness. Themes to be covered include how the Greek concept of *acedia* went from being the vice of slaves to becoming the vice of monks; the emergence of a secular conception of idleness during the First Industrial Revolution in the circles around the physiocrats; the evolution of the notion of idleness in the age of Imperialism when the myth of the absentee worker and that of the lazy native were mutually reinforcing; and the development of a scientific discussion on the techniques to maximize labor output in the Ford factory models and their adoptions by Fascist states and the Soviet Union. The study will conclude with a discussion about the current debate on idleness at the inception of a fourth Industrial Revolution.

**Tree of Pearls: The Extraordinary
Architectural Patronage of the
13th-Century Egyptian Slave-
Queen Shajar al-Durr**

D. Fairchild Ruggles
Associate

Department of Landscape Architecture



Tomb of Shajar al-Durr, Cairo

Queen Shajar al-Durr (r. 1250) was a rare case of a woman ruler in Egypt, and her distinctive architectural patronage changed the face of Cairo and had a lasting impact on Islamic architecture. Rising from slave origins, Shajar al-Durr (whose name means “Tree of Pearls”) became concubine, wife, and regent to the Sultan Salih (r. 1240-1249), and ultimately was appointed as the legitimate ruler of Egypt after the sultan’s untimely death. Her reign was short and so controversial that the caliph wrote from Baghdad to condemn the appointment: “If you have no man who can rule, then we will send you one.” In architectural history, her patronage was innovative because of the tombs that she added to Salih’s madrasa

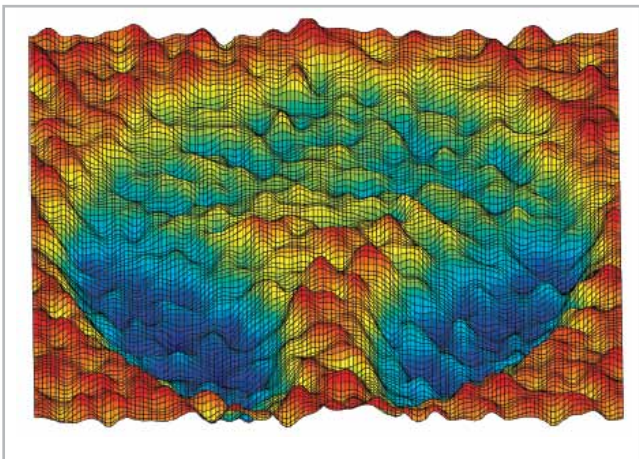
(theological college) and her own, thereby transforming those institutions into commemorative monuments. For the first time, an architectural complex was empowered to stand for the founder himself, visibly and unforgettably manifest in the tomb’s high dome, rising above the urban skyline. This dramatic transformation—in which architecture embodied human identity—was made possible by Shajar al-Durr, a woman who began her career as a mere slave. Her path-breaking patronage contradicts the prevailing assumption among historians of Islam that there was no distinctive female voice in art and architecture.

Mass Transport in Random Environments

Dallas Trinkle

Associate

Materials Science & Engineering



The processing of materials as well as their technologically important properties are controlled by a combination of thermodynamics—which determines equilibrium—and kinetics—how a material evolves. Mass transport in solids, where different chemical species diffuse in a material due to random motion with or without a driving force, is a fundamental kinetic process for a wide variety of materials problems. Even the new manufacturing technique of “additive manufacturing”—where metallic or ceramic materials are printed in three dimensions to simultaneously create complex shapes and graded chemical compositions—involves complex mass transport due to rapid heating and cooling of the part during processing.

Given the central role mass transport plays in material science and engineering, significant advances in predictive modeling will impact the development of materials for a wide array of applications. Recently, Professor Trinkle solved a significant problem in diffusion that now enables the development of new theoretical tools to greatly extend computational modeling of transport for complex materials. During his CAS research appointment Professor Trinkle will work with mathematicians and scientists from across the world at the UCLA Institute for Pure and Applied Mathematics, during a semester-long program on “Complex High-Dimensional Energy Landscapes.” He will also incorporate methods from advanced statistical mechanics to greatly extend our computational modeling tools. This will lead to significant new modeling capabilities with unprecedented accuracy and computational efficiency to computationally predict mass transport, capable of impacting the development of advanced alloys, battery materials, control of corrosion, and new processing methods.

Special Visual Effects: Digital Rendering in the Global Effects Industry

Julie Turnock
Associate

Department of Media & Cinema Studies



Still from *The Revenant* (2015)

Understanding moving images historically, technologically and aesthetically is vitally important in today's mediascape. As the aesthetic that organizes our perceptions of the real, special visual effects have had an enormous influence on how we process the world. This book project will show how attention to the discourses and material practices of digital rendering can upend many theoretical assumptions about new media. Namely, this project challenges the widespread idea that digital imaging technologies facilitate greater realism, convergence and interoperability.

Professor Turnock will explore the ways digital rendering, especially CGI in the blockbuster cinema that economically and aesthetically feeds other areas of moving image media, counterintuitively has led to less digital interoperability rather than more. In examining

the industrial, historical and aesthetic practices of digital imaging since 1990 within a long historical trajectory, the book will argue that rather than a unitary notion of "the digital" as many theorize, instead new rendering technology has in fact led to many digitals, creating turmoil in cinema's labor relations, professional identities, and visual aesthetics, and also impacting the reality effect of those visual images. This book project will show that considering the digital moving image across moving image media such as television, advertising, and internet video demonstrates the continuing vitality of cinema's one hundred-year-old scholarly methodology and discourses to media studies more broadly.

Real Time Transposable Element Activity in Individual Live Cells

Amy Jaye Wagoner Johnson

Associate

Department of Mechanical Science and
Engineering



Photo credit: EPA

Marine life in a section of the Great Barrier Reef
untouched by bleaching

Professor Wagoner Johnson will apply additive manufacturing (i.e., 3D printing) to the global environmental challenge of coral reef restoration. The need for novel approaches to coral reef restoration is clear, as is the urgency in the application of the approaches.

This research focuses on new ways to enhance coral reef restoration using techniques that are currently used in bone tissue engineering. Professor Wagoner Johnson will produce 3D-printed, engineered substrates with sub-millimeter features that will enhance and accelerate coral polyp reproduction and growth. This project is not only a new application for additive manufacturing, but it is also a new approach in coral reef restoration research. The influence of substrate properties such as composition, porosity and topography on the reproduction, growth, and survival of coral is a new and important area of coral reef research given their precipitous decline in the past 30 years.



Photo credit: AFP/Getty Images

Coral bleaching off Heron Island on the Great Barrier Reef .

Orpheus Crosses the Atlantic: Greek and Latin Texts by Native Americans in Colonial New England

Craig Williams
Associate

Department of Classics



Detail from a letter by Caleb Cheeshahteamauk
(Wampanoag), 1663

Colonial New England saw a focused effort by Protestant missionaries to train select young American Indian men in “the learned languages” in preparation for college or the ministry. The result was a body of texts written by Native North Americans in Ancient Greek and Latin prose and verse which forms the centerpiece of this book. Professor Williams is the first scholar to gather, translate, and interpret these texts as a complex and unique body of writing.

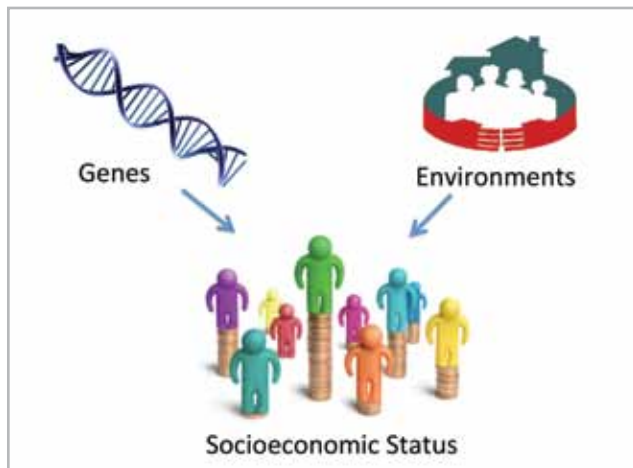
Professor Williams’ book will make significant contributions to scholarly conversations happening in several fields. Classicists, including those specializing in Neo-Latin, have not written about this material and are largely unaware of its existence. Those working in the field of reception studies, exploring the widely varying uses made of the languages, literatures, and cultures of ancient Greece and Rome, have recently begun looking beyond European and Euro-American contexts to Africa, India, Latin America, and the Caribbean,

but Native North American receptions of Greece and Rome have not yet been studied. Specialists in Native American Studies and Atlantic History have discussed some but not all of this material, and typically do not have the background in Greek and Latin studies to fully contextualize the texts. Professor Williams’ book will simultaneously interpret these Greek and Latin texts with the tools of classical philology, for example by analyzing features of their language or their allusions to classical literature, and explore the ways in which these and other Native-authored texts engaging with Greece and Rome negotiate the relationship between the deep and living antiquity of their authors’ indigenous cultures and the recently encountered antiquity of the European settler-colonists.

The Genetic and Environmental Influences on Social Mobility

Yilan Xu
Beckman Fellow

Department of Agricultural
& Consumer Economics



Economic and sociology literature has shown strong persistence in wealth, income, and other socioeconomic status (SES) across generations and over one's lifetime, leading to social immobility. Parental SES can be transmitted to their children and persist over children's lifetime through abilities, intelligence, temperaments, as well as the family, neighborhood, and school environments. Some of these effects are genetic, while others are environmental.

In this study, Professor Xu will empirically explore the roles of genes, environments, and their interactions in explaining social mobility, using twins and siblings from the National Longitudinal Survey of Adolescent Health (Add Health). The knowledge derived from this research will be significant because social

immobility has led to social stratification, resulting in persistent disparities in economic opportunities and individual welfare. The relative importance of genetic and environmental influences discovered in this study will inform the mix of policy interventions that could be used to enhance social and economic mobility. Professor Xu's innovation is to apply the genetic method used in psychology to an economic and policy issue. Specifically, she will partition the genetic and environmental influences using twins and siblings and infer the Gene \times Environment interactions through longitudinal observations. The research method developed in this project could be used to understand the genetic and environmental mechanisms of many other socioeconomic phenomena.

Audible Cosmology: Engendered Bells in Bulgarian Belief • Visual Representation and Sensing from Mobile Cameras • The Linkage Between Topology and Geometry in Dimension • Multiscale Study of Bone Fracture, Adaptation, Regeneration and Bone-Inspired Materials • The Impact of Deforestation on Vector-borne Diseases in Southern Malawi: The Case of the Blantyre Fuelwood Project Area • Native Speakers, Interrupted: Agents of Change in Heritage Languages • Before Unemployment: Work, Idleness and the Uber-working Class • Tree of Pearls: The Extraordinary Architectural Patronage of the 13th-Century Egyptian Slave-Queen Shajar al-Durr • Mass Transport in Random Environments • Special Visual Effects: Digital Rendering in the Global Effects Industry • Coral Reef Restoration using Additive Manufacturing (3D Printing) • Orpheus Crosses the Atlantic: Greek and Latin Texts by Native Americans in Colonial New England • Justice at Work: The Expanding Politics of Urban Equity • Monitoring and Improving Positioning Integrity for Unmanned Aerial Vehicles (UAVs) • A General Framework for Analyzing the Sustainability of Resource Recovery from Bodily Waste • Selective Pd-Catalyzed Olefin Functionalization Reactions • A Systematic Search for Merging Black Holes in the Early Universe • Integrative Dissection of Bacterial Community Assembly • Materials with Strongly Coupled Order Parameters • The Genetic and Environmental Influences on Social Mobility

CAS

Center for
Advanced
Study



University of Illinois Urbana-Champaign
Levis Faculty Center—Suite 200
919 West Illinois Street
Urbana, IL 61801

Phone: 217.333.6729

www.cas.illinois.edu