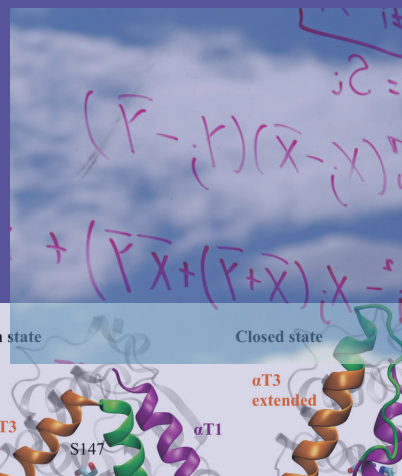
CAS

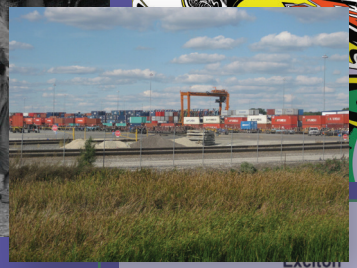
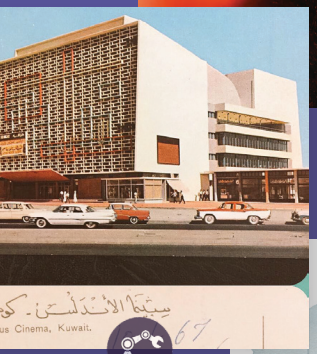
Center for Advanced Study

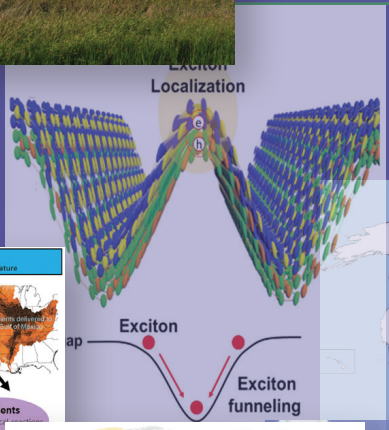
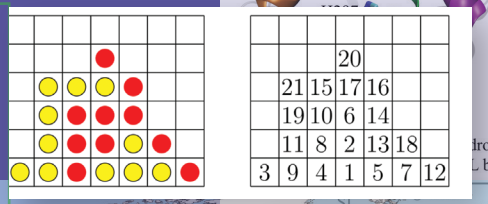
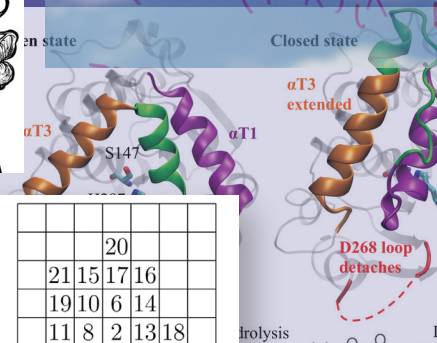
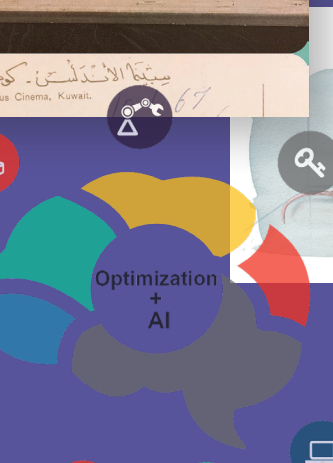
RESEARCH APPOINTMENTS / ASSOCIATES AND FELLOWS 2020 - 21

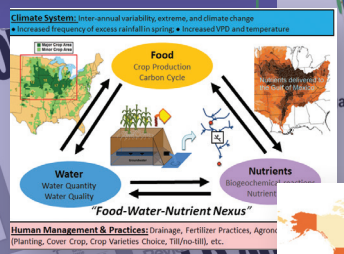
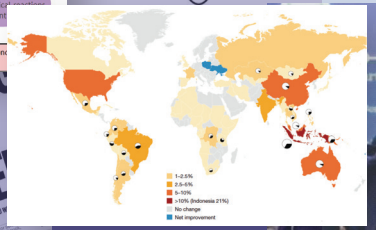
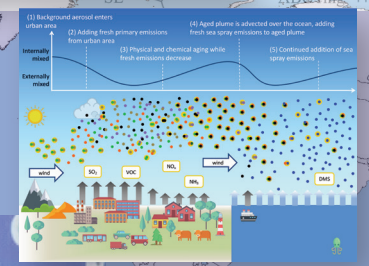
University of Illinois Urbana-Champaign



FORGOTTEN VOICES, HIDDEN PLEASURES: VIOLIN CULTURE IN BRITAIN, C. 1870-1930 • THE INVENTION OF AL-ANDALUS: USES OF THE PAST IN CONTEMPORARY CULTURE • STATISTICAL OPTIMAL TRANSPORT AND GEOMETRIC DATA ANALYSIS • DISTRIBUTED AND DISCRETE MODULATORY ACTIONS OF DBI IN THE NEUROCIRCUITRY OF SOCIAL BEHAVIOR • GROWING OLD IN THE AGE OF TECHNOLOGY • SEDIMENTATION OF FLOWS: THE DES PLAINES-KANKAKEE CONFLUENCE AND SPACES OF DISTRIBUTION • ENSURING CO-SUSTAINABILITY OF FOOD PRODUCTION AND ENVIRONMENTAL QUALITY IN THE U.S. MIDWEST AGROECOSYSTEMS • NEW OPTIMIZATION PARADIGMS FOR LARGE-SCALE PROBABILISTIC INFERENCE • UNDERSTANDING THE ALLOCATION AND EFFECTIVENESS OF GLOBAL FUNDING FOR FOREST CONSERVATION • SINGLE QUANTUM EMITTERS BASED ON ATOMICALLY-THIN STRAINED SEMICONDUCTORS • WHEN WILL COMPLEX SYSTEMS THRIVE, SURVIVE OR COLLAPSE? • TAINTING THE WELL OR PRIMING THE PUMP? THE DYNAMICS OF COOPERATION IN CIVIL WAR • CHEMISTRY ACROSS MULTIPLE PHASES (CAMP): A NOVEL FLEXIBLE TREATMENT FOR MULTIPHASE CHEMISTRY IN ATMOSPHERIC MODELS • STE(A)M POWERED STORIES • HISTORIOGRAPHIES OF DISPLACEMENT: A COMPARATIVE STUDY OF PALESTINIANS IN BERLIN, SANTIAGO, AND CHICAGO • DOES POLITICAL ATTITUDE DISAGREEMENT FOSTER SOCIETAL CONFLICT? A GLOBAL EXAMINATION ACROSS 40 YEARS AND 98 COUNTRIES • UNRAVELING THE MOLECULAR MAGIC OF WITCHWEED • RABBINIC INFERNO: HELL AND SALVATION IN CLASSICAL JUDAISM • SOLID FOUNDATIONS IN EARLY GRADE LITERACY AND POST-PRIMARY SCHOOL TRANSITIONS • ALGEBRA, COMBINATORICS, AND COMPLEXITY

CAS

Research Appointments 2020-21

Each year, 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 for Advanced Study's mission, these appointments provide incentives to pursue the highest level of scholarly achievement. They also provide faculty members with unusual opportunities 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 campus and off-campus communities. 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 2020-21 Associates and Fellows.

CAS

CAS Review Committee

The review committee for the Associates and Fellows program consists of the Center for Advanced Study Professors. 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

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

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

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

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Invitation to Apply
We invite the campus faculty to submit proposals for the **2021-22** academic year Associates and Fellows Program. For more information, please consult our website at www.cas.illinois.edu

Application deadline:
October 6, 2020

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FORGOTTEN VOICES, HIDDEN PLEASURES: VIOLIN CULTURE IN BRITAIN, C. 1870-1930

Christina Bashford
Associate

Music

An elementary school violin class in late Victorian Britain.

Late Victorian Britain was marked by what one contemporary described as a "perfect craze" for learning and playing the instruments of the violin family. This surge in musical activity, stimulated by the supply of newly affordable instruments in the 1870s, was underscored by changing social and cultural values that broke down longstanding barriers of gender and class, and was advanced by a growing commercial and educational infrastructure. It also endured, impacting both the British compositional tradition and multiple spheres of performance. By 1900, learning and playing the violin, viola, and cello—instruments with strong expressive potential and of great material beauty—had become normalized within patterns of classical and popular music-making. This state of affairs survived World War I to flourish through the 1920s, before declining in the early 1930s, when the impact of sound technology reduced interest in social music-making.

During her CAS appointment, Professor Bashford will work toward completing her book project, *Forgotten Voices, Hidden Pleasures: Violin Culture in Britain, c.1870-1930,* which rehabilitates this violin culture through a broad historical analysis of the practical and conceptual impact of the violin family in the UK. Over the last century, the diverse activities of the culture's players and enthusiasts—among them middle-class women, working-class men, and state-school children—have been silenced or forgotten by the historical record, even though the culture's legacies have reverberated into the present. As well as making music for pleasure, many of the players operated in the less glamorous, poorly-paid sectors of the music profession. They were complemented by a swathe of hobbyist instrument makers and collectors who have also been ignored. Recovering all these people's voices, pleasures, and contributions is essential to understanding how and why the violin family impacted British culture and society so profoundly during this era.

THE INVENTION OF al-ANDALUS: USES OF THE PAST IN CONTEMPORARY CULTURE

Eric Calderwood
Associate

Comparative & World Literature

From the nineteenth century until the present, the memory of al-Andalus (medieval Muslim Iberia) has served a diverse array of political and cultural projects, from European colonialism to pan-Arab nationalism to ongoing debates about immigration, feminism, and the Israeli-Palestinian conflict. *The Invention of al-Andalus* explores contemporary representations of al-Andalus in literature, film, television, music, and tourism from several different cultural and geographic contexts, spanning Spain, Morocco, Egypt, Syria, Lebanon, Israel/Palestine, and the United States. Professor Calderwood argues that contemporary claims about al-Andalus tell us more about our current moment than they do about the medieval past. By tracing competing and contradictory ideas about al-Andalus, his book maps out the desires that we project onto the Andalusi past, in order to see how that past shapes our understanding of the present and our hopes for the future. This project challenges a tradition of scholarship that has treated al-Andalus as a symbol of tolerance and cross-cultural understanding while, at the same time, ignoring the voices of contemporary Arab and Muslim authors, artists, and scholars. The book offers a multilingual and transnational account of the various understandings of al-Andalus in contemporary culture. It also asks larger questions about the political uses of history. Why and how do some historical moments, like al-Andalus, become useful and useable in different cultural contexts? Can anachronism be benign, or even desirable? Ultimately, the book advocates for a mode of cultural memory that is capacious enough to accommodate, and even welcome, contradiction and multiple perspectives.

STATISTICAL OPTIMAL TRANSPORT AND GEOMETRIC DATA ANALYSIS

Xiaohui Chen
Associate

Statistics

Current approaches to Big Data (or high-dimensional and massive data) and associated computational tools have left behind modern applications, such as image processing and computer vision, where data are not collected and expressed as vectors of real numbers or points in Euclidean space. Thus, there is a pressing need for transferring the success of traditional data processing resources and developing new statistical techniques to accommodate more general types of data.

Although there has been recent promising progress in computational optimal transport, understanding its fundamental strengths and limitations as a statistical tool is currently in its infancy. Professor Chen's overarching research goal is to develop new computational and statistical techniques to analyze data that is more complex than the Euclidean space valued data via the optimal transport theory, and to provide strong theoretical support for the statistical optimal transport with applications to geometric data analysis. The proposed research is expected to provide key enabling technologies for high-impact applications in machine learning and data science such as brain image scans based on magnetic resonance imaging (MRI) data.

DISTRIBUTED AND DISCRETE MODULATORY ACTIONS OF DBI IN THE NEUROCIRCUITRY OF SOCIAL BEHAVIOR

Catherine Christian-Hinman
Fellow

Molecular & Integrative Physiology

Alexis Demetriades

Reduced social interest is a common presentation in autism spectrum disorders. Mice exhibiting autism-like behaviors and associated genetic mutations can show improved social interest after treatment with benzodiazepines, which act on receptors for the neurotransmitter GABA. Professor Catherine Christian-Hinman's ongoing work investigates a protein called diazepam binding inhibitor (DBI), which can mimic some benzodiazepine actions. Her team recently discovered that mice genetically lacking DBI show reduced social interest towards other mice. In parallel, recent human genetic studies have begun to link DBI dysfunction and autism. These findings suggest that DBI modulates brain activity in a manner that promotes social interest and motivation. A key aspect of DBI biology, however, is that the protein is expressed in all cells. DBI has also been linked to several diverse physiological processes. These characteristics suggest that the actions of DBI are both: 1) distributed, affecting a wide number of brain areas; and 2) discrete, with specific features and effects found only in certain brain regions and neuronal subpopulations.

During her CAS appointment, Professor Christian-Hinman plans to conduct studies at the genetic, cellular, and behavioral levels to pinpoint where in the brain DBI acts to modulate social behavior. Specifically, she and her research team will use markers of neuronal activity to map groups of neurons that are activated during a social interaction and identify neuron populations that are over- or under-activated in mice genetically lacking DBI. Next, they will use viral vectors and chemogenetic tools to selectively manipulate neuronal activity to attempt to restore social interest levels in mice lacking DBI. Lastly, they will use transcriptomics and bioinformatics to determine the impacts of loss of DBI on the expression of other genes in the brain at both regional and cellular levels. These studies have the potential to provide clues to new therapies for social deficits in autism.

GROWING OLD IN THE AGE OF TECHNOLOGY

Amanda Ciafone
Fellow

Media & Cinema Studies

Professor Ciafone's book, *Growing Old in the Age of Technology,* challenges the dominant academic paradigm of applied research on technology and aging that frames technologies as remedies for "curing" old age or solutions that protect, assist, or empower older people. In the 20th century US, technologies transformed the experience and understanding of aging with new definitions of productivity, cultural representations of old age, means for financing retirement, mechanisms for independent living, and biotechnical interventions to extend life. But this book shows how the promise of a "successful" old age—independent, productive, and healthy with proper technological assistance enabling self-maintenance—also came with new expectations, judgments, and inequalities around how people grow old.

Growing Old in the Age of Technology combines archival, interpretive, and ethnographic methods in its interrogation of the relationship between technology and old age to ensure that it is grounded in historical evidence, attendant to the forms and materiality of media and technologies, and engaged with the lived experiences and perspectives of older people and those who care for them. During her CAS appointment, Professor Ciafone will complete research in the archives of 1930's Social Security advocates who framed the elderly, unable to work efficiently with industrial machines or upgrade their skills, as slowing the economy through obsolescence by technology. For a later chapter of the book, she will conduct ethnographic fieldwork with immigrant domestic workers and digital devices, "technologies of the home" working, often in conjunction with each other, to care for people in old age. For the concluding chapter, she will analyze the polarized technological future of aging in which the privileged seemingly delay biological age through life extension technologies and others are "weathered" old before their time.

SEDIMENTATION OF FLOWS: THE DES PLAINES-KANKAKEE CONFLUENCE AND SPACES OF DISTRIBUTION

Julie Cidell
Associate

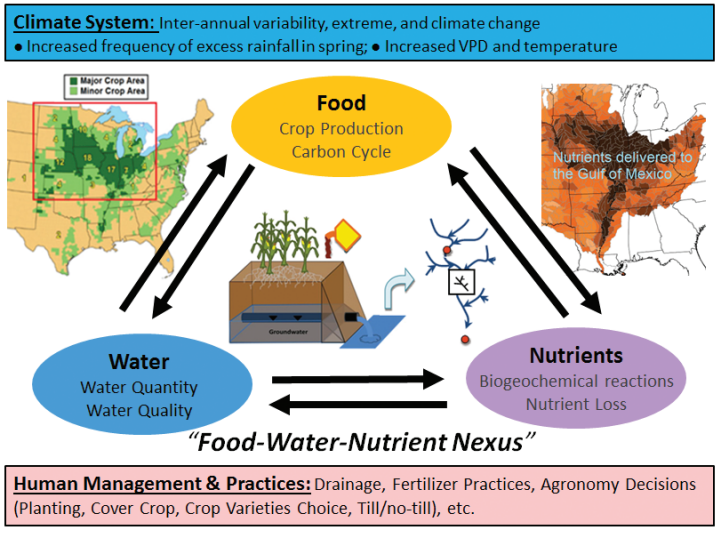
Geography & Geographic Information Science

River confluences shape surrounding landscapes through flows of water that pass through them and human flows that traverse them. This historical geography examines the Des Plaines-Kankakee confluence in northeastern Illinois as a local space of distribution with global significance. It is a low-lying, flat area, with shifting river courses and frequent floods but no settlements nearby. Today, it functions as an inland port, built upon an ammunition plant alongside major routes for freight and early human settlement. These layers of flows build upon each other over time, producing a sedimented landscape not unlike the rivers themselves. How can this confluence region and its unique patchwork of land uses help us understand relationships between spaces of distribution and their surroundings?

ENSURING CO-SUSTAINABILITY OF FOOD PRODUCTION AND ENVIRONMENTAL QUALITY IN THE U.S. MIDWEST AGROECOSYSTEMS

Kaiyu Guan
Fellow

Natural Resources & Environmental Sciences



Over the past two centuries, the US Midwest has transformed from natural prairie/wetlands to fertile croplands that currently produce about one-third of global corn and soybeans. Such landscape transformation by human activities through extensively subsurface "tiling" (drainage piping) and intensified uses of fertilizer and other inputs has also created significant concerns in environmental sustainability. With further stress from climate change, could the US Midwest remain the global food basket in the next 100 years? How can we ensure co-sustainability of food production and environmental quality in this landscape? Carbon (e.g. crop productivity), hydrology (both water quantity and quality), and nutrient cycles are closely intertwined in this landscape from the field/headwater scale to the whole river network and continental scales (greater Mississippi river basin). Thus, a "system" analysis of the complex feedbacks and interactions is required to assess potential adaptations in the US Midwest agroecosystem. This project adopts a "system" view to holistically model and quantify the coupled "food-water-nutrient nexus" for the US Midwest agroecosystems.

NEW OPTIMIZATION PARADIGMS FOR LARGE-SCALE PROBABILISTIC INFERENCE

Niao He
Beckman Fellow

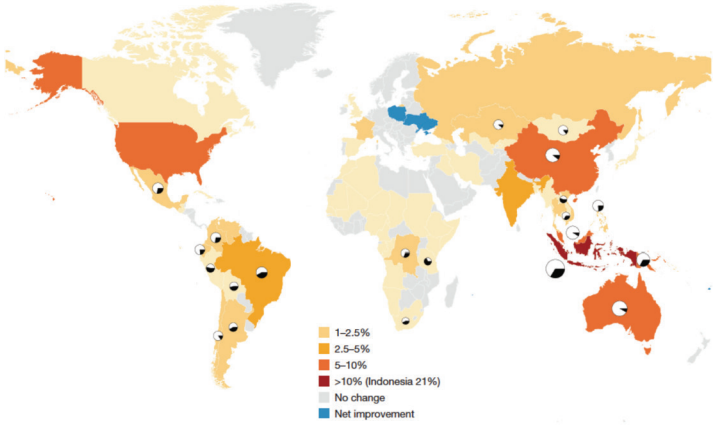
Industrial & Enterprise Systems Engineering

Probabilistic methods are ubiquitous across artificial intelligence, science, and engineering. On the one hand, probabilistic methods capture the central role of uncertainty, leading to high quality estimates and predictions in practice. On the other hand, modern applications to computer vision, bioscience, and robotics, among others, routinely require large complex models with millions of parameters which must be estimated using terabytes of data. Unfortunately, classic probabilistic estimation techniques simply do not accurately scale to such modern big data applications. During her CAS appointment, Professor He will address these foundational issues based on new optimization insights, with a view towards enabling a variety of high-impact applications that are not currently feasible. This project bridges large-scale optimization and probabilistic modeling and estimation with immediate high-impact applications to healthcare analytics, computer vision, and a wide spectrum of future applications to all areas of A.I.

UNDERSTANDING THE ALLOCATION AND EFFECTIVENESS OF GLOBAL FUNDING FOR FOREST CONSERVATION

Daniel Miller
Fellow

Natural Resources and Environmental Sciences



Effects of conservation spending on global biodiversity declines, 1996-2008. Colors show percentage of all global declines associated with each country. Pie charts show the predicted reduction in decline (in black) if spending had been $5 million higher (for selected countries). Waldron et al, *Nature*, 2017.

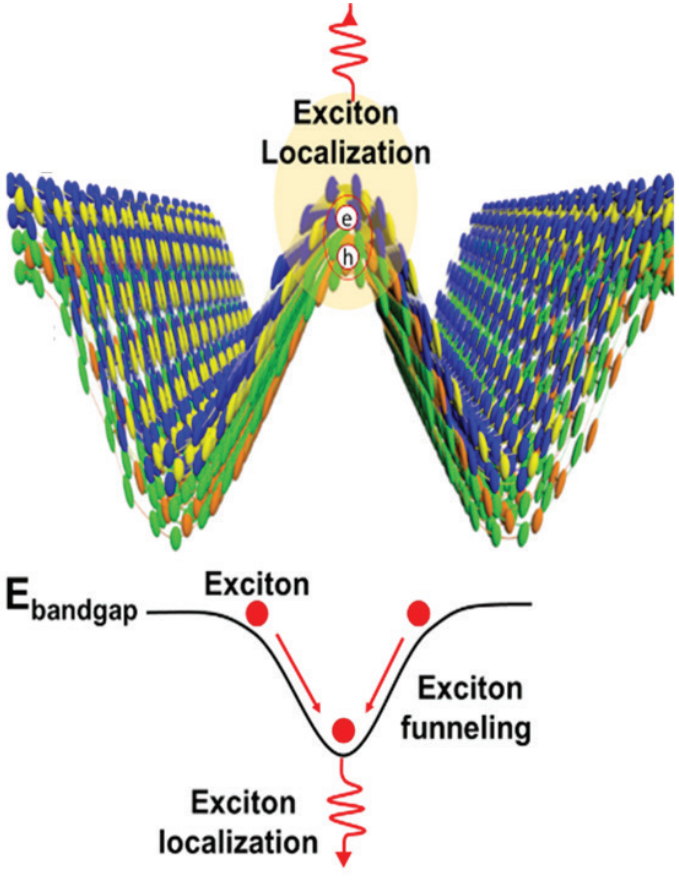
Protecting forests is key to enhancing global sustainability by reducing climate change, biodiversity loss, and poverty. Billions of dollars in international aid have therefore been committed to forest conservation programs, especially in forest-rich but economically poor countries across the globe. Research demonstrates that the level of financial resources committed to forest conservation is one of the most important determinants of conservation success.

However, there is a significant lack of systematic knowledge of funding flows and their impacts. Building such knowledge first requires basic empirical information on forest conservation investment. This project will address this research gap by 1) synthesizing current literature on the allocation and effectiveness of forest conservation funding, 2) developing a novel method to track forest conservation aid based on machine learning and natural language processing approaches, and 3) mapping forest conservation aid flows globally over the past four decades.

Results from this research project will advance knowledge of the allocation of different kinds and amounts of forest aid. In so doing, they will generate evidence needed for interdisciplinary understanding of the impacts of such funding on forest ecosystems and local communities around the world. The project will also lead to a new method that has applications beyond forest conservation aid, including the ability to track funding in other sectors, such as health and sanitation. In these ways, this project will contribute to a broader science of philanthropy that can be harnessed to guide future research and investments toward achieving global sustainability goals.

SINGLE QUANTUM EMITTERS BASED ON ATOMICALLY-THIN STRAINED SEMICONDUCTORS

SungWoo Nam
Associate
Mechanical Science & Engineering



Atomically-thin transition-metal dichalcogenides (TMDs) have recently come to the fore as the next generation of optoelectronics, owing to their highly luminescent characteristics. In particular, researchers have focused on developing single quantum (or single photon) emitters based on luminescent centers from defect sites in TMDs. However, defect engineering approaches have faced challenges due to the difficulties in deterministic control of emissions.

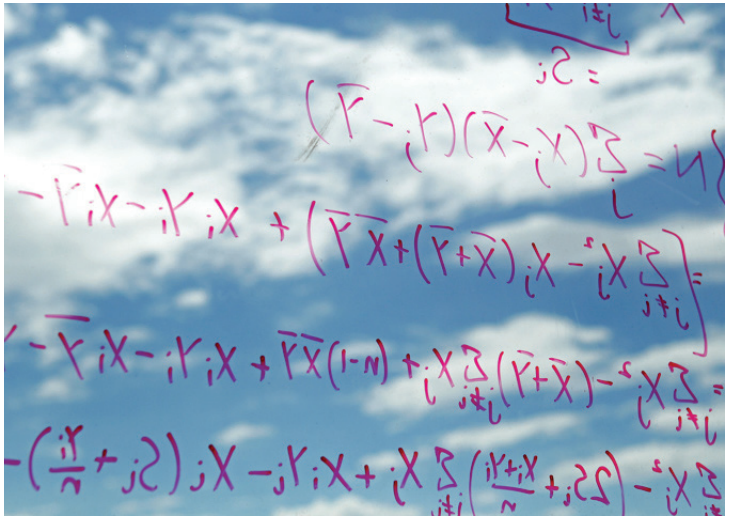
During his CAS appointment, Professor Nam plans to advance our understanding of artificial quantum emitters by moving beyond defects to investigate the effect of straining on luminescent properties of atomically-thin TMDs. In his strain engineering approach, localized (or confined) electron-hole pairs (i.e., excitons) induced by local tensile strain lead to the highly luminescent single photon centers. Given that single photon centers are deterministically controlled by local straining, his approach is poised to solve the most critical challenge of precise, deterministic control of emission centers.

In recent work, Professor Nam and his research group demonstrated that straining TMD materials, such as WSe2 and MoS2 monolayers, can lead to controlled straining and confinements of excitons in TMDs. They will use the same strategy to further realize single quantum emission from strained TMDs. This new capability will lead to an efficient, single photon source based on strained TMD semiconductors that can be used in next generation, scalable quantum cryptography.

WHEN WILL COMPLEX SYSTEMS THRIVE, SURVIVE OR COLLAPSE?

James P. O'Dwyer
Associate

Plant Biology



During his CAS appointment, Professor O'Dwyer plans to forge new links between ecology, economics, anthropology, and organizational studies. He will lay concrete groundwork by focusing on a specific topic: cooperation and the exchange of resources. Exchange is widespread in biological systems where, for example, trees trade nutrients via shared underground fungal networks, and bacterial communities swap metabolites via crossfeeding. Exchange is also central in social systems, for example, as a means to mitigate uncertain environments in ancestral and modern societies. This project will underline the potential for exchange to help the players in a complex system mitigate uncertain environments, but will also draw upon Professor O'Dwyer's own recent work demonstrating that exchange can lead to instability. This potential for instability has important implications for understanding depopulation, disintegration, and collapse across complex systems; this project will open new channels of communication across multiple fields.

TAINTING THE WELL OR PRIMING THE PUMP? THE DYNAMICS OF COOPERATION IN CIVIL WAR

Alyssa K. Prorok
Fellow

Political Science

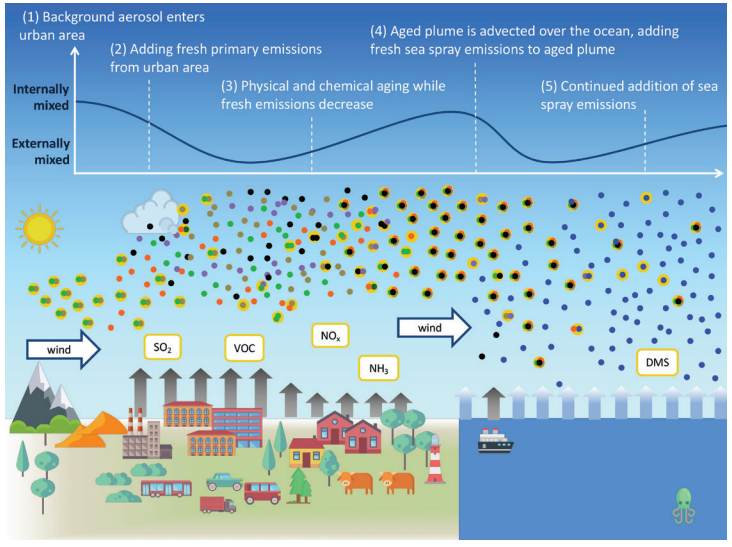
Civil war is generally understood as a series of violent interactions between combatants. Scholars have devoted considerable attention to understanding the dynamics of violence during civil wars. Yet cooperation between combatants is also common during conflict, with examples as diverse as joint de-mining exercises during the Colombian conflict, to trade in oil between ISIS and the Syrian regime, to a succession of negotiations and ceasefires with varying levels of success in both cases. Due to the overwhelming focus on violence, however, we know very little about the determinants or effects of cooperative behavior during conflict. Professor Prorok will examine how cooperative interactions and their outcomes influence future cooperation, battle dynamics, and the prospects for sustainable peace in civil wars using an original dataset on cooperative events in civil conflicts between 1989 and 2018. These data are being collected using a combination of automated and human coding of news reports extracted from the Cline Center's Global News Archive.

This project advances research by shifting focus from violent events to the less visible, but equally important, cooperative interactions that occur during civil conflict. It demonstrates the importance of non-violent interactions for subsequent conflict trajectory and prospects for peaceful resolution.

CHEMISTRY ACROSS MULTIPLE PHASES (CAMP): A NOVEL FLEXIBLE TREATMENT FOR MULTIPHASE CHEMISTRY IN ATMOSPHERIC MODELS

Nicole Riemer
Associate

Atmospheric Sciences



"Aerosol Mixing State: Measurements, Modeling, and Impacts," Riemer et al., 2019, *Review of Geophysics*, 57, 187-249, https://doi.org/10.1029/2018RG000615.

Despite decades of study, aerosol impacts still contribute the largest uncertainty in climate projections. One of the reasons is the complexity of aerosols in the atmosphere and the challenges that this introduces when it comes to representing aerosols in chemical transport models. Progress in the identification of increasingly complex aerosol processes have resulted in an advanced understanding of the evolution of atmospheric systems, but have also introduced a level of complexity that few atmospheric models were originally designed to handle. To improve models, new insights from laboratory experiments and field studies need to be incorporated, but this process is severely hampered by archaic legacy codes. What is needed now is a flexible modeling framework for multiphase chemistry that integrates physicochemical processes easily, rapidly, and efficiently on state-of-the-art computing platforms.

In a collaborative effort with the Barcelona Supercomputing Center and the National Center of Atmospheric Research, Professor Riemer and her lab are developing the Chemistry Across Multiple Phases (CAMP) model. CAMP is designed to be:

- portable: useable as a stand-alone library able to interact with any model's internal configuration, including how it represents aerosol systems.
- flexible: fully run-time configurable chemical mechanisms requiring no changes to the source code or re-compilation of the model.
- self-contained: solves the complete chemical system, including gas- and condensed-phase reactions and phase transfer as a single kinetic system.

CAMP will take high-level mechanism descriptions and automatically execute them efficiently within host models ranging from highly-detailed particle-resolved aerosol representations to simplified representations for use in global earth-system models. This will allow modelers to try out new chemistry and assess their impacts at scale. Furthermore, the ultra-detailed simulations will be the ideal benchmark to quantify the errors in global-scale aerosol models, which is increasingly important as global models push the spatial resolution down towards the kilometer scale.

STE(A)M POWERED STORIES

Stacey Robinson
Beckman Fellow

Graphic Design

Stacey Robinson has co-developed several well-received projects over the past five years and is now embarking on his own solo illustrated productions in order to establish himself as a Science, Technology, Engineering (through Art) and Math-based graphic novelist. During his CAS appointment, he plans to develop the synopses of three new stories, crafting for each a 12-point "Hero's Journey" template. In addition, he will create the cast of characters and 10 pages of initial illustrations, solidifying the premise, world, and stylistic approach to the story-telling. In order to deepen his investigations of gender and education, he will collaborate with Professor Ruth Nicole Brown and her cooperative Sol-Hot which conducts Black Girl Genius Week, a traveling lecture, and performance engagement practice which centers Black girls through Hip-Hop culture. Professor Robinson will also work with community organizer and poet Shaya Robinson, assisting her as illustrator for her upcoming youth interaction-based performance and exhibition. Lastly, he will work with one of his prior collaborators Kamau Granthum in developing a new body of work which will explore Black colonial survival through the intersections of Black history and speculative futures via digital collage and House music.

HISTORIOGRAPHIES OF DISPLACEMENT: A COMPARATIVE STUDY OF PALESTINIANS IN BERLIN, SANTIAGO, AND CHICAGO

Lila Sharif
Beckman Fellow

Asian American Studies

Palestinian refugees are forced to flee during European Zionist incursions in Historic Palestine in 1948. Palestinians would soon become the largest displaced population in history.

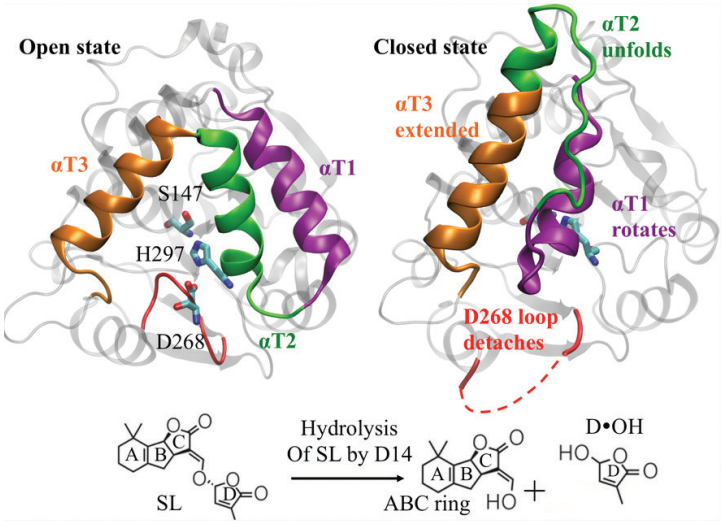
Refugees and displacement are defining issues of the 21st century. United Nations data shows that nearly 66 million human beings in the world are displaced from their homes—more than at any other time in recorded history. Refugees, conceptualized primarily as a problem to be solved by benevolent 'hosting' nation-states, have long been the subjects of volumes of study in the social sciences. However, the focus on refugee suffering and assimilation has precluded any critical examination of the global socio-historical conditions that create refugee "crises" to begin with, as well as the divergent experiences of displacement, racism, and resettlement that inform their relationships to Western nation-states. Moreover, much of the discourse on refugees assumes integration into a monolithic "West," when, in fact, the "West" is filled with diverse and divergent histories in relation to race, genocide, and displacement.

Building on the field of critical refugee studies, this project uses an interdisciplinary, comparative, and transnational framework to intervene in these dominant discourses about refugees. Through an in-depth ethnographic study of Palestinian refugees—the largest and most protracted refugee population to date—Professor Sharif will explore the locally-specific and intersecting historical, political, social, and cultural conditions that have made Berlin, Santiago, and Chicago key sites for Palestinian resettlement since the ongoing Palestinian exodus, as well as the ways in which these refugee experiences complicate both our conception of the "West" as well as the figure of the "refugee." She asks: how have Palestinian refugees made a life in these distinct "Wests," how do they expand upon what we know about refugee lifeworlds, and what does this mean for the generations of refugees to come?

UNRAVELING THE MOLECULAR MAGIC OF WITCHWEED

Diwakar Shukla
Fellow

Chemical & Biomolecular Engineering



The open and closed state of the strigolactone receptors in plants. The hydrolysis reaction occurs in the closed state of the receptor to signal the presence of the host plants near the parasitic witchweed.

Witchweed, or Striga hermonthica, is a parasitic weed and an agricultural pest that destroys its host plants by using strigolactone (SL), a plant hormone released by the host plant into the soil, as a germination stimulant, after which it absorbs nutrients from its host and kills it. Weeds sense these hormones with pico-molar affinity whereas host plant proteins exhibit micro-molar affinity for these hormones. The origin of this affinity difference remains elusive as the host and parasite strigolactone receptors share high sequence structure and binding site conservation across species. This problem of ligand selectivity is central to the grand challenge of designing small molecules (herbicides) to target witchweed receptors with minimal effect on the host plant. Standard structural arguments cannot explain this selectivity. Therefore, this problem represents a critical challenge for agricultural productivity and future food security.

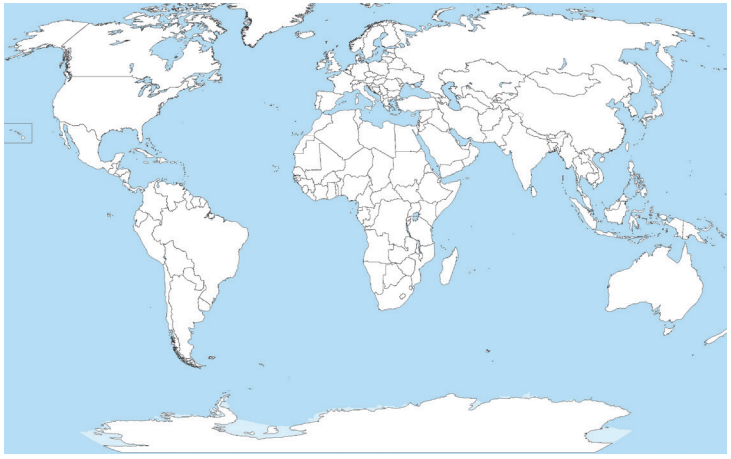
The central objective of Professor Shukla's research project is to understand the molecular processes responsible for strigolactone selectivity in witchweed and employ the resulting hypothesis for the design of selective and potent inhibitors for witchweed. In particular, Professor Shukla and his research group will look at the molecular events involved in the strigolactone perception and subsequent receptor activation in atomistic detail using molecular simulations. They will employ the reinforcement learning based adaptive sampling methods they developed for conducting large-scale distributed simulations of these receptors. Finally, they will perform ligand design based on the intermediate states identified during the simulations.

An inhibitor for witchweed will help to reduce crop losses and improve food security in witchweed-vulnerable regions. Professor Shukla's work approaches this design problem from a mechanistic standpoint and aims to gain insights into fundamental details currently inaccessible by experiments. Very little, if any, comprehensive mechanistic studies of SL signaling have previously been undertaken, so this work presents a novel synergistic integration of computational chemistry and plant biology approaches for addressing this critical challenge.

DOES POLITICAL ATTITUDE DISAGREEMENT FOSTER SOCIETAL CONFLICT? A GLOBAL EXAMINATION ACROSS 40 YEARS AND 98 COUNTRIES

Chadly Stern
Beckman Fellow

Psychology



Philosophers and social theorists have long argued that a plurality of opinions, civil disagreement, and constructive debate are necessary aspects of healthy societies. However, over the past several decades researchers have also highlighted a growing trend of attitude polarization. This increasing divergence in attitudes is generally characterized as a social problem that generates tension and strife. Despite persistent discussion about the potential impact of attitude disagreement for society, scholars still fail to possess a firm understanding of the factors that produce attitude disagreement among everyday citizens and the direct consequences of this disagreement.

During his CAS Beckman Fellowship, Professor Stern plans to address these issues in a comprehensive manner. Specifically, he will examine (a) whether the structure of a society's legal system impacts levels of citizen attitude disagreement over time, (b) whether the amount of attitude disagreement among citizens predicts fluctuations in levels of conflict within a society, and (c) whether there is a particular amount of attitude disagreement that shifts constructive disagreement to the incitement of internal conflict. To address the proposed questions, he will integrate individual, societal, and institutional data. Specifically, he will utilize attitude data collected over the course of 40 years from thousands of citizens who hail from a total of 98 countries. These data will be aggregated with information about legal infrastructures derived from government texts and academic institutions, as well as statistics about societal conflict harvested from millions of online media articles. Overall, this project adopts an interdisciplinary approach drawing from psychology, political science, and related disciplines to develop a broad understanding of the antecedents and consequences of attitude disagreement among everyday people.

SOLID FOUNDATIONS IN EARLY GRADE LITERACY AND POST-PRIMARY SCHOOL TRANSITIONS

Rebecca Thornton
Associate

Economics

Do foundational investments in early grade reading lead to improved learning outcomes in later years? If so, is one year of an intervention enough? Can a low-cost literacy program be as effective over time as a more costly one? This study will extend a longitudinal dataset of students who were participants in a randomized literacy intervention during grades 1-4, as they transitioned out of primary school and into their adolescent years. The original study involved students who entered the first grade in 2013 and 2014 in 128 primary schools in Northern Uganda. The study found that the literacy program raised reading by the equivalent of 6.3 grade-levels of learning by the end of the fourth grade in mother tongue reading—among the largest improvements ever achieved for a randomized education intervention. There were also large effects on English reading among students receiving the intervention. This proposed study will extend the data and contribute additional analysis to 1) measure the effects of foundational literacy skills in primary school—due to the intervention—on primary school completion, secondary school enrollment, and learning outcomes (while also measuring labor market participation, aspirations, motivation, and other measures of well-being); 2) compare the differential effects of two versions of delivery of the literacy program (a full-cost version and a lower-cost version) to estimate the differences in cost-effectiveness; and 3) compare two levels of exposure to the program (one year vs. four years) to estimate the differences in cost-effectiveness. The project will collect and analyze data from approximately 2,600 students in two cohorts in grades 7 and 8 to understand how foundational literacy skills affect school and life transitions.

RABBINIC INFERNO: HELL AND SALVATION IN CLASSICAL JUDAISM

Dov Weiss
Associate

Religion

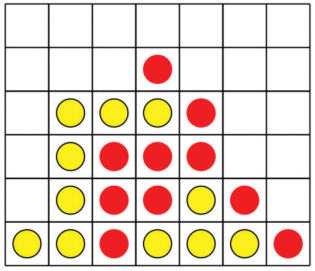
In their 1885 Pittsburgh Platform, the leading Rabbis of American Reform Judaism declared that "we reject as ideas not rooted in Judaism, the belief … [in] Gehenna (hell)." The authors of the Oxford textbook *Invitation to World Religions Today* (2016), studied by thousands of undergraduates, seem to concur. They analyze the doctrines of hell within Christianity, Hinduism, Islam, Jainism, and Zoroastrianism, but leave out Judaism. Moreover, as a Google search of the words "Judaism" and "hell" reveal, there is a widespread assumption today—even among many Jews—that traditional Judaism rejects the existence of fiery torments in the afterlife. Arguing that these attitudes misrepresent the history of Judaism, Professor Weiss's forthcoming book *Rabbinic Inferno* produces the first scholarly book on afterlife retribution in the rabbinic era (70-700 CE). Rather than absent in classical Jewish discourse, or occupying its periphery, hell (Gehinnom in Hebrew) played a central role in ancient Jewish literature and culture.

The modern academic study of ancient Judaism echoes the Pittsburgh Platform's dismissal of hell, as scholars of rabbinic literature have given relatively little attention to Gehinnom. To begin to fill this scholarly lacuna within the Jewish tradition, *Rabbinic Inferno* uses ancient Jewish discourse about Gehinnom—as it emerges in rabbinic biblical interpretation—to unearth the distinctive anxieties, values, aesthetics, fantasies, and hopes within classical Jewish culture. Without such analysis, our understanding of Judaism remains incomplete. This book will trace how Jewry's once near-unanimous belief in Gehinnom lost popularity in the medieval period when Moses Maimonides (1138-1204, Egypt) rejected its actual existence. Its decline intensified in the modern period when eighteenth-century German Jewish enlighteners, notably Moses Mendelssohn (1729-1786, Berlin), rejected it. These historical developments, together with the 1885 Reform rabbinic declaration in Pittsburgh, culminated in the modern Jewish rejection of Gehinnom.

ALGEBRA, COMBINATORICS, AND COMPLEXITY

Alexander Yong
Associate

Mathematics



			20			
	21	15	17	16		
	19	10	6	14		
	11	8	2	13	18	
3	9	4	1	5	7	12

Counting Connect Four

Complexity theory concerns theoretical limits on how fast computers can solve a problem, such as deciding if $2^{82,589,933} - 1$ is prime (it is). From a practical perspective, the presumed hardness of factoring a large integer is critical to internet security. Philosophically speaking, the famous P vs NP problem essentially asks: can creativity be automated? There are many deep connections between complexity and combinatorics, but traditionally through graph theory and optimization. Recent pure mathematics work with his Illinois research group brings Professor Yong's own core competency of *algebraic combinatorics* into the conversation in a novel way: through the study of *Newton polytopes*. These geometric objects trace back to 1676 correspondence from Isaac Newton to Henry Oldenburg (the creator of scientific peer review).

During his Spring 2021 CAS Release Time appointment, Professor Yong will participate in the program on *Combinatorial Algebraic Geometry* at the Institute for Computational and Experimental Research in Mathematics (ICERM) at Brown University.

FORGOTTEN VOICES, HIDDEN PLEASURES: VIOLIN CULTURE IN BRITAIN, C. 1870-1930 • THE INVENTION OF AL-ANDALUS: USES OF THE PAST IN CONTEMPORARY CULTURE • STATISTICAL OPTIMAL TRANSPORT AND GEOMETRIC DATA ANALYSIS • DISTRIBUTED AND DISCRETE MODULATORY ACTIONS OF DBI IN THE NEUROCIRCUITRY OF SOCIAL BEHAVIOR • GROWING OLD IN THE AGE OF TECHNOLOGY • SEDIMENTATION OF FLOWS: THE DES PLAINES-KANKAKEE CONFLUENCE AND SPACES OF DISTRIBUTION • ENSURING CO-SUSTAINABILITY OF FOOD PRODUCTION AND ENVIRONMENTAL QUALITY IN THE U.S. MIDWEST AGROECOSYSTEMS • NEW OPTIMIZATION PARADIGMS FOR LARGE-SCALE PROBABILISTIC INFERENCE • UNDERSTANDING THE ALLOCATION AND EFFECTIVENESS OF GLOBAL FUNDING FOR FOREST CONSERVATION • SINGLE QUANTUM EMITTERS BASED ON ATOMICALLY-THIN STRAINED SEMICONDUCTORS • WHEN WILL COMPLEX SYSTEMS THRIVE, SURVIVE OR COLLAPSE? • TAINTING THE WELL OR PRIMING THE PUMP? THE DYNAMICS OF COOPERATION IN CIVIL WAR • CHEMISTRY ACROSS MULTIPLE PHASES (CAMP): A NOVEL FLEXIBLE TREATMENT FOR MULTIPHASE CHEMISTRY IN ATMOSPHERIC MODELS • STE(A)M POWERED STORIES • HISTORIOGRAPHIES OF DISPLACEMENT: A COMPARATIVE STUDY OF PALESTINIANS IN BERLIN, SANTIAGO, AND CHICAGO • DOES POLITICAL ATTITUDE DISAGREEMENT FOSTER SOCIETAL CONFLICT? A GLOBAL EXAMINATION ACROSS 40 YEARS AND 98 COUNTRIES • UNRAVELING THE MOLECULAR MAGIC OF WITCHWEED • RABBINIC INFERNO: HELL AND SALVATION IN CLASSICAL JUDAISM • SOLID FOUNDATIONS IN EARLY GRADE LITERACY AND POST-PRIMARY SCHOOL TRANSITIONS • ALGEBRA, COMBINATORICS, AND COMPLEXITY

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