

# Annual Report 2020-21

NSF Award DMS-1929348

Covering activity between August 1, 2020 and May 31, 2021

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### 1. Overview

This is the 2020-21 annual report for the Institute for Mathematical and Statistical Innovation, funded by NSF grant DMS-1929348. It covers activities of the Institute which took place between August 1, 2020 and May 31, 2021.

The Institute for Mathematical and Statistical Innovation (IMSI) is a mathematical sciences research institute hosted by the University of Chicago, and operated in partnership with Northwestern University, the University of Illinois at Chicago, and the University of Illinois at Urbana-Champaign.

#### 1.1 Mission

The mission of IMSI is to bring rigorous mathematics and statistics to bear on complex urgent problems of significant scientific and social importance and to spur transformational change in the mathematical sciences and the mathematical sciences community. There are three primary pillars to this mission: scientific activity, a focus on diversity and broadening participation in the mathematical sciences, and a focus on effective communication about mathematical science research to a variety of audiences.

IMSI is committed to first-rate interdisciplinary research in areas of great societal interest and impact where the mathematical sciences have the potential to contribute. It aims to make a difference in ways that are both scientifically and socially important. The institute will focus the bulk of its scientific activity during the period of the current grant on six themes: Climate Science, Data and Information, Health and Medical Care, Materials Science, Quantum Computing and Information, and Uncertainty Quantification. These areas embody significant challenges for society at large, and meaningful progress in these areas will in many cases require engagement from researchers and decision makers across a variety of sectors, including academic research, national labs, government, and the private sector, and will highlight the important and expanding role played by the mathematical sciences across these sectors.

A crucial factor in addressing these scientific challenges is the diversity of those engaged in research and activity at IMSI. The challenges with which we intend to engage will require perspectives and insight from a number of directions in order to make progress. As suggested above, these insights and perspectives must emerge from interactions among researchers from multiple disciplines and employment sectors. At the same time, there is often a need for research to usefully inform policy and decision making, which requires expanding conversation and engagement beyond the realm of basic research. Moreover, the broad social impacts of these challenges implies that effective engagement with them will often require the participation of a community of researchers who can collectively bring an understanding of how these challenges are experienced across human society as a whole. This points to a need for broad participation in the mathematical sciences.

The third pillar in IMSI's mission is an emphasis on effective communication and, beyond that, effective collaboration and engagement. An important aspect of scientific progress is that the

insights it generates must propagate and land with those who can make effective use of them. This often requires communicating and collaborating across differences arising from boundaries between intellectual disciplines, research cultures, employment sectors and roles, career and education stages, positions in society, and more. Scientific research often defaults to a mode of experts speaking to experts who emerge from similar research cultures. IMSI aims to encourage scientific research that does not remain confined to this mode, and to provide ways for researchers in the mathematical sciences to build skills in communicating across differences.

#### **1.2 Review of the first year**

We received an award notice in July 2020, and the institute launched on August 1, 2020. The first year of operation has been a time of ramping up infrastructure and activity as rapidly as possible while navigating the constraints imposed by the COVID-19 pandemic.

IMSI is hosted on the campus of the University of Chicago at 1155 East 55th Street, in space formerly occupied by the Harris School of Public Policy. The space includes an auditorium, a seminar room, offices, conference rooms, kitchens, and lounge areas. Renovation of that space has been a high priority this year and, after some COVID-related delays, is nearing completion. We expect to be able to occupy the space once the University allows a return to campus, which we expect will take place by September.



The Directorate of IMSI consists of Kevin Corlette (UChicago, Director), Doug Simpson (UIUC, Associate Director), and Takis Souganidis (UChicago, Scientific Adviser). For the first few months of IMSI operation, the only staff support for the institute was provided part time by staff in the UChicago Department of Mathematics, the Kavli Institute for Cosmological Physics, and the University of Chicago Physical Sciences Division.

We began the process of hiring staff immediately at launch. The search for an Executive Director extended over the fall. That search concluded with the hiring of Philip (Bo) Hammer, who started as IMSI's Executive Director on January 1, 2021. Bo came to us from the American Institute of Physics (AIP), where he was the founding and interim Executive Director of the AIP Foundation. He also led AIP's major antiracism initiative that addressed underrepresentation of African Americans in physics and astronomy. Hammer received his BS in Physics from Humboldt State University and his PhD in Physics from the University of Oregon.

Our next hire was Denise Slavinski, who began as Assistant Director on March 1, 2021. Following this, Blendia Hubbard and Alexandra Erichson were hired as Program Coordinators starting on March 22, 2021 and April 26, 2021, respectively. In addition, Fuad Khaleel was hired in the UChicago Physical Science Division's Local Business Center as a Financial Administrator. He will be devoting 50% of his time to IMSI. We have recently offered Bernard Davis a position as our Manager of Information Technology and Audiovisual Services, which he has accepted with an anticipated start date of July 12, 2021. We currently have a search open for a Director of Communications and Engagement. After the conclusion of this search, we plan to wait for in person operations to begin before evaluating the need for further staff hires.

Another significant dimension of the ramp up period for IMSI has been an effort to raise awareness within the mathematical sciences community about the institute and its activities. One initiative in this direction was the IMSI Opening Conference on *Vistas in the Applied Mathematical Sciences* held virtually on October 7-9, 2020, which featured ten talks highlighting areas related to IMSI's themes. The conference included remarks by Juan Meza (Director of the Division of Mathematical Sciences at NSF), Robert Zimmer (President of the University of Chicago), Ka Yee Lee (Provost of the University of Chicago), and Angela Olinto (Dean of the Physical Science Division at the University of Chicago). Other initiatives have included

- individual emails to chairs of mathematics and statistics departments across the country describing the institute and its goals and planned activity,
- meetings with the leadership of the American Statistical Association (ASA) and the Society for Industrial and Applied Mathematics (SIAM) to develop strategies for engaging their members in institute activity,
- publishing articles introducing IMSI in *SIAM News*, *Amstat News*, and the *IMS Bulletin* (from the Institute of Mathematical Statistics),
- holding an Introduction to IMSI webinar in December 2020,
- sending announcements of IMSI activities to the ASA Connect and SIAM Activity Groups lists,
- starting an IMSI email newsletter,
- establishing IMSI social media accounts on Facebook, Instagram, and Twitter, and implementing a corresponding social media strategy,
- being an exhibitor at the 2020 Field of Dreams conference, and
- participating in the Math Institutes reception at the 2021 Joint Mathematics Meetings.

The institute's website is a crucial component of its public face. The current website was developed internally by the IMSI team over the course of two months prior to the institute's

official launch in August. We have been working with a web design firm on a more permanent solution, but the required procurement process and the effort to fully align the firm's design and development process with our needs has left us well behind the schedule we had hoped for. Even after we have taken delivery of the final product, it will take a significant amount of time and effort to transition from the current website to the new one.

All IMSI-sponsored activity this year has taken place under the dual constraints of a short ramp up period and the COVID-19 pandemic. In general, we expect to operate on a quarter system mirroring the academic calendar of the University of Chicago. The typical pattern we anticipate each year is hosting long programs in the fall and spring quarters, standalone workshops mainly in the winter and summer quarters, and outreach and workforce development programs throughout the year. Our initial proposal for the Mathematical Sciences Research Institutes competition called for us to host long programs on *Distributed Solutions to Complex Societal Problems* and *Decision Making and Uncertainty* during our first year of operation, but it soon became apparent that the timing of the public announcement would leave us with far too little runway to give those programs a reasonable chance at success. We therefore decided to defer those programs to the 2021-22 academic year, and instead implemented a sequence of workshops on topics related to IMSI's themes. These workshops have given us a chance to begin more in depth exploration of all of our themes, and to make contact with some of the communities which will be essential to making progress in the areas those themes encompass.

Every activity we have hosted this year has been virtual. In the fall, we hosted the Graduate Opportunities for Women (GROW) conference, part of a series of annual conferences initiated in 2015 aimed at increasing the number of women going to graduate school in the mathematical sciences. This took place over three Saturdays in September and October. In addition, we hosted the Opening Conference mentioned above, and a workshop on *Dealing with COVID-19 in Theory and Practice*. The latter was organized by Andrew W. Lo, and was organized around four themes: Public Health, Data Science, Economic Impact, and the Path Forward. The workshop made it evident that the mathematical sciences are relevant to understanding many different aspects of the pandemic, and to informing important decisions related to it. During the winter and spring, IMSI hosted seven weeklong workshops:

- Mathematical and Computational Materials Science,
- Confronting Climate Change,
- The Multifaceted Complexity of Machine Learning,
- Topological Data Analysis,
- Verification, Validation, and Uncertainty Quantification Across Disciplines
- Decision Making in Health and Medical Care: Modeling and Optimization, and
- Quantum Information for Mathematics, Economics, and Statistics.

In addition, IMSI was approached by the American Mathematical Society and the organizing committee for its new paraDIGMS initiative, which focuses on diversity in mathematics graduate education. We welcomed the opportunity to collaborate with them on the initial paraDIGMS conferences, which took place in October 2020 and April 2021. All of these activities are discussed in more detail later in this report.

IMSI is currently (June 2021) hosting a virtual summer school on *Introduction to Mean Field Games*. This will be followed by a summer school on *Introduction to Decision Making and Uncertainty*. These programs are intended to lay the foundations for participation in the two long programs IMSI will host in 2021-22. In addition, we have launched our summer internship program for an initial cohort of Ph.D. students through our partnership with the University of Illinois at Urbana-Champaign. Interns will participate in a two week skills workshop, and will then participate in eight week virtual internships with sponsors. Our partners at the University of Illinois at Chicago (UIC) plan to host the first iteration of their new branch of the Young Scholars Program. The Young Scholars Program is a very successful but oversubscribed outreach program for middle and high school students which is hosted at the University of Chicago. The UIC branch of this program is expected to help meet the demand for such programs, and also to reach new audiences. All of these programs will be reported on in our next annual report.

The institute's primary governing bodies are the Board of Advisors (BOA) and Scientific Committee (SC). The first meetings of these groups took place in January (SC) and February (BOA) of this year. These meetings provided opportunities to orient both groups to IMSI's mission and goals, and to discuss important foundational issues as we build the institute.

#### 1.3 Impact of COVID-19

The institute began its operations a few months after the start of the COVID-19 pandemic, and has operated under its influence throughout its first year. A primary effect of this has been that all institute activity has been virtual; as a consequence, much of the NSF funding for our first year which was intended to support participants in our activities has gone unspent. Another effect was a slowdown in the pace of the renovation of institute space. However, we have been able to take advantage of this to make the renovation process more considered and deliberate than it might have been if we had needed to make our space ready for activity within a few months. There has been a similar effect on our effort to hire institute staff: we have had time for a more considered and appropriately staged process than would have been possible if we had needed to prepare ourselves for in person activity starting a few weeks after our launch.

# 2. Participant Demographics

### 2.1 List of Activities

#### IMSI Activities 2020-2021

Abbreviated Name	Title	Dates
GROW 2020	Graduate Research Opportunities for Women 2020	September 13 and October 18 and 24, 2020
Opening Conference	Opening Conference: Vistas in the Applied Mathematical Sciences	October 7-9, 2020
COVID-19	Dealing with COVID-19 in Theory and Practice	October 29-30, 2020
paraDIGMS 2020	paraDIGMS Fall Conference: Diversity in Graduate Mathematical Sciences	November 20-23, 2020
MCMS21	Mathematical and Computational Materials Science	February 15-19, 2021
CCC21	Confronting Climate Change	March 1-5, 2021
MCML21	The Multifaceted Complexity of Machine Learning	April 12-16, 2021
paraDIGMS 2021	paraDIGMS 2021 Spring Conference: Diversity in Graduate Mathematical Sciences	April 23-26, 2021
TDA21	Topological Data Analysis	April 26-30, 2021
VVUQAD21	Verification, Validation, and Uncertainty Quantification Across Disciplines	May 10-14, 2021
DMHMC21	Decision Making in Health and Medical Care: Modeling and Optimization	May 17-21, 2021
QIMES21	Quantum Information for Mathematics, Economics, and Statistics	May 24-28, 2021

### 2.2 Demographics by Type of Activity

Research Workshops '20-'21 includes all activities except the GROW '20 and paraDIGMS conferences.

#### Demographics by Activity

Activity		Research Workshops '20-'21	GROW '20	paraDIGMS '20-'21
	Total Number of Participants (Includes all participants, speakers, and organizers)	1482	227	856

	Female	411	182	386
	Male	940	4	386
Gender	Other	1	2	18
	Do Not Wish to Provide	61	0	48
	Unknown	69	39	18
	American Indian or Alaskan Native	4	3	4
	Asian	432	74	145
	Black or African American	29	8	74
Race	Native Hawaiian or Other Pacific Islander	0	1	8
	White	691	93	503
	Do Not Wish to Provide	244	5	82
	Unknown	95	53	68
	Hispanic or Latino	81	22	105
Ethnicity	Not Hispanic or Latino	1092	161	669
Ethnicity	Do not wish to provide	228	5	64
	Unknown	81	39	18
	Faculty Member or Academic Administrator	612	25	509
	Graduate Student	300	8	249
	Non-academic Employment	250	1	18
Employment/	Postdoctoral Associate	77	0	22
Educational Status	Retired / Not Employed / Self- employed	39	0	7
	Undergraduate Student	25	177	25
	High School Student	0	0	0
	Unknown	179	16	26

#### 2.3 Demographics for Research Workshops

The following demographic information includes participants, organizers, speakers, facilitators, and panelists. Some individuals may be reflected more than one time if they participated in more than one workshop. This category of activity includes the following events:

- Opening Conference: Vistas in the Applied Mathematical Sciences
- Dealing with COVID-19 in Theory and Practice
- Mathematical and Computational Materials Science
- Confronting Climate Change
- The Multifaceted Complexity of Machine Learning
- Topological Data Analysis
- Verification, Validation, and Uncertainty Quantification Across Disciplines
- Decision Making in Health and Medical Care: Modeling and Optimization
- Quantum Information for Mathematics, Economics, and Statistics

Our template for gathering demographic, professional, and educational data on participants changed midway through the year, after we became aware of NSF specifications. As a result, some of our data includes categories not provided for in the NSF specifications. In addition, some participants did not register through our website, and thus did not provide data.

#### Research Workshops 2020-2021 - Participants by Gender



#### Research Workshops 2020-2021 - Participants by Race



# Race - Research Workshops 2020-2021

*Note:* Participants could select multiple races. Some individuals may be reflected in this chart more than once.

Research Workshops 2020-2021 - Participants by Ethnicity



Research Workshops 2020-2021 - Participants by Employment/Educational Status



Employment/Educational Status -All Workshops 2020-2021

#### Research Workshops 2020-2021 - Participants by Employer/School Location (United States)



US-based Participants by State - Research Workshops 2020-21

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Research Workshops 2020-2021 - Participants by Employer/School Location (United States)

	-	-	
State	Number of Participants	State	Number of Participants
Alabama	2	Montana	7
Alaska	0	North Carolina	39
Arizona	4	North Dakota	0
Arkansas	0	Nebraska	3
California	74	New Hampshire	2
Colorado	9	New Jersey	11
Connecticut	5	New Mexico	6
Delaware	5	Nevada	2
District of Columbia	6	New York	81

Florida	11	Ohio	28
Georgia	9	Oklahoma	2
Hawaii	0	Oregon	2
Idaho	2	Pennsylvania	44
Illinois	327	Rhode Island	4
Indiana	12	South Carolina	10
Iowa	9	South Dakota	0
Kansas	6	Tennessee	3
Kentucky	0	Texas	40
Louisiana	7	Utah	7
Maine	0	Virginia	19
Maryland	14	Vermont	0
Massachusetts	70	Washington	10
Michigan	41	West Virginia	0
Minnesota	19	Wisconsin	26
Mississippi	0	Wyoming	0
Missouri	4	Unknown	20

#### Research Workshops 2020-2021 - Participants by Employment/School Location (Country)

Employer/School Location by Country - Research Workshops 2020-21

< 5 5-10 10-25 25-50 ≥ 50</p>



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Research Workshops 2020-2021 - Participants by Employment Location (Country)			
Country	Number of Participants	Country	Number of Participants
Australia	4	Malaysia	1
Austria	14	Mexico	8
Belgium	3	Morocco	1
Brazil	3	Netherlands	4
Cameroon	1	Nigeria	3
Canada	23	Norway	2
Chile	13	Pakistan	3
China	3	Philippines	1
Denmark	1	Poland	6
France	32	Romania	1
Germany	32	Russia	2

Honduras	1	Saudi Arabia	4
Hong Kong	1	Senegal	2
India	16	Slovenia	1
Indonesia	5	Spain	12
Iran	2	Sweden	6
Ireland	1	Switzerland	16
Israel	8	Thailand	1
Italy	18	Turkey	9
Japan	2	United Arab Emirates	2
Jordan	1	United Kingdom	43
Korea, South	5	United States	1002
Latvia	1	Unknown	162

#### 2.4 Demographics for GROW

**GROW 2020 - Participants by Gender** 



## Gender - GROW 2020

#### **GROW 2020 - Participants by Race**



Race - GROW 2020

*Note:* Participants could select multiple races. Some individuals may be reflected in this chart more than once.

#### **GROW 2020 - Participants by Ethnicity**



GROW 2020 - Participants by Employment/Educational Status



**GROW 2020 - Participants by Employer/School Location (United States)** 



# **US-based Participants by State - GROW 2020**

GROW 2020 - Participants by Employment Location (United States)			
State	Number of Participants	State	Number of Participants
Alabama	3	Montana	0
Alaska	0	Nebraska	2
Arizona	6	Nevada	0
Arkansas	0	New Hampshire	0
California	27	New Jersey	2
Colorado	3	New Mexico	0

Connecticut	0	New York	14
Delaware	1	North Carolina	7
District of Columbia	0	North Dakota	0
Florida	4	Ohio	4
Georgia	4	Oklahoma	2
Hawaii	1	Oregon	3
Idaho	0	Pennsylvania	5
Iowa	3	Rhode Island	1
Illinois	63	South Carolina	1
Indiana	4	South Dakota	0
Kansas	0	Toppossoo	0
Italisas	0	Termessee	0
Kentucky	0	Texas	7
Kentucky Louisiana	0 0 3	Texas Utah	7 0
Kentucky Louisiana Massachusetts	0 0 3 20	Texas Utah Vermont	7 0 0
Kentucky Louisiana Massachusetts Maryland	0 0 3 20 2	Texas Utah Vermont Virginia	0   7   0   2
Kentucky Louisiana Massachusetts Maryland Maine	0 0 3 20 2 0	Texas Utah Vermont Virginia Washington	7   0   2   6
Kentucky Louisiana Massachusetts Maryland Maine Michigan	0 0 3 20 2 0 9	Texas Utah Vermont Virginia Washington West Virginia	0     7     0     2     6     0
Kentucky Louisiana Massachusetts Maryland Maine Michigan Minnesota	0 0 3 20 2 0 9 2 2	Texas Utah Vermont Virginia Washington West Virginia Wisconsin	7   0   2   6   0   6   6
Kentucky Louisiana Massachusetts Maryland Maine Michigan Minnesota Mississippi	0 0 3 20 2 0 9 2 0 0	Texas Utah Vermont Virginia Washington West Virginia Wisconsin Wyoming	0     0     0     2     6     0     6     0     6     0     6     0

## GROW 2020 - Participants by Employer/School Location



Employer/School Location by Country - GROW 2020

Created with Datawrapper

GROW 2020 - Participants by Employment Location			
Country	Number of Participants	Country	Number of Participants
China	1	Mexico	1
Colombia	1	United States	218
India	3	Unknown	3

#### 2.5 Demographics for Fall and Spring paraDIGMS Conferences

Fall and Spring paraDIGMS - Participants by Gender



Fall and Spring paraDIGMS - Participants by Race

# Race - paraDIGMS 2020-2021



*Note:* Participants could select multiple races. Some individuals may be reflected in this chart more than once.

#### Fall and Spring paraDIGMS - Participants by Ethnicity



Fall and Spring paraDIGMS - Participants by Employment/School Type

# Employment/School Type - paraDIGMS 2020-2021





# **US-based Participants by State - paraDIGMS 2020-2021**

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Fall and Spring paraDIGMS 2020-2021 - Participants by Employment Location (United States)			
State	Number of Participants	State	Number of Participants
Alabama	8	Montana	5
Alaska	0	Nebraska	16
Arizona	24	Nevada	2
Arkansas	0	New Hampshire	6
California	82	New Jersey	15
Colorado	17	New Mexico	3

Connecticut	11	New York	55
Delaware	2	North Carolina	33
District of Columbia	7	North Dakota	0
Florida	7	Ohio	11
Georgia	44	Oklahoma	3
Hawaii	4	Oregon	9
Idaho	0	Pennsylvania	35
Illinois	63	Rhode Island	12
Indiana	19	South Carolina	3
lowa	18	South Dakota	0
Kansas	5	Tennessee	10
Kentucky	5	Texas	37
Louisiana	17	Utah	16
Maine	1	Virginia	18
Maryland	17	Vermont	2
Massachusetts	38	Washington	30
Michigan	42	West Virginia	5
Minnesota	11	Wisconsin	9
Mississippi	0	Wyoming	0
Missouri	5		

## Fall and Spring paraDIGMS - Participants by Employer/School Location (Country)



Employer/School Location by Country - paraDIGMS

Created with Datawrapper

Fall and Spring paraDIGMS 2020-2021 - Participants by Employment Location			
Country	Number of Participants	Country	Number of Participants
Algeria	1	Kenya	2
Australia	1	Luxembourg	1
Brazil	1	Mexico	1
Canada	18	Nigeria	1
Colombia	4	Puerto Rico	1
Czech Republic	1	Romania	1
Egypt	1	Russia	1
Germany	4	Spain	3
Ghana	1	Sweden	1
Guam	1	Switzerland	2
India	12	United Kingdom	7

Iran	1	United States	785
Israel	3	Unknown	4
Italy	1		

# 3. Description of Activities

For each activity, we list organizers, speakers, panelists, and other presenters. Full participant lists are included in an appendix.

#### **3.1 Opening Conference**

#### October 7-9, 2020: Opening Conference: Vistas in the Applied Mathematical Sciences

This conference, "Vistas in the Applied Mathematical Sciences," explored IMSI's scientific themes: Climate Science, Data and Information, Health Care and Medicine, Materials Science, Quantum Information, and Uncertainty. The international roster of speakers, from academia and the private sector, gave talks that exemplified the range of societally relevant topics that IMSI will be exploring over the next several years.

This workshop was attended by 224 unique participants, including speakers.

Speakers	Affiliation
Scott Aaronson	Computer Science, University of Texas at Austin
Tony Cai	Wharton Statistics, University of Pennsylvania
Omar Ghattas	Mechanical Engineering, University of Texas at Austin
Kristin Lauter	Microsoft
Claude Le Bris	CERMICS, Ecole des Ponts & Inria
Pierre-Louis Lions	College de France
Andrew Lo	Sloan School of Management, Massachusetts Institute of Technology
Jose Scheinkman	Economics, Columbia University
Karen Willcox	Oden Institute for Computational Engineering and Sciences, University of Texas at Austin
Laure Zanna	Courant Institute, New York University

#### 3.2 Workshops

#### October 29-30, 2020: Dealing with COVID-19 in Theory and Practice

The extraordinary impact of COVID-19 requires equally extraordinary measures, which were the focus of this workshop. Four major themes were represented: Public Health Challenges, The Role of Data Science, Measuring and Managing Economic Impact, and The Path Forward. One unique aspect of this workshop was the breadth of participants, bringing together stakeholders from the most relevant communities, including biomedical experts, epidemiologists, public health officials, economists, business professionals, and bioethicists.

One of the key objectives of this workshop was to encourage collaboration across disciplines that have practical impact in the near term. Participants noted the heavy emphasis and mathematics and statistics, which highlighted the important role to be played by the mathematical sciences in advancing the science and policies related to future global pandemics. According to our post-workshop evaluation, participants expressed the most interest in workshop topics at the intersection of data science, public health, and economic impact. This type of feedback will be useful in planning future IMSI scientific activities that explore these critical societal issues.

Organizer	Affiliation
Andrew Lo	Sloan School of Management, Massachusetts Institute of Technology
Speakers (Listed by Theme)	Affiliation
Public Health	
Rupam Bhattacharyya	Biostatistics, University of Michigan
Sarah E. Cobey	Ecology & Evolution, University of Chicago
Nigel Goldenfeld	Physics, University of Illinois at Urbana-Champaign
Sergei Maslov	Bioengineering, University of Illinois at Urbana-Champaign
Bhramar Mukherjee	Biostatistics, University of Michigan

This workshop was attended by 382 unique participants, including organizers and speakers from the four workshop themes.

Debashree Ray	Epidemiology, Johns Hopkins University
Maxwell Salvatore	Biostatistics, University of Michigan
Data Science	
Michael Jordan	EECS, Statistics, IEOR, University of California, Berkeley
Xiao-Li Meng	Statistics, Harvard University
Mihaela van der Schaar	University of Cambridge
Daniel Weitzner	CSAIL, Massachusetts Institute of Technology
Economic Impact	
Emil Verner	Sloan School of Management, Massachusetts Institute of Technology
Andrew Metrick	Yale School of Management, Yale University
Andrew Atkeson	Economics, University of California, Los Angeles
Path Forward	
Arthur Caplan	Population Health, New York University
Rena Conti	Questrom School of Business, Boston University
Jim Robinson	CEPI
Monique K. Mansoura	The MITRE Corporation

#### February 15-19, 2021: Mathematical and Computational Materials Science

Computational Materials Science is a well-established field that lies at the intersection of many disciplines, including mechanics, computational techniques, numerical analysis, and mathematical theory. Among other things, it describes how materials deform, are damaged, and age. These phenomena can be studied at various scales, from microscopic scales described using the framework of quantum mechanics, to macroscopic scales modeled with continuum mechanics, via intermediate mesoscopic scales where atomistic and molecular dynamics techniques are key.

This workshop brought together leading experts who presented their research and illustrated the challenging practical questions where the mathematical sciences can play a significant role in the future. Participants highlighted the quality and diversity of the talks by an impressive international group of thought leaders in the field, and they appreciated the focus on mathematical and numerical methods targeted at a range of materials science topics. Participants also noted the opportunity presented by IMSI's multi-disciplinary focus and the interconnectedness of our scientific themes, and suggested future overlapping topics such as "quantum and topological materials" and "machine learning and materials design".

This workshop was attended by 135 unique participants, including organizers and speakers:

Organizers	Affiliation
Qiang Du	Columbia University
Irene Fonseca	Carnegie Mellon University
Richard James	University of Minnesota
Claude Le Bris	Ecole des Ponts & Inria
Jianfeng Lu	Duke University
Danny Perez	Los Alamos National Lab
Speakers	Affiliation
Gregoire Allaire	Ecole Polytechnique
Kaushik Bhattacharya	California Institute of Technology
Ludovic Chamoin	ENS Paris-Saclay
Selim Esedoglu	University of Michigan
Manuel Friedrich	Universität Münster
Vikram Gavini	University of Michigan
Miranda Holmes-Cerfon	New York University
Tony Lelièvre	Ecole des Ponts ParisTech
Lin Lin	University of California, Berkeley
Chun Liu	Illinois Institute of Technology
Mitchell Luskin	University of Minnesota
Noa Marom	Carnegie Mellon University

Maria Giovanna Mora	Università degli Studi di Pavia
Cyrill Muratov	New Jersey Institute of Technology
Felix Otto	Max Planck Institute, Leipzig
Christoph Ortner	University of Warwick
Sylvia Serfaty	New York University
Xiaochuan Tian	University of California, San Diego
Peter Voorhees	Northwestern University
Michael Weinstein	Columbia University
Barbara Zwicknagl	Technische Universität Berlin

#### March 1-5, 2021: Confronting Climate Change

The workshop brought together leaders in mathematics, statistics, and atmospheric sciences to address grand climate challenges and their impacts and served as a precursor to a future semester-long program. A major goal of IMSI climate change activities will be to develop next-generation suites of science-driven mathematical and statistical tools and capabilities to address decision-relevant climate hazards and impacts, foster new multidisciplinary collaborations, and integrate young scientists and researchers into industry, private sector, and academic research. In particular, the organizers envision mathematical and statistical techniques and diagnostic tools to advance understanding of the dynamics and interactions between global climate and decision-relevant regional impacts, and human health hazards.

Among the many highlights was the importance of diverse data sources to feed into models and the need for greater use of statistical models. One participant appreciated, "the interesting dialogue on economics of heat stress effects in determining social cost of carbon, highlighting the importance of taking physics-based constraints (wet bulb temperature and mammalian physiology) into account as opposed to using empirical methods." The virtual nature of this workshop was met with a variety of feedback, ranging from appreciation of the timing and ease of interacting with other participants, to frustration with not being able to engage informally with other participants and the difficulty of out-of-timezone attendance for those contending with work and home life balance. Nevertheless, one participant appreciated that the "presenters were extremely good at raising questions and discussing each other's talks."

This workshop was attended by 104 unique participants, including organizers and speakers.

Organizers	Affiliation
Vera Hur	University of Illinois at Urbana-Champaign

Bo Li	University of Illinois at Urbana-Champaign
Robert Rosner	University of Chicago
Ryan Sriver	University of Illinois at Urbana-Champaign
Robert Trapp	University of Illinois at Urbana-Champaign
Speakers	Affiliation
Amy Braverman	Jet Propulsion Laboratory, California Institute of Technology
Tamma Carleton	University of California, Santa Barbara
Edwin Gerber	New York University
Chris Jones	University of North Carolina, Chapel Hill
Mikyoung Jun	University of Houston
Klaus Keller	Pennsylvania State University
Boualem Khouider	University of Victoria
Robert Lund	University of California, Santa Cruz
Raymond Pierrehumbert	University of Oxford
Leslie Smith	University of Wisconsin – Madison
Richard Smith	University of North Carolina, Chapel Hill
Susan Solomon	Massachusetts Institute of Technology
Michael Stein	Rutgers University
Laure Zanna	New York University

#### April 12-16, 2021: The Multifaceted Complexity of Machine Learning

This workshop focused on developing a better understanding of the different types of complexity within machine learning, how they can be jointly leveraged to understand the solvability of learning problems, and fundamental trade-offs among them. For example, modern machine learning methods, coupled with new optimization and statistical inference strategies, have demonstrated an unprecedented potential to solve challenging problems in a range of applications with societal relevance. The workshop addressed foundational understanding of when and how to use certain methods in applications ranging from computer vision to healthcare to agriculture.

Our post-workshop survey indicated generally positive feedback from the participants, indicating that they found the workshop scientifically important and that it stimulated new ideas for research and potential collaboration. As with every other workshop, before and after, participants expressed disappointment and some frustration about having to convene remotely, while of course fully appreciating the necessity of doing so. One researcher quantified the impact, noting that the workshop "would have been 25x more productive, useful, and helpful if it was in person."

This workshop was attended by 124 unique participants, including organizers and speakers:

Organizers	Affiliation
Avrim Blum	Toyota Technological Institute of Chicago
Olgica Milenkovic	University of Illinois at Urbana-Champaign
Lev Reyzin	University of Illinois at Chicago
Matus Telgarsky	University of Illinois at Urbana-Champaign
Rebecca Willett	University of Chicago
Speakers	Affiliation
Jayadev Acharya	Cornell University
Peter Bartlett	University of California, Berkeley
Kamalika Chaudhuri	University of California, San Diego
Jelena Diakonikolas	University of Wisconsin – Madison
Vitaly Feldman	Apple
Surbhi Goel	Microsoft Research New York City Lab
Moritz Hardt	University of California, Berkeley
Daniel Hsu	Columbia University
Stephanie Jegelka	Massachusetts Institute of Technology
Adam Klivans	University of Texas at Austin
Andreas Krause	ETH Zurich
Aryeh Kontorovich	Ben-Gurion University
Samory Kpotufe	Columbia University
Po-Ling Loh	University of Wisconsin – Madison

Andrei Risteski	Carnegie Mellon University
Tselil Schramm	Stanford University
Gregory Valiant	Stanford University
Rachel Ward	University of Texas at Austin

#### April 26-30, 2021: Topological Data Analysis

This workshop consisted of plenary lectures, invited talks, and poster sessions covering a wide range of topics in Topological Data Analysis (TDA), from theory to concrete applications of TDA in science and engineering. The goals of the workshop were to foster scientific interactions across the growing breadth of the applied topology community and to provide an opportunity for algebraic topologists, statisticians, and data scientists curious about this dynamic new field to learn more about it. Applied areas covered by the presenters included medical imaging, materials engineering, neurology, and artificial intelligence. TDA is a relatively new field attracting multidisciplinary contributions across the mathematical sciences and keen interest among scientists seeking new tools for extracting information from their increasingly complex data.

Survey results revealed that the participants generally encountered new people and perspectives, sparking fresh conversations about a number of key topics within TDA. There was strong agreement that the topics covered are scientifically important and have an important role to play in a breadth of disciplines and applications. The workshop was also a valuable introduction to the field: "As a newbie of TDA, I can say without any doubt that I understood the main ideas and techniques that make TDA really effective in practice, and not only interesting from a theoretical point of view. This was possible thanks to the wonderful given talks." Finally, the poignancy of the times was expressed eloquently by another participant: "One highlight for me was simply the ability to attend a few talks virtually. I am a mid-career mathematician, and the pandemic has very negatively affected my research profile. All of my time and energy went into online teaching and homeschooling my children for the past 400 days when we had no in-person schooling. So, having the opportunity to attend at least a few talks was a highlight in itself."

Organizers	Affiliation
Brittany Fasy	Montana State University
Kathryn Hess	École Polytechnique Fédérale de Lausanne
Matthew Kahle	Ohio State University
Sayan Mukherjee	Duke University
Jose Perea	Michigan State University

Speakers	Affiliation
Nicholas Berkouk	Ecole Polytechnique Fédérale de Lausanne
Lorin Crawford	Microsoft Research New England
Stefania Ebli	Ecole Polytechnique Fédérale de Lausanne
Ximena Fernández	Swansea University
Hitesh Gakhar	University of Oklahoma
Barbara Giunti	Technische Universität Graz
Celia Hacker	Ecole Polytechnique Fédérale de Lausanne
Teresa Heiss	Institute of Science and Technology Austria
Sara Kalisnik	Bentley University
Sadok Kallel	American University of Sharjah
Woojin Kim	Duke University
Marc Lange	Elbformat Consulting
Facundo Memoli	Ohio State University
Ezra Miller	Duke University
Anthea Monod	Imperial College London
Chul Moon	Southern Methodist University
Elizabeth Munch	Michigan State University
Vidit Nanda	University of Oxford
Bastian Rieck	ETH Zurich
Antonio Rieser	CONACYT-CIMAT, A.C
Luis Scoccola	Michigan State University
Elchanan Solomon	Duke University
Katharine Turner	Australian National University
Alexander Wagner	Duke University
Bei Wang	University of Utah
Yusu Wang	University of California, San Diego

Iris Yoon	University of Delaware
Poster Presenters	Affiliation
Mehmet Emin Aktas	University of Central Oklahoma
Erik J Amezquita	Michigan State University
Aras Asaad	Oxford Drug Design
Tahmineh Azizi	Kansas State University
Rituparna Basak	New Jersey Institute of Technology
Håvard Bakke Bjerkevik	Graz University of Technology
Elyse Borgert	University of North Carolina, Chapel Hill
Chao Cheng	New Jersey Institute of Technology
Veronica Ciocanel	Duke University
Pedro Conceicao	University of Aberdeen
Justin M Curry	University at Albany, State University of New York
Russell J Funk	University of Minnesota, Twin Cities
Jehan Ghafuri	The University of Buckingham
Golnar G Gharooni Fard	University of Colorado, Boulder
Sayonita Ghosh Hajra	California State University, Sacramento
Mario R Gomez Flores	Ohio State University
İsmail Güzel	İstanbul Technical University
Niklas Hellmer	Polish Academy of Sciences
Paul Samuel Ignacio	University of the Philippines Baguio
Péguy Kem-Meka Tiotsop Kadzue	Academia Avance
Miroslav Kramar	University of Oklahoma
Darrick Lee	University of Pennsylvania
Elise McMahon	GlaxoSmithKline; Cornell University
Nikola Milicevic	University of Florida, Gainesville

Senthil Mudaliar	United States Army
Arnur Nigmetov	Lawrence Berkeley National Laboratory
Miguel O'Malley	Wesleyan University
Matt Piekenbrock	Michigan State University
Brenda L Praggastis	Pacific Northwest National Laboratory
Yu Qin	Tulane University
Alexander Rolle	Graz University of Technology
Benjamin Roycraft	University of California, Davis
Alexander D Smith	University of Wisconsin – Madison
Francesca Tombari	КТН
Josué Tonelli-Cueto	Inria Paris & IMJ-PRG
Álvaro Torras Casas	Cardiff University
Renata Turkes	University of Antwerp
Mikael Vejdemo-Johansson	College of Staten Island, The City University of New York
Siddharth Vishwanath	Pennsylvania State University
Milton Chi-Chong Wong	University of Macau
Min-Chun Wu	Penn State University
Ling Zhou	Ohio State University

# May 10-14, 2021: Verification, Validation, and Uncertainty Quantification Across Disciplines

With the ongoing increase in computational capabilities, the reach of computational sciences is rapidly broadening well beyond its traditional 'homes' of physics, chemistry and computational engineering sciences to the biological and social sciences. Accordingly, questions regarding the veracity of the computational results must be inevitably confronted. This workshop brought together practitioners from across the natural and social sciences, from data rich to data poor environments, together with computer scientists and applied mathematicians involved in developing verifying and validating (V&V) simulation codes and uncertainty quantification (UQ) methodologies, and to seed interactions between these disparate areas. The organizers' goal is that advances in V&V and UQ will lead to progress in computation across the natural and social sciences.

The highlight of this workshop was the breadth of societally important topics addressed by the speakers, illustrating the applicability of V&V and UQ in advancing fields such epidemiology, legal decision-making, finance, and ecology. Survey respondents were especially appreciative that the workshop highlighted the meaningful role that the mathematical sciences can play in other disciplines and/or applications and that it generated ideas for potential future research.

This workshop was attended by 33 unique participants, including organizers and speakers.

Organizers	Affiliation
Mihai Anitescu	Argonne National Laboratory; University of Chicago
Fausto Cattaneo	University of Chicago
Carlo Graziani	Argonne National Laboratory; University of Chicago
Robert Rosner	University of Chicago
Speakers	Affiliation
Liliana Borcea	University of Michigan
Stephen Eubank	University of Virginia
Roger Ghanem	University of Southern California
Dimitrios Giannakis	New York University
Earl Lawrence	Los Alamos National Laboratory
Ann Lee	Carnegie Mellon University
Andrea Malagoli	SwissRe Corporate Solutions
William Oberkampf	W.L. Oberkampf Consulting
Daniel Sanz-Alonso	University of Chicago
Maike Sonnewald	Princeton University; Geophysical Fluid Dynamics Laboratory
Daniel Tartakovsky	Stanford University
Jonathan Weare	Courant Institute of Mathematical Sciences, New York University
David Weisbach	University of Chicago

# May 17-21, 2021: Decision Making in Health and Medical Care: Modeling and Optimization

The purpose of this workshop was to bring together key representatives from communities that are stakeholders in developing a better understanding of decision-making challenges in a range of health and medical care topics and propose new approaches to address them. Topics included i) measuring and incorporating patient preferences in the drug approval process, ii) applying data science and device discovery and development, biopharma investments, and healthcare delivery, iii) disruptive technologies for facilitating telemedicine and crowdsourced diagnoses, iv) innovative financial engineering solutions to funding biomedical innovation, and v) new approaches to pricing, access, and universal healthcare coverage. The workshop served as a platform for mathematicians, statisticians, computer scientists, economists and medical doctors to discuss the development of new techniques and quantitative areas to study such complex interacting systems.

The workshop's focus on decision making in health care areas that are deeply important to practitioners, patients, and their families proved valuable to the participants. Hardly anyone is untouched in some way by these topics, and the participants, mainly health care professionals, reflected this in their comments. One participant commented: "I thought the workshop was terrific. Great ideas, interesting perspectives, a very diverse group of obviously highly selected participants with different professional backgrounds, with high quality dialogue. And some really terrific presentations, especially Laura Esserman's at the very end. Also especially enjoyed the insights from Neil Kumar, which from my perspective raised a number of interesting questions regarding corporate responsibility and sustainability."

This workshop was attended by 73 unique participants, including organizers and speakers from the four workshop themes:

Organizers	Affiliation
Andrew Lo	Sloan School of Management, Massachusetts Institute of Technology
Thaleia Zariphopoulou	Mathematics, IEOR, and McCombs School of Business, University of Texas at Austin
Speakers (Listed by Theme)	Affiliation
Rare Diseases	
Audrey Davidow	Pitt Hopkins Research Foundation
llan Irony	Center for Biologics Evaluation and Research, U.S. Food and Drug Administration
Neil Kumar	BridgeBio

Anne Pariser	National Center for Advancing Translational Sciences, National Institutes of Health
Nora Yang	Stratify Therapeutics
COVID-19 and Infectious Diseases	
Rena Conti	Questrom School of Business, Boston University
Dimitrios Gouglas	CEPI
Randy Hyer	Moderna
Monique Mansoura	The MITRE Corporation
Xiao-Li Meng	Statistics, Harvard University
Obstetrics and Gynecology	
Radek Bukowski	Dell Medical School, University of Texas at Austin
Mike Giles	Mathematical Institute, University of Oxford
Dimitri Kusnezov	U.S. Department of Energy
Thaleia Zariphopoulou	Mathematics, IEOR, and McCombs School of Business, University of Texas at Austin
Oncology	
Christiana Bardon	Burrage Capital
Don Berry	MD Anderson Cancer Center and Berry Consultants
Laura Esserman	School of Medicine, University of California, San Francisco
Gary Gordon	Global Coalition for Adaptive Research
Larry Norton	Memorial Sloan Kettering Cancer Center

#### May 24-28, 2021: Quantum Information for Mathematics, Economics, and Statistics

This workshop explored a range of challenges in quantum information processing, which seeks to use the information embedded in the state of a quantum system to solve previously intractable computational problems and revolutionize simulation. Another topic was developing scalable quantum hardware that circumvents the physical limits on the

computational power of existing technologies. Current research is advancing applications of quantum algorithms in finance, chemistry, medicine, communications, encryption, and data security. This intensely interdisciplinary field draws upon the physical sciences and the mathematical sciences, such as: geometry, group theory, functional analysis, number theory, operator theory, probability theory, topology, complexity theory, and learning theory.

Respondents to the post-workshop survey were pleased with the diversity of perspectives presented by the speakers and the opportunity to meet new colleagues, all of which sparked meaningful scientific conversations. The talk on quantum application in finance drew particular praise from a number of participants, with one noting, "Monday's talk on quantum algorithms for finance, was well-organized, informative, and accessible even to those without extensive background in either algorithms or finance."

This workshop was attended by 85 unique participants, including organizers and speakers:

Organizers	Affiliation
Scott Aaronson	University of Texas at Austin
David Awschalom	University of Chicago
Brian DeMarco	University of Illinois at Urbana-Champaign
Marius Junge	University of Illinois at Urbana-Champaign
Paul Kwiat	University of Illinois at Urbana-Champaign
Umesh Vazirani	University of California, Berkeley
Speakers	Affiliation
Giuseppe Carleo	École polytechnique fédérale de Lausanne
Ulysse Chabaud	California Institute of Technology
Andrew Childs	University of Maryland
Bryan Clark	University of Illinois at Urbana-Champaign
William Fefferman	University of Chicago
Maria Kieferova	University of Technology Sydney
Damian Markham	Centre National de la Recherche Scientifique
Roman Orus	Donostia International Physics Center
Marco Pistoia	JP Morgan Chase
Edgar Solomonik	University of Illinois at Urbana-Champaign

Joel Wallman	University of Waterloo
Andreas Winter	Universitat Autònoma de Barcelona
Henry Yuen	Columbia University

#### 3.3 Special Events

# September 13 and October 18 and 24, 2020: Graduate Research Opportunities for Women (GROW) 2020

The Graduate Research Opportunities for Women (GROW) 2020 conference was aimed at increasing the number of female undergraduate students who pursue graduate degrees in the mathematical sciences. It was part of an annual series of GROW conferences which started in 2015-17 at Northwestern University and continued with conferences at the University of Michigan (2018) and the University of Illinois at Urbana-Champaign (2019). Each of the previous events took place in person over a weekend; because of the necessity of holding the event virtually, we decided to take the opportunity to spread the event out in time to try to build more of a sense of community among the participants.

The conference was open to undergraduates from U.S. colleges and universities, including international students. The conference featured lectures, panel discussions about graduate research in the mathematical sciences, networking opportunities, and advice on preparing applications for graduate school.

Post-conference surveys confirmed that GROW was of high impact for the participants, in that it gave them a more realistic, achievable, and broader vision of graduate school admissions and their own prospects. GROW strengthened the resolve of a number of participants to apply to graduate school, while a smaller number of others took GROW as an opportunity to consider non-grad school options as a viable path for a woman in mathematics.

This event was attended by 227 unique individuals, including organizers, speakers, and panelists.

Organizers	Affiliation
Kevin Corlette	University of Chicago
Mimi Dai	University of Illinois at Chicago
Denis Hirschfeldt	University of Chicago
Vera Mikyoung Hur	University of Illinois at Urbana-Champaign
Maryanthe Malliaris	University of Chicago

Nikki Pitcher	University of Chicago
Laura Schaposnik	University of Illinois at Chicago
Mary Silber	University of Chicago
Takis Souganidis	University of Chicago
Rebecca Willett	University of Chicago
Contributors	Affiliation
Chloe Avery	University of Chicago
Guher Camliyurt	University of Chicago
Radwa Dawood	University of Illinois at Chicago
Meg Doucette	University of Chicago
Thomas Hameister	University of Chicago
Denis Hirschfeldt	University of Chicago
Kasia Jankiewicz	University of Chicago
Roxie Jiang	University of Illinois at Chicago
Yundi Kong	University of Illinois at Chicago
Howie Masur	University of Chicago
Peter May	University of Chicago
Vinh Nguyen	University of Illinois at Chicago
Nikki Pitcher	University of Chicago
Sarah Reitzes	University of Chicago
Megan Roda	University of Chicago
Mariya Sardarli	University of Chicago
Yike Tang	University of Illinois at Chicago

Danielle Tucker	University of Illinois at Chicago
Dolores Walton	University of Chicago
Shmuel Weinberger	University of Chicago
Emily Wenger	University of Chicago
Miaomai Zhou	University of Illinois at Chicago
Seyed Zoalroshd	University of Chicago
Panelists	Affiliation
Alejandra Alvarado	Eastern Illinois University
Izzet Coskun	University of Illinois at Chicago
Denis Hirschfeldt	University of Chicago
Vera Hur	University of Illinois at Urbana-Champaign
Bryna Kra	Northwestern University
Mary Silber	University of Chicago
Beth Tipton	Northwestern University
Tandy Warnow	University of Illinois at Urbana-Champaign
Amie Wilkinson	University of Chicago
Rebecca Willett	University of Chicago
Kevin Corlette	University of Chicago
Takis Souganidis	University of Chicago
Dana Mendelson	University of Chicago
Jingshu Wang	University of Chicago
Lorin Crawford	Brown University and Microsoft Research
Mimi Dai	University of Illinois at Chicago

Daniel Hess	University of Chicago
Richard Laugesen	University of Illinois at Urbana-Champaign
Bo Peng	IDEO
Valerie E. Taylor	Argonne National Laboratory
David Uminsky	University of San Francisco; University of Chicago
Suzanne L. Weekes	Worcester Polytechnic Institute
Graduate Student Panelists	Affiliation
Emily Wenger	University of Chicago
Chloe Avery	University of Chicago
Meg Doucette	University of Chicago
Ruoxi Jiang	University of Chicago
Sarah Reitzes	University of Chicago
Dolores Walton	University of Chicago
Speakers	Affiliation
Sami Assaf	University of Southern California
Rina Foygel Barber	University of Chicago
Kathryn Mann	Cornell University
Emily Riehl	Johns Hopkins University
Rebecca Willett	University of Chicago

# November 20-23, 2020: paraDIGMS Fall Conference: Diversity in Graduate Mathematical Sciences

This conference was the first in the American Mathematical Society's <u>paraDIGMS</u> initiative to build a community of practice for graduate education in mathematics, with the goal of highlighting the work of individuals and organizations to build a diverse and equitable profession at the graduate level. The audience was mathematical scientists at all career

levels with particular focus on graduate program leaders, since they have the potential to change department practices and culture that can lead to improvements in recruiting and retaining individuals from historically underrepresented groups.

This fall session of the paraDIGMS special event was attended by 421 unique individuals, including organizers and speakers:

Organizers	Affiliation
Matthew Ando	University of Illinois at Urbana-Champaign
Justin Lanier	University of Chicago
Marissa Loving	Georgia Institute of Technology
Bianca Viray	University of Washington
Plenary Speakers	Affiliation
Raegan Higgins	Texas Tech University
Ebony McGee	Vanderbilt University
William Y. Vélez	University of Arizona
Workshop Facilitators	Affiliation
Casey Miller	Rochester Institute of Technology
Julie Posselt	University of Southern California
Panelists	Affiliation
Emily Butler	GlaxoSmithKline Pharmaceuticals
Carla Cotwright-Williams	National Association of Mathematicians
Jessica De Silva	California State University, Stanislaus
Lorelle Espinosa	Sloan Foundation
Rebecca Garcia	Sam Houston State University
David Goldberg	Purdue University
Marcia Gumpertz	North Carolina State University
Susan Hermiller	University of Nebraska
Theodore Hodapp	American Physical Society

Rick Laugesen	University of Illinois at Urbana-Champaign
Karen Marrongelle	National Science Foundation
Lloyd Munjanja	University of Illinois at Urbana-Champaign
Candice Price	Smith College
Sarah Salmon	University of Colorado, Boulder
Simone Sisneros-Thiry	California State University, East Bay
Belin Tsinnajinnie	Santa Fe Community College
Corey Welch	Iowa State University
Dwight Anderson Williams II	Iowa State University
Joycelyn Wilson	Spelman College

# April 23-26, 2021: paraDIGMS 2021 Spring Conference: Diversity in Graduate Mathematical Sciences

This was the second AMS paraDIGMS conference and furthered the work of growing a community of practice committed to equitable and inclusive graduate school recruiting, admissions, and retention in the mathematical sciences.

Feedback from the first two paraDIGMS conferences indicates broad agreement among the participants that this program is filling an important need in the mathematical sciences community: "I have struggled to find the words to accurately convey just how powerful the conference was and how much of a positive impact it had on me. I feel more empowered to take the lessons I've learned back to my department." Participants also expressed a range of reactions in confronting the difficult challenges laid out by the speakers and during discussions. These inputs are providing AMS and IMSI much useful information for future program planning, particularly related to the challenges of a remote convening and how to moderate discussions and breakouts when the topic fraught with a range of sensitive issues and personal experiences.

This spring session of the paraDIGMS special event was attended by 435 unique individuals, including organizers and speakers:

Organizers	Affiliation
Matthew Ando	University of Illinois at Urbana-Champaign
Justin Lanier	University of Chicago

Marissa Loving	Georgia Institute of Technology
Bianca Viray	University of Washington
Plenary Speakers	Affiliation
Erica Graham	Bryn Mawr College
Shirley Malcom	American Association for the Advancement of Science
Kasso Okoudjou	Tufts University
Francis Su	Harvey Mudd College
Panelists	Affiliation
Silas Alben	University of Michigan
Federico Ardila	San Francisco State University
Claudio Gómez-Gonzáles	University of California, Irvine
Jacqueline Hughes-Oliver	North Carolina State University
Amzi Jeffs	University of Washington
John Peca-Medlin	University of California, Irvine
Emily Riehl	Johns Hopkins University
Kim Ruane	Tufts University
Liz Tatum	University of Illinois at Urbana-Champaign

## 4. Preparation for Future Activity

The institute will host two long programs in 2021-22: Distributed Solutions to Complex Societal Problems (September 17-December 20, 2021) and Decision Making and Uncertainty (March 21-May 27, 2022). These programs were included in the NSF proposal for the institute as part of the menu of activity for the first year, but the timing of the public announcement caused us to defer both programs to the second year. As soon as the institute was publicly announced, work with organizing committees for both programs began. Potential participants were identified and invited to apply, workshop schedules were finalized, workshop organizing committees were formed, and workshop speakers were invited. Applications for both programs opened in the fall, and were announced through a number of channels. We are anticipating a full opening for in person activity in the fall, but COVID-19 continues to impact the ability of potential participants to plan trips to the institute, especially from abroad and especially for the fall.

The IMSI Scientific Committee met for the first time in January 2021. Among the topics on the agenda was a discussion of a framework for proposals for long programs. As a consequence of this discussion, the description of expected components of a full proposal for a long program on the IMSI website was updated as follows:

- Title of the program
- Scientific description: A description of the topic for the workshop, in terms accessible to a general audience of mathematicians and statisticians. What are the primary problems to be addressed? What is the history of the subject? Explicitly address what areas of mathematics and statistics will be drawn upon. What other disciplines will be involved? How would the program relate to IMSI themes? What is the significance of the topic to society at large? Are there connections to industry or national labs?
- **Abstract**: A short description of the program's topic and goals, suitable for advertising the program.
- **Related programs**: Are there programs or workshops, either recent or planned, at IMSI or elsewhere, on similar topics? Does the program build on previous programs or workshops? Does it complement what has been done elsewhere?
- **Organizing committee**: Who are the organizers? What commitments can they make about being in residence at IMSI during the program? The proposal should identify one primary and and one secondary contacts among the members of the organizing committee for communication with IMSI.
- **Key participants**: Identify researchers who are important to the success of the program who are not members of the organizing committee. How willing are they to participate?
- Workshop plans: Describe plans for an introductory and a small number (typically 3) specialized workshops over the course of the program. Plans should include topics, members of organizing committees, and confirmed or invited speakers. In addition, organizers are encouraged to propose a Research Collaboration Workshop in conjunction with their program, and to identify confirmed or invited team leaders.

- **Other planned activity**: Describe the activity planned during the program outside the framework of workshops. In addition, describe any plans for activity leading up to the program and/or for follow-up activity.
- **Deliverables**: Are there any specific deliverables that can be expected from the program?
- Human resources plan: Describe efforts made to diversify the program organizing committee, the list of key participants, and workshop organizing committees and lists of speakers. Describe plans for recruiting a diverse set of participants. Diversity has many dimensions, including gender, race, ethnicity, career stage, employment sector, and research area. We recognize that organizers are unlikely to achieve complete success in recruiting a meaningfully diverse set of participants across all these dimensions, but we do expect proposers to identify the dimensions in which they can realistically expect to be successful.
- **Mentoring Plan**: How will early career researchers and students participating in the program be mentored? What kinds of intellectual and professional support will they be offered?
- **Communication plan**: Describe plans for establishing effective communication and collaboration within an intellectually diverse collection of participants at a variety of career stages. This will likely be intertwined with the human resources and mentoring plans. Also describe any plans for communicating about program activity and providing access points to broader audiences. What will the most interesting aspects of the program be for a broader scientific audience? For the public? Are there connections with industry or policy making that will be explored?
- **Preferred timing**: Propose one or more quarters during which the program could take place. Explain time constraints the organizers and key participants have. Long programs are typically scheduled two years ahead of time.
- Additional funding sources: Are there any other sources of funding that might help support the program?

Similarly, the description of expected components of workshop proposals was updated as follows:

- Title of the workshop
- **Scientific description**: A description of the topic for the workshop in terms accessible to a general audience of mathematical scientists. What are the goals for the workshop, and why is the topic timely?
- Abstract: A brief description of the workshop, suitable for advertising it.
- **Organizing committee**: List of the proposed organizers, with a primary contact identified.
- **Proposed speakers**: A list of proposed speakers, including any information available about willingness to participate. The list does not need to be complete at the time the proposal is considered.
- **Proposed activities**: What activities will be involved in the workshop? Possibilities include invited lectures, introductory or survey talks aimed at a broad audience, contributed talks, panel discussions, poster sessions, discussions of open problems

and challenges in the field, and social events. What potential do the planned activities have to spark or further collaboration in the area?

- Access points for broader audiences: In general, we prefer that workshops not confine themselves exclusively to the model of experts speaking to experts. Will there be access points for broader audiences in any of the activities planned for the workshop? Are there connections with industry or policy making that will be explored?
- Proposed length: How long should the workshop be?
- **Preferred timing**: What preferences or constraints do the organizers have for scheduling the workshop?
- Additional funding sources: Are there additional funding sources that might help support the workshop?

The Scientific Committee approved two proposals for long programs in 2022-23: Confronting Global Climate Change in fall of 2022, and Mathematics, Statistics, and Innovation in Medicine and Health Care in spring of 2023.

# 5. Governance

IMSI has two principal governing boards.

The IMSI **Board of Advisors** provides guidance to the Director on Institute activities, operations, and strategic planning. In addition, it plays a role in the search for and appointment of the Director. The Board has dedicated seats for one institutional member from each of the partner institutions (Northwestern University, the University of Chicago, the University of Illinois at Chicago, and the University of Illinois at Urbana-Champaign), with the remaining seats allocated to general and *ex officio* members. Members serve four year terms, except in the case of *ex officio* members. At full strength, the Board is expected to have 12-20 members in all, exclusive of *ex officio* members; it will build to full size over the next 2-3 years. The current institutional and general members of the Board of Advisors are as follows.

C. Allen Butler	Daniel H. Wagner Associates	
T. Tony Cai	Wharton Statistics, University of Pennsylvania	
Laura Frerichs	Research Park, University of Illinois at Urbana-Champaign	
Pierre-Louis Lions	Collège de France	
Brooke Shipley	Mathematics, Statistics, and Computer Science, University of Illinois at Chicago	
Karen Willcox	Oden Institute for Computational Engineering and Sciences, University of Texas at Austin	
Patrick Wolfe (Chair)	Statistics, Purdue University	
Eric Zaslow	Mathematics, Northwestern University	

The **Scientific Committee** provides guidance on the overall direction for scientific activity at the Institute and evaluates proposals for specific activities. Terms for members are typically three years in length. The current members of the Scientific Committee are as follows.

Alicia Carriquiry	Statistics, Iowa State University
René Carmona	ORFE, Princeton University
Amir Dembo	Statistics and Mathematics, Stanford University
Bjorn Engquist (Chair)	Mathematics and ICES, University of Texas at Austin
Thomas Grandine	The Boeing Company (retired)

Larry Hedges	Statistics, Northwestern University	
Claude Le Bris	CERMICS, Ecole Nationale des Ponts et Chaussées and Inria	
Rebecca Willett	Statistics and Computer Science, University of Chicago	

# 6. Evaluation

IMSI works with East Main Evaluation and Consulting (EMEC) to evaluate its programs and activities. EMEC offers consulting and evaluation services with expertise in science and mathematics education and technology. The proposed effort will be managed by Barbara P. Heath, Ph.D. Dr. Heath founded EMEC in 2004 and has evaluated over 30 STEM focused programs including CyVerse (formerly iPlant), multiple Math and Science Partnerships, and various informal education efforts.

This year, the IMSI project team collaborated with EMEC to design post-activity surveys of participants for the following events:

- GROW Conference. Sept.-Oct. 2020
- Dealing with COVID-19 in Theory and Practice. Oct 2020
- paraDIGMS Conference. Nov 2020
- Mathematical and Computational Materials Science. Feb 2021
- Confronting Climate Change. Mar 2021
- The Multifaceted Complexity of Machine Learning. Apr 2021
- paraDIGMS Conference. Apr 2021
- Topological Data Analysis. Apr 2021
- Verification, Validation, and Uncertainty Quantification Across Disciplines. May 2021
- Decision Making in Health and Medical Care. May 2021
- Quantum Information for Mathematics, Economics, and Statistics. May 2021

The surveys were designed to gauge the nature of participant experience during each activity, to measure the degree to which participants thought the specific goals for each activity were achieved, and to gather feedback about possible future directions. Surveys were typically deployed a few days after the end of the activity, and participants were given two weeks to respond. A reminder was typically sent a week after the initial deployment of each survey.

In addition, IMSI worked with EMEC on the development of a longer term framework and plan for evaluating the degree to which IMSI's activities and strategies advance its mission and goals. This effort will inform the evaluation process for the more ambitious activities IMSI will undertake as it emerges from its ramp-up period and COVID restrictions.

# 7. External Funding

IMSI receives substantial in-kind support from the University of Chicago. This support includes a full teaching release and administrative supplement for the Director, an administrative supplement for the Scientific Adviser, and the full salary of the Executive Director. In addition, the University has covered the cost of the renovation of the space IMSI occupies.

In addition, the University of Illinois at Urbana-Champaign provided support through a partial teaching release for the Associate Director.

#### Other Funding Support

University of Chicago Physical Sciences Division Dean	\$123,485
American Mathematical Society	\$2,000
American Mathematical Society	
"Mathematics Programs that Make a Difference" Award	\$1,000
(for GROW)	

Total

\$126,245

# 8. Director Biographies

#### Kevin Corlette, Director

Kevin Corlette was appointed as the Director of IMSI on August 1, 2020. He has been a faculty member of the Department of Mathematics at the University of Chicago since 1987. He served as chair of the department from 2001-2007, and again from 2017-2020. In addition, he served as director of the Masters Program in Financial Mathematics from 2012-2015. His research lies in differential and algebraic geometry, and has touched on areas such as non-Abelian Hodge theory, rigidity of lattices in Lie groups, and representations of fundamental groups of Kähler manifolds. He was a recipient of an NSF Postdoctoral Fellowship, a Sloan Research Fellowship, and a Presidential Young Investigator Award. He was an invited speaker at the 1994 International Congress of Mathematicians.

#### Douglas Simpson, Associate Director

Douglas Simpson was appointed as the Associate Director of IMSI on August 1, 2020. He has been a faculty member of the Department of Statistics at the University of Illinois at Urbana-Champaign since 1985, serving as chair of the department from 2000-2019. In addition, he served as director of the department's statistical consulting center 1995-2000. His research areas include applied and computational statistics, robust statistical methods, machine learning, and functional data methodology for quantitative image analysis. He was a recipient of an NSF Mathematical Sciences Postdoctoral Research Fellowship. He has served on NSF review panels and as a regular member of the NIH Biostatistical Methods and Research Design study group. He is a fellow of the American Association for the Advancement of Science, the American Statistical Association, and the Institute for Mathematical Statistics.

#### Takis Souganidis, Scientific Adviser

Takis Souganidis is Professor of Mathematics and Member of the Committee in Computational and Applied Mathematics at the University of Chicago. He works in deterministic and stochastic partial differential equations, and is interested in applied mathematics. He was a recipient of a Sloan Research Fellowship, and a Presidential Young Investigator Award. He was an invited speaker at the 1994 International Congress of Mathematicians and the 2019 International Congress on Industrial and Applied Mathematics. He is a Fellow of the AAAS, AMS, and SIAM.

#### Philip W. Hammer, Executive Director

Philip (Bo) W. Hammer was appointed Executive Director of IMSI on January 1, 2021. Hammer comes to IMSI after 10 years at the American Institute of Physics, where he was the founding and interim Executive Director of the AIP Foundation. He also led AIP's major antiracism initiative that addressed under representation of African Americans in physics and astronomy. Hammer received his BS in Physics from Humboldt State University and his PhD in Physics from the University of Oregon. From 1991-93, Hammer was an ONR Postdoctoral Fellow at the Naval Surface Warfare Center in Silver Spring, MD. Hammer spent the '93-'94 year as an APS Congressional Science Fellow working on the staff of the Subcommittee on Science in the US House of Representatives. He worked at AIP from 1994-2000, and was Director of the Society of Physics Students and Sigma Pi Sigma. From 2000-2008, Hammer was a vice president The Franklin Institute Science Museum in Philadelphia. Hammer is a Fellow of the American Physical Society.