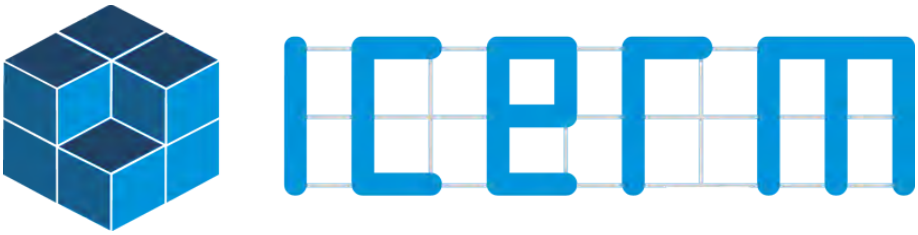

Institute for Computational and Experimental Research in Mathematics

Annual Report
May 1, 2017 – April 30, 2018

Brendan Hassett, Director
Mathew Borton, IT Director
Jeff Brock, Associate Director
Ruth Crane, Assistant Director
Sigal Gottlieb, Deputy Director
Elisenda Grigsby, Deputy Director
Jeffrey Hoffstein, Consulting Associate Director
Caroline Klivans, Associate Director
Jill Pipher, Consulting Associate Director
Bjorn Sandstede, Associate Director
Homer Walker, Consulting Associate Director
Ulrica Wilson, Associate Director for Diversity and Outreach

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Mission

"The mission of the Institute for Computational and Experimental Research in Mathematics (ICERM) is to support and broaden the relationship between mathematics and computation: specifically, to expand the use of computational and experimental methods in mathematics, to support theoretical advances related to computation, and address problems posed by the existence and use of the computer through mathematical tools, research and innovation."

Core Programs and Events

ICERM's scheduled programs and events from May 1, 2017 through April 30, 2018

TYPE	TITLE	START	END	# Participants
Special Event	The 2017 Tony and Pat Houghton Conference on Non-Equilibrium Physics of Soft and Biological Systems	8-May-17	9-May-17	17
Collaborate @ICERM	Interplay among hypersurface singularities, Hodge theory and the moduli of hyper-surfaces and their hyperplane sections.	15-May-17	19-May-17	3
Topical Workshop	Probabilistic Scientific Computing: Statistical inference approaches to numerical analysis and algorithm design	5-Jun-17	9-Jun-17	69
Collaborate @ICERM	Local representations of paramodular forms	12-Jun-17	16-Jun-17	3
Summer@ICERM	Summer@ICERM 2017: Topological Data Analysis	19-Jun-17	11-Aug-17	32
Topical Workshop	Robust Methods in Probability & Finance (under auspices of VI-MSS program, in collaboration with the University of Freiburg)	19-Jun-17	23-Jun-17	52
Topical Workshop	Women in Data Science and Mathematics Research Collaboration Workshop (WiSDM) (Partially funded by AWM ADVANCE, DIMACS, Brown's Data Science Initiative)	17-Jul-17	21-Jul-17	52
Collaborate @ICERM	Towards the Classification of Arithmetic Hyperbolic Reflection Groups	17-Jul-17	21-Jul-17	4

Collaborate @ICERM	Kirrillov-Reshetikhin Supercrystals	31-Jul-17	4-Aug-17	4
Collaborate @ICERM	Hyperplane Arrangements	31-Jul-17	4-Aug-17	3
Collaborate @ICERM	Iterating evolutes and involutes in the spherical and hyperbolic geometries.	31-Jul-17	4-Aug-17	4
Topical Workshop	Localized Kernel-Based Meshless Methods for Partial Differential Equations	7-Aug-17	11-Aug-17	39
Collaborate @ICERM	Orbit decompositions of the symmetric spaces of SLn(k)	7-Aug-17	11-Aug-17	6
Topical Workshop	Pedestrian Dynamics: Modeling, Validation and Calibration	21-Aug-17	25-Aug-17	56
Research Cluster	Research Cluster: Wave Propagation and Imaging in Random Media	6-Sep-17	13-Oct-17	30
Semester Program	Mathematical and Computational Challenges in Radar and Seismic Reconstruction	6-Sep-17	8-Dec-17	59
Program Workshop	Industrial Problems in Radar and Seismic Reconstruction	11-Sep-17	13-Sep-17	43
Program Workshop	Waves and Imaging in Random Media	25-Sep-17	29-Sep-17	57
Research Cluster	Research Cluster: Mathematical and Computational Aspects of Radar Imaging	2-Oct-17	3-Nov-17	32
Program Workshop	Mathematical and Computational Aspects of Radar Imaging	16-Oct-17	20-Oct-17	59
Special Event	Modern Math Workshop 2017 (funded by MSIDI NSF grant)	18-Oct-17	19-Oct-17	96
Public Lecture	Musical Geometry, Games, and Multimedia Art (featuring Dmitri Tymoczko, Princeton)	18-Oct-17		115
Research Cluster	Research Cluster: Wave Propagation and Inversion in Seismic Applications	23-Oct-17	21-Nov-17	25
Program Workshop	Advances in model reduction for large-scale forward and inverse scattering problems	3-Nov-17	3-Nov-17	30
Program Workshop	Recent Advances in Seismic Modeling and Inversion: From Analysis to Applications	6-Nov-17	10-Nov-17	58

Program Workshop	Geometry and Topology of Data (funded by TRIPODS through DSI)	11-Dec-17	13-Dec-17	46
Semester Program	Point Configurations in Geometry, Physics and Computer Science	1-Feb-18	4-May-18	52
Program Workshop	Optimal and Random Point Configurations	26-Feb-18	2-Mar-18	86
Public Lecture	Sleeping Beauty and Other Probability Conundrums (featuring Peter Winkler, Dartmouth)	28-Feb-18		92
Program Workshop	Fast Algorithms for Generating Static and Dynamically Changing Point Configurations	12-Mar-18	16-Mar-18	66
Public Lecture	Crowd Computing: Scientific discoveries by protein-folding game players (featuring Firas Khatib, UMass Dartmouth)	13-Mar-18		48
Program Workshop	Computation and Optimization of Energy, Packing, and Covering	9-Apr-18	13-Apr-18	60
Program Workshop	Computation and Optimization of Energy, Packing, and Covering	9-Apr-18	13-Apr-18	60

Participant Summaries by Program Type

ICERM Funded Participants

			Gender and Ethnicity							Geographical Point of Origin									
	Program Type	Total Participants	Female	# Reporting Gender	African American	American Indian	Asian	Hispanic	# Reporting Ethnicity	US - Midwest	US - Northeast	US - South	US - West	Africa	Asia	Canada	Europe	Latin & South America	Oceania
Summer@ICERM 2017		25	9	22	1	0	1	1	7	6	10	5	3	0	0	0	0	1	0
7 Collaboration Groups		27	6	17	1	0	1	1	13	5	7	8	4	0	0	1	1	1	0
Modern Math Workshop		55	26	53	13	0	12	28	63	2	18	16	19	0	0	0	0	0	0
TRIPODS		28	4	18	1	0	0	2	16	5	10	8	2	0	0	0	3	0	0
Fall Semester '17	Semester Program	57	11	40	0	0	7	1	24	11	9	10	9	0	1	3	13	1	0
	Workshop 1	35	6	24	0	0	3	0	12	6	9	9	6	0	1	1	3	0	0
	Workshop 2	49	6	32	0	0	5	1	23	5	9	6	10	0	1	0	17	1	0
	Workshop 3	54	10	39	0	0	3	1	22	10	20	9	8	0	0	0	7	0	0
	Workshop 4	23	4	15	0	0	2	0	8	4	3	7	2	0	0	1	6	0	0
	Workshop 5	52	9	28	0	0	7	0	18	8	7	13	6	0	0	3	15	0	0
	Research Cluster 1	30	5	22	0	0	2	1	12	5	3	5	7	0	1	1	7	1	0
	Research Cluster 2	32	6	24	0	0	2	1	11	7	5	7	6	0	1	1	4	1	0
	Research Cluster 3	25	4	18	0	0	3	0	10	4	3	5	5	0	1	2	5	0	0
	Total	357	61	242	0	0	34	5	140	60	68	71	59	0	6	12	77	4	0
	% of # Reporting		25%		0%	0%	24%	4%		17%	19%	20%	17%	0%	2%	3%	22%	1%	0%
Spring Semester '18	Semester Program	48	7	45	1	0	6	2	27	3	7	9	0	0	3	0	22	1	3
	Workshop 1	69	8	57	1	0	4	4	37	9	15	8	3	0	2	0	29	1	2
	Workshop 2	57	11	50	1	0	6	2	30	4	10	14	7	0	4	0	15	1	2
	Workshop 3	52	4	47	1	0	7	2	26	5	12	9	0	0	1	0	20	1	4
	Workshop 4	62	9	51	1	0	7	1	29	5	19	8	5	0	4	1	17	1	2
	Total	288	39	250	5	0	30	11	149	26	63	48	15	0	14	1	103	5	13
	% of # Reporting		16%		3%	0%	20%	7%		9%	22%	17%	5%	0%	5%	0%	36%	2%	5%
Topical '17-'18	Workshop A	34	7	26	0	0	7	1	16	7	6	4	7	0	1	0	8	0	1
	Workshop B	38	8	32	1	0	15	0	23	10	16	1	1	0	1	0	9	0	0
	Workshop C	44	43	43	1	0	13	3	37	5	13	9	12	0	3	2	0	0	0
	Workshop D	30	5	24	0	0	4	0	8	5	1	2	10	0	2	0	10	0	0
	Workshop E	42	15	35	0	0	4	0	20	4	10	4	3	0	0	1	20	0	0
	Total	188	78	160	2	0	43	4	104	31	46	20	33	0	7	3	47	0	1
	% of # Reporting		49%		2%	0%	41%	4%		16%	24%	11%	18%	0%	4%	2%	25%	0%	1%

All Participants (ICERM funded and Non-ICERM funded)

			Gender and Ethnicity							Geographical Point of Origin	
	Program Type	Total Participants	Female	# Reporting Gender	African American	American Indian	Asian	Hispanic	# Reporting Ethnicity	US Based	Foreign Based
Summer@ICERM 2017		32	11	26	1	0	2	2	11	31	1
7 Collaboration Groups		27	6	17	1	0	1	1	13	24	3
Modern Math Workshop		96	38	76	15	1	13	39	84	95	1
TRIPODS		46	7	33	2	0	3	2	27	42	4
Fall Semester '17	Semester Program	59	11	42	0	0	7	1	25	41	18
	Workshop 1	43	6	32	0	0	3	0	17	38	5
	Workshop 2	57	8	40	0	0	5	3	30	38	19
	Workshop 3	59	11	42	0	0	4	1	25	51	8
	Workshop 4	30	4	18	0	0	2	0	9	22	8
	Workshop 5	58	10	34	0	0	9	0	23	37	21
	Research Cluster 1	30	5	22	0	0	2	1	12	20	10
	Research Cluster 2	32	6	24	0	0	2	1	11	25	7
	Research Cluster 3	25	4	18	0	0	3	0	10	17	8
	Total	393	65	272	0	0	37	7	162	289	104
	% of # Reporting		24%		0%	0%	23%	4%		74%	26%
Spring Semester '18	Semester Program	56	9	53	1	0	9	2	33	21	35
	Workshop 1	86	10	69	1	0	7	5	48	50	36
	Workshop 2	66	14	59	1	0	12	2	37	39	27
	Workshop 3	61	6	55	1	0	12	2	32	31	30
	Workshop 4	78	13	65	1	1	12	1	43	44	34
	Total	347	52	301	5	1	52	12	193	185	162
	% of # Reporting		17%		3%	1%	27%	6%		53%	47%
Topical '17-'18	Workshop A	69	9	49	0	0	16	2	36	56	13
	Workshop B	52	10	44	1	0	20	0	33	38	14
	Workshop C	52	51	51	2	0	14	3	46	47	5
	Workshop D	39	9	32	0	0	6	2	14	23	16
	Workshop E	56	19	46	0	0	6	1	30	31	25
	Total	268	98	222	3	0	62	8	159	195	73
	% of # Reporting		44%		2%	0%	39%	5%		73%	27%

ICERM Funded Speakers

			Gender and Ethnicity							Geographical Point of Origin									
	Program Type	Total Participants	Female	# Reporting Gender	African American	American Indian	Asian	Hispanic	# Reporting Ethnicity	US - Midwest	US - Northeast	US - South	US - West	Africa	Asia	Canada	Europe	Latin & South America	Oceania
Summer@ICERM 2017		1	0	1	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0
7 Collaboration Groups		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Modern Math Workshop		4	1	4	1	0	0	0	1	0	2	1	1	0	0	0	0	0	0
TRIPODS		19	3	11	1	0	0	1	9	3	8	4	2	0	0	0	2	0	0
Fall Semester '17	Semester Program	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Workshop 1	9	3	7	0	0	0	0	1	2	2	1	3	0	0	1	0	0	0
	Workshop 2	20	2	8	0	0	1	1	8	2	3	1	3	0	1	0	9	1	0
	Workshop 3	23	3	14	0	0	0	0	3	3	12	1	4	0	0	0	3	0	0
	Workshop 4	6	1	2	0	0	0	0	0	1	1	2	0	0	0	0	2	0	0
	Workshop 5	24	4	10	0	0	2	0	6	2	3	5	3	0	0	1	10	0	0
	Research Cluster 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Research Cluster 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Research Cluster 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	82	13	41	0	0	3	1	18	10	21	10	13	0	1	2	24	1	0
	% of # Reporting		32%		0%	0%	17%	6%		12%	26%	12%	16%	0%	1%	2%	29%	1%	0%
Spring Semester '18	Semester Program	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Workshop 1	26	3	15	0	0	0	0	4	6	8	0	2	0	0	0	9	1	0
	Workshop 2	22	5	16	0	0	1	0	6	1	4	7	6	0	2	0	2	0	0
	Workshop 3	22	1	21	0	0	1	0	8	0	6	5	0	0	1	0	8	0	2
	Workshop 4	20	5	13	0	0	0	0	4	0	6	0	4	0	1	0	9	0	0
	Total	90	14	65	0	0	2	0	22	7	24	12	12	0	4	0	28	1	2
	% of # Reporting		22%		0%	0%	9%	0%		8%	27%	13%	13%	0%	4%	0%	31%	1%	2%
Topical '17-'18	Workshop A	18	3	11	0	0	0	0	2	3	4	2	3	0	0	0	5	0	1
	Workshop B	16	1	10	0	0	0	0	2	4	6	0	0	0	0	0	6	0	0
	Workshop C	3	2	2	0	0	0	0	1	0	1	0	0	0	1	1	0	0	0
	Workshop D	22	3	16	0	0	0	0	2	3	0	1	8	0	1	0	9	0	0
	Workshop E	21	7	14	0	0	0	0	6	1	2	3	2	0	0	1	12	0	0
	Total	80	16	53	0	0	0	0	13	11	13	6	13	0	2	2	32	0	1
	% of # Reporting		30%		0%	0%	0%	0%		14%	16%	8%	16%	0%	3%	3%	40%	0%	1%

All Speakers (ICERM funded and Non-ICERM funded)

			Gender and Ethnicity							Geographical Point of Origin	
	Program Type	Total Participants	Female	# Reporting Gender	African American	American Indian	Asian	Hispanic	# Reporting Ethnicity	US Based	Foreign Based
Summer@ICERM 2017		1	0	1	0	0	0	0	1	1	0
7 Collaboration Groups		0	0	0	0	0	0	0	0	0	0
Modern Math Workshop		10	2	6	1	0	0	0	1	10	0
TRIPODS		20	3	12	1	0	0	1	9	18	2
Fall Semester '17	Semester Program	0	0	0	0	0	0	0	0	0	0
	Workshop 1	9	3	7	0	0	0	0	1	8	1
	Workshop 2	20	2	8	0	0	1	1	8	9	11
	Workshop 3	23	3	14	0	0	0	0	3	20	3
	Workshop 4	6	1	2	0	0	0	0	0	4	2
	Workshop 5	24	4	10	0	0	2	0	6	13	11
	Research Cluster 1	0	0	0	0	0	0	0	0	0	0
	Research Cluster 2	0	0	0	0	0	0	0	0	0	0
	Research Cluster 3	0	0	0	0	0	0	0	0	0	0
	Total	82	13	41	0	0	3	1	18	54	28
	% of # Reporting		32%		0%	0%	17%	6%		66%	34%
Spring Semester '18	Semester Program	0	0	0	0	0	0	0	0	0	0
	Workshop 1	26	3	15	0	0	0	0	4	16	10
	Workshop 2	22	5	16	0	0	1	0	6	18	4
	Workshop 3	23	1	22	0	0	1	0	8	12	11
	Workshop 4	21	5	13	0	0	0	0	4	11	10
	Total	92	14	66	0	0	2	0	22	57	35
	% of # Reporting		21%		0%	0%	9%	0%		62%	38%
Topical '17-'18	Workshop A	20	3	13	0	0	0	0	2	14	6
	Workshop B	17	1	11	0	0	0	0	2	11	6
	Workshop C	3	2	2	0	0	0	0	1	1	2
	Workshop D	22	3	16	0	0	0	0	2	12	10
	Workshop E	22	7	15	0	0	0	0	7	9	13
	Total	84	16	57	0	0	0	0	14	47	37
	% of # Reporting		28%		0%	0%	0%	0%		56%	44%

ICERM Funded Postdocs

			Gender and Ethnicity							Geographical Point of Origin									
	Program Type	Total Participants	Female	# Reporting Gender	African American	American Indian	Asian	Hispanic	# Reporting Ethnicity	US - Midwest	US - Northeast	US - South	US - West	Africa	Asia	Canada	Europe	Latin & South America	Oceania
Summer@ICERM 2017		2	1	2	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0
7 Collaboration Groups		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Modern Math Workshop		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRIPODS		6	2	6	0	0	0	0	5	0	3	1	0	0	0	0	2	0	0
Fall Semester '17	Semester Program	7	0	3	0	0	2	0	3	3	0	2	1	0	0	1	0	0	0
	Workshop 1	5	0	1	0	0	0	0	1	2	0	2	1	0	0	0	0	0	0
	Workshop 2	9	1	5	0	0	2	0	4	2	2	3	1	0	0	0	1	0	0
	Workshop 3	8	1	4	0	0	2	1	4	4	1	2	1	0	0	0	0	0	0
	Workshop 4	5	0	1	0	0	1	0	1	2	0	2	0	0	0	1	0	0	0
	Workshop 5	6	0	2	0	0	2	0	2	3	0	2	0	0	0	1	0	0	0
	Research Cluster 1	5	0	1	0	0	0	0	1	2	0	2	1	0	0	0	0	0	0
	Research Cluster 2	5	0	1	0	0	0	0	1	2	0	2	1	0	0	0	0	0	0
	Research Cluster 3	5	0	1	0	0	0	0	1	2	0	2	1	0	0	0	0	0	0
	Total	55	2	19	0	0	9	1	18	22	3	19	7	0	0	3	1	0	0
	% of # Reporting		11%		0%	0%	50%	6%		40%	5%	35%	13%	0%	0%	5%	2%	0%	0%
Spring Semester '18	Semester Program	9	2	8	0	0	3	0	5	1	1	1	0	0	2	0	3	0	1
	Workshop 1	15	2	13	0	0	3	2	10	2	3	0	1	0	2	0	6	0	1
	Workshop 2	10	2	10	0	0	3	0	6	1	2	0	1	0	2	0	3	0	1
	Workshop 3	7	1	7	0	0	2	0	3	2	2	0	0	0	0	0	2	0	1
	Workshop 4	8	2	8	0	0	2	0	4	1	3	0	1	0	0	0	2	0	1
	Total	49	9	46	0	0	13	2	28	7	11	1	3	0	6	0	16	0	5
	% of # Reporting		20%		0%	0%	46%	7%		14%	22%	2%	%	0%	12%	0%	33%	0%	10%
Topical '17-'18	Workshop A	5	1	2	0	0	0	0	1	0	1	0	1	0	0	0	3	0	0
	Workshop B	5	1	5	1	0	2	0	5	2	1	0	0	0	0	0	2	0	0
	Workshop C	6	6	6	0	0	3	1	6	0	4	1	1	0	0	0	0	0	0
	Workshop D	5	1	4	0	0	1	0	3	0	0	0	3	0	1	0	1	0	0
	Workshop E	4	1	2	0	0	1	0	1	0	2	0	0	0	0	0	2	0	0
	Total	25	10	19	1	0	7	1	16	2	8	1	5	0	1	0	8	0	0
	% of # Reporting		53%		6%	0%	44%	6%		8%	32%	4%	20%	0%	4%	0%	32%	0%	0%

All Postdocs (ICERM funded and Non-ICERM funded)

			Gender and Ethnicity							Geographical Point of Origin	
	Program Type	Total Participants	Female	# Reporting Gender	African American	American Indian	Asian	Hispanic	# Reporting Ethnicity	US Based	Foreign Based
Summer@ICERM 2017		2	1	2	0	0	0	0	1	2	0
7 Collaboration Groups		3	0	3	0	0	0	1	2	3	0
Modern Math Workshop		2	1	1	0	0	0	0	0	2	0
TRIPODS		10	2	9	0	0	1	0	7	7	3
Fall Semester '17	Semester Program	7	0	3	0	0	2	0	3	6	1
	Workshop 1	7	0	3	0	0	0	0	2	7	0
	Workshop 2	9	1	5	0	0	2	0	4	8	1
	Workshop 3	8	1	4	0	0	2	1	4	8	0
	Workshop 4	5	0	1	0	0	1	0	1	4	1
	Workshop 5	6	0	2	0	0	2	0	2	5	1
	Research Cluster 1	5	0	1	0	0	0	0	1	5	0
	Research Cluster 2	5	0	1	0	0	0	0	1	5	0
	Research Cluster 3	5	0	1	0	0	0	0	1	5	0
	Total	31	2	15	0	0	6	1	13	29	2
	% of # Reporting		13%		0%	0%	46%	8%		94%	6%
Spring Semester '18	Semester Program	10	2	9	0	0	4	0	6	3	7
	Workshop 1	17	2	15	0	0	4	2	12	7	10
	Workshop 2	11	2	11	0	0	4	0	7	4	7
	Workshop 3	8	1	8	0	0	3	0	4	4	4
	Workshop 4	11	2	11	0	0	4	0	6	6	5
	Total	57	9	54	0	0	19	2	35	24	33
	% of # Reporting		17%		0%	0%	54%	6%		42%	58%
Topical '17-'18	Workshop A	11	1	8	0	0	4	0	6	8	3
	Workshop B	8	1	8	1	0	3	0	7	5	3
	Workshop C	8	8	8	1	0	3	1	8	8	0
	Workshop D	5	1	4	0	0	1	0	3	3	2
	Workshop E	8	3	6	0	0	1	1	4	4	4
	Total	40	14	34	2	0	12	2	28	28	12
	% of # Reporting		41%		7%	0%	43%	7%		70%	30%

ICERM Funded Graduate Students

			Gender and Ethnicity							Geographical Point of Origin									
	Program Type	Total Participant	Female	# Reporting	African American	American Indian	Asian	Hispanic	# Reporting	US - Midwest	US - Northeast	US - South	US - West	Africa	Asia	Canada	Europe	Latin & South America	Oceania
Summer@ICERM 2017		5	2	3	0	0	1	0	2	1	3	1	0	0	0	0	0	0	0
7 Collaboration Groups		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Modern Math Workshop		8	3	8	1	0	2	6	12	0	1	3	4	0	0	0	0	0	0
TRIPODS		2	1	2	0	0	0	1	3	0	0	2	0	0	0	0	0	0	0
Fall Semester '17	Semester Program	2	0	2	0	0	0	0	1	0	0	0	0	0	0	0	2	0	0
	Workshop 1	1	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0
	Workshop 2	3	0	3	0	0	0	0	2	0	0	0	0	0	0	0	3	0	0
	Workshop 3	6	2	6	0	0	0	0	5	1	2	0	1	0	0	0	2	0	0
	Workshop 4	2	0	2	0	0	0	0	1	0	0	0	0	0	0	0	2	0	0
	Workshop 5	5	0	5	0	0	2	0	4	0	0	3	0	0	0	0	2	0	0
	Research Cluster 1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
	Research Cluster 2	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
	Research Cluster 3	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
	Total	22	2	22	0	0	2	0	14	1	3	3	1	0	0	0	14	0	0
	% of # Reporting		9%		0%	0%	14%	0%		5%	14%	14%	5%	0%	0%	0%	64%	0%	0%
Spring Semester '18	Semester Program	5	1	5	1	0	0	2	7	0	1	2	0	0	0	0	2	0	0
	Workshop 1	9	1	9	1	0	0	2	11	1	2	2	0	0	0	0	4	0	0
	Workshop 2	6	2	6	1	0	1	2	8	0	1	3	0	0	0	0	2	0	0
	Workshop 3	11	1	10	1	0	3	2	11	1	3	2	0	0	0	0	5	0	0
	Workshop 4	11	2	10	1	0	2	1	10	1	5	3	0	0	1	0	1	0	0
	Total	42	7	40	5	0	6	9	47	3	12	12	0	0	1	0	14	0	0
	% of # Reporting		18%		11%	0%	13%	19%		7%	29%	29%	0%	0%	2%	0%	33%	0%	0%
Topical '17-'18	Workshop A	6	1	6	0	0	1	1	7	1	1	0	2	0	0	0	2	0	0
	Workshop B	13	5	13	0	0	11	0	13	3	7	1	1	0	1	0	0	0	0
	Workshop C	14	14	14	0	0	5	1	14	1	4	3	5	0	1	0	0	0	0
	Workshop D	2	0	2	0	0	1	0	1	1	0	0	0	0	0	0	1	0	0
	Workshop E	9	2	9	0	0	1	0	6	1	3	1	0	0	0	0	4	0	0
	Total	44	22	44	0	0	19	2	41	7	15	5	8	0	2	0	7	0	0
	% of # Reporting		50%		0%	0%	46%	5%		16%	34%	11%	18%	0%	5%	0%	16%	0%	0%

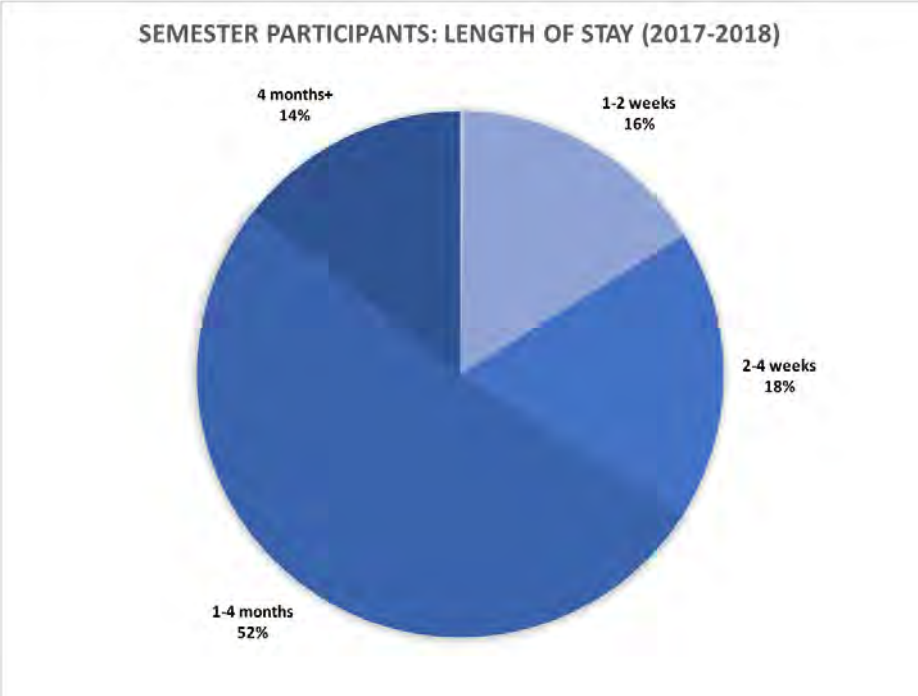
All Graduate Students (ICERM funded and Non-ICERM funded)

			Gender and Ethnicity							Geographical Point of Origin	
	Program Type	Total Participants	Female	# Reporting Gender	African American	American Indian	Asian	Hispanic	# Reporting Ethnicity	US Based	Foreign Based
Summer@ICERM 2017		6	2	4	0	0	1	0	3	6	0
7 Collaboration Groups		0	0	0	0	0	0	0	0	0	0
Modern Math Workshop		16	6	14	1	0	3	9	18	15	1
TRIPODS		7	3	6	0	0	1	1	7	7	0
Fall Semester '17	Semester Program	2	0	2	0	0	0	0	1	0	2
	Workshop 1	3	0	3	0	0	0	0	2	3	0
	Workshop 2	6	1	6	0	0	0	1	4	3	3
	Workshop 3	6	2	6	0	0	0	0	5	4	2
	Workshop 4	4	0	4	0	0	0	0	1	2	2
	Workshop 5	8	1	8	0	0	4	0	6	5	3
	Research Cluster 1	1	0	1	0	0	0	0	0	0	1
	Research Cluster 2	1	0	1	0	0	0	0	0	0	1
	Research Cluster 3	1	0	1	0	0	0	0	0	0	1
	Total	32	4	32	0	0	4	1	19	17	15
	% of # Reporting		13%		0%	0%	21%	5%		53%	47%
Spring Semester '18	Semester Program	7	1	7	1	0	0	2	8	3	4
	Workshop 1	15	1	12	1	0	1	2	13	11	4
	Workshop 2	7	3	7	1	0	2	2	9	4	3
	Workshop 3	12	1	11	1	0	4	2	12	7	5
	Workshop 4	19	4	17	1	1	3	1	18	12	7
	Total	60	10	54	5	1	10	9	60	37	23
	% of # Reporting		19%		8%	2%	17%	15%		62%	38%
Topical '17-'18	Workshop A	18	2	14	0	0	5	2	15	16	2
	Workshop B	17	6	17	0	0	13	0	17	13	4
	Workshop C	16	16	16	0	0	5	1	16	15	1
	Workshop D	5	1	5	0	0	2	1	4	1	4
	Workshop E	15	3	13	0	0	2	0	10	10	5
	Total	71	28	65	0	0	27	4	62	55	16
	% of # Reporting		43%		0%	0%	44%	6%		77%	23%

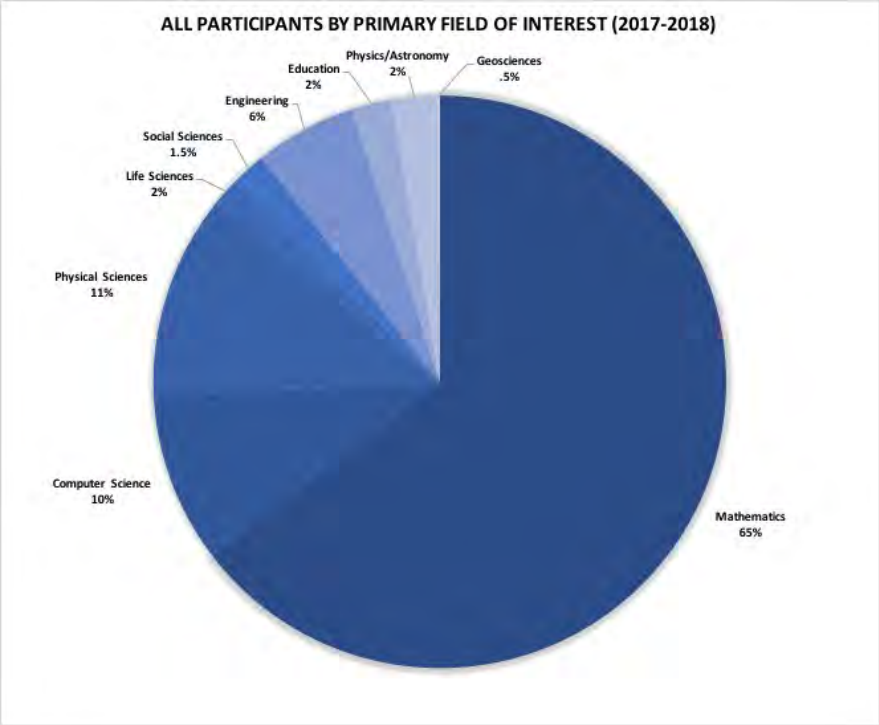
Additional Participant Data

The charts below display breakdowns of ICERM's confirmed participants by category during the reporting period for all funded programs.

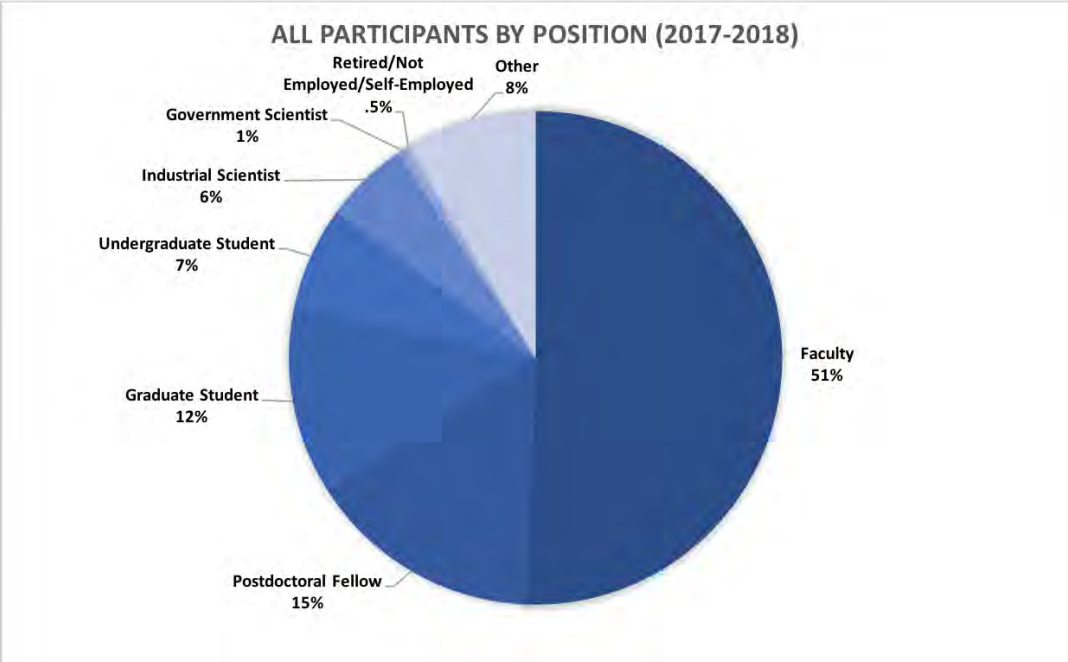
Semester Program Length of Stay



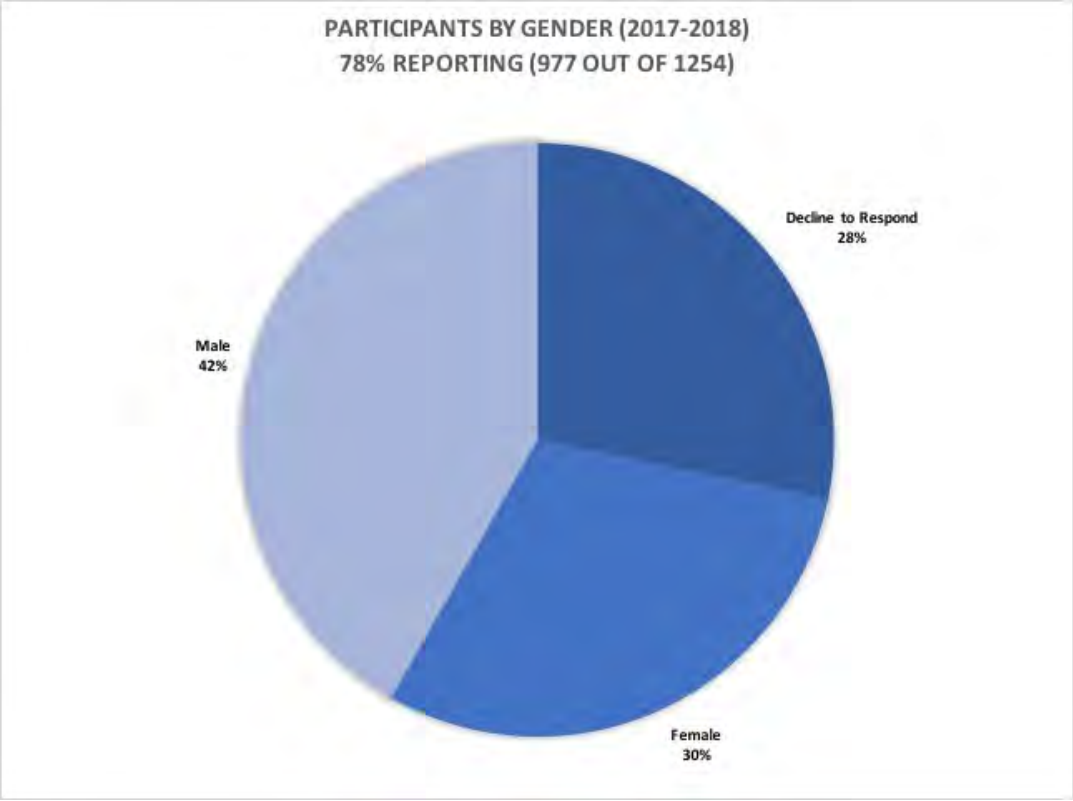
Primary Field of Interest



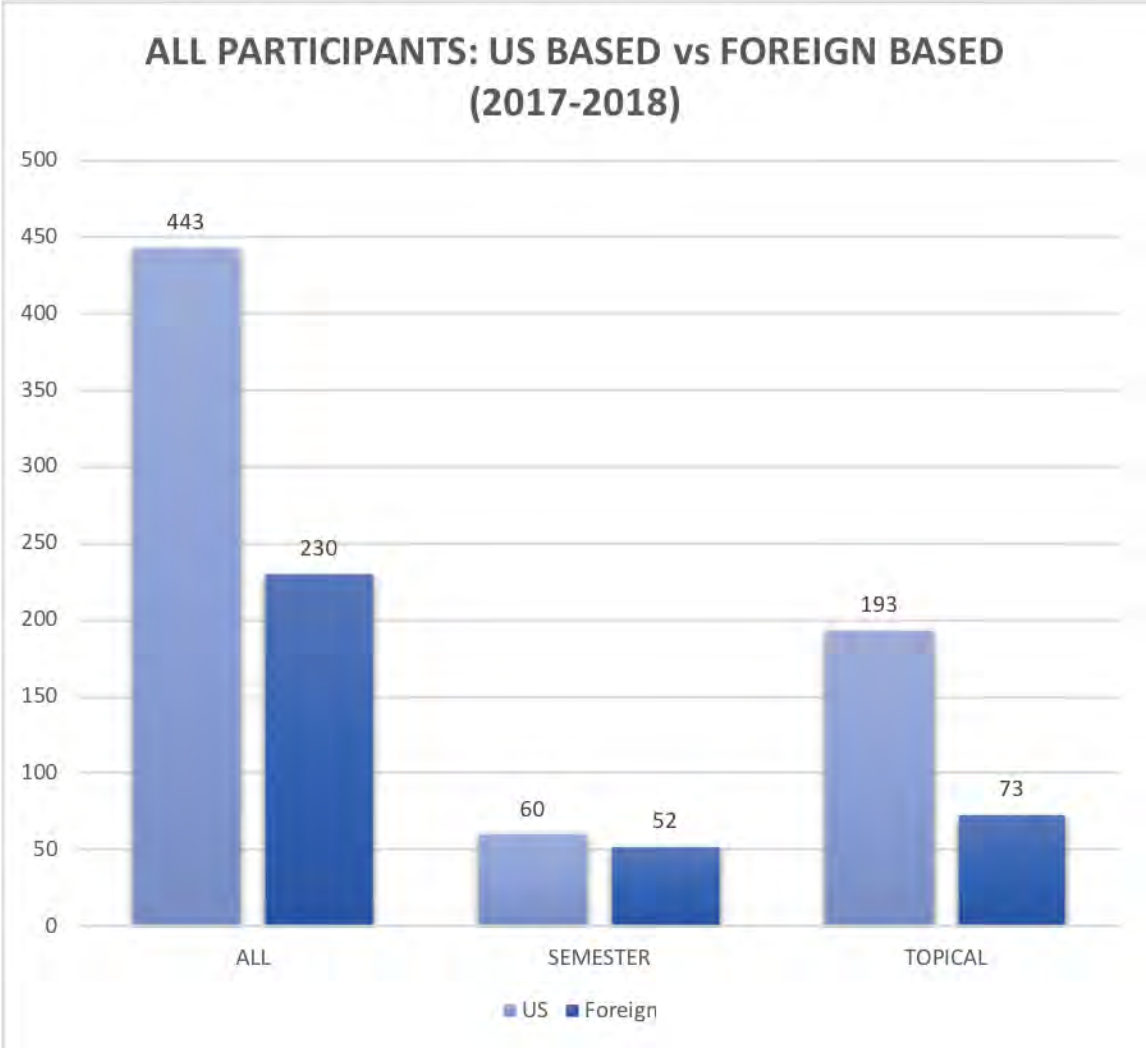
Position



Gender



US vs Foreign Based Participants



Semester Programs

Since its inaugural semester program in September 2011, a large portion of the Institute's activity has taken place in the context of semester long thematic programs together with their associated workshops.

Semester Program Process

ICERM's Scientific Advisory Board SAB meets annually in November, and schedules conference calls as needed throughout the year. The 2016 annual meeting and a subsequent conference call in June resulted in the selection of semester programs and topical workshops through Spring 2019.

The semester program selection process follows these steps:

1. Solicitation of Proposals

ICERM hosts two semester programs per year. Each has 5-10 organizers and typically incorporates three week-long associated workshops. Semester program proposers are asked to contact the ICERM Director to discuss program ideas prior to starting a pre-proposal.

Pre-Proposal Requirements

A 2-3-page document which describes the scientific goals, lists the organizers of the program, and identifies the key participants.

Pre-Proposal Target Deadline

All pre-proposals should be submitted to the ICERM Director. Target deadlines are early September and mid-April. The ICERM directors and a subcommittee of the Scientific Advisory Board SAB review all pre-proposals. Proposers receive feedback within a few weeks of their submission.

Semester Program Full Proposal Requirements

Full Proposals for semester programs consist of 6-10 pages containing:

- A description of the program area/theme written with a general mathematical audience in mind,
- A description of the central scientific challenges to be addressed by the program,
- A list of organizers normally around 5-10, most of whom will be in residence for the semester program,
- A list of 8-10 high priority senior scientists who are likely to visit ICERM as long-term participants for a month or more,
- An additional ranked list of up to 20 or more potential long-term participants the organizing committee feels will help form a critical mass for the scientific program,
- A main contact chair of organizing committee,
- A description of the three proposed workshops including potential organizers if possible,
- A discussion of the experimental and computational aspects of the program,
- Concrete plans for involving and mentoring graduate students, postdocs, and early-career mathematicians in the program tutorials at the beginning of the program and/or before workshops, weekly student/postdoc seminars, advising and other structured mentoring activities from the senior participants,
- An assigned organizer responsible for coordination of mentoring,
- Plans for ensuring the participation of underrepresented groups organizers are expected to work with ICERM directors on diversity issues.

Semester Program Full Proposal Deadline

All full proposals should be submitted to the ICERM Director. Target deadlines are October 1st and May 1st. The ICERM directors and the Scientific Advisory Board SAB review all proposals. Proposers receive feedback within a few weeks of their submission.

2. Proposal Selection

The Science Advisory Board SAB approves the semester programs. The deadline for proposals is at least a week prior to the annual November SAB meeting typically the end of the month. Proposals are usually sent out for review. Once a proposal is accepted, an ICERM Director and members of a SAB subcommittee are assigned to assist the organizers and the organizers are provided with a semester program planning timeline. The "high priority" list of senior scientists are contacted and invited to participate immediately upon approval of the program and this list by the SAB. Program dates are scheduled with details posted on the ICERM website and various on-line math organization calendars SIAM, AMS, European Mathematical Society, National Math Institutes, and Conference Service Mandl. Program and/or workshop ads are placed in appropriate publications if recommended by the organizers and directors. In addition, ICERM reserves some funds for applicants to the program.

From this point on, organizers are involved in making decisions on the following: ICERM postdoc selection; applications for long-term visitors, graduate students, and workshop participants; mentoring of students and postdocs an institute Director assists the organizers with mentor coordination. The Directors make the final decision on all invitations. `The chair of the organizing committee or other designated organizer assists ICERM staff by providing appropriate program images for web and print ads and may be asked to review marketing materials.

3. Selection of Long-term Visitors/Research Fellows

The organizers propose a ranked list of 15 to 20 research fellows. ICERM Directors approve and/or suggest additions or re-rankings in consultation with assigned SAB members. The standard model for long-term participation for senior faculty is through paid leaves such as sabbatical.

4. Offers to Research Fellows

Once the list of research fellows has been finalized and funding determined, an invitation is sent to each. The invitation describes the program and outlines the support to be provided. Using its Cube database, ICERM tracks demographic information about, and all interactions with, research fellows.

5. Semester Workshops

The semester program proposal should include a list of organizers for each of its three workshops. The organizers propose an initial ranked list of 20-25 possible speakers and a list of 10 alternates. The ICERM Directors approve and/or suggest additions or re-rankings in consultation with assigned SAB members. Formal invitations are sent by ICERM staff describing the program and outlining the support to be provided to those who indicate an interest.

The chair of each workshop's organizing committee or other designated organizer assists ICERM staff by providing appropriate program images for the workshop's web and print ads, and may be asked to review marketing materials.

6. Application Process

Once the organizers and Directors agree there is enough critical mass in terms of confirmed long-term visitors and/or workshop speakers, the on-line application for that particular program is opened on the ICERM website. All applications are stored in the institute's proprietary "Cube" database (see also the "Recruiting and Selection of ICERM-Funded Posdocs" later in this report). The ICERM postdoctoral fellow applicants who were not hired are either automatically entered into the online applicant pool, or they are alerted that these positions have closed and that they should apply online for partial support to attend if they are still interested.

7. Applicant Selection

ICERM's proprietary "Cube" database and visitor management system is where participants go to apply for our programs. Program organizers are regularly provided a list of applicants and copies of their supporting documents and are asked to recommend a ranking of applicants for their program. ICERM Directors review the ranked list, re-rank as appropriate and make the final selections, taking into consideration the remaining budget for the program, diversity, participant support requested, and whether or not the applicant if a young researcher has an advisor already participating in the program. ICERM staff then updates the applicant about their status, and any support they are eligible for, as appropriate.

Financial Decisions for Semester Programs

Financial decisions are made by ICERM Directors based on discussions with organizers. On average, the institute provides stipends for 5 postdoctoral fellows and 1 institute postdoctoral fellow each semester, with support for travel and shared housing for 12-15 graduate students per program. There is support for housing and travel for around 15-20 long-term visitors including organizers who stay for 4 months, and up to 60 additional shorter term visitors who stay for 1-4 weeks. In addition, there is support for workshop attendees. The institute has very limited funds for stipends and buyout of teaching for key participants. Some funds are reserved for support for applicants to the program. In general, ICERM will aim to help participants negotiate sabbatical leaves and teaching release from their departments to participate in institute programs.

Opening, "Middle" and Closing Events

Semester program opening and closing events are tailored to each program. Here are some examples of planned events during semester programs.

Opening event

Lasts about 1-2 days, beginning on first day of program and includes:

- 10-15 minute introductory presentations by the postdocs and grad students, designed to get everyone acquainted
- Opening reception on first day of program
- Talks related to upcoming workshops
- IT tutorial led by ICERM's IT staff

Weekly Seminar non-workshop weeks

- The weekly seminar includes talks by visitors in residence at ICERM. Program organizers are provided with names and dates to facilitate scheduling.

Mini-Series (Optional)

- Mini-courses or other multi-session events are encouraged.

Research Clusters (Optional)

A Research Cluster takes place during a semester program and is an independently organized research group activity in a focused subfield of that semester program.

A typical Research Cluster lasts at least 10 days, and as long as 4-6 weeks, and focuses on immediate progress on a major problem or on several problems of significance in the field of the program. In addition to the invited participants, interested faculty, postdocs or graduate students in residence at ICERM may participate in the research cluster.

The activity period begins with a collection of tutorials or a short possibly two-day workshop. The research activities, planned by the organizers, may consist of teamwork, daily/weekly seminars, and closing presentations. In collaboration with an ICERM director, Research Cluster organizers develop a list of 6-15 key scientists to form the core cohort of the cluster.

Prior to each of semester workshops

- Full-day tutorials the Thursday and Friday the week before each workshop.
- Tutorials are given by long term visitors to the program

During Semester Workshops

- Workshops last 1 week and usually consist of 50-minute talks with 10 minutes of Q&A.
- Sometimes one afternoon is left “open” for collaborations and small groups
- A poster session is scheduled early in the workshop week

- Non-workshop weeks
- Lectures occur through either mini courses, research seminars, special talks, and/or computational working group meetings
- Young Researcher Seminar, where graduate students and postdocs meet sans faculty and discuss scientific questions
- Postdocs and grad students are mentored throughout the program, both informally and with formal professional development seminars and meetings

Final Event

During the first week of the program a 1-day closing event is planned with input from the organizing committee. Some possible models include:

- Short talks from all long-term visitors who are still in residence
- Special Colloquium to close out the event on the last day of the program
- Time set aside for takeaways

- Closing reception

Note: Sample schedules and organizer timelines can be found in Appendix A.

2017-2018 Semester Programs

Fall 2017 Semester Program: Mathematical and Computational Challenges in Radar and Seismic Reconstruction

September 6, 2017- December 8, 2017

Organizing Committee:
Alexandre Aubry, ESPCI Paris Tech
Liliana Borcea, University of Michigan
Margaret Cheney, Colorado State University
Armin Doerry, Sandia National Laboratories
Vladimir Druskin, Schlumberger Doll Research
Albert Fannjiang, University of California at Davis
Alison Malcolm, Memorial University of Newfoundland
Eric Mokole, The MITRE Corporation (U.S. Naval Research Laboratory, ret.)
Frank Robey, MIT Lincoln Laboratory
Knut Solna, University of California at Irvine
Chrysoula Tsogka, University of Crete
Lexing Ying, Stanford University
Edmund Zelnio, Air Force Research Laboratory

Program Description:
Inversion and imaging with waves is of fundamental importance in both radar and seismic reconstruction. Mathematics provides the key technology in both areas and, despite differing in many important respects, they have much in common in their underlying mathematical frameworks, approaches, and challenges. This semester program will focus on advancing their common mathematical and computational methodologies, as well as selected subjects distinct to each area, in the context of new challenges and opportunities that have arisen in recent years. Both theory and applications will be of interest. Participants will be drawn from academia, industry, and governmental laboratories in order to broadly address theory, applications, and their synergy.

The program will be influenced by recent developments in wave propagation and imaging, data acquisition and analysis, and high-performance computing. Driven by the ongoing need for more realistic mathematical models and simulations, recent advances in wave propagation and imaging in complex media are increasingly convincing and competitive but present new challenges. New sensor technologies have led to new types of data that can be collected, as well as to unprecedented volumes of data. This wealth of data offers new potential for gaining

insights but also poses new needs for large-scale data-analysis algorithms that can effectively exploit advances in computing.

There is an outstanding opportunity to build on these developments and to bring the field to new levels of realistic inversion scenarios and problem scales. Topics to be considered in the semester program include wave propagation, inversion, and imaging in random media; statistical aspects of inverse problems, including homogenization and uncertainty quantification; optimization methods for inversion and imaging; large-scale computation and inverse problems, including methods for model reduction and large-scale optimization; and subjects of particular interest in radar reconstruction or in seismic inversion.

All Long-term Visitors to Fall 2017 Semester Program (10+ Days)

Name	Institute	Days@ICERM
Ricardo Alonso	Matemática PUC-Rio de Janeiro	13
Mario Bencomo	Rice University	286
Liliana Borcea	University of Michigan	83
Brian Borchers	New Mexico Institute of Mining and Technology	95
Julien Chaput	Colorado State University	87
Margaret Cheney	Colorado State University	96
Armin Doerry	Sandia National Laboratories	21
Vladimir Druskin	Schlumberger-Doll Research Center	88
Raluca Felea	Rochester Institute of Technology	13
Fernando G. Vasquez	Universite Grenoble Alpes	18
Santimoy Kundu	Indian Institute of Technology (ISM)	89
Wei Li	Louisiana State University	121
Alexander Mamonov	University of Houston	100
Shixu Meng	University of Michigan	123
Dimitrios Mitsoudis	Technological Educational Institute of Athens	21
Cliff Nolan	University of Limerick	107
Alexei Novikov	Penn State University	48
Symeon Papadimitropoulos	University of Crete	74
Oleg Poliannikov	Massachusetts Institute of Technology	93
Kui Ren	University of Texas at Austin	53
Herurisa Rusmanugroho	Memorial University of Newfoundland	15
Knut Solna	University of California at Irvine	31
Chrysoula Tsogka	University of California, Merced	91
Homer Walker	Worcester Polytechnic Institute	94
Alexey Yamilov	Missouri University of Science and Technology	27
Yang Yang	Michigan State University	74
Evren Yarman	Schlumberger Cambridge Research	58
Mikhail Zaslavsky	Schlumberger	90

Yimin Zhong	University of Texas at Austin	125
Jörn Zimmerling	TU Delft	77

Here follows a sample of the most substantive comments from our long-term visitors:
Some Long-term Visitor Comments for "Please describe how ICERM has (or has not) added to your knowledge of experimental/computational methodologies and/or theoretical developments within this topic.":

- *The workshops I attended were on one hand focused on specific problem of imaging and wave propagation but brought in the perspective of mathematicians and practitioners. This is very nice for effective interaction.*
- *My participation to ICERM has been very beneficial. Both experimental/computational and theoretical aspects of the topic were well represented. I really appreciated the presence of "practitioners" who by dealing with the real-world problems can help us mathematicians in identifying new challenges to work on.*
- *I came from applied math/geophysical imaging background. Here I learned random media aspect of imaging and radar imaging, in particular SAR technology.*
- *ICERM has exposed me to computational methodologies and theoretical developments outside of my area of expertise through the many technical talks given throughout the program and the conversations with other experts. I am currently pursuing reference material suggested by ICERM participants to further my knowledge.*
- *It was a bit hit and miss in terms of the physics. I learned a fair amount from some of the speakers, especially from the labs, with regard to current problems in radar. I learned much less in terms of methodology, and in general I felt that the techniques were either too hypothetical for real world applications or conversely too experimental with no development.*
- *The talks given by experimentalists were very instructive for me. The discussions were useful. I could start a new collaboration on a recent experiment reported during the conference. Although it is not possible to predict the output of this collaboration, I am very happy of this outcome.*
- *Participation in the semester program helped me to develop a broader understanding of current research in inverse scattering problems, particularly in recent developments in full waveform inversion and numerical methods for efficient forward modeling in support of FWI. I was also able to learn about recent developments in seismic interferometry.*
- *I learned more in depth about concepts I briefly heard on conferences before. The length of the lectures really helps in understanding the concepts more detailed.*
- *Having more computational people around has encouraged me to do more computation. I have not done it yet but hope to do so. The opportunity to meet new people, or people that I was not that familiar before has opened up potential new projects, which was one of the main things I wished to achieve here. So, this has been very helpful.*

Some Long-term Visitor Comments for "Briefly describe program highlights":

- *My highlight of this program was the one-day workshop on application of model reduction to inverse scattering. It was truly interdisciplinary workshop, that brought*

leading academic researchers in computational and theoretical PDEs, computational linear algebra, electrical engineering, and geophysicists from oil industry working on that topic. It resulted in very engaging, truly multidisciplinary discussions that hopefully will come to some fruition in the future.

- *For me the most interesting aspect of the program was in the comparison of inverse scattering problems in different areas of application- what at first seem to be very similar problem are turning out to have unique aspects that can make it quite difficult to transfer ideas between the different application domains but that also highlight the more important fundamental ideas.*
- *Good mix of fundamental science and applied research. Wide scope.*
- *I had chance to talk to peers extensively, for more than an hour per day on average. After workshop talks, we exchange questions and browse papers together. This greatly helped my understanding of this area. I also talked to about 3 faculty visitors a lot. It's so much easier to communicate talking face to face.*
- *Integration of different communities with different ways of communications, of thinking and of working.*
- *Many wonderful presentations, the ability to communicate with the people in the same research are, a great support by ICERM staff*
- *Networking, feedback on my talk with new directions to look into.*
- *The highlight for me was getting to know other experts in various (perhaps adjacent) fields through the course of the program. Having almost the entire semester to interact with people, both in professional and more casual settings, has personally made it easier to establish a more genuine connection that will yield perhaps collaborations in the near future. If anything, ICERM has been a great place for me to jumpstart my professional network.*
- *The workshops were very informative and brought researchers that are leaders in the field. These were very generous in terms of sharing their knowledge and some of them gave many tutorial lectures.*

Research Cluster 1: Wave Propagation and Imaging in Random Media

September 6, 2017- October 13, 2017

Organizing Committee:
Alexandre Aubry, ESPCI Paris Tech
Liliana Borcea, University of Michigan
Albert Fannjiang, University of California at Davis
Knut Solna, University of California at Irvine
Chrysoula Tsogka, University of Crete

Program Description:
Wave propagation and imaging in complex environments is an important topic in applied mathematics with a wide range of applications, including not only radar and seismic reconstruction but also many others, such as laser beam propagation through clouds, light

propagation through the atmosphere in astronomy, secure communications in scattering media, medical imaging, and nondestructive evaluation of materials. This cluster will involve contemporary topics on waves in random media. Recent progress in this area has been motivated on the one hand by a range of applications that involve partly or fully incoherent waves, such as time reversal, active-array imaging, passive imaging and hybrid imaging, and on the other hand by advances in sensor technology that have brought new and massive amounts of data.

Mathematically, the problem of waves in random media may be placed in a stochastic framework, where the complex environments are realizations of random fields and the scattering regimes are determined by important physical scales, such as the wavelength, the distance of propagation, and the scale of the fluctuations. The theory for waves in random media is concerned in particular with describing the statistics of the wave field in a concise manner. It is fundamental to applications in imaging through complex environments.

This cluster brings together scientists with expertise in stochastic analysis and theoretical, numerical, and experimental wave propagation and imaging, random matrix theory, and compressed sensing with the goal of exchanging ideas and advancing the field. The main topics of interest are:

- Theoretical and numerical studies of wave propagation in random media in a variety of scattering regimes and setups.
- Inverse source problems and inverse scattering problems in random media.
- Imaging with distributed and opportunistic noise sources.
- Applications of random matrix theory for improved detection and imaging in strong random media.
- Imaging of sparse scenes and connections to compressed sensing.
- Time dependent problems, where the medium or the scatterers to be imaged are in unknown motion.

Participant List Research Cluster 1

Name	**Institute**
Ricardo Alonso	Matemática PUC-Rio de Janeiro
Mario Bencomo	Rice University
Liliana Borcea	University of Michigan
Brian Borchers	New Mexico Institute of Mining and Technology
Julien Chaput	Colorado State University
Margaret Cheney	Colorado State University
Laurent Demanet	MIT
Armin Doerry	Sandia National Laboratories
Vladimir Druskin	Schlumberger-Doll Research Center
Josselin Garnier	Ecole Polytechnique
Christophe Gomez	Aix-Marseille University
Fernando G. Vasquez	Universite Grenoble Alpes

Santimoy Kundu	Indian Institute of Technology (ISM), Dhanbad
Wei Li	Louisiana State University
Alison Malcolm	Memorial University of Newfoundland
Alexander Mamonov	University of Houston
Shixu Meng	University of Michigan
Cliff Nolan	University of Limerick
Alexei Novikov	Penn State University
Olivier Pinaud	Colorado State University
Kui Ren	University of Texas at Austin
Sergey Skipetrov	Centre National de la Recherche Scientifique (CNRS)
Knut Solna	University of California at Irvine
Chrysoula Tsogka	University of California, Merced
Alexey Yamilov	Missouri University of Science and Technology
Yang Yang	Michigan State University
Evren Yarman	Schlumberger Cambridge Research
Mikhail Zaslavsky	Schlumberger
Yimin Zhong	University of Texas at Austin
Jörn Zimmerling	TU Delft

Workshop 1: Industrial Problems in Radar and Seismic Reconstruction

September 11, 2017-September 13, 2017

Organizing Committee:
Liliana Borcea, University of Michigan
Margaret Cheney, Colorado State University
Armin Doerry, Sandia National Laboratories
Vladimir Druskin, Schlumberger Doll Research
Frank Robey, MIT Lincoln Laboratory
Burt Tilley, WPI
Suzanne Weekes, WPI

Program Description:
In radar and seismic reconstruction, as in other areas of applied mathematics, interactions between academic and non-academic researchers create synergies that are vital to advancing both theory and applications. The purpose of this three-day workshop is to enrich the semester program through such interactions. It is expected that most participants will be drawn from the semester program; however, others are also welcome to participate. Applications from graduate students, postdocs, and other early-career investigators are especially encouraged.

Each of the first two days of the workshop will begin with background talks, after which experts from industrial and governmental laboratories will present "real-world" problems to workshop participants. The participants will then brainstorm possible approaches to the problems under

the guidance of the experts. On the third day, designated participants will present summaries of the proposed approaches and their potential advantages and disadvantages.

Workshop participants will not be expected to solve the problems during the workshop. Hopefully, though, the discussions will provide motivation for developments later in the program and perhaps stimulate research during the semester and beyond.

Participant List Workshop 1

Name	**Institute**
Mario Bencomo	Rice University
Liliana Borcea*	University of Michigan
Brian Borchers	New Mexico Institute of Mining and Technology
Christopher Bresten	University of Massachusetts Dartmouth
Hui Cao	Yale University
Julien Chaput	Colorado State University
Margaret Cheney*	Colorado State University
Armin Doerry*	Sandia National Laboratories
Vladimir Druskin	Schlumberger-Doll Research Center
Joseph Gaone	Worcester Polytechnic Institute
Josselin Garnier	Ecole Polytechnique
Mikhail Gilman	North Carolina State University
Zachary Grant	University of Massachusetts Dartmouth
Murthy Guddati	North Carolina State University
Alfa Heryudono	University of Massachusetts, Dartmouth
Derek Kane	DEKA Research and Development
Santimoy Kundu	Indian Institute of Technology (ISM), Dhanbad
Wei Li	Louisiana State University
Alison Malcolm*	Memorial University of Newfoundland
Alexander Mamonov	University of Houston
Shixu Meng	University of Michigan
Shari Moskow	Drexel University
Cliff Nolan	University of Limerick
Konstantin Osypov*	Chevron
Paris Perdikaris	Massachusetts Institute of Technology
Oleg Poliannikov	Massachusetts Institute of Technology
Maziar Raissi	Brown University
Kui Ren	University of Texas at Austin
Daniel Renzi	Weill Cornell Medical College in Qatar
Frank Robey*	MIT
Knut Solna	University of California at Irvine
Burt Tilley	Worcester Polytechnic Institute
Chrysoula Tsogka	University of California, Merced

Semyon Tsynkov	North Carolina State University
Denes Vigh*	Schlumberger
Homer Walker	Worcester Polytechnic Institute
Suzanne Weekes	Worcester Polytechnic Institute
Alexey Yamilov	Missouri University of Science and Technology
Yang Yang	Michigan State University
Mikhail Zaslavsky	Schlumberger
Edmund Zelnio*	Air Force Research Laboratory
Smaine Zeroug*	Schlumberger Research
Yimin Zhong	University of Texas at Austin

*Workshop speaker

Some Workshop Participant Comments for "Please describe how ICERM has (or has not) added to your knowledge of experimental/computational methodologies and/or theoretical developments within this topic.":

- *ICERM essentially forces you outside of your comfort zone, but within the reach of understanding. It's quite lovely, really.*
- *The intro talks on radar and seismic were fantastic.*
- *I now have a better understanding of the problems, practices, and techniques used by the seismic imaging community. I expect this to generate promising ideas for solving radar-related problems.*
- *The workshop afforded participants in the semester program an opportunity to hear about "real-world" radar and seismic problems from non-academic experts. The range of problems presented was very impressive and exceeded expectations. The afternoon breakout sessions provided excellent opportunities to learn about the problems in more depth and to explore the feasibility of different approaches.*
- *I better understood scope of unsolved problems for radar and seismic imaging, and the most important found connection of this problems to mu current research in reduced order modeling. That will guide my work during semester and define my collaboration. Really great start!*
- *By having practitioners speak and then host questions in the breakout sessions, this allowed me to clarify where my theoretical focus should be directed. The fact that the problem presenters were willing to keep in contact seems as though it will be very useful.*
- *The introductory lectures were helpful in getting a broad overview of recent progress on mathematical methods in radar and seismic imaging. The introductory talk by Allison Malcolm on seismic inversion/migration was particularly good.*

Some Workshop Participant Comments for "Briefly describe workshop highlights":

- *Simply being immersed in completely different areas of research that can potentially overlap with my own.*
- *Compared to large conferences with intense schedules, this event gives many more opportunities for interactions and discussions.*
- *The discussions and discussing ideas with the postdocs.*

- *Have a viewing portal into formerly mysterious processing techniques.*
- *Hearing about possible applications of machine learning to seismic and perhaps radar applications.*
- *Talks of Denes Vight and Ed Zelnio, that highlited a common problem in seismic and radars, that is suppression of multiple scattering effects.*
- *I found the introductory talks to be more useful than the specific problems that we considered.*
- *Having access and Interacting with top notch researchers from different but related fields.*
- *The introductory talks providing an overview of radar and seismology were very valuable.*

Workshop 2: Waves and Imaging in Random Media

September 25, 2017- September 29, 2017

Organizing Committee:
Josselin Garnier, University Paris Diderot
Kui Ren, University of Texas - Austin
Chrysoula Tsogka, University of Crete

Program Description:
Wave propagation and imaging in complex media is an interdisciplinary area in applied mathematics, with roots in hyperbolic partial differential equations, probability theory, statistics, optimization, and numerical analysis. It has a wide range of applications, including not only radar and seismic reconstruction but also many others, such as laser beam propagation through clouds, light propagation through the atmosphere in astronomy, secure communications in scattering media, medical imaging, and nondestructive testing of materials.

This workshop will present some of the latest advances in this area including wave propagation with time-dependent perturbations, source and reflector imaging in random media with sensor arrays, applications of random matrix theory for detection and imaging, imaging with cross correlation techniques, imaging with opportunistic or noise sources, applications of compressed sensing for imaging of sparse scenes, super-resolution in imaging, waves in novel media, e.g. metamaterials...

Participant List Workshop 2

Name	**Institute**
Ricardo Alonso*	Matemática PUC-Rio de Janeiro
Guillaume Bal*	University of Chicago
Aniceto Belmonte*	Polytechnic University of Catalonia, Spain
Mario Bencomo	Rice University
Nicholas Bender	Yale University
Liliana Borcea*	University of Michigan

Brian Borchers	New Mexico Institute of Mining and Technology
Michel Campillo*	Université Joseph Fourier
Remi Carminati*	ESPCI Paris
Julien Chaput	Colorado State University
Zhiming Chen*	Chinese Academy of Sciences, China
Margaret Cheney	Colorado State University
Laurent Demanet	MIT
Vladimir Druskin	Schlumberger-Doll Research Center
Tegan Emerson	Naval Research Laboratory
Mathias Fink*	ESPCI, France
Jason Fleischer*	Princeton University
Sonia Fliss*	ENSTA, France
Josselin Garnier	Ecole Polytechnique
Nathan Gibson	Oregon State University
Christophe Gomez*	Aix-Marseille University
Fernando G. Vasquez*	Universite Grenoble Alpes
Eric Hernandez	University of Vermont
Roarke Horstmeyer*	Charite Medical School in Berlin, Germany
Chia Wei Hsu	Yale University
Estapraq Kahlil	Langston University
Derek Kane	DEKA Research and Development
Arnold Kim	UC Merced
Jichun Li	University of Nevada Las Vegas
Wei Li	Louisiana State University
Wenjing Liao*	Georgia Institute of Technology
Alexander Mamonov	University of Houston
China Mauck	University of Utah
Shixu Meng	University of Michigan
Dimitrios Mitsoudis	Technological Educational Institute of Athens
Miguel Moscoso*	Universidad Carlos III de Madrid, Spain
Cliff Nolan	University of Limerick
Alexei Novikov	Penn State University
Ricardo Pablo Pedro	MIT
Symeon Papadimitropoulos	University of Crete
George Papanicolaou*	Stanford University
Owen Pembery	University of Bath
Olivier Pinaud*	Colorado State University
Oleg Poliannikov	Massachusetts Institute of Technology
Kui Ren	University of Texas at Austin
John Schotland*	University of Michigan
Jon Sjogren	Towson University
Sergey Skipetrov*	Centre National de la Recherche Scientifique (CNRS)

Knut Solna	University of California at Irvine
Chrysoula Tsogka	University of California, Merced
Homer Walker	Worcester Polytechnic Institute
Michael Weinstein*	Columbia University
Alexey Yamilov	Missouri University of Science and Technology
Evren Yarman	Schlumberger Cambridge Research
Hasan Yilmaz	Yale University
Mikhail Zaslavsky	Schlumberger
Hongkai Zhao	UC Irvine
Yimin Zhong	University of Texas at Austin
Jörn Zimmerling	TU Delft

*Workshop speaker

Some Workshop Participant Comments for "Please describe how ICERM has (or has not) added to your knowledge of experimental/computational methodologies and/or theoretical developments within this topic.":

- *There was a good balance between theory and experiments/numerics since there were speakers that were focusing on both.*
- *This exposed me to several new ideas in imaging for tissue, and in thinking about how to characterize light within tissue. There are a number of ideas which I hope to prototype myself or pursue collaboration with the presenters.*
- *The workshop exposed me to a broad range of approaches to waves and imaging in random media outside of my own approaches, and thus has added to my knowledge of all aspects of this topic.*
- *I learned quite a lot about the modeling of random media and challenges remained. The talk on imaging in Radar brings in new idea for me to look at my problems in the reverse time migration methods.*
- *Most of the talks (by mathematicians and physicists) were very well prepared and opened very interesting discussions and paved the way for collaborations.*
- *All the participants came from different area of the field (theoretical/applied/experimental), which can cause communication problem. Nevertheless, the open mindedness of the participants overcomes this issue.*

Some Workshop Participant Comments for "Briefly describe workshop highlights":

- *Very well prepared and clear talks. A mixture of mathematical developments and experimental works. I learned about new problems in imaging of which I was not aware previously (imaging of satellites and of laser beams in the atmosphere).*
- *I really liked several of the talks. I like the long format of each talk (45 min. to 1 hour), as well as the ample time between to discuss with others, ask questions and take a break and think*
- *I am not exactly in the field, but learned a lot and found connection with what I am doing*

- *I gained a great deal of insight into the problems from the presentations of Mathias Fink, Jason Fleishcer and Roarke Horstmeyer.*
- *The opportunity to talk with physicists and to present my work to them*
- *Being able to present my work (in poster form) to those working in the field and receiving interest in my work and helpful comments and observations on how to improve and advance it.*
- *The workshop brings me the knowledge about the modeling of random media which motivates me to study the related problems in imaging algorithms.*
- *Catching up on work of Prof. Papanicoloau (again personalizing the scientific endeavor!), learning about the TQFT aspects of insulators, and hearing about research in radar from Prof. M Cheney and her colleague.*
- *Presentation of recent and original problems and point of views on waves in complex media (continuous recording in seismology, wave front shaping in optics, ...).*

Research Cluster 2: Mathematical and Computational Aspects of Radar Imaging

October 2, 2017-November 3, 2017

Organizing Committee:
Margaret Cheney, Colorado State University
Armin Doerry, Sandia National Laboratories
Eric Mokole, The MITRE Corporation (U.S. Naval Research Laboratory, ret.)
Frank Robey, MIT Lincoln Laboratory
Ed Zelnio, Air Force Research Laboratory

Program Description:
Radar imaging is a highly developed field that involves a rich variety of mathematical and computational areas, such as electromagnetic theory and partial differential equations, functional analysis, harmonic analysis, coding theory, Lie groups, and statistical signal processing. Still, many challenges remain. For example, more of the physics needs to be incorporated into solutions to the radar inverse problem, including physical scattering mechanisms, multiple scattering, moving objects, and corrections for propagation through random or complex media.

Recent hardware developments make it possible to collect an unprecedented amount of data, sampled at extremely high rates and often including polarimetry, and mathematical techniques are needed for fast, accurate image formation and interpretation of this data. Seismology is faced with many similar mathematical problems; this program provides an opportunity for synergistic development of both fields.

This cluster will bring together laboratory scientists and academic researchers with the overarching goal of advancing the field of radar imaging. Particular attention will be paid to

exploring mathematical commonalities between radar and seismic imaging and to possibilities for applying seismic imaging techniques to radar imaging. Specific topics of interest include:

- Statistical methods, including detection theory.
- Imaging moving targets, including moving targets such as wind turbines.
- Imaging extended targets, particularly those with direction-dependent and polarization-dependent reflectivities.
- Imaging under conditions of multiple scattering, including within the target, within the environment, and between both.
- Extraction of information from radar data & radar images, including identification of objects, terrain, and material properties, and identification of activity.
- Waveform design, and application of seismic techniques in the radar context.

Participant List Research Cluster 2

Name	**Institute**
Ricardo Alonso	Matemática PUC-Rio de Janeiro
Mario Bencomo	Rice University
Liliana Borcea	University of Michigan
Brian Borchers	New Mexico Institute of Mining and Technology
Julien Chaput	Colorado State University
Margaret Cheney	Colorado State University
Laurent Demanet	MIT
Armin Doerry	Sandia National Laboratories
Vladimir Druskin	Schlumberger-Doll Research Center
Raluca Felea	Rochester Institute of Technology
Fernando G. Vasquez	Universite Grenoble Alpes
Felix Herrmann	Georgia Tech
Julie Jackson	Air Force Institute of Technology
Santimoy Kundu	Indian Institute of Technology (ISM), Dhanbad
Wei Li	Louisiana State University
Alexander Mamonov	University of Houston
Shixu Meng	University of Michigan
Eric Mokole	The MITRE Corporation (U.S. Naval Research Laboratory, ret.)
Cliff Nolan	University of Limerick
Alexei Novikov	Penn State University
Kui Ren	University of Texas at Austin
Frank Robey	MIT
Knut Solna	University of California at Irvine
Chrysoula Tsogka	University of California, Merced
Semyon Tsynkov	North Carolina State University
Alexey Yamilov	Missouri University of Science and Technology
Yang Yang	Michigan State University

Evren Yarman	Schlumberger Cambridge Research
Mikhail Zaslavsky	Schlumberger
Edmund Zelnio	Air Force Research Laboratory
Yimin Zhong	University of Texas at Austin
Jörn Zimmerling	TU Delft

Workshop 3: Mathematical and Computational Aspects of Radar Imaging

October 16, 2017- October 20, 2017

Organizing Committee:
Margaret Cheney, Colorado State University
Armin Doerry, Sandia National Laboratories
Eric Mokole, The MITRE Corporation (U.S. Naval Research Laboratory, ret.)
Frank Robey, MIT Lincoln Laboratory

Program Description:
This workshop will bring together mathematicians and radar practitioners to address a variety of issues at the forefront of mathematical and computational research in radar imaging. Some of the topics planned include shadow analysis and exploitation, interferometry, polarimetry, micro-Doppler analysis, through-the-wall imaging, noise radar, compressive sensing, inverse synthetic-aperture radar, moving target identification, quantum radar, multi-sensor radar systems, waveform design, synthetic-aperture radiometry, passive sensing, tracking, automatic target recognition, over-the-horizon radar, ground-penetrating radar, and Fourier integral operators in radar imaging.

Participant List Workshop 3

Name	**Institute**
Mario Bencomo	Rice University
Shannon Blunt	University of Kansas
Liliana Borcea	University of Michigan
Brian Borchers	New Mexico Institute of Mining and Technology
Julien Chaput	Colorado State University
Yanlai Chen	University of Massachusetts, Dartmouth
Margaret Cheney	Colorado State University
Victor Churchill	Dartmouth College
Anthea Coster*	MIT Haystack Observatory
David Crouse*	Naval Research Laboratory
Laurent Demanet*	MIT
Armin Doerry*	Sandia National Laboratories
Oliver Dorn*	The University of Manchester
Vladimir Druskin	Schlumberger-Doll Research Center

Raluca Felea*	Rochester Institute of Technology
Matt Ferrara	Matrix Research
Anne Gelb	Dartmouth College
Mikhail Gilman	North Carolina State University
John Gray*	Naval Surface Warfare Center Dahlgren
Allan Greenleaf*	University of Rochester
Andrew Homan	Matrix Research
Julie Jackson*	Air Force Institute of Technology
Donghwan Kim	Dartmouth College
Marco Lanzagorta*	Naval Research Laboratory
Wei Li	Louisiana State University
Alexander Mamonov	University of Houston
Jodi Mead	Boise State University
F. Patricia Medina	Worcester Polytechnic Institute
Shixu Meng	University of Michigan
Mahta Moghaddam*	University of Southern California
Eric Mokole	The MITRE Corporation
Kaitlyn Muller	Villanova University
Arje Nachman	Air Force Office of Scientific Research
Ram Narayanan	The Pennsylvania State University
Cliff Nolan*	University of Limerick
Alexei Novikov	Penn State University
Minah Oh	James Madison University
Daniel Onofrei	University of Houston
Symeon Papadimitropoulos	University of Crete
Laura Petto	Dartmouth College
Christian Pichot*	Universite Cote d'Azur, CNRS
Thomas Pizzillo	Navy Research Laboratory
Oleg Poliannikov	Massachusetts Institute of Technology
Eric Quinto	Tufts University
Raghu Raj*	U.S. Naval Research Laboratory
Ann Raynal*	Sandia National Laboratories
Kui Ren	University of Texas at Austin
Brian Rigling	Wright State University
Robert Riley	Sandia National Laboratories
Frank Robey*	MIT
Tapan Sarkar*	Syracuse University
Theresa Scarnati	Arizona State University
John Schotland	University of Michigan
Jacob Shapiro	Purdue University
Plamen Stefanov	Purdue University
David Tahmoush*	Naval Research Laboratory

Chrysoula Tsogka	University of California, Merced
Semyon Tsynkov*	North Carolina State University
Homer Walker	Worcester Polytechnic Institute
Francis Watson	Defence Science and Technology Laboratory
Derek West*	Sandia National Laboratory
Evren Yarman	Schlumberger Cambridge Research
Wei-Hsuan Yu	ICERM
Mikhail Zaslavsky	Schlumberger
Edmund Zelnio*	Air Force Research Laboratory
Yimin Zhong	University of Texas at Austin
Jörn Zimmerling	TU Delft

*Workshop speaker

Some Workshop Participant Comments for "Please describe how ICERM has (or has not) added to your knowledge of experimental/computational methodologies and/or theoretical developments within this topic.":

- *The scope and format of this workshop were excellent. I am extremely satisfied with the output of this workshop: extension of my network, scientific discussions, adding scientific knowledge in methods, other fields and applications of radar imaging. The format of having 50 scientists in one session room is excellent.*
- *This workshop topic is not traditionally studied by mathematicians (despite being very rich from a mathematical point of view), so the key was bringing in practicing radar engineers, many from laboratories, to give the talks.*
- *I'm a beginner in this field, and the talks were of quite varied levels, which was very helpful to me. This allowed participants of varying levels of background to learn.*
- *Certainly, venues like ICERM are a good step toward enabling interdisciplinary awareness and interactions. However, I do wish that there were more concrete follow-on problems or actions to bridge the gap between theory and application coming out of the workshop.*
- *As a radar engineer, I was pleased to learn techniques from the seismic community that seem to be relevant to my own work.*
- *This workshop had a strongly applied tilt. It would have been nice to have a clearer picture of what the practitioners want or need from more theoretical researchers.*
- *I had a stimulating conversation with an engineer at the conference about practical issues related to some math I have studied and this was inspiring to my future research and I hope we are able to work together.*

Some Workshop Participant Comments for "Briefly describe workshop highlights":

- *Oliver Dorn from University of Manchester gave a very interesting talk. I was able to have scientific conversations with him -Ed Zelnio's talk. He posed a specific classification problem and possible data set. -Armin Doerry's tutorial(s) was a very nice exposition for experts and non-experts. -Julie Jackson's talk. -Derek West gave another classification problem that I may be able to solve. I am excited to see if he provides data after his*

paper is published. -The panel discussion was excellent. -The music-geometry talk on Wednesday (?) evening was excellent and relaxing.

- *The panel session towards the end of the week was the clear highlight, though this only worked well because it was on the back of the variety of talks which came before it.*
- *Interaction with experts on Fourier integral operator calculus.*
- *discussions sparked after my presentation*
- *Definitely collaborating with people on my research! Bouncing ideas off them and discussing math in person is always much more productive than over email or on skype.*
- *In general, the tutorial nature of this workshop was a very nice way to grasp difficult concepts, but the interactions and networking relationships will perhaps be the longer lasting outcome for me. I commend Brown for having the vision to establish ICERM workshops, having extraordinary facilities to allow for such events, and the helpful staff and organizers who no doubt spent great effort in making the workshop happen flawlessly.*
- *I thoroughly enjoyed the discussions that were prompted by the various presentations.*
- *Getting to interact with colleagues in my general areas of research, making new contacts, generating new ideas, and sharing my own research with others.*
- *The tutorials on the basics of radar (SAR in particular) gave a very clear summary of the state of the art (or at least what can be publicly discussed). The talk on microwave imaging of the brain was somewhat off-topic for the workshop but of great interest to me.*
- *I had a stimulating conversation with an engineer (Julie Jackson) at the conference about practical issues related to some math I have studied and this was inspiring to my future research and I hope we are able to work together. I enjoyed seeing friends and colleagues and catching up mathematically. Margaret Cheney did a great job organizing it and making sure people gave talks suitable for the diverse audience.*
- *Laurent Demanet's presentation was the highlight of the workshop for me because it introduced me to the significant potential advantages of interferometric approaches to inverse scattering problems.*

Research Cluster 3: Wave Propagation and Inversion in Seismic Applications

October 23, 2017-November 21, 2017

Organizing Committee:
Vladimir Druskin, Schlumberger Doll Research
Alison Malcolm, Memorial University of Newfoundland
Lexing Ying, Stanford University

Program Description:
Seismic inversion is the process of transforming seismic data generated by active or passive sources into a quantitative description of the subsurface properties of the earth. It addresses important problems related to our energy needs, to hazards such as earthquakes and volcanic

eruptions, and to the general study of Earth's interior on a planetary scale. It draws extensively from the mathematical sciences by applying tools from signal processing, elastic and electromagnetic theory, partial differential equations, harmonic analysis, inverse-problem theory, numerical analysis, optimization, and statistics.

The sheer volume of seismic data also makes it arguably the oldest area with "big data." Theoretical and engineering developments have advanced this field tremendously in the past several decades; however, there remain many fundamental open questions, ranging from uniqueness and uncertainty through the nonlinear nature of these problems.

This cluster will bring together academic and industrial researchers with the goal of addressing some of the key challenges in the analysis of inverse problems, with emphasis on reconstruction, big data and fast algorithms. Thematic topics include:

- Fast and massively parallel algorithms for the propagation and scattering of seismic waves, direct and iterative solvers and preconditioners, source dynamics.
- Stability analysis of seismic inverse problems and optimization, referred to as full waveform inversion in exploration seismology.
- Numerical techniques cutting across direct and inverse problems: multiscale and spectral finite elements, regularization, numerical homogenization, reduced-order model methods, multiscale time stepping, hybrid methods combining high frequency asymptotics with standard numerical discretization.
- Direct inverse methods in time-harmonic, time-dependent, and reduced-order model formulations.
- Data filtering and reduction for imaging a particular target (partial data analysis, redundancy), learning.

Participant List Research Cluster 3

Name	**Institute**
Mario Bencomo	Rice University
Liliana Borcea	University of Michigan
Brian Borchers	New Mexico Institute of Mining and Technology
Julien Chaput	Colorado State University
Margaret Cheney	Colorado State University
Laurent Demanet	MIT
Armin Doerry	Sandia National Laboratories
Vladimir Druskin	Schlumberger-Doll Research Center
Felix Herrmann	Georgia Tech
Santimoy Kundu	Indian Institute of Technology (ISM), Dhanbad
Wei Li	Louisiana State University
Alison Malcolm	Memorial University of Newfoundland
Alexander Mamonov	University of Houston
Shixu Meng	University of Michigan
Cliff Nolan	University of Limerick

Alexei Novikov	Penn State University
Kui Ren	University of Texas at Austin
Johan Robertsson	ETH Zurich
Chrysoula Tsogka	University of California, Merced
Yang Yang	Michigan State University
Evren Yarman	Schlumberger Cambridge Research
Lexing Ying	Stanford University
Mikhail Zaslavsky	Schlumberger
Yimin Zhong	University of Texas at Austin
Jörn Zimmerling	TU Delft

Workshop 4: Advances in model reduction for large-scale forward and inverse scattering problems

November 3, 2017 (one day only)

Organizing Committee:
Liliana Borcea, University of Michigan
Alexander Mamonov, University of Houston
Shari Moskow, Drexel University
Mikhail Zaslavsky, Schlumberger Doll Research

Program Description:
Model order reduction is a wide topic in computational mathematics that is generally used to approximate the response of complex systems. A recent development in this field is concerned with using reduced order models for solving efficiently and accurately inverse problems for partial differential equations. Such reduced order models are called data driven, because they are constructed from data interpolation conditions. Moreover, they are designed to respect the physics of the problem, such as loss of resolution away from the surface of measurements in diffusive inverse problems and causality conditions in inverse problems for the wave equation. This workshop will be focused on this novel approach to inversion, with particular emphasis on applications to inverse scattering problems arising in seismic imaging. The workshop will also celebrate the work of Dr. Vladimir Druskin, who has been making outstanding contributions to this field.

Participant List Workshop 4

Name	**Institute**
Mario Bencomo	Rice University
Liliana Borcea	University of Michigan
Brian Borchers	New Mexico Institute of Mining and Technology
Christopher Bresten	University of Massachusetts Dartmouth
Margaret Cheney	Colorado State University
Vladimir Druskin	Schlumberger-Doll Research Center

Maurizio Falcone	Sapienza Università di Roma
Dominic Gastaldo	UMass Dartmouth
Tom Hagstrom*	Southern Methodist University
Ivars Kirsteins	NUWC
Robert Kohn	Courant Institute of Mathematical Sciences NYU
Wei Li	Louisiana State University
Alexander Mamonov	University of Houston
Shixu Meng	University of Michigan
Shari Moskow*	Drexel University
Cyrill Muratov	New Jersey Institute of Technology
Cliff Nolan	University of Limerick
Alexei Novikov	Penn State University
Dzevat Omeragic*	Schlumberger Limited
Symeon Papadimitropoulos	University of Crete
Lothar Reichel*	Kent State University
Rob Remis*	TU Delft
Kui Ren	University of Texas at Austin
Herurisa Rusmanugroho	Memorial University of Newfoundland
Valeria Simoncini*	Università di Bologna
Chrysoula Tsogka	University of California, Merced
Homer Walker	Worcester Polytechnic Institute
Mikhail Zaslavsky	Schlumberger
Yimin Zhong	University of Texas at Austin
Jörn Zimmerling	TU Delft

*Workshop speaker

Workshop 5: Recent Advances in Seismic Modeling and Inversion: From Analysis to Applications

November 6, 2017-November 10, 2017

Organizing Committee:

Maarten de Hoop, Rice University
Vladimir Druskin, Schlumberger Doll Research
Alison Malcolm, Memorial University of Newfoundland
Alexander Mamonov, University of Houston
Lexing Ying, Stanford University

Program Description:

This workshop will bring together academic and industrial researchers with the goal of addressing some of the key challenges in the analysis of seismic inverse problems, with emphases on reconstruction, big data and fast algorithms. We aim to facilitate interactions among scientists addressing all aspects of these problems, from analysts addressing such questions as stability and uniqueness through geophysicists developing new acquisition systems

and applying cutting-edge ideas to field data sets. The workshop will place particular emphasis on fast algorithms that address the unique big-data requirements of seismic imaging from the reservoir to whole-Earth scale.

Specific topics will include analysis of seismic inverse problems leading to reconstruction (iterative or direct) from finite data; emerging acquisition technologies; uncertainty quantification; big-data simulation; inversion and model reduction, including compressed sensing; fast solvers in frequency and time; anisotropy; and applications at a variety of scales.

Participant List Workshop 5

Name	**Institute**
Mark Asch	Université de Picardie Jules Verne
Mario Bencomo	Rice University
Elena Beretta*	Politecnico of Milan
Liliana Borcea	University of Michigan
Brian Borchers	New Mexico Institute of Mining and Technology
Christopher Bresten	University of Massachusetts Dartmouth
Margaret Cheney	Colorado State University
Jorio Cocola	Rice University
Maarten de Hoop	Rice University
Laurent Demanet*	MIT
Vladimir Druskin	Schlumberger-Doll Research Center
Bjorn Engquist	UT Austin
Romina Gaburro	University of Limerick
Murthy Guddati*	North Carolina State University
Stefan Guettel*	The University of Manchester
Fernando G. Vasquez*	Universite Grenoble Alpes
Tom Hagstrom*	Southern Methodist University
Felix Herrmann*	Georgia Tech
Heiner Igel*	Ludwig-Maximilians-UniversitV§t MvºnchenMvºnchen
Muhammad Izzatullah	King Abdullah University of Science and Technology
Jiahua Jiang	University of Massachusetts Dartmouth
Misha Kilmer*	Tufts University
Matti Lassas*	University of Helsinki
Wei Li	Louisiana State University
Vadim Lisitsa*	Trofimuk Institute of Petroleum Geology and Geophysics
Alison Malcolm	Memorial University of Newfoundland
Alexander Mamonov*	University of Houston
Shixu Meng	University of Michigan
Susan Minkoff*	University of Texas at Dallas
Cliff Nolan	University of Limerick
Alexei Novikov	Penn State University

Lauri Oksanen*	University College London
Symeon Papadimitropoulos	University of Crete
Olga Podgornova*	Schlumberger-Doll Research Center
Oleg Poliannikov	Massachusetts Institute of Technology
Jianliang Qian*	Michigan State University
Rakesh Rakesh	University of Delaware
Rob Remis*	TU Delft
Herurisa Rusmanugroho	Memorial University of Newfoundland
Jia Shi	Rice University
Plamen Stefanov	Purdue University
Chris Stolk*	University of Amsterdam
Chrysoula Tsogka	University of California, Merced
George Turkiyyah	American University of Beirut
Massimiliano Vassallo	Schlumberger
Jean Virieux*	Université Grenoble Alpes, ISTerre
Homer Walker	Worcester Polytechnic Institute
Jianlin Xia*	Purdue University
Yang Yang	Michigan State University
Evren Yarman	Schlumberger Cambridge Research
Lexing Ying	Stanford University
Wei-Hsuan Yu	ICERM
Mikhail Zaslavsky*	Schlumberger
Leonardo Zepeda Nunez*	Lawrence Berkeley National Lab
Jian Zhai	Rice University
Hongkai Zhao*	UC Irvine
Yimin Zhong	University of Texas at Austin
Jörn Zimmerling*	TU Delft

*Workshop speaker

Some Workshop Participant Comments for "Please describe how ICERM has (or has not) added to your knowledge of experimental/computational methodologies and/or theoretical developments within this topic.":

- *Better theoretical framework on various strategies concerning PDE solvers and theoretical assessment on inversion methods*
- *I learned about a lot of other ideas that I would like to investigate in my own research and I got several good suggestions after my own talk about new areas to investigate. I also met some folks I did not know and appreciate those connections.*
- *It was particularly helpful for me to learn about fast sweeping methods and domain decomposition approaches to the Helmholtz equation. The different talks on full waveform inversion were also very nice, as they covered different aspects.*
- *We have considered a new problem in radar imaging and how it can be addressed in a mathematical frame work that also enables efficient computation.*

Some Workshop Participant Comments for "Briefly describe workshop highlights":

- *We apparently found a new approach to data-driven reduced order models for waves in unbounded models in discussions during break (with Murthy Guddati, Fernando Guevarra Vasquez, Alex Mamonov, Rob remis and Jorn Zimmerling*
- *There was an excellent and very diverse group of people, which was great. The program would have benefited from having guided discussions rather than Q&A after each talk. That would have allowed us to discuss what the main scientific questions are at this moment.*
- *The two presentations on matrix/tensor factorization approaches by Felix Herman and Misha Kilmer were the most interesting to me as "new" approaches. The presentation by Jean Vireiux was very good in pointing out important issues in modeling for FWI that need to be addressed by the community.*
- *The most important highlight is how far mathematical seismology is from geophysical seismology.*
- *Mixing different communities from theoretical mathematics, applied mathematics, computer sciences, physics and Earth sciences*
- *Making stronger connections to theoreticians in discussions in between talks.*
- *In my opinion the workshop covered all modern approaches to seismic modelling and revealed actual and challenging questions in this field. The event defiantly allowed me to systematize the problems and modern approaches to solve them.*
- *Fantastic topical diversity and level of speakers. Best I've seen in years.*
- *Exposure to presentations from diverse viewpoints. Very high level of participants. Mixture of young and old.*
- *- ICERM Public Lecture: Musical Geometry, Games, and Multimedia Art, Dmitri Tymoczko, Princeton University - Presentation by French mathematicians in the first and third workshops. They have an elegant way of tackling practical problems using the command of latest mathematical tools in conjunction with physical insight. - Radar presentations coming from Sandia labs, Naval SWC, AFRL, NRL and MIT Haystack observatory.*

Spring 2018 Semester Program: Point Configurations in Geometry, Physics and Computer Science

February 1 - May 4, 2018

Organizing Committee:
Christine Bachoc, University of Bordeaux
Henry Cohn, Microsoft Research - New England
Peter Grabner, Technische Universität Graz
Doug Hardin, Vanderbilt University
Edward Saff, Vanderbilt University
Achill Schürmann, University of Rostock

Sylvia Serfaty, Université Pierre et Marie Curie Paris
Salvatore Torquato, Princeton University
Rob Womersley, University of New South Wales

Program Description:
The arrangement of point configurations in metric spaces, whether deterministic or random, is a truly interdisciplinary topic of great interest in mathematics, physics and computer science. Mathematical aspects involve optimization, discretization of manifolds, best packing and cubature, among others. For physics, such configurations arise in the study of crystallization, point processes connected with random matrices, self-assembling materials, jammed states, hyperuniformity and phase transitions. For computer science, extremal point configurations play a fundamental role in coding and information theory, and lattice-based protocols in cryptography and related computational complexity issues are of growing importance. Furthermore, there has been recent and substantial progress on related age-old problems (such as the Kepler conjecture).

The investigation of the above topics often evolves from the development of efficient computational methods that enable extensive numerical experiments. In turn, these experiments suggest conjectures that become the focus of rigorous theorem proving, which may also require some computer assistance. The program topics include random point configurations, computation and optimization of energy, packing and covering, multi-pole methods, sparsity, and frames, and the theory of lattices with applications to coding and cryptography.

All Long-term Visitors to Spring 2018 Semester Program (10+ Days)

Name	Institute	Dates@ICERM
Kartick Adhikari	Indian Statistical Institute	20
Christine Bachoc	Université de Bordeaux	88
Eiichi Bannai	Kyushu University	20
Etsuko Bannai	Kyushu University	19
Eva Bayer	EPFL Lausanne, Switzerland	56
Mario Bencomo	Rice University	286
Dmitriy Bilyk	University of Minnesota	74
Peter Boyvalenkov	Bulgarian Academy of Sciences	29
Johann Brauchart	Technische Universität Graz	40
Djalil Chafai	Universite Paris-Dauphine	13
Renaud Coulangeon	Université de Bordeaux	27
Juan Criado del Rey	University of Cantabria	83
Matthew de Courcy-Ireland	Princeton University	62
David de Laat	ICERM/MIT	123
Maria Dostert	ICERM/EPFL	119
Peter Dragnev	Purdue University Fort Wayne	29

Mathieu Dutour Sikiric	Rudjer Boskovic Institute	92
Ujué Etayo	Universidad de Cantabria	89
Ahram Feigenbaum	Vanderbilt University	93
Damir Ferizovic	Graz University of Technology	14
Adrianna Gillman	Rice University	12
Alexey Glazyrin	University of Texas Rio Grande Valley	94
Peter Grabner	Technische Universität Graz	92
Doug Hardin	Vanderbilt University	94
Rob Kusner	University of Massachusetts, Amherst	92
Wai Yeung Lam	Brown University	92
Zhongyang Li	University of Connecticut	87
Xin Li	University of Central Florida	14
Satya Majumdar	Université de Paris-Sud, CNRS	20
Giorgio Mantica	Universita' dell'Insubria	24
Philippe Moustrou	IMB, Université de Bordeaux	119
Oleg Musin	University of Texas Rio Grande Valley	20
Mircea Petrache	Pontificia Universidad Catolica de Chile	62
Alexander Reznikov	Florida State University	92
Roman Riser	University of Haifa	20
Edward Saff	Vanderbilt University	93
Antonello Scardicchio	International Centre for Theoretical Physics	15
Robert Schüler	Universität Rostock	10
Achill Schürmann	Universität Rostock	25
Gregory Schehr	Université de Paris-Sud	14
Raffaello Seri	Università degli Studi dell'Insubria	37
Ian Sloan	University New South Wales	20
Tetiana Stepaniuk	Graz University of Technology	27
Maya Stoyanova	Sofia University	29
Christophe Vignat	Tulane university	89
Oleksandr Vlasiuk	Vanderbilt University	92
Yuguang Wang	ICERM/LTU/UNSW	120
Robert Womersley	University of New South Wales	96
Wei-Hsuan Yu	ICERM	229

Here follows a sample of the most substantive comments from our long-term visitors:
Some Long-term Visitor Comments for "Please describe how ICERM has (or has not) added to your knowledge of experimental/computational methodologies and/or theoretical developments within this topic.":

- *The wide thematic collection of subjects gave me new insights and new connections.*
- *Greatly increased my knowledge of areas like quantum cryptography, while opening new connections and opportunities for experiments suggesting new theoretical advances in other areas.*

- *It was a great way to catch up on the topic, and to have my work known to the audience.*
- *I learnt quite a few new mathematical developments in this field. I'm a physicist and was not familiar with these techniques before. Hence it was useful for me.*
- *It was very interesting to hear more about computational methods. I also had many helpful discussions from the theoretical side.*
- *ICERM has expanded my general knowledge of methodologies*
- *During the lattices workshop, I've learned quite a lot of new material, which will most definitely help my future research.*

Some Long-term Visitor Comments for "Briefly describe program highlights":

- *Especially, in the weeks between the workshops there was a very productive working atmosphere, which allowed to concentrate on research and collaboration. The seminars organized during these periods gave a good insight into the different areas covered by the participants.*
- *Continuing to work with both existing and new colleagues on a wide range of both ongoing and new research projects.*
- *collaborations in the future research with some young participants*
- *Nice and highly professional conversations 2. Nice talks during the workshops 3. Great team work on our projects*
- *---Talk by Gerard Ben Arous on optimization techniques ---Talk by Fernando de Oliveira on sets avoiding distance 1. ---Talk by David de Laat on semidefinite programs.*
- *The Henry Cohn's lectures are favorite and the most useful for me!*
- *the mix of research time and discussions with experts and newcomers in the field between workshops and the workshops bringing together a much larger group of people further away from my research interests*
- *I particularly enjoyed the last two workshops. All the lectures by Henry Cohn, both at ICERM and at Brown were wonderful, and I also really appreciated all the introductory talks, especially about semi definite programming.*
- *The lecture by Oded Regev was very enlightening, he was a great choice for the first lecture of the workshop.*

Workshop 1: Optimal and Random Point Configurations

February 26, 2018-March 2, 2018

Organizing Committee:
Peter Grabner, Technische Universität Graz
Doug Hardin, Vanderbilt University
Arno Kuijlaars, KU Leuven
Sylvia Serfaty, Courant Institute of Mathematical Sciences, NYU

Program Description:
This workshop will focus on probabilistic and physical aspects of systems of interacting points: their statistical mechanics, phase transitions, and ground states. Such systems include random

point processes arising in probability and statistical physics, such as random matrices, determinantal processes, zeros of random polynomials, disordered ground states, and hyperuniform systems as well as configurations satisfying a geometric or analytic optimality constraint. Special cases also involve disordered and ordered sphere packings and covering problems.

While systems of interacting particles, their free energy and crystallization properties have been studied for a long time in the statistical physics community, there has also been much activity recently, both in the random matrix community and probability communities and in the complex analysis community to understand the microscopic laws of eigenvalues of random matrices and points in beta-ensembles, as well as understanding and quantifying the rigidity of related random point processes and obtaining explicit formulas for correlation functions. Large point sets with quantifiable distribution properties have long played an important role also in approximation, numerical integration, and coding theory. All these communities are seldom mixing, while these topics also link with globally and locally optimal point configurations that arise in approximation theory, including their crystallization properties. A central objective would thus be to connect the probability, statistical physics, mathematical physics and approximation theory communities.

Participant List Workshop 1

Name	**Institute**
Luis Daniel Abreu	Austrian Academy of Sciences
Kartick Adhikari	Indian Statistical Institute
Andrew Ahn	MIT
Ganesh Ajjanagadde	MIT
Ian Alevy	Brown University
Christine Bachoc	Université de Bordeaux
Carlos Beltran*	Universidad de Cantabria
Gerard Ben Arous*	NYU
Laurent Bétermin*	University of Copenhagen
Dmitriy Bilyk*	University of Minnesota
Sergiy Borodachov*	Towson University
Alexei Borodin*	MIT
Paul Bourgade*	NYU
Peter Boyvalenkov	Institute of Mathematics and Informatics
Johann Brauchart*	Technische Universität Graz
Raphael Butez	Université Paris Dauphine
Djalil Chafai*	Université Paris Dauphine
Yanlai Chen	University of Massachusetts, Dartmouth
Henry Cohn	Microsoft Research New England
Juan Criado del Rey	University of Cantabria
Matthew de Courcy-Ireland	Princeton University
David de Laat	ICERM/MIT

Stefano De Marchi	University of Padova
Maria Dostert	ICERM/EPFL
Peter Dragnev*	Purdue University Fort Wayne
Ioana Dumitriu*	University of Washington
Mathieu Dutour Sikiric	Rudjer Boskovic Institute
Alan Edelman*	MIT
Ujué Etayo	Universidad de Cantabria
Ahram Feigenbaum	Vanderbilt University
Damir Ferizovic	Graz University of Technology
Alexisz Gaal	NYU
Augusto Gerolin	University of Jyväskylä
Subhroshekhar Ghosh*	National University of Singapore
Alexey Glazyrin	University of Texas Rio Grande Valley
Vadim Gorin*	MIT
Peter Grabner	Technische UniversitV§t Graz
Alice Guionnet*	ENS de Lyon
Doug Hardin	Vanderbilt University
Diane Holcomb*	KTH Stockholm
Alex Iosevich	University of Rochester
Richard Kenyon	Brown University
Mihalis Kolountzakis	University of Crete
Arno Kuijlaars*	KU Leuven
Woden Kusner	Vanderbilt University
Rob Kusner	University of Massachusetts, Amherst
Bertrand Lacroix-A-Chez-Toine	Université Paris-Sud
Wai Yeung Lam	Brown University
Thomas Leble*	Courant Institute of Mathematical Sciences
Alan Legg	Indiana University-Purdue University Fort Wayne
Norman Levenberg*	University of Indiana
Zhongyang Li	University of Connecticut
Mylene Maida*	Université des Sciences et Technologies de Lille
Giorgio Mantica	Universita' dell'Insubria
Andrei Martinez-Finkelshtein	Baylor University
Ryan Matzke	University of Minnesota
Colin McSwiggen	Brown University
Elizabeth Meckes*	Case Western Reserve University
Philippe Moustrou	IMB, Université de Bordeaux
Cyrill Muratov	New Jersey Institute of Technology
Oleg Musin	University of Texas Rio Grande Valley
Akil Narayan	University of Utah
Irina Nenciu*	University of Illinois
Mircea Petrache*	Pontificia Universidad Catolica de Chile

Leonid Petrov	University of Virginia
Igor Pritsker	Oklahoma State University
James Propp	UMass Lowell
Roman Riser	University of Haifa
Simona Rota Nodari*	Université de Bourgogne
Edward Saff	Vanderbilt University
Sylvia Serfaty*	New York University
Raffaello Seri	Università degli Studi dell'Insubria
Leila Setayeshgar	Providence College
Tatyana Shcherbina	Princeton University
Guilherme Silva	University of Michigan
Stefan Steinerberger	Yale University
Tetiana Stepaniuk	Graz University of Technology
Kenneth Stephenson	University of Tennessee
Maya Stoyanova	Sofia University
Ken'ichiro Tanaka	University of Tokyo
Robert Tichy	Graz University of Technology
Benedek Valko*	University of Wisconsin
Frank Vallentin	University of Cologne
Christophe Vignat	Tulane university
Oleksandr Vlasiuk	Vanderbilt University
Alexander Volberg	Michigan Sate University
Yuguang Wang	ICERM/LTU/UNSW
Zili Wang	Brown University
Robert Womersley	University of New South Wales
Wei-Hsuan Yu	ICERM
Xufan Zhang	Brown University

*Workshop speaker

Some Workshop Participant Comments for "Please describe how ICERM has (or has not) added to your knowledge of experimental/computational methodologies and/or theoretical developments within this topic.":

- *Discussion with eminent experts in the field, contact to very young scientists, poster discussions, a very interesting general lecture*
- *ICERM provided an ideal environment for extended discussions with speakers and participants.*
- *I appreciated that there were several talks that emphasized the value of using computation as a tool when working towards theoretical results. It was also clear from several presentations how simulations could be used to give conjectures that were then proven. This workshop focused more on the theoretical side. It seemed to bring together two different communities of people and I think cross communication would have been easier if there was more of an attempt made to provide something like an introduction to the two different groups.*

- *Learned more about related fields of research and some open problems. Started regular meeting and research discussions with a group of several mathematicians at ICERM.*
- *Expanded my knowledge of probabilistic approaches to minimal energy problems and what they can contribute both theoretically and computationally*
- *I was unaware of the state of the art in many subjects that were covered by the program. It allowed me to discover this very interesting field and meet world leading contributors in random point configurations. It was overall a very enriching experience.*
- *I am able to ask questions on problems which are of great interest to me, to discuss such problems. New developments were made in several interesting for me problems. I think that at least two publications will come as a result.*
- *Theoretical developments: 1. Understood the connection between the Coloumb gas model, random matrices, and how in turn they relate to energy minimization. 2. Came upon some very interesting ideas, such as the corner process of a random matrix, and the relation to Macdonald polynomials. These might have a direct bearing on some of the research I do for my PhD.*
- *I was aware of the existence of some of the literature on several topics but not of the importance/relevance and details of these works. It was extremely helpful to attend the talks and participate in the workshop.*
- *I learned both about theoretical methods related to my work, but also computational software. Very helpful.*

Some Workshop Participant Comments for "Briefly describe workshop highlights":

- *Interactions with people after my talk. It gave me a better idea of what related questions other people would find interesting. In particular it got me back to work on a problem I had set aside a while ago.*
- *Posters by young scientists, general lecture by Peter Winkler*
- *I really appreciate the diversity of topics addressed during this week (random matrices, statistical mechanics, graphs...) and the fact that the speakers come from different scientific communities.*
- *Several of the talks provided the highlights, especially those that started with an overview of the subject area.*
- *Heard talks of leading scientists; Small group meetings in a comfortable and advanced meeting room.*
- *As far as I am concerned, the most important aspect of this workshop was the emphasis on random and stochastic aspects of energy minimization problems because this direction is away from my usual concerns and so I could learn about it.*
- *Gerard Ben Arous' talk was inspiring.*
- *This workshop was very useful for my research and will influence directions of my future research.*
- *Listening interesting presentations. 2. Making important conversations. 3. Developing previous collaborations. 4. Establishing new collaborations. 5. Finding new problems to target. 6. Giving idea(s) to PhD student(s) to solve their problems. At least in one case it was quite useful.*

- *It was mainly interesting for me to see some fields which are touching to mine but are quite distinct. The use of this meeting for me was to introduce me, essentially, to a new class of problems, a new community and their methods. These fields are somewhat close to my work so far but even closer to my interests.*
- *I could meet interesting people with common research interests. The different approaches to similar problems are very inspiring.*
- *The talk by Subhro Ghosh on rigidity that I didn't know about and has some significance for my research.*
- *I loved the fact that there are fewer and longer talks, this allowed me a more in-depth window in the subjects approached and I didn't feel like the speakers were very rushed. It also allowed for ample conversation and work opportunities outside of the lecture hall.*

Workshop 2: Fast Algorithms for Generating Static and Dynamically Changing Point Configurations

March 12, 2018-March 16, 2018

Organizing Committee:
Natasha Flyer, NCAR
Adrianna Gillman, Rice University
Doug Hardin, Vanderbilt University
Jingfang Huang, Carolina Center for Interdisciplinary Applied Mathematics
Ed Saff, Vanderbilt University

Program Description:
This workshop focuses on fast algorithms for the generation of high quality point configurations and meshes such as hierarchical schemes combined with energy or geometrical optimization techniques. Energy methods utilizing appropriate potentials for a prescribed density on a given manifold have been effective in generating point configurations with good covering and packing properties. These methods rely on efficient energy, gradient, and potential computations which can be achieved by hierarchical algorithms that model a system in a recursively compressed (low-rank or low-dimensional) form where information is transmitted non-locally on a hierarchical tree structure. Different aspects of this technique can be found in the classical FFT, multigrid, and fast multipole method (FMM), as well as the recently developed fast direct solvers, multilevel models in statistics, and convolutional neural networks in deep learning.

Fast generation of point configurations and meshes for dynamically evolving systems is especially challenging. For example, in molecular dynamics simulations, the shape of the molecule changes at each time step, and many numerical methods require an underlying "mesh" (e.g., points in particle methods, or surface or volume elements in finite element and integral equation methods) at each time step. Among the essential considerations are the history dependency of the meshes for simulations where the mesh needs to be updated at each time step; coupling of the fast spatial algorithms with the state-of-the-art point and mesh generation tools; recursive algorithm implementation and parallelization; and applications in

atmosphere, Earth, gravitational models, dynamics of biomolecular systems; fluid dynamics, and beyond.

Participant List Workshop 2

Name	**Institute**
Kartick Adhikari	Indian Statistical Institute
Travis Askham*	University of Washington
Christine Bachoc	Université de Bordeaux
Alex Barnett*	Flatiron Institute
Eva Bayer	EPFL Lausanne, Switzerland
Dmitriy Bilyk	University of Minnesota
George Biros*	ICES
Sergiy Borodachov	Towson University
Peter Boyvalenkov	Institute of Mathematics and Informatics
Johann Brauchart	Technische UniversitV§t Graz
James Bremer*	University of California, Davis
Xuemei Chen*	University of San Francisco
Min Hyung Cho	University of Massachusetts Lowell
Henry Cohn	Microsoft Research New England
Juan Criado del Rey	University of Cantabria
Steve Damelin	American Mathematical Society
Matthew de Courcy-Ireland	Princeton University
David de Laat	ICERM/MIT
Maria Dostert	ICERM/EPFL
Peter Dragnev	Purdue University Fort Wayne
Mathieu Dutour Sikiric	Rudjer Boskovic Institute
Ujué Etayo	Universidad de Cantabria
Ahram Feigenbaum	Vanderbilt University
Natasha Flyer*	NCAR
Adrianna Gillman*	Rice University
Alexey Glazyrin	University of Texas Rio Grande Valley
Peter Grabner	Technische Universität Graz
Doug Hardin*	Vanderbilt University
Teresa Head-Gordon*	UC-Berkeley
Alfa Heryudono	University of Massachusetts, Dartmouth
Jingfang Huang*	UNC
David Hyeon	Seoul National University
Robert Krasny*	University of Michigan
Bidisha Kundu	Indian Institute of Science
Rob Kusner	University of Massachusetts, Amherst
Wai Yeung Lam	Brown University
Jing-Rebecca Li*	INRIA-Saclay, Equipe DEFI

Zhongyang Li	University of Connecticut
Xin Li	University of Central Florida
Benzhuo Lu*	Chinese Academy of Sciences
Per-Gunnar Martinsson*	University of Oxford
Philippe Moustrou	IMB, Université de Bordeaux
Oleg Musin	University of Texas Rio Grande Valley
Mike O'Neil*	NYU
Mircea Petrache	Pontificia Universidad Catolica de Chile
Manas Rachh*	Yale University
Alexander Reznikov	Florida State University
Roman Riser	University of Haifa
Edward Saff	Vanderbilt University
Raffaello Seri	UniversitV† degli Studi dell'Insubria
Kirill Serkh*	New York University
Joungmin Song	GIST
Tetiana Stepaniuk	Graz University of Technology
Mark Stock	Applied Scientific Research, Inc.
Maya Stoyanova	Sofia University
Xiaobai Sun*	Duke University
Anna-Karin Tornberg*	Kungliga Tekniska Hogskolan
George Turkiyyah*	American University of Beirut
Christophe Vignat	Tulane university
Oleksandr Vlasiuk*	Vanderbilt University
Yuguang Wang	ICERM/LTU/UNSW
Robert Womersley	University of New South Wales
Wei-Hsuan Yu	ICERM
David Zhang*	Vanderbilt University
Yabin Zhang	Rice University
Xiaosheng Zhuang	City University of Hong Kong

*Workshop speaker

Some Workshop Participant Comments for "Please describe how ICERM has (or has not) added to your knowledge of experimental/computational methodologies and/or theoretical developments within this topic.":

- *It was very useful for me to catch up on the recent developments in simulation tools for complex geometry. The workshop was very focused yet involved several different application areas where these methods can be applied, so it was very good for me, for future reference, in case I wanted to apply my methods to those application areas.*
- *There were few presentations by people doing theoretical work. This made it difficult to understand what types of computational techniques may prove useful for them.*
- *The algorithmic part was the one I was feeling less interested in, but attending the talks definitely increased my interest and knowledge for the field.*

- *Learnt a lot about fast methods, especially Fast Multipole Methods, and their key features.*
- *To my knowledge, the workshop created the opportunity for roughly three groups of researchers who by convention may not go to the same conferences and have ideas exchanged, cross-examined, stimulated and further developed as we did at the workshop.*
- *The ICERM workshop was extremely valuable in making me aware of current research in the field. I also appreciate that the slides and videos are posted so that students and postdocs who did not attend the workshop can still review them.*
- *My daily research is analytical work, but from time to time I do some numerical simulation though not having much expertise. It was a good occasion to learn more about computational methods.*

Some Workshop Participant Comments for "Briefly describe workshop highlights":

- *I appreciated the fact that experimental and theoretical math appeared so intimately connected in these talks. This has convinced me that algorithms should always be considered in the possible solution of a difficult problem.*
- *Different approaches to fast methods, especially for problems arising from integral equation formulations*
- *While I would have benefited from more computer science-type talks, I was impressed by the participants' breadth of knowledge of boundary integral methods, which are a key part of my work.*
- *Brought together a lot of people in 3 different fields (tree codes and fast matrix factorization, integrable eqns., numerical alg. for node distributions and their applications) in a good collaborative environment that allowed for questions and discussion that would not have happened had the workshop not occurred.*
- *From my perspective, we got the most recent research advances, in theory, computational simulation, and more importantly, their direct or indirect impact on important application problems. The theoretical parts are on sampling, semi-analytical solutions to not only compress the expression but also increase computational accuracy. Some simulation results are stunning. I was happy to see classical mathematics used for modern high-dimensional data analysis.*
- *Starting 2 new collaborations.*
- *This workshop was very useful and will influence directions of my future research.*
- *George Biros and Xiaobai Sun's talks*

Workshop 3: Computation and Optimization of Energy, Packing, and Covering

April 9, 2018-April 13, 2018

Organizing Committee:

Achill Schürmann, University of Rostock
Salvatore Torquato, Princeton University
Frank Vallentin, Universität zu Köln

Rob Womersley, University of New South Wales

Program Description:
The packing and covering of equal geometric shapes, such as spheres or convex polyhedra, are classical geometric optimization problems. They have a long mathematical tradition and were for instance part of Hilbert's famous twenty-three problems for the 20th century. Nevertheless, seemingly simple packing and covering problems are still extremely hard to solve and generally, far from a solution. Likewise, minimal energy problems for pair potentials, of which best-packing is a special case, have many such unresolved questions.

However, in recent years several new developments with computer assisted approaches have led to previously unexpected breakthrough results. These involve massive computer searches and techniques from numerical optimization, as well as the creation and application of new optimization techniques, such as specific semi-definite programming bounds. New techniques for computer assisted certified proofs allow one to obtain results that would otherwise have been difficult, if not impossible, to check.

During this workshop, we will bring together energy, packing and covering experts from these new computation-based research directions.

Participant List Workshop 3

Name	**Institute**
Ganesh Ajjanagadde	MIT
Christine Bachoc*	Université de Bordeaux
Eiichi Bannai*	Kyushu University
Etsuko Bannai	Bannai
Eva Bayer	EPFL Lausanne, Switzerland
Dmitriy Bilyk	University of Minnesota
Sergiy Borodachov	Towson University
Patrick Charbonneau*	Duke University
Ji Hoon Chun	Indiana University Bloomington
Sebastian Cioaba	University of Delaware
Henry Cohn*	Microsoft Research New England
Renaud Coulangeon*	Université de Bordeaux
Juan Criado del Rey	University of Cantabria
Steve Damelin*	American Mathematical Society
Matthew de Courcy-Ireland*	Princeton University
David de Laat*	ICERM/MIT
Fernando de Oliveira Filho*	Technical University Delft
Marjolein Dijkstra*	Utrecht University
Maria Dostert	ICERM/EPFL
Peter Dragnev	Purdue University Fort Wayne
Mathieu Dutour Sikiric*	Rudjer Boskovic Institute

Ujué Etayo	Universidad de Cantabria
Ahram Feigenbaum	Vanderbilt University
Alexey Garber	The University of Texas Rio Grande Valley
Subhroshekhar Ghosh	National University of Singapore
Alexey Glazyrin*	University of Texas Rio Grande Valley
Peter Grabner*	Technische UniversitV§t Graz
Doug Hardin*	Vanderbilt University
Sorin Istrail	Brown University
Randall Kamien*	University of Pennsylvania
Jaeuk Kim	Princeton University
Woden Kusner*	Vanderbilt University
Rob Kusner	University of Massachusetts, Amherst
Wai Yeung Lam	Brown University
Alan Legg	Indiana University-Purdue University Fort Wayne
Zhongyang Li	University of Connecticut
Zheng Ma	Princeton University
Satya Majumdar	UniversitV© de Paris-Sud, CNRS
William Martin	Worcester Polytechnic Institute
Philippe Moustrou	IMB, Université de Bordeaux
Oleg Musin*	University of Texas Rio Grande Valley
Mircea Petrache	Pontificia Universidad Catolica de Chile
Jan Rolfes	University of Cologne
Edward Saff	Vanderbilt University
Takashi Sakajo	Kyoto University
Antonello Scardicchio*	International Centre for Theoretical Physics
Gerd Schroeder-Turk*	Murdoch University
Robert Schüler	Universität Rostock
Achill Schürmann	Universität Rostock
Richard Schwartz*	Brown University
Sylvia Serfaty	New York University
Ian Sloan	University New South Wales
Joshua Socolar*	Duke University
Salvatore Torquato*	Princeton University
Frank Vallentin	University of Cologne
Christophe Vignat	Tulane university
Oleksandr Vlasiuk	Vanderbilt University
Yuguang Wang	ICERM/LTU/UNSW
Robert Womersley*	University of New South Wales
Wei-Hsuan Yu	ICERM
Marc Zimmermann	Technische Universität Dortmund

*Workshop speaker

Some Workshop Participant Comments for "Please describe how ICERM has (or has not) added to your knowledge of experimental/computational methodologies and/or theoretical developments within this topic.":

- *Several talks helped to keep me up to date with the recent developments in various optimization problems (e.g. SDP methods). As regards theoretical developments, I would say the opportunity to meet people from other fields was very profitable, and undoubtedly beyond my expectations. For instance, the talk by A. Scardicchio provided new insights into my own work on the topic of perfect forms.*
- *I particularly liked the Statistical Physics color of the workshop that added a new angle to the problem of packing, with the presence of pure Physicists and Chemists*
- *Bringing together both physicists and mathematicians, with their different perspectives on the same problem.*
- *The talks by Patrick C, Peter G, Woden K, Henry C, and Rich S were particularly inspiring.*
- *I came to learn quite a bit about hypercuniformity, one of the topics covered during this conference.*
- *Presentation topics were an interesting mix of subfields. I had chances to hear about topics I did not previously appreciate. The conference schedule was well designed, allowing ample but not excessive time for discussion between presentations.*
- *In line with what I believe to be the underlying philosophy of ICERM, the workshop has been exceptionally successful in bringing two research communities together: researchers from physics and materials science on the one hand, and researchers from mathematics on the other who all work on problems related to optimal packings and energies of packings and related topics. The organisers have done an amazing job in identifying, within both communities, not only top-notch scientists but also those that are willing to engage in this interdisicplinary discourse. Being a member of the physics community, I have learned an incredible amount about the mathematical research into optimal point sets, Riesz energies, and the like and discovered approaches to my own research topics of which I was not aware or had not got a good handle on before.*
- *I was interested seeing talks by people outside of math (physics, chemistry)*

Some Workshop Participant Comments for "Briefly describe workshop highlights":

- *The interdisciplinary, highlighting the interaction between sphere packing problems, hyper uniformity and statistical physics.*
- *Lovely relaxed schedule, yet full of fantastic science. Probably my personal highlight was to learn about Rob Wommersley's research, about the work done by Woden Kusner and the work done by Achill Schürmann, and the work by Ed Saff, as I was less familiar with these. I also had great conversations with my 'physics mates', Sal Torquato, Patrick Charbonneau and Marjolein Djikstra and I learnt quite about their work by their great attempts to cast it in a slightly more mathematical form than usual.*
- *Different viewpoints on problems, each able to contribute to the understanding of the problem*
- *All the talks were nice, but I particularly thought that the talks of Christine Bachoc and Henry Cohn were really interesting.*

Workshop 4: Computational Challenges in the Theory of Lattices

April 23, 2018-April 27, 2018

Organizing Committee:

Christine Bachoc, Université de Bordeaux
Henry Cohn, Microsoft Research New England and MIT
Renaud Coulangeon, Université de Bordeaux
Chris Peikert, University of Michigan
Akshay Venkatesh, Stanford University

Program Description:

This workshop will focus on the computational aspects of the theory of Euclidean lattices and on their applications to other areas in mathematics and computer science. It will put emphasis on computational challenges on lattice problems that have recently arisen from unexpected connections to other domains such as algebraic topology, automorphic forms, or cryptography.

A major goal of this workshop is to bring together researchers from different areas, working with Euclidean lattices, and to facilitate their interactions.

Topics will include the reduction theory of lattices and its applications, Voronoi algorithms and their use to compute the cohomology of arithmetic groups, the classification of lattice genera and the computation of spaces of modular forms, the algorithmic aspects of lattice based cryptography, in particular the relationship between the security of cryptographic primitives and the hardness of lattice problems.

Participant List Workshop 4

Name	**Institute**
Michal Andrzejczak	Military University of Technology
Christine Bachoc	Université de Bordeaux
Eiichi Bannai	Kyushu University
Etsuko Bannai	Kyushu University
Mohammad Bardestani	University of Munster
Eva Bayer*	EPFL Lausanne, Switzerland
Mario Bencomo	Rice University
Jean-FranVßois Biasse	University of South Florida
Dmitriy Bilyk	University of Minnesota
Sergiy Borodachov	Towson University
Wai Kiu Chan	Wesleyan University
Jingwei Chen	Chinese Academy of Sciences
Henry Cohn	Microsoft Research New England
Renaud Coulangeon	Université de Bordeaux
Juan Criado del Rey	University of Cantabria
Daniel Dadush*	Centrum Wiskunde & Informatica

Matthew de Courcy-Ireland	Princeton University
David de Laat	ICERM/MIT
Gabrielle De Micheli	University of Pennsylvania
Maria Dostert*	ICERM/EPFL
Peter Dragnev	Purdue University Fort Wayne
Leo Ducas*	Centrum Wiskunde & Informatica
Dung Duong	Kyushu University
Mathieu Dutour Sikiric*	Rudjer Boskovic Institute
Noam Elkies*	Harvard University
Ujué Etayo	Universidad de Cantabria
Ahram Feigenbaum	Vanderbilt University
Lenny Fukshansky*	Claremont McKenna College
Venkata Gandikota	Johns Hopkins University
Alexey Garber	The University of Texas Rio Grande Valley
Alexey Glazyrin	University of Texas Rio Grande Valley
Peter Grabner	Technische Universität Graz
Charles Grover	Imperial College London
Anna Haensch*	Max Planck Institute for Mathematics
Doug Hardin	Vanderbilt University
George Hauser	Rutgers University
Nadia Heninger*	University of Pennsylvania
Aleksandra Horubala	Warsaw University of Technology
David Joseph	Imperial College London
Ruth Kellerhals	University of Fribourg
Aleksandr Kolpakov	University of Neuchâtel
Abhinav Kumar*	Stony Brook University
Rob Kusner	University of Massachusetts, Amherst
Wai Yeung Lam	Brown University
Tim Weng Lee	Osaka University
Hendrik Lenstra*	Universiteit Leiden
Zhongyang Li	University of Connecticut
Tamar Lichter	Rutgers University
Satya Majumdar	Université de Paris-Sud, CNRS
Ivan Martino	Northeastern University
Daniele Micciancio*	University of California
Stephen Miller*	Rutgers University
Philippe Moustrou*	IMB, Université de Bordeaux
Oleg Musin	University of Texas Rio Grande Valley
Phong Nguyen*	University of Tokyo
Padraig O Cathain	Worcester Polytechnic Institute
Christopher Peikert	University of Michigan, Ann Arbor
Mircea Petrache	Pontificia Universidad Catolica de Chile

Lam Pham	Yale University
James Propp	UMass Lowell
Oded Regev*	New York University, Courant Institut
Sinai Robins	University of Sao Paulo
Adeline Roux-Langlois*	Univ Rennes, CNRS, IRISA
Mohamed Sabt	CNRS
Edward Saff	Vanderbilt University
Achill Schürmann*	Universität Rostock
Gregory Schehr	Université de Paris-Sud
Sylvia Serfaty	New York University
Barak Shani	The University of Pennsylvania
Alice Silverberg*	University of California Irvine
Damien Stehle*	Ecole Normale Supv©rieure de Lyon
Noah Stephens-Davidowitz	Princeton University
Akshay Venkatesh	Stanford University
Christophe Vignat	Tulane university
Oleksandr Vlasiuk	Vanderbilt University
John Voight*	Dartmouth College
Yuguang Wang	ICERM/LTU/UNSW
Daniel Waszkiewicz	Warsaw University of Technology
Robert Womersley	University of New South Wales
Ziqing Xiang	University of Georgia
Wei-Hsuan Yu	ICERM
Emmanouil Zampetakis	MIT
Giorgos Zirdelis	Northeastern University

*Workshop speaker

Some Workshop Participant Comments for "Please describe how ICERM has (or has not) added to your knowledge of experimental/computational methodologies and/or theoretical developments within this topic.":

- *The topics of the workshop were carefully selected to present the current advances in the field. In my opinion, the part of the workshop devoted to encryption/decryption could be smaller, but I understand that this is not necessarily in agreement with the organizers.*
- *The topics of the conference were broad and the speakers of highest quality. I learned a lot about important and recent developments in the field*
- *ICERM has indeed added much to my scientific knowledge and to the experimental/computational knowledge and methods that I now use. For example, various algorithms in sage were pointed out to me by some of the participants, who helped develop these algorithms for sage, and I will use them in my research.*
- *Very interesting talks on lattice-based cryptography and on theory of lattices*
- *The workshop is fantastic. Many excellent researchers from many background come and give excellent talks which introduce audience lots of aspects of several related*

areas/problems. It is great that ICERM has created such an amazing event to connect people. Specially, ICERM has created a warm environment with extremely helpful staff.
- *Miller's and Kumar's talks were especially illuminating, particularly about their new results for monotone energies with Cohn et al.*

Some Workshop Participant Comments for "Briefly describe workshop highlights":
- I met one of my coauthors in the workshop, and we solved a problem together. We are considering writing a paper on it.
- Different communities were gathered and I have the impression that they have indeed communicated and have had fruitful interactions. It was one of the main goals of this conference.
- Hearing about exciting work done in computational aspects of number theory (like John Voight's work). It encouraged me to go back to work we did 5 years ago on lattice isomorphism and make it more applicable to number theory.
- Meeting new scientists and talking about specific problems of lattices was extremely useful; I highly recommend such a workshop/semester program in the future as well, to continue the research that started here now.
- Regev's Talk on reverse Minkowski theorem
- Some excellent survey talks; exchange with younger people; personal contact to researcher known previously through their articles, only.
- Chatting about problems with Cohn, Dostert, Kellerhans, Kumar, Miller and Robbins.
- It was one of the best conferences I attended in the recent years! The talks were especially excellent. I also appreciated an opportunity to communicate with a variety of people from my research community, as well as those from adjacent areas. Many of the discussions I had will undoubtedly influence my future research.

Note: for a list of upcoming semester programs, see Appendix B.

Topical Workshops

ICERM hosts several topical workshops each year. These workshops typically last 5 days and focus on a timely and exciting theme of interest that aligns with ICERM's mission of supporting and broadening the relationship between mathematics and computation.

Pre-Proposal Requirements
A 1-2-page pre-proposal document which describes the scientific goals, lists the organizers of the program, and identifies the key participants.

Pre-Proposal Deadline
All pre-proposals should be submitted to the ICERM Director. The target deadlines for submissions are early September and mid-April. The ICERM directors and a subcommittee of the Scientific Advisory Board SAB will review all pre-proposals. Proposers will receive feedback within a few weeks of their submission.

Topical Workshop Full Proposal Deadline
All full proposals should be submitted to the ICERM Director. Target deadlines are October 1st and May 1st. All full proposals are considered by the Scientific Advisory Board SAB potentially after an external review. Decisions are typically reached within one-to-two months of the target deadlines.

1. Solicitation of Topical Workshop Proposals
A topical workshop proposal should be of 2-4 pages length and contain the following:

- A description of the program area/theme written with a general mathematical audience in mind,
- A list of organizers normally around 3-6,
- The main contact chair of the organizing committee,
- A discussion of the experimental and computational aspects of the program,
- Plans for ensuring the participation of underrepresented groups organizers are expected to work with ICERM directors on diversity issues.

2. Proposal Selection
The Science Advisory Board SAB approves the topical workshops. The deadline for proposals is mid-October, prior to the annual November SAB meeting, and mid-May, prior to an annual conference call. Approved program dates will be scheduled with details posted on the ICERM website and various on-line math organization calendars SIAM, AMS, European Mathematical Society, National Math Institutes.

From this point on, applications for graduate students and workshop participants will be considered; the chair of the workshop organizing committee or other designated organizer will assist ICERM staff by providing appropriate program images for web and print ads, and may be asked to review marketing materials.

3. Recommendation of Speakers
The organizers will propose a ranked list of 20-25 speakers, which the ICERM Directors will approve and/or suggest additions or re-rankings in consultation with SAB members.

4. Invitations to Speakers
Once the list of workshop speakers has been finalized and funding determined, an invitation will be sent to each. The invitation will describe the workshop and outline the support to be provided. Using its Cube database, ICERM will track demographic information about, and all interactions with, speakers.

5. Application Process
Once the organizers and Directors agree there is enough critical mass in terms of confirmed speakers, the on-line application for that particular workshop will be opened on the ICERM website.

6. Applicant Selection

ICERM's proprietary “Cube” database and visitor management system is where participants go to apply for our programs. Program organizers are regularly provided a list of applicants and copies of their supporting documents and are asked to recommend a ranking of applicants for their program. ICERM Directors review the ranked list, re-rank as appropriate and make the final selections, taking into consideration the remaining budget for the program, diversity, participant support requested, and whether or not the applicant if a young researcher has an advisor already participating in the program. ICERM staff then updates the applicant about their status, and any support they are eligible for, as appropriate.

Financial Decisions for Topical Workshops

Financial decisions are made by ICERM Directors based on discussions with organizers. There is support for housing and travel support for around 20-25 speakers including organizers, who stay for 1 week. The institute reserves some funds to support uninvited applicants.

Topical Workshops in 2017-2018

ICERM has hosted 5 topical workshops from May 2017 to April 2018. These workshops focus on topics of current interest in the mathematical sciences.

Topical Workshop 1: Probabilistic Scientific Computing: Statistical Inference Approaches to Numerical Analysis and Algorithm Design

June 5-9, 2017

Organizing Committee:
Philipp Hennig, Max Planck Institute
George Em Karniadakis, Brown University
Michael A Osborne, University of Oxford
Houman Owhadi, Caltech
Paris Perdikaris, MIT

Workshop Description:
There is an urgent and unmet need to formally analyze, design, develop and deploy advanced methods and algorithms that can scale in statistical and computational efficiency to the size of modern data sets and the complexity of contemporary mathematical models. Addressing this need will require a holistic approach involving new foundational theory, algorithms, and programming language design.

The emerging research theme of Probabilistic Scientific Computing (PSC) or Probabilistic Numerics lies at the nexus of these overlapping directions. It aims to improve statistical quantification of uncertainty, improve computational efficiency, and build more effective and

scalable numerical methods for statistical models by leveraging the natural correspondence between computation and inference.

The primary goal of the workshop is to introduce recent results and new directions in probabilistic scientific computing to the US research communities in statistics and machine learning, in numerical analysis, and in theoretical computer science.

Participant List Topical Workshop 1

Name	**Institute**
Mark Ainsworth	Brown University
Hessam Babaee	University of Pittsburgh
Tom Bertalan	Princeton University
Ilias Bilionis*	Purdue University
Tamara Broderick*	Massachusetts Institute of Technology
Yanlai Chen	University of Massachusetts, Dartmouth
Zhizhong Chen	Brown University
Oksana Chkrebtii*	The Ohio State University
Bastien Chopard	University of Geneva
Jon Cockayne*	University of Warwick
David Cooper	Brown University
Andreas Damianou	Amazon.com
Jana de Wiljes	University of Potsdam
Yuchen Dong	WPI
Jeovv° Farias Sales Rocha Neto	Brown university
Guosheng Fu	University of Minnesota
Roman Garnett*	Washington University in St. Louis
Tarsilo Girona	Brown University
Javier Gonzalez Hernandez	Amazon.com
Mamikon Gulian	Brown University
Ling Guo	Shanghai Normal University
Stephen Guth	Massachusetts Institute of Technology
Matthew Harrison	Brown University
Md Mehedi Hasan	Brown University
Philipp Hennig*	Max Planck Institute for Intelligent Systems
Chris Huber	Brown University
Ilse Ipsen*	North Carolina State University
Jiahua Jiang	University of Massachusetts Dartmouth
Nianqiao Ju	Harvard Univeristy
Andrew Kaluzny	Brown University
Hamid Karani	Georgia Institute of Technology
George Karniadakis	Brown University
Toni Karvonen	Aalto University

Hans Kersting*	Max Planck Institute for Intelligent Systems
Yannis Kevrekidis*	Johns Hopkins University
Julia Kroos	BCAM - Basque Centre for Applied Mathematics
Neil Lawrence*	University of Sheffield
Seungjoon Lee	Brown University
Xingjie Li	University of North Carolina at Charlotte
Jichun Li	University of Nevada Las Vegas
Zhen Li	Brown University
Guang Lin	Purdue University
zhiping mao	Brown University
Govind Menon*	Brown University
Jeff Miller*	Harvard T.H. Chan School of Public Health
Saviz Mowlavi	Massachusetts Institute of Technology
Chris Oates*	University of Technology Sydney
Paulo Orenstein	Stanford University
Houman Owhadi*	California Institute of Technology
Paris Perdikaris*	Massachusetts Institute of Technology
Prashant Rai	Sandia National Labs
Maziar Raissi*	Brown University
Florian Schaefer*	California Institute Of Technology
Daniele Schiavazzi	University of Notre Dame
Leila Setayeshgar	Providence College
Fangying Song	Brown University
Panos Stinis	Pacific National Laboratory
Tim Sullivan*	Free University of Berlin
Kyle Taljan	Case Western Reserve University
Molei Tao	Georgia Institute of Technology
Tom Trogdon*	University of California Irvine
Zhong Yi Wan	MIT
Grzegorz Wasilkowski*	University of Kentucky
Nickolas Winovich	Purdue University
Xiu Yang	Pacific Northwest National Laboratory
Liu Yang	Brown University
Alireza Yazdani	Brown Univeristy
Zhongqiang Zhang	Worcester Polytechnic Institute
Xueyu Zhu	University of Iowa

*Workshop speaker

Some Workshop Participant Comments for "Please describe how ICERM has (or has not) added to your knowledge of experimental/computational methodologies and/or theoretical developments within this topic.":

- *I re-learnt numerical integration and numerical differentiation through a probabilistic interpolation. This incredibly opens my mind about numerical analysis and brings me new directions of research.*
- *The workshop gave me a better overview over the different branches of work related to "probabilistic numerics". In particular I liked that it brought together people working in Machine Learning/Statistics and scientific computing/numerical methods.*
- *This is a brand new topic, and the first of its kind workshop on bridging rigorous math with machine learning. This is the future!*
- *I came into the workshop as an outsider working in pure math in random matrix theory. I had some experience with machine learning and was keen to gain some perspective on the field and learn where I might contribute. The meeting was a great success from this standpoint as I both learned a good deal and now know where to begin should I decide to work in similar areas in the future.*
- *It was interesting to see techniques in multi-resolution expansion applied to PDE and problems in numerical linear algebra. It also was interesting to hear about ideas on generalizations of these constructions, i.e., Gamblets. The hands-on tutorial on Gaussian processes was well designed and the code was provided, I wish there was a similar tutorial on Gamblets. I also really liked the presentation on Bayesian optimization!*
- *My theoretical understanding of Gaussian Processes (and various pieces of the Bayesian framework more generally) grew substantially.*
- *This was a really interesting meeting, great people. Really enjoyed it, as one other attendee pointed out, we would have benefited from more panel sessions to help people understand each others' viewpoint.*

Some Workshop Participant Comments for "Describe the highlight of this workshop":

- *I learnt a lot from this workshop, especially the first day of tutorials. The short courses from Professor Owhadi demonstrated a completely new point of view for understanding numerical errors (worst estimate vs mixed estimate), finite elements, multi-grids and hence numerical analysis. In addition, I developed a research connection and found a potential research topic and collaboration.*
- *Generally, the interaction of people in ML/Stats and scientific computing/applied math. Maybe most exemplified by the panel discussion, in the end.*
- *The first day of tutorials gave a broad introduction to the topic, and set the stage for the subsequent lectures. I think the biggest highlight of the workshop was the diversity of the topics presented, and the open atmosphere that encouraged people to interact with each other.*
- *The discussions with other researchers during the break times*
- *I am exposed to the forefront of Uncertainty Quantification and stochastic numerical methods for solving ODEs. This will benefit my research work a lot.*
- *New field for me, very inspiring.*
- *it was interesting to see the current trends in this field and to attend presentations on very different perspectives.*

Topical Workshop 2: Robust Methods in Probability and Finance:

June 19-23, 2017

Organizing Committee:

Tomasz R. Bielecki, Illinois Institute of Technology
Patrick Dondl, University of Freiburg
Philipp Harms, University of Freiburg
Eva Lutkebohmert-Holtz, University of Freiburg
Marcel Nutz, Columbia University
Thorsten Schmidt, University of Freiburg

Workshop Description:

On financial markets one never observes the same data twice; market configurations are subject to change across time. This poses some specific challenges to inference, prediction, and optimal control in financial contexts. Classically, strong model assumptions are needed, while current research aims at methods which are robust with respect to model misspecification. This issue lies at the heart of the envisaged workshops, and the program of the workshops will reflect recent developments in this direction.

The last decade saw a rise of robust methods in probability and finance resulting in new numerical and theoretical challenges. Interestingly, these challenges bring together methodologies from PDEs, probability, stochastic analysis, and control theory. Mathematically speaking, robustness typically translates into nonlinearity showing up as a defining feature. Examples in this direction are nonlinear expectations, nonlinear PDEs, and H-infinity optimal stochastic control. Finance has a long tradition of fruitful interactions between these areas. Numerical results often build the first step for subsequent theoretical analysis (and vice versa), thus fitting specifically into ICERM's orientation towards computational and experimental research.

Topics of particular interest are dynamic and robust methods in the following areas: filtering, prediction, optimal control, calibration, pricing, risk management, and machine learning.

This workshop is held under the auspices of the VI-MSS program, in collaboration with the University of Freiburg.

Participant List Topical Workshop 2

Name	Institute
Beatrice Acciaio*	London School of Economics
Tamer Basar*	University of Illinois at Urbana-Champaign
Erhan Bayraktar*	University of Michigan
Tomasz Bielecki*	Illinois Institute of Technology
Justin Calareso	Rose-Hulman institute of Technology
René Carmona*	Princeton University

Tao Chen	Illinois Institute of Technology
Zhizhong Chen	Brown University
Po-Keng Cheng	The State University of New York at Stony Brook
Igor Cialenco*	Illinois Institute of Technology
Sam Cohen*	University of Oxford
Rama Cont*	Imperial College London
Patrick Dondl	Albert-Ludwigs-Universität Freiburg
Ibrahim Ekren*	ETH Zurich
Tolulope Fadina	University of Freiburg
Shibi Feng	Illinois Institute of Technology
Wendell Fleming	Brown University
Sandrine Gümbel	University of Freiburg
Miguel Angel Garrido Garcia	Columbia University
Christoph Gerhart	University of Freiburg
Ruoting Gong	Illinois Institute of Technology
Jia Guo	University of Michigan
Philipp Harms*	University of Freiburg
Yicong Huang	Illinois Institute of Technology
Ioannis Karatzas*	Columbia University
Donghan Kim	Columbia University
Daniel Lacker*	Brown University
Junbeom Lee	National University of Singapore
Taehee Lee	Brown University
Yan Li	Brown University
Wenjian Liu	City University of New York
Eva Lutkebohmert-Holtz	University of Freiburg
Ning Ning	University of California, Santa Barbara
Stefano Novello	Imperial College London
Marcel Nutz*	Columbia University
Weijie Pang	Worcester Polytechnic Institute
Hyungbin Park	Worcester Polytechnic Institute
Ethan Petersen	Rose-Hulman Institute of Technology
Scott Robertson*	Boston University
Patchara Santawisook	WPI
Thorsten Schmidt*	University of Freiburg
Glenn Shafer*	Rutgers Business School
Konstantinos Spiliopoulos	Boston University
Florian Stebegg	Columbia University
Yavor Stoev	University of Michigan
Stephan Sturm	WPI
Xiaowei Tan	Columbia University
Wayne Tarrant	Rose-Hulman Institute of Technology

Tushar Vaidya	Singapore University of Technology and Design
Gu WANG	Worcester Polytechnic Institute
Haoran Wang	The University of Texas at Austin
Ruoyu Wu	Brown University
YAN XU	Carnegie Mellon University
Jiaxuan Ye	Worcester Polytechnic Institute
Yuchong Zhang*	Columbia University

*Workshop speaker

Some Workshop Participant Comments for "Please describe how ICERM has (or has not) added to your knowledge of experimental/computational methodologies and/or theoretical developments within this topic.":

- *The great number of talks and subsequent discussions during coffee or lunch breaks provided the perfect opportunity to enrich my knowledge on several topics within mathematical finance.*
- *ICERM provided an opportunity to learn from leading experts in the area of mean-field games and its applications.*
- *Got introduced the most recent development in Mean-Field Games, which is something I'm interested in.*

Some Workshop Participant Comments for "Describe the highlight of this workshop":

- *There were very good opportunities to discuss recent work and approaches to robust methods in finance.*
    - *Stimulating and broad discussions after every presentation. - Good schedule which left time for further discussions. - Perfect seminar room and common space*
- *The chance of meeting so many researchers and start what could hopefully be long term and fruitful relations was definitely the highlight for me*
- *Interesting lectures of high caliber. Plenty of time for discussion and exchange of ideas.*
- *Making connections with other researchers for future collaborations.*
- *The opportunity to discuss with great mathematicians within a very nice atmosphere. Especially as young researcher this opportunity is of great importance. This was also possible due to the well-planned time framework.*
- *I benefited tremendously from every session, and the presentation of my research work was the highlight for me.*

Topical Workshop 3: Women in Data Science and Mathematics Research Collaboration Workshop (WiSDM):

July 17-21, 2017

Organizing Committee:

Carlotta Domeniconi, George Mason University
Ellen Gasparovic, Union College

Giseon Heo, University of Alberta
Kathryn Leonard, CSU Channel Islands
Regina Liu, Rutgers University
Julie Mitchell, University of Wisconsin
Deanna Needell, UCLA
Linda Ness, Rutgers University
Emina Soljanin, Rutgers University
Sibel Tari, Middle East Technical University
Xu Wang, Wilfrid Laurier University

Workshop Description:
Research Collaboration Workshop for Women in Data Science and Mathematics (WiSDM). This program will bring together women at all stages of their careers, from graduate students to senior researchers, to collaborate on problems in data science. The scientific focus will be on cutting edge problems in the areas of predictive modeling, multi-scale representation and feature selection, statistical and topological learning, and related areas. Data science is a cross-disciplinary field relying on statistics, computer science and mathematics and driven by problems in many other disciplines. While data science has emerged as a prominent new field enrolls record numbers and attracts research talents from many scientific disciplines, the role of theoretical and applied mathematics has not been highly visible. Mathematics provides many structured representations that can be in the analysis of data arising from such diverse fields as geometric measure theory, classical analysis, computational topology, shape theory, algebraic statistics, and spectral graph theory. Furthermore, mathematics may enable more classes of data sets to be represented as measures and distributions which could then leverage classical statistical techniques.

Meanwhile, mathematics and computer science are two of three disciplines with the lowest percentage of women attaining PhDs (28% and 24%, respectively). Creating explicit research bridges between these groups will provide networks of women with similar research interests, and will also create pathways for the female-friendly culture in statistics to make its way into mathematics and computer science. This workshop will generate research collaborations, and highlight mathematics as a primary contributor. Successful applicants will be assigned to a research problem based on their expertise. Each group will aim to include a more senior person in each of statistics, machine learning, and mathematics.

Partially supported by NSF-HRD 1500481 - AWM ADVANCE grant. Additional support for some participant travel will be provided by DIMACS in association with its *Special Focus on Information Sharing and Dynamic Data Analysis*. Co-sponsored by Brown's Data Science Initiative.

Project Descriptions
Project 1: Predictive Models for Molecular Data
Using data generated in past molecular modeling projects, participants will be encouraged to apply a range of machine learning and informatics techniques to analyze the data and

build/optimize predictive models. Some prior models have been built with a hundred or so experimental data points, while other bimolecular models have utilized over 50,000 data points. Through these exercises, participants will learn the applicability of varied machine learning methods to datasets of different sizes (both the number of data points and the length of feature vectors). In addition, best practices in cross-validation will be discussed, so as to give participants a sense of how to organize their data in a way that is most rigorous when existing relationships among the data points are known. It may be possible to include deep learning methods as well.

Project 2: Representation of Data as Multi-Scale Features and Measures
Recently, multi-scale representation theorems from harmonic analysis and geometric measure theory due to Fefferman, Kenig and Pipher, Peter W. Jones, Coifman and Lafon, etc. have been exploited to compute canonical multi-scale representations of data samples. The representations have been exploited for multiple purposes, including for supervised machine learning (where they provide automatically constructed features), for unsupervised learning of regimes and anomalies, for statistical fusion and construction of confidence measures, and for data visualization. The methods are very general and have been demonstrated on network and sensor data sets. Multi-resolution inference has been proposed by X. Meng as an important new research challenge in statistics. This research collaboration would enable assessment of the applicability of multiscale representation approaches to other types of data (e.g., molecular modeling data used to study obstructive sleep apnea, and possibly a cyber-security related data set). It would also serve the purpose of introducing this approach to statistical researchers who may be interested in statistical fusion, data depth, and confidence measures. In addition, new multi-scale methods for representation of data as measures characterizing mathematical properties of the data (e.g. geometric properties) could be developed and applied.

Project 3: Inferential Models Founded in Statistical and Topological Learning
Pediatric obstructive sleep apnea (OSA) is a form of sleep-disordered breathing characterised by recurrent episodes of partial or complete airway obstruction during sleep and is prevalent in one to five percent of school-aged children. While the gold standard for pediatric OSA diagnosis is an overnight polysomnography (PSG), the high cost of this procedure and the lack of sleep clinics often precludes children from receiving necessary treatment and ultimately has a significant impact on overall future quality of life through numerous OSA-associated sequelae. A systematic review and meta-analysis of pediatric OSA literature reveals a link between craniofacial morphology and OSA prevalence in pediatric patients. The presence of this relationship has led to the hypothesis that experienced dentists and orthodontists may be able to identify children at risk of developing OSA simply by observing a child's craniofacial characteristics. In this project, we propose a study of real-word pediatric OSA datasets in order to (1) develop a statistical and topological learning (STL) model that can accurately predict OSA severity, and (2) verify whether OSA severity measurements given by orthodontists are comparable to those given by sleep specialists via PSG. To tackle the substantial number of variables inherent in OSA data—including time series data (e.g.: EOG, EMG, and ECG), three dimensional images of the face and upper airway, medical history, dental measurements, various questionnaires, blood and urine samples, and other sleep-disordered breathing risk

factors—we propose a review of existing STL methods in order to achieve the above research goals. In particular, we will incorporate techniques from various fields, including time series analysis, shape analysis, persistent homology, zigzag persistence, graphical LASSO, tensor regression, as well as numerous clustering techniques from statistics and machine learning.

Project 4: Stochastic signal processing for high dimensional data (Deanna Needell)
In today's world, data is exploding at a faster rate than computer architectures can handle. For that reason, mathematical techniques to analyze large-scale objects must be developed. One mathematical method that has gained a lot of recent attention is the use of sparsity and stochastic designs. Sparsity captures the idea that high dimensional signals often contain a very small amount of intrinsic information. Often, through randomized designs, signals can be captured using a very small number of measurements. On the recovery side, stochastic methods can accurately estimate signals from those measurements in the underdetermined setting, as well as solve large-scale systems in the highly overdetermined setting. Participants will learn the mathematical background to such acquisition and reconstruction approaches, and we will explore the impact on many applications of interest to modern researchers and practitioners. In particular, we will select several applications of interest to the group and design stochastic algorithms for those frameworks. The participants will run experiments on synthetic data from those applications, and work on theoretical guarantees for the methods.

Project 5: The Hubness Phenomenon in High Dimensional Spaces
Recent studies have established the emergence of an interesting phenomenon in high dimensional data, known as hubness. Hubness causes certain data examples to appear more often than others as neighbors of points, thus generating a skewed distribution of nearest neighbor counts.

High dimensional data are ubiquitous, e.g. text, images, and biological data can easily contain tens of thousands of features. Often, though, data have an intrinsic dimensionality that is embedded within the full dimensional space. In this project we'll investigate the relationship between the hubness phenomenon and the intrinsic dimensionality of data, with the ultimate goal of recovering the subspaces data lie within. We are particularly interested in the scenario where the relevant subspace depends on the location within the input space. The findings of this study may enable effective subspace clustering of data, as well as outlier identification.

Project 6: Codes for Data Storage with Queues for Data Access
Large volumes of data, which are being collected for the purpose of knowledge extraction, have to be reliably, efficiently, and securely stored. Retrieval of large data files from storage has to be fast (and often anonymous and private). This project is concerned with big data storage and access, and its relevant mathematical disciplines include algebraic coding and queueing theory. Large-scale cloud data storage and distributed file systems, e.g., Amazon EBS and Google FS, have become the backbone of many applications such as web searching, e-commerce, and cluster computing. Cloud services are implemented on top of a distributed storage layer that acts as a middleware to the applications, and also provides the desired content to the users, whose interests range from performing data analytics to watching movies. Coding theory has

been essential in providing solutions for reliable, efficient, and secure telecommunications, but these solutions are inadequate when storing and moving very large files across networks is necessary. Many new deep problems that arise in such circumstances simultaneously belong to both fundamental coding and queueing theory but have so far been mostly separately addressed. Participants of this project will, according to their preferences regarding combinatorics, algebra and probability, learn about and work on some coding and/or queueing problems in the era of big data. The hope is that some would take interest in both of these interwoven and indispensable aspects of big data storage and access. Undergraduates are welcome.

Participant List Topical Workshop 3

Name	**Institute**
Sarah Anderson	University of St. Thomas
Gülce Bal	Middle East Technical University
Elizabeth Beer	Institute for Defense Analyses
Yang Chen	University of Michigan
Haiyan Cheng	Willamette University
Carlotta Domeniconi	George Mason University
Natalie Durgin	Spiceworks
Hillary Fairbanks	University of Colorado Boulder
Brie Finegold	Rincon Research Corporation
Alyson Fox	University of Colorado Boulder
Julia Grigsby	Boston College
Anna Grim	Brown University
Rachel Grotheer	Goucher College
Giseon Heo	University of Alberta
Chenxi Huang	Yale/YNHH Center for Outcomes Research and Evaluation
Aarti Jajoo	Baylor College of Medicine
Ann Johnston	Penn State University
Gauri Joshi	IBM T. J. Watson Research Center
Nianqiao Ju	Harvard University
Fatemeh Kazemikordasiabi	Rutgers University
Christine Kelley	University of Nebraska-Lincoln
Soojeong Kim	Yonsei University
Katherine Kinnaird	Brown University
Fiona Knoll	Clemson University
Alona Kryshchenko	California State University of Channel Islands
Kathryn Leonard	California State University, Channel Islands
Rachel Levanger	University of Pennsylvania
Shuang Li	Colorado School of Mines
Anna Little	Jacksonville University
Anna Ma	Claremont Graduate University

Priya Mani	George Mason University
Gretchen Matthews	Clemson University
Carolyn Mayer	University of Nebraska - Lincoln
Melissa McGuirl	Brown University
F. Patricia Medina	Worcester Polytechnic Institute
Jesse Metcalf-Burton	Department of Defense
Julie Mitchell	University of Wisconsin
Deanna Needell	UCLA
Linda Ness	Rutgers University
Melissa Ngamini	Morehouse College
Megan Owen	Lehman College, City University of New York
Jing Qin	Montana State University
Franziska Seeger	University of Washington
Emina Soljanin*	Rutgers University
Sui Tang	Johns Hopkins University
Sibel Tari*	Middle East Technical University
Marilyn Vazquez	George Mason University
Xu Wang*	Wilfrid Laurier University
Melanie Weber	Princeton University
Tina Woolf	Claremont Graduate University
Karamatou Yacoubou Djima	Amherst College
Lori Ziegelmeier	Macalester College

*Workshop speaker

Some Workshop Participant Comments for "Please describe how ICERM has (or has not) added to your knowledge of experimental/computational methodologies and/or theoretical developments within this topic.":

- *I was exposed to several data science techniques and ideas that I had not seen before or had only briefly been exposed to previously: Topological Data Analysis, multiscale techniques in signal processing, the concept of hubness-- also saw more examples of the applications of these techniques to biological and medical areas. Most importantly, I met many individuals whose research I will want to read more about or alongside of whom I was able to learn or see a different viewpoint.*
- *It was interesting to see the scope of the different projects, and to see what approaches people were using. I'm much more interested in topological data analysis than I was formerly. I see the potential for useful connections between coding theory and my own field of research, which I was not aware of before.*
- *I think I was able to learn how essential it is for me to familiarize myself even more with the computational tools like R and Python that most people in my group were using. I wish we had been given more background information on the particular data and topic we were to work on. My group was divided in 2 and we only receive background info about one of the project and that was the project I wasn't working on. But apart from that my experience was great.*

- *I was placed on a project where I already had some knowledge, but I definitely learned about a new algorithm I didn't really know previously. Because of the time constraint, that was pretty much all I could learn about that week. There were a lot of other methodologies, etc. presented by the other groups that sounded interesting. During break times I was able to at least get an idea of who to contact if I wanted to know more about them and to chat informally at the time.*
- *Based on my experience, the primary material of the project was fairly new; however, I had the background to learn about the project, algorithm, and application. This was a great opportunity where I was working with others who could help answer the questions that I needed and improve my understanding of the methods. For my part of the project I worked on comparing dimension reduction techniques, e.g., PCA, independent component analysis, so I gained knowledge on how to implement those in Matlab.*
- *The workshop provided an excellent opportunity for me to work with people with different background and expertise. My group worked very efficiently. It was an accelerated learning experience and very productive week. We were also able to use the ICERM computing resources for our work, the technical support personnel was very helpful.*
- *I now have much broader awareness of theoretical developments relevant to my research interests. I also got lots of practice with statistical experiments on synthetic data.*
- *I was able to see how techniques were applied to specific problems in data science and could ask talk with the person who was applying the techniques.*
- *After working with researchers at national labs and senior students, I got a better perspective of how to approach a research problem, what are the priority questions to focus on before jumping into a solution for the problem. However, I felt the schedule was tightly packed with less room for cross group interactions.*
- *This was a fantastic experience. My only regret was that it wasn't longer. The space and support were essential to our productive collaboration.*
- *ICERM added to my knowledge of experimental/computational methodologies by providing experience with python, tensorflow for machine learning, and approaches to computational biology problems.*

Some Workshop Participant Comments for "Describe the highlight of this workshop":

- *It was great to meet so many mathematicians and data scientists. Work with them side by side for a week focused on one topic. I also enjoyed learning about different projects during final presentations*
- *We worked on two research problems, both of which will likely result in publications. Personally, I discovered a new application of my research to graph analytics processing and am excited to pursue this direction further.*
- *it is great chances to meet female mathematicians and build a collaboration relationship*
- *A highlight of the workshop was the last day - seeing what everyone had accomplished in only one week. Another highlight was the informal breaks and mealtimes that I spent with talented individuals with whom I hope to keep in touch.*

- *Realizing that my research is actually data science (instead of it being on the periphery, as I had thought)*
- *I was able to meet women with different background, some who had limited knowledge like me and others with more experience in DATA Science. I was glad to meet women that I can see myself aspiring to emulate in the future who have it all figured out it seems. I am really grateful to have been able to be a part of this Summer Workshop.*
- *It was really a great opportunity for me to have a collaboration and to have a team work experience. Also, I could find many scientific connections.*
- *One of the highlights, honestly, was being at a workshop with only other women. I was starting to feel a little apprehensive before the workshop and I realized it was because I was anticipating being part of a group and not feeling like I could contribute. When I thought more about it, I realized that in the past (at other workshops) it was because the group dynamic had been dominated by male voices and/or I had felt intimidated. Here I was less afraid to throw out ideas and speak candidly about my own doubts or struggles with the research process. I was so glad to meet other women at different career stages who sometimes struggled with imposter syndrome and not knowing what direction to go in, just like me!*
- *Having entered industry after graduate school, the most exciting thing about this workshop was the opportunity to join a research community as a Data Scientist, and further, getting traction on a research problem of interest!*
- *The two main highlights for me were: 1) having the opportunity to meet and work with a large number of women in the field. Everyone I met was so excited to be there and contribute to the projects. It was very inspirational! 2) Having the projects (vs conference style talks) was very beneficial to me as I prefer hands-on learning. I think having the smaller groups really lends itself to increased participation - as I am one of the types who often doesn't speak up as much; but the organization of this workshop allowed me to be more vocal and contribute. Because of this, I feel that I got a lot out of my experience.*
- *Expand my professional network and give me great opportunity to collaborate intensively with other researchers.*
- *I'm excited that it's all women in this workshop. Many team leaders role modeled their confidence and research excellence. This is the first time I collaborated with all women and it was the best! ICERM has treated us really well with great coffee break food. Many thanks to all the ICERM staff and organizers for their hard work.*
- *The highlight of the workshop for me was being able to meet new collaborators, work in a female-only setting, and have the opportunity to work on new data.*
- *Spending a week talking about math with women. There are some women-only events that are primarily focused on networking -- I felt that this event was very well set up so that networking happened organically, but the main focus was to actually do math, and I loved that. The diversity was also great - women in so many stages of their careers, and from so many different places!*
- *Working as a group leader with the participants was truly a joy. We worked well together and made both scientific connections and friendships over the course of the week,. I would absolutely volunteer to do this again.*

- *Working on a completely new scientific problem in a comfortable, encouraging, and positive collaborative environment. The networking and connections built during the workshop are extremely valuable, and especially connecting with other women in math and data science at all levels of their careers.*
- *Being surrounded by and doing real research with women. This was the best women-based workshop I've been to!*

Topical Workshop 4: Localized Kernel-Based Meshless Methods for Partial Differential Equations

August 7-11, 2017

Organizing Committee:
Oleg Davydov, University of Giessen, Germany
Greg Fasshauer, Colorado School of Mines
Natasha Flyer, National Center for Atmospheric Research
Bengt Fornberg, University of Colorado-Boulder
Elisabeth Larsson, Uppsala University, Sweden

Workshop Description:
This workshop will provide a platform for researchers working on localized kernel-based methods to present and discuss their latest developments, as well as the current theoretical and practical challenges in the field. These methods, such as radial basis function-generated finite differences (RBF-FD) or RBF-generated partition of unity methods (RBF-PUM), promise to develop into general-purpose meshless techniques for the numerical solution of partial differential equations that inherit the ease of implementation of the finite difference method, and yet potentially possess a greater ability than the finite element method to fit any geometry or adapt to singularities or other features of the solution.

The numerical evidence collected in recent years by a rapidly growing community of researchers suggests that these methods combine numerical stability on irregular node layouts, high computational speed, high accuracy, easy local adaptive refinement, and excellent opportunities for large-scale parallel computing. Despite recent efforts to provide error bounds for local kernel-based methods, their theory is still in its infancy.

The key topics of the workshop will include the latest computational achievements for large-scale computing in the geosciences, the mathematical tools of analysis for providing a solid foundation for the development and exploitation of the methods, the applications that benefit the most from their meshless nature, and the ways for techniques developed within other numerical methods to be combined with localized kernel-based methods in order to optimize a model in terms of accuracy and computational cost.

The main aspects of localized kernel-based methods and their applications will be presented in a number of survey lectures and tutorials accessible to graduate students and other researchers with background in numerical analysis and scientific computation.

Participant List Topical Workshop 4

Name	**Institute**
Mahdieh Alizadeh	East Tehran Branch Islamic Azad University
Sadia Arshad	Chinese Academy of Sciences
Gregory Barnett*	Sandia National Laboratory
Victor Bayona*	Universidad Carlos III de Madrid
Nahuel Caruso	Rosario National University
Jose Castillo*	San Diego State University
Oleg Davydov*	University of Giessen
Alessandra De Rossi*	University of Turin
Greg Fasshauer	Colorado School of Mines
Natasha Flyer*	NCAR
Bengt Fornberg*	University of Colorado
Doug Hardin*	Vanderbilt University
Alfa Heryudono*	University of Massachusetts, Dartmouth
Salam Khan	Alabama A&M University
Saeja Kim	University of Massachusetts Dartmouth
Manuel Kindelan*	Universidad Carlos III
Nadun Lakshitha Kulasekera Mudiyanselage	Michigan Technological University
Elisabeth Larsson*	Uppsala University
Yan Li	Brown University
Martin Maxey	Brown University
Michael McCourt*	SigOpt
Fabian Moenkeberg	EPFL Lausanne
Reza Mollapourasl	Wayne State University
Cecile Piret*	Michigan Technological University
Rodrigo Platte*	Arizona State University
Luciano Ponzellini Marinelli	National University of Rosario
Jonah Reeger*	Air Force Institute of Technology
Christian Rieger*	University of Bonn
Robert Schaback*	University of Göttingen
Varun Shankar*	University of Utah
Andriy Sokolov*	Technical university of Dortmund
Igor Tominec	University of Uppsala
Nathaniel Trask	Sandia National Laboratory
Adrean Webb*	University of Tokyo
Grady Wright*	Boise State University
Guangming Yao	Clarkson University

Zhongqiang Zhang	Worcester Polytechnic Institute
Peng Zhang	University of Electronic Science and Technology in China
Barbara Zwicknagl*	University of Würzburg

*Workshop Speaker

Some Workshop Participant Comments for "Please describe how ICERM has (or has not) added to your knowledge of experimental/computational methodologies and/or theoretical developments within this topic.":

- *This was a truly great workshop that gathered the world experts within the topic, and the results that were presented was at the very research frontier. I think we all learned new things from one another.*
- *Several fantastic people were present who had a great knowledge of the field and we're able to help me expand my understanding of it. I think that there were numerous outstanding presentations which helped me appreciate the state of the art for computational method using localized kernel approximations. There were few people discussing the theory of the topic, but I don't see that as a problem given the nature of the topic and the current research directions.*
- *All papers are very interesting that have presented during workshop. Most of the work is related to real problems in Geoscience that is valuable. Solving nonlinear problems is difficult even with numerical techniques. During this workshop I learnt that radial basis method gave excellent results for solving nonlinear equations.*
- *The present topic (kernels / RBF methods) is poised to become one of the most (if not, the most) important numerical method for large-scale simulations in a wide area of applications (geophysics, weather, climate) over the next decade. Nevertheless, specialized workshops are very rare (the last major one was at U. Mass. Dartmouth in 2011). Without ICERM now, key advances in this field (with major societal impact) would have been delayed. The workshop was extremely timely, and ICERM's role in it was critical.*

Some Workshop Participant Comments for "Describe the highlight of this workshop":

- *Presentations by Robert Schaback and Elisabeth Larsson*
- *The strong focus on localized kernel-based meshless methods had the consequence that the majority of experts working in the field were present. This led to exchanges of ideas on the highest possible level, in particular in the "Software Session" and in the "Panel Discussion". I saw that my own work on the stability problem addresses a serious gap in what can be rigorously proven about these methods, and I received plenty of encouragement to go on that way.*
- *Every talk that was given was of great interest to me (which is not always the case). The atmosphere was friendly and the discussion was alive both during sessions and breaks. The whole group moved forward together in sharing our experiences.*
- *The breadth of presenters was valuable, as were our discussions regarding the relevance of the topic outside of its core constituency. As someone (I think the only one) coming*

from industry, I appreciated being able to hear the community members with various backgrounds explain what their computational goals were and to try to identify points of overlap with my own. I think that I can use some of the ideas learned here in my own applications and look forward to collaborating with several of the presenters.

- *Good interaction between researchers specializing in computations/applications vs. in theory. This division seems to have diminished. Also, the major efforts in some national labs (such as Sandia and NCAR) came across very well - in a way that should greatly benefit the more 'academic' isolated efforts in the field - maybe a 'wake-up call' for some participants of how the field in just a few years has moved from a curiosity to maybe the most important development for the future.*
- *The highlight of the workshop was the introduction to many of the other researchers in my field that I have not yet had an opportunity to connect with. The ample breaks and format for the talks allowed for very good discussion throughout.*
    - *I discovered new fields and topics of research - I met people working on the same topic that I study*
- *Many new research presentations, new techniques, and software information.*
- *See the current state in the theory of rbf's. I had lots of inspiring discussions with the participants for my phd and future research topics.*

Topical Workshop 5: Pedestrian Dynamics: Modeling, Validation and Calibration

August 21-25, 2017

Organizing Committee:
Alethea Barbaro, Case Western Reserve University
José A. Carrillo, Imperial College London
Benedetto Piccoli, Rutgers University
Armin Seyfried, Forschungszentrum Jülich
Marie-Therese Wolfram, University of Warwick

Workshop Description:
The complex dynamical behavior of large pedestrian crowds has long fascinated researchers from various scientific fields. Academic studies began in earnest in the last century, starting with empirical observations in the early 1950's and continuing with the development of models in the field of applied physics. In more recent years, applied mathematicians have become increasingly interested in the analytical aspects and computational challenges related to simulation of existing models. With ongoing technical development, more and more data such as pedestrian trajectories and velocities have become available, leading to new questions of calibration of the mathematical models.

Since the inception of the field of study, several scientific communities have been independently working on the challenge of describing and simulating pedestrian dynamics. While mathematicians have mainly focused on the modeling and analytical aspects, physicists have developed experimental setups and methods to determine velocity data for large

pedestrian groups in different settings. In scientific computing, research interests lie, on the one hand, in data extraction from video material and, on the other, in simulation and the development of efficient computational methods to describe the dynamics of large pedestrian groups. The main aims of this workshop are to initiate contact between these scientific fields, to foster interdisciplinary research and to explore new research directions such as data assimilation techniques and big-data analysis.

Participant List Topical Workshop 5

Name	**Institute**
Nicole Abaid*	Virginia Tech
Fatima Al Reda	Paris-Sud University
Bani Anvari*	University of Southampton
Cecile Appert-Rolland*	University of Paris - Sud
Sylwester Arabas	Chatham Financial
Jiuyang Bai	Brown University
Nicolas Bain	ENS de Lyon
Muhammad Baqui	George Mason University
Alethea Barbaro	Case Western Reserve University
Brittany Baxter	Brown University
Andrea Bertozzi*	UCLA
Sachit Butail	Northern Illinois University
Jose Antonio Carrillo	Imperial College London
Alina Chertock*	North Carolina State University
Winnie Daamen*	Delft University of Technology
Gregory Dachner	Brown University
Pierre Degond*	Imperial College London
Paola Goatin*	INRIA
Susana Gomes	Imperial College London
Walter Harper	Bridgewater State University
Leah Isherwood	University of Massachusetts - Dartmouth
Dante Kalise	RICAM, Austrian Academy of Sciences
Ioannis Karamouzas*	Clemson University
Theodore Kolokolnikov*	Dalhousie University
Alona Kryshchenko	California State University of Channel Islands
Laura Kunzer*	Human Factors Research Consultancy Training
Daniel Lacker	Brown University
Benedict Leimkuhler*	University of Edinburgh
Doron Levy*	University of Maryland
Yan Li	Brown University
Dinesh Manocha*	University of North Carolina at Chapel Hill
Avi Mayorcas	Oxford University
F. Patricia Medina	Worcester Polytechnic Institute

Sebastien Motsch*	Arizona State University
Linda Ness	Rutgers University
Julien Pettre*	INRIA
Jan-Frederik Pietschmann*	University of MvºnsterMvºnster
Rabie Ramadan	Temple University
Najmeh Salehi*	Temple University
Rafael Sanchez-Bailo	Imperial College London
Filippo Santambrogio*	Laboratoire de Mathematiques d'Orsay
Armin Seyfried	Forschungszentrum Juelich
Anna Sieben*	University of Bochum
Samuel Stewart	University of Minnesota
Eitan Tadmor*	University of Maryland
Alexandria Volkening	The Ohio State University
Cornelia von Krüchten*	University of Cologne
Vardan Voskanyan	King Abdullah University of Science and Technology
Li Wang	University at Buffalo
William Warren*	Brown University
Trenton Wirth	Brown University
Marie-Therese Wolfram	University of Warwick
Abdolmajid Yolmeh	Rutgers University
Xinghui Zhiong	Zhejiang University
Ming Zhong	Johns Hopkins University
Quanyan Zhu	New York University

*Workshop speaker

Some Workshop Participant Comments for "Please describe how ICERM has (or has not) added to your knowledge of experimental/computational methodologies and/or theoretical developments within this topic.":

- *ICERM was an excellent opportunity to become familiar with bio-inspired mathematical models for engineering solutions.*
- *it's a great combination of numerics, PDE/theories, experimental methods and data. I've learned a lot from the ODE modeling perspective, and was able to make connections and possible new collaboration.*
- *The topic is highly transdisciplinary and the proportion of presenters from each discipline was well balanced. Some presentations were pedagogical, other were more for experts of the field.*
- *This workshop really introduced me to the mathematical research community in pedestrian modeling. At the CCICADA center at Rutgers I have become aware of the importance of modeling crowd movements especially in public spaces which need to be secured and I obtained simulation data from crowd simulators developed by two Rutgers CS professors. The workshop included a rich variety of theoretical and experimental work. I had begun to imagine how the problem might be formalized in terms of differential geometry so I could recognize and greatly appreciate the theoretical*

formulations. Another of my goals was to identify more sources of data. Two of the presenters have offered use of their data.
    - *Described experimental/computational methodologies were often not applicable for my purposes - I learned much about macroscopic approaches which I seldom use*
- *The workshop helped me gain knowledge through: a) Series of excellent invited talks b) The group discussion that facilitated communication between researchers from different disciplines*

Some Workshop Participant Comments for "Describe the highlight of this workshop":

- *I appreciated presentations from the field of psychology, which is not to be found in the conferences I usually go to. I would say the same from presenters from the field of mathematics, who are however easier to reach in my network.*
- *The plenary talks were phenomenal. I enjoyed the discussion about micro and macro scale models.*
- *Filippo Santambrogio's talk on formulation and application of Wasserstein distance theory to pedestrian dynamics was the highlight for me. I had several very helpful follow-up conversations with him about how to compute the Wasserstein distance for the non-parametric model that I am using to characterize stochastic processes. This is really invaluable for my research.*
- *Merging analysts and experimentalists*
- *The invited talks were the highlight for me, since I had the chance to get to know highly relevant work that other people do in different disciplines, and see how pedestrian dynamics is viewed from the eyes of a mathematician, physicist, computer scientist, psychologist, etc.*
- *Insights in macroscopic models. Psychological approaches in studying crowds.*
- *As a second year PhD student working on experiment based micro model, I never know there are macro model and meso model. And I was amazed by the similarity between physical fluid, bacteria, and human pedestrians. This workshop gave me a broad review of the field and a direction of learning.*

Note: for a list of upcoming topical workshops, see Appendix B.

Collaborate@ICERM (C@I)

Collaborate@ICERM is ICERM's newest program. It offers teams of 3-6 researchers the opportunity to spend five days at the institute during the summer (May-August) or in the month of January. The team research project should have a computational or experimental component. ICERM provides access to a variety of software packages as well as to high performance computing through Brown's Center for Computation and Visualization.

Proposals should specify the research project, the members of the team, the case for convening at ICERM, and possible dates. The proposal narrative should be no longer than 2-3 pages.

Supporting materials should include short CVs of team members. This program provides funding for travel to the institute and local accommodations for six nights. International travel is partially supported. The entire team should be present for the week at ICERM, and are required to write a 2-page follow-up report within a month of being at ICERM. Proposals involving research projects that continue a collaboration fostered at one of the past ICERM semester programs are encouraged.

Collaborate@ICERM Process

The Collaborate@ICERM selection process follows these steps:

1. Solicitation of Proposals

ICERM solicits and recruits proposals from faculty nationally.

2. Future Proposal Selection

Programs are selected from proposals submitted to ICERM in an open competition. Proposals are reviewed by the ICERM Science Board during their November annual meeting and spring conference call.

Collaborate@ICERM Participants and Projects

C@I 1: Interplay among hypersurface singularities, Hodge theory and the moduli of hypersurfaces and their hyperplane sections (May 15 - 19, 2017)

- Patricio Gallardo, University of Georgia
- Zheng Zhang, Texas A&M University
- Jesus Martinez-Garcia, Johns Hopkins University

C@I 2: Local representations of paramodular forms (Jun 12 - 16, 2017)

- Ralf Schmidt, University of Oklahoma
- Cris Poor, Fordham University
- David Yuen, Lake Forest College

C@I 3: Towards the Classification of Arithmetic Hyperbolic Reflection Groups (Jul 17 - 21, 2017)

- Benjamin Linowitz, Oberlin College
- Mikhail Belolipetsky, IMPA
- Anna Haensch, Max Planck
- Wai Kiu Chan, Wesleyan University

C@I 4: Kirrillov-Reshetikhin Supercrystals (Jul 31 - Aug 4, 2017)

- Daniel Bump, Stanford University
- Anne Schilling, UC Davis
- Travis Scrimshaw, University of Queensland
- Ben Brubaker, University of Minnesota

C@I 5: Hyperplane Arrangements (Jul 31 - Aug 4, 2017)

- Alexander Woo, University of Idaho
- William Slofstra, University of Waterloo
- Edward Richmond, Oklahoma State University

C@I 6: Iterating evolutes and involutes in the spherical and hyperbolic geometries (Jul 31 - Aug 4, 2017)

- Maxim Arnold, UT Dallas
- Ivan Izmestiev, University of Fribourg
- Sergei Tabachnikov, Penn State
- Dmitry Fuchs, UC Davis

C@I 7: Orbit decompositions of the symmetric spaces of SLn(k) (Aug 7 - 11, 2017)

- Jennifer Schaefer, Dickinson College
- Ellen Ziliak, Benedictine University
- Catherine Buell, Fitchburg State University
- Aloysius Helminck, University of Hawai'i
- Vicky Klima, Appalachian State University
- Carmen Wright, Jackson State University

Note: For summary reports from each of the Collaborate@ICERM programs listed above, see Appendix C.

Hot Topics Workshops:

This year, ICERM was the recipient of one of the Simons Foundation Targeted Grants to Institutes. The Simons funding, totaling nearly $1 million over 5-years (2017-2021), enhances and expands ICERM's efforts to bring top scholars to the institute to explore big questions in mathematical research.

ICERM uses the additional funding to improve financial support for the academic leaders of the institute’s semester-long topical conferences and workshops.

ICERM also plans to use these funds for a new type of workshop that focuses on exciting and emerging discoveries in mathematics. By design, these 2-3 day "Hot Topic" workshops allows the institute to attract key organizers and speakers and be much nimbler when developing the programs (within 3-4 months, rather than 16-20 months for our regular workshops). They can originate through suggestions from ICERM boards or the community. A Simons Foundation Targeted Grant provides financial support of around $50K for each Hot Topics workshop, including honoraria to attract key speakers and organizers.

Anyone interested in developing a Hot Topics Workshop simply needs to contact the ICERM Director with the following:

- List of potential organizers (you may suggest yourself!)
- Description of the program area/theme (1 paragraph)
- Explanation about why it is a "Hot Topic" (1 paragraph)
- List of 8-10 potential high-level speakers/participants, and their research areas.

Hot Topics suggestions are accepted on a rolling basis. Suggestions are considered by the ICERM Directors, and a sub-committee of ICERM's Scientific Advisory Board that decides which ideas are developed into workshops. ICERM responds to all Hot Topics suggestions within two weeks.

Program Promotions

ICERM programs and events are marketed through a variety of outlets: its website, dedicated Facebook page and Twitter account, targeted blast emails, posters mailed to purchased targeted university and college lists, placement of advertisements in mathematical journals and newsletters, director participation in conferences and exhibits, upcoming program fliers and announcements made available to all ICERM participants, and various on-line math organization calendars (SIAM, AMS, European Mathematical Society, National Math Institutes, and Conference Service Mandl, etc.).

ICERM's email database is made up of former and upcoming participants, ICERM board members, academic and corporate sponsors, and the department managers from higher education math departments in both the US and overseas. It currently has over 4,000 contact emails. Posters for ICERM's summer undergraduate research program (Summer@ICERM) are target mailed to institutions known to have undergraduate programs in mathematics, applied math, and computer science.

During this reporting cycle, ICERM has had a speaker, a booth and/or joint representation with other institutions at the following locations and national events:

- Hosted Modern Math Workshop at SACNAS, Fall 2017 (Salt Lake City, UT)
- Mathematical Field of Dreams Conference, Fall 2017 (St. Louis, MO)
- Joint Mathematics Meeting (JMM), Winter 2018 (San Diego, CA)
- LATMAT, Spring 2018 (Los Angeles, CA)
- Infinite Possibilities Conference, Spring 2018 (Washington, DC)

All program advertising emphasizes diverse participation and uses language encouraging minority and under-represented students to apply. More details about this can be found in the "Outreach/Diversity" section of this report.

Communications Plan

During this reporting cycle, ICERM developed a formal communications plan. ICERM will maintain contact with recent, current and upcoming program participants, board members, corporate and academic sponsors, "Friends of ICERM" (non-mathematicians), and the general population. It will do so through regular "touches" via ICERM's website, social media posts, public lectures, E-newsletters, annual magazine/report, presence at national mathematics conferences, renewal celebrations, regular marketing (posters, print ads), and ad hoc communications. Most importantly, through the efforts of the director and Brown University's Provost, ICERM has developed a solid relationship with the university's Advancement group who is committed to working with the institute to develop prospective donors and build relationships with corporations and foundations.

To date, ICERM has been met its goal of producing quarterly e-newsletters and has vastly increased its social media presence and activities. In addition, the institute looks forward to the launch of a fully redesigned website in the coming year.

Organization/Infrastructure

ICERM's governing body is a Board of Trustees (BOT). The Scientific Advisory Board (SAB) oversees all scientific activities of the Institute and selects the scientific programs. The Education Advisory Board, or EAB coordinates the oversight of educational activities at all levels at ICERM. This year, ICERM adjusted all of the board terms to a July-June cycle, which makes keeping track of membership status and recruiting easier.

Board of Trustees (BOT)

The Board of Trustees oversees all institute activities. This includes being responsible for reviewing the budget for the coming year, developing policies and procedures, advising on the appointment of new directors and actively recruiting for the position as needed, and taking a leadership role in fundraising and public awareness. The Board of Trustees has a face-to-face meeting at ICERM for one day each year (usually in late spring), and one or two conference-call meetings if needed.

Board of Trustee member appointments are for four years. Chairs from the Scientific Advisory Board (SAB) and the Education Advisory Board (EAB), as well as the ICERM Directors, act as ex officio members.

Board of Trustee Members:

Name	Institution
Douglas Arnold	University of Minnesota
Sir John Ball	University of Oxford
Jennifer Chayes	Microsoft Research
Bruce Hendrickson	Lawrence Livermore National Laboratory

Peter Jones (Chair)	Yale University
David Keyes	Columbia University/KAUST
Yann LeCun	NYU and Director of Research, Facebook
Yvon Maday	Université Pierre et Marie Curie
Jonathan Mattingly	Duke University
Jill Mesirov	University of California, San Diego
Jill Pipher	Brown University

Both Jonathan Mattingly and Jill Mesirov joined the SAB in 2017.

Note: The minutes from the May 31, 2017 annual Board of Trustees meeting can be found in Appendix D.

Scientific Advisory Board (SAB)

The Scientific Advisory Board (SAB) is responsible for approving the programs and scientific activities of the Institute. In addition, through direct communication with the Directors, Science Board members will be involved in shaping the direction of the scientific enterprise through specific suggestions of thematic programs, program organizers and participants.

Terms are three years. Three of the seats on this Board are reserved for senior representatives of Google Research, IBM, and Microsoft Research. The ICERM Directors act as ex officio members of this committee.

Scientific Advisory Board Members:

Name	**Institution**
Jeffrey Brock	Brown University
Henry Cohn	Microsoft Research
Qiang Du	Columbia University
Vanja Dukic	University of Colorado, Boulder
Charles Epstein (Chair)	University of Pennsylvania
Rachel Kuske	Georgia Institute of Technology
Ricardo Nochetto	University of Maryland
Kavita Ramanan	Brown University
Anne Schilling	University of California/Davis
Cosma Shalizi	Carnegie Mellon University
Rich Schwartz	Brown University
Carol Woodward	Lawrence Livermore National Laboratory

Kavita Ramanan joined the SAB in 2017. Anna Gilbert (2014-2017) and Guillermo Sapiro (2014-2017) rotated off in 2017.

Note: The minutes from the November 17-18, 2017 SAB annual meeting and the minutes from the May 17, 2017 mid-year SAB conference call can be found in Appendix E.

Education Advisory Board (EAB)

The Education Advisory Board is charged with (1) oversight of the mentoring mechanisms and professional development of both graduate students and postdoctoral candidates, (2) oversight of undergraduate research programs, and helping to develop and identify successful proposals, and (3) developing proposals for K-12 outreach programs, including student internships and teacher education, and identifying alternative sources of funding.

Principally, the focus of the EAB will be the educational activities pertaining to Undergraduates, Secondary and Primary school students, Teachers in STEM fields, and the community at large. Subcommittees will have oversight over the following activities:

- Summer Undergraduate Research Programs: Oversight includes the task of reviewing and rank-ordering proposals for summer undergraduate research programs from faculty.

- Outreach Activities: Oversight includes proposing and reviewing all projects and programs involving the interaction between ICERM and the communities listed above. Review of such programs will include advice on assessment and evaluation.

- External Funding: The EAB will explore opportunities for external funding for outreach activities, and, where possible, facilitate and pursue such funding opportunities.

- Public Outreach: The EAB will identify potential speakers and topics for public lectures to the community at large.

- Dissemination and Evaluation: This subcommittee will recommend external evaluators and review evaluation processes.

Terms are three years. The ICERM Directors act as ex officio members of this committee.

Education Advisory Board Members:

Name	Institution
John Ewing	Math for America
Karen Haberstroh	Brown University
Katharine A. Ott	Bates College
Lynn Rakatansky	RI Mathematics Teachers Association Executive Board
Sergei Tabachnikov (Chair)	Pennsylvania State University
Ulrica Wilson	Morehouse College

Note: The minutes from the September 15, 2017 annual Education Advisory Board meeting can be found in Appendix F.

Mathematics Institute Directors Meeting (MIDs)

The May 2017 MIDs meeting minutes can be found in Appendix G.

ICERM's Early Career Training and Mentorship

A special focus of the operations of the institute is the training and mentorship of younger and early career mathematicians, through specific outreach programs and directed opportunities for connections between mathematicians at different stages in their career. This includes ICERM's postdoctoral program, integration and support of graduate students in the context of semester programs, and summer research programs for undergraduates (Summer@ICERM). The addition of postdoctoral fellows (as described above) and graduate students is essential to the success of ICERM's programs.

Postdoctoral Program

ICERM's postdoctoral program brings early career mathematicians to the institute in order to support and expand their research and to create lasting career collaborations and connections. ICERM supports postdoctoral researchers in two different ways: postdoctoral fellows, who participate in a single semester program and are supported by a stipend, and a smaller number of institute fellows, who stay at ICERM for one year and are supported by a salary for 9 months with the possibility of additional summer support.

Recruiting and Selection of ICERM-Funded Postdocs

ICERM's postdoctoral positions are widely advertised using MathJobs.org, print and online publications of the Society for Industrial and Applied Mathematics News, Notices of the American Mathematical Society, the Association of Women in Mathematics, the Society for the Advancement of Chicanos and Native Americans in Science, and on the ICERM website. These positions are also advertised at the NSF Institute Reception at the joint meetings of the AMS/MAA. ICERM collects applications via Mathjobs.org, an online job application service provided by the American Mathematical Society.

In all written material sent out, it is emphasized that Brown is an EEO/AA Employer and that ICERM encourages applications from women and minority candidates.

ICERM sets a mid-January deadline for postdoctoral applications. Application review begins immediately and continues until the positions are filled.

The Postdoctoral Fellow Search Committee consists of the ICERM Semester Program organizers for the upcoming programs and the ICERM Director and Deputy Directors.

The program organizers review all of the applications and provide a rank-ordered list to the ICERM Directors for each of the two types of positions (Institute and Semester postdocs). Directors review the total applicant pool and the ranked lists, and may suggest changes. The

directors approve all offers, and Brown University's Dean of the Faculty generates the appointment paperwork.

2017-2018 ICERM Postdoctoral Cohort

ICERM Postdoctoral Fellows (4 months w/benefits; funds for travel to and from institute)

Name	Previous Institute	ICERM Semester Program
Wei Li	Louisiana State University	Fall 2017
Shixu Meng	University of Michigan	Fall 2017
Yimin Zhong	University of Texas at Austin	Fall 2017
David de Laat	MIT	Spring 2018
Maria Dostert	EPFL	Spring 2018
Philippe Moustrou	University of Bordeaux	Spring 2018
Yuguang Wang	UNSW Sydney	Spring 2018

ICERM Institute Fellows (9 months w/benefits; funds for travel to and from institute)

Name	Previous Institute	ICERM Semester Program
Mario Bencomo	Rice University	2017-2018: focus on Fall 2017
Wei-Hsuan Yu	ICERM	2017-2018: focus on Spring 2018

Note: one fall 2017 semester postdoc (not listed above) had to drop-out due to issues with his visa.

Based on available information, the ICERM stipend-supported postdocs for 2016-2017 break down as follows:

	Male		Female	
Black	0		0	
Hispanic	0		0	
American Indian/Alaskan Native	0		0	
Asian/Pacific Islands	4		1	
White	3		1	
Other (specify)	0	+	0	
	7		2	= 9 Total

Keeping Track of Former Postdocs (Institute and Semester)

ICERM Research Fellows are supported with a salary for one semester. We expect that these postdoctoral fellows will be on leave from, or have deferred the start of, another position. The institute makes every effort to keep in touch with its postdoctoral alums in order to track their professional growth.

ICERM-funded postdocs *(to date)*	Period of Stay	Where are they as of Spring 2018?
Emre Esenturk	Fall 2011	University of Warwick

Jeffrey Haack	Fall 2011	Los Alamos National Laboratory
Andong He	**Fall 2011**- Spring 2012	Passed away in 2016
Ahmed Kaffel	Fall 2011	Marquette University
Daniela Tonon	Fall 2011	Maître de Conférence, Université Paris Dauphine
Dongming Wei	Fall 2011	Associate Director RBC Capital Markets
Cecile Armana	Spring 2012	University of Franche-Comté
Anupam Bhatnagar	Spring 2012	Senior Data Scientist at Unity Technologies
Alon Levy	Fall 2011 – **Spring 2012**	Transit Writer at the Marron Institute
Bianca Viray	Spring 2012	University of Washington
Xiaoguang Wang	Spring 2012	Zhejiang University
Daniel Cargill	Fall 2012	Operations Research Analyst at Air Force Research Laboratory
Arnab Ganguly	Fall 2012	Louisiana State University
Peng Hu	Fall 2012	Oxford-Man University
Hao Ni	Fall 2012	University College
Aaron Smith	**Fall 2012** - Spring 2013	University of Ottawa
Julio Andrade	Fall 2012 - **Spring 2013**	Universty of Exeter
Kwangho Choiy	Spring 2013	Southern Illinois University
Zajj Daugherty	Spring 2013	CUNY
Martina Lanini	Spring 2013	Università di Roma Tor Vergata
Ben Salisbury	Spring 2013	Central Michigan University
Ryan Greene	Fall 2013	The Ohio State University
BoGwang Jeon	Fall 2013	Columbia University
Rodolfo Rios-Zertuche	Fall 2013	Ecole Normale Supérieure
Giulio Tiozzo	**Fall 2013** – Spring 2014	University of Toronto
Anastasiia Tsvietkova	Fall 2013	Rutgers University
Kyle Fox	Spring 2014	University of Texas at Dallas
Danupon Nanongkai	Spring 2014	KTH
Amanda Redlich	Spring 2014	Bowdoin College
Charalampos Tsourakakis	Spring 2014	Boston University
Grigory Yaroslavtsev	Fall 2013 - **Spring 2014**	Indiana University
Ali Ahmed	Fall 2014	Information Technology University (Lahore)
Ulas Ayaz	**Fall 2014** – Spring 2015	MIT
Jacqueline Davis	Fall 2014	Arizona State University
Pawel Siedlecki	Fall 2014	Polish Academy of Science
Li Wang	Fall 2014	University of Illinois
Tyler Helmuth	Spring 2015	University of Bristol

Marcin Lis	Spring 2015	University of Cambridge
Emily Russell	Fall 2014 – **Spring 2015**	Google
Xuan Wang	Spring 2015	Data Scientist at Databricks
Samuel Watson	Spring 2015	Brown University/DSI
Olga Balkanova	Fall 2015	University of Gothenburg
Sandro Bettin	Fall 2015	University of Genova
Edgar Costa	Fall 2015	Dartmouth College
Anna Medvedovsky	**Fall 2015** – Spring 2016	Max Planck Institute
James Weigandt	**Fall 2015** – Spring 2016	Purdue University
Abel Farkas	Spring 2016	Hebrew University of Jerusalem
Marta Canadell	Fall 2015 – **Spring 2016**	Data Scientist & Analytics at Cyberclick
Nishant Chandgotia	Spring 2016	Tel Aviv University
Zhiqiang Li	Spring 2016	Stony Brook University
Polina Vytnova	Spring 2016	University of Warwick
Hannah Alpert	**Fall 2016** – Spring 2017	The Ohio State University
Chaim Even-Zohar	Fall 2016	University of California, Davis
Isaac Mabillard	Fall 2016	Junior Business Analyst at Systemorph
Greg Malen	Fall 2016	Duke University
Jose Alejandro Samper Casas	Fall 2016	University of Miami
John Wiltshire-Gordon	Fall 2016	University of Wisconsin, Madison
Sergey Dyachenko	Fall 2016 – **Spring 2017**	University of Illinois, Urbana-Champaign
Seok Hyun Hong	Spring 2017	Penn State University
Cecilia Mondaini	Spring 2017	Texas A&M
Olga Trichtchenko	Spring 2017	University of Washington
Xeucheng Wang	Spring 2017	Tsinghua University
Xiaoqian Xu	Spring 2017	Carnegie Mellon University
Mario Bencomo	**Fall 2017** – Spring 2018	Rice University
Wei Li	Fall 2017	Louisiana State University
Shixu Meng	Fall 2017	University of Michigan
Yimin Zhong	Fall 2017	University of California, Irvine
David de Laat	Spring 2018	MIT
Maria Dostert	Spring 2018	Universität zu Köln
Philippe Moustrou	Spring 2018	University of Tromsø
Yuguang Wang	Spring 2018	University of New South Wales
Wei-Hsuan Yu	Fall 2017 – **Spring 2018**	National Central University in Taiwan

Graduate Students

Support for Graduate Students

The research semester program budget includes partial support for a cohort of graduate students. A housing allowance $850/month and travel to the institute is provided to about 10-14 graduate students each of whom applies to be in residence for the entire semester. Applicants include graduate students working with visitors to the program, as well as students who intend to come without an advisor. Graduate students must arrange for a letter of recommendation from their advisor to be sent separately. The graduate student applications are rank-ordered by the semester program organizing committee, and subsequently reviewed by the Deputy Director overseeing the development of that particular program. Final decisions are made by the directors. The ability to provide a mentor for each graduate student in residence is a factor in the decision.

Training and Mentoring Programs

Before an ICERM semester program starts, all postdocs and graduate students are assigned a mentor. The institute provides all senior mentors with written guidelines that spell out their responsibilities and the responsibilities of mentees. Currently, Associate Director Caroline Klivans coordinates these efforts and works with the members of the Program Organizing Committee assigned to be responsible for mentorship.

In addition, at the beginning of each semester program, directors hold mentor/mentee introductory meetings. These meetings emphasize that mentors should help mentees start to build a research cohort and help them create contacts and resources which will persist beyond the program.

The mentoring program for the Institute Postdoctoral Fellows necessarily includes a plan for the "off semester" when these postdocs are in residence at ICERM while there is no active research program in their area. In most cases, postdocs are matched with mentors at Brown in Math, Applied Math, or Computer Science in order to continue their ICERM research. During this reporting cycle, Institute Postdoc, Hannah Alpert, continued her ICERM "off semester" research at MIT with Larry Guth. Professor Guth is her faculty advisor and he also attended the fall 2016 semester program.

ICERM Postdoctoral Participant and Mentor list by Semester Program

Postdoc	Mentor	Program
Mario Bencomo	Vladimir Druskin	Fall 2017 ICERM Institute Postdoc
Julien Chaput*	Margaret Cheney	Fall 2017 ICERM/Independent
Wei Li	Liliana Borcea	Fall 2017 ICERM Postdoctoral Fellow
Shixu Meng	Liliana Borcea	Fall 2017 ICERM Postdoctoral Fellow
Yimin Zhong	Chrysoula Tsogka	Fall 2017 ICERM Postdoctoral Fellow
David de Laat	Henry Cohn	Spring 2018 ICERM Postdoctoral Fellow
Maria Dostert	Christine Bachoc	Spring 2018 ICERM Postdoctoral Fellow

Philippe Moustrou	Christine Bachoc	Spring 2018 ICERM Postdoctoral Fellow
Mircea Petrache	Peter Grabner	Spring 2018 ICERM/Independent
Yuguang Wang	Doug Hardin	Spring 2018 ICERM Postdoctoral Fellow
Wei Hsuan Yu	Henry Cohn	Spring 2018 ICERM Institute Postdoc

*Advisor also attended the program

Graduate Student Mentoring

Graduate Student	Mentor	Program
Symeon Papadimitropoulos*	Chrysoula Tsogka	Fall 2017
Qi Xue		Fall 2017
Jorn Zimmerling	Liliana Borcea and Vladimir Druskin	Fall 2017
Maria Etayo	Ed Saff	Spring 2018
Juan Criado del Ray	Peter Grabner	Spring 2018
Matthew de Courcy Ireland	Henry Cohn	Spring 2018
Ahram Feigenbaum*	Doug Hardin	Spring 2018
Oleksandr Vlasiuk*	Ed Saff	Spring 2018

*Advisor also attended the program/acted as mentor

Roundtable Discussions

To prepare graduate students and postdocs better for their future careers, the institute also organizes regular roundtable discussions with long-term visitors, Brown faculty, and directors, that in the course of each semester, cover the following topics:

- Preparing job applications
- Writing and submitting papers
- Writing grant proposals
- Ethics in research as required by NSF – mandatory, attendance is taken
- Job opportunities in industry and government labs

Peer-to-Peer Discussions

During semester programs, there are regularly scheduled postdoc-graduate student seminars, expressly limited to junior researchers. This gives participating postdocs and graduate students an opportunity to discuss research topics and any other issues openly, without senior people present. The format is completely flexible. For example, it could feature talks by postdocs or graduate students on their current research or provide an opportunity to read and report on papers, or give an introduction to upcoming talks in other seminars. The group could even ask a senior participant to give a tutorial lecture and then follow up with a discussion session afterwards.

Graduate Students and Postdocs as Mentors

It is expected that some of the graduate students and postdocs may play an integral part in the Summer Undergraduate programs by supporting faculty in working with the undergraduate participants.

ICERM has been approached several times by past participants asking if ICERM can share its earlier career training and mentoring program materials. For example, "I participated in one of your Professional Development sessions. I was impressed by how organized your program was, and by how positive and non-judgemental your interactions with the post-docs were. After that particular session ended, I wondered if my department (the Applied Math Department at the U. of Colorado, Boulder) might create such a well-designed mentoring program for our doctoral students and post-docs." ICERM is pleased to make all of its resource materials for its Graduate Students and Postdoctoral Fellows available to the general public on its website, which can be found at: https://icerm.brown.edu/pds/

Summer Undergraduate Research Program

Summer Undergraduate Research Program Process

The summer undergraduate research program selection process follows these steps:

1. Solicitation of Proposals

ICERM has started to solicit and recruit proposals from faculty nationwide. Faculty leading the program will spend a period of 8 weeks in Providence during the summer, teaching and supervising the undergraduates, with the assistance of graduate student TAs and/or postdoctoral fellows.

2. Future Proposal Selection

Programs are selected from proposals submitted to ICERM in an open competition. Successful programs typically have a significant computational component. Summer research programs which pair with the semester programs are especially encouraged, but not required. A subcommittee of the EAB and an Associate Director, vet proposals. External evaluations of proposals are solicited. Preliminary decisions on summer programs are made by the Directors and must be approved by the Education Advisory Board.

3. Application Process

Undergraduates apply to the program through MathPrograms.org and a ranked list of applicants are made by the faculty program leaders and the Directors.

4. Applicant Selection

Undergraduate participants are selected by instructional staff of the summer research program and the selections are finalized by ICERM Director(s). At all stages of recruitment, solicitation, and selection, committees are instructed about the diversity goals of the National Science

Foundation, and ICERM in particular. To ensure a diverse group of applicants, ICERM advertises and recruits from minority serving organizations.

Financial Decisions for Program

Each faculty member receives either salary or expenses, or some combination of the two. Both regular faculty members and senior postdoctoral researchers are eligible to serve as faculty mentors. An institute postdoc who wishes to participate in the summer program can receive summer support. Each graduate student supporting a program receives a stipend commensurate with a summer teaching stipend. Undergraduate participants funded by ICERM receive a stipend, travel funds within the United States, and meals and accommodation in a Brown dormitory.

Summer 2017: Summer@ICERM – Topological Data Analysis

June 19 – August 11, 2017

Organizing Committee:
Jeffrey Brock, Brown University
Katherine Kinnaird, Brown University
Facundo Mémoli, The Ohio State University
José Perea, Michigan State University

Program Description
The 2017 Summer@ICERM program is designed for a select group of 16-20 undergraduate scholars. The program will give undergraduates an opportunity for exposure and research in the methods of "Applied Topology" in the study of complex data sets.

The program will offer mini-courses for students at the beginning of the program:

- Persistent Homology from the Computational Viewpoint;
- Distances Between Metric Spaces and Applications; and
- Topological Time Series Analysis.

The faculty advisors will then present several research projects that are highly interdisciplinary and represent areas where topological data analysis stands to have a deep and meaningful impact:

1. Shape Classification;
2. Action Recognition;
3. Feature Recognition from Persistent Diagrams;
4. Local Persistence Diagrams;
5. Configuration Spaces;
6. Künneth Formula for Persistent Homology;
7. Classification of Music Data Streams: Music Information Retrieval; and
8. Analysis of Hippocampal Networks.

Tackling these projects will require a combination of analytical and computational approaches, and students will be expected to gain intuition into some of these problems via analysis, computer experimentation, and visualization.

Throughout the eight-week program, students will work on their assigned projects in groups of two to four, supervised by faculty advisors and aided by teaching assistants. Students will meet daily, attend mini-courses, learn how to write reports in LaTeX, give weekly team talks about their findings, attend professional development seminars, and write up their research into a poster and/or paper by the end of the program.

ICERM provides an excellent research environment, and the students and their faculty and TA mentors will have access to shared offices and collaborative space throughout the institute. They also will have access to ICERM's computer facilities and specialized software. ICERM staff will provide logistical support for students and will help build community through fun activities and events.

The Data Science Initiative, a hub at Brown University for research and education in the foundational methodologies, domain applications, and societal impacts of data science, is pleased to support this Summer@ICERM program through faculty and postdoctoral mentorship, and undergraduate support.

Participants will be expected to gain intuition into some of these problems via analysis, computer experimentation, and visualization.

All Summer@ICERM students funded by ICERM receive a $3,500 stipend, support for travel within the U.S., and room and board.

Mini-Courses:
Mini-Course 1: Theoretical Aspects of Computational Topology. Lecturer: Sara Kališnik Verovšek
This course is devoted to theoretical foundations of computational topology. We will start with a short overview of the field and show some applications that students will learn more about by the end of the class. We will define simplicial complexes, homology groups, discuss triangulations of point clouds and learn the theory behind one of the most popular tools in applied topology, persistent homology.

Mini-Course 2: Computational Topology. Lecturer: Henry Adams
This course is an introduction to computational topology, and we motivate the course topics with recent applications of topology. The first application is to data analysis: the shape of a dataset often reflects important patterns within. Two such datasets with interesting shapes are a space of 3x3 pixel patches from optical images, which can be well-modeled by a Klein bottle, and the conformation space of the cyclo-octane molecule, which is a Klein bottle glued to a 2-sphere along two circles of singularities. We introduce homology as a way to measure the number of holes in a topological space, and persistent homology as a way to measure the number of holes in a dataset.

Mini-Course 3: Distances Between Metric Spaces and Applications. Lecturer: Facundo Méamoli
This course is an introduction to Metric Geometry and applications. Of particular importance will be the definition and properties of the so called Gromov-Hausdorff distance between metric spaces and applications to shape and data analysis and matching. We'll also look into the setting of directed/asymmetric networks.

Mini-Course 4: Topological Time Series Analysis. Lecturer: Jose Perea
Time varying observations are ubiquitous in today's data rich world; examples include real-valued time series (like sounds and temperature measurements), video data (thought of as ordered sequences of image frames) and dynamic networks (again, ordered sequences of graphs).

2017 Summer@ICERM Cohort

The "Summer@ICERM" program had a cohort of 20 students. 14 students were funded through the NSF; 5 via a Brown University Undergraduate Training and Research Award (UTRA); 1 student was funded through Brown's Data Science Initiative and Mathematics Department.

Name	Institute	Role	Funding Source
Alice Antia	Carleton College	Undergraduate Student	ICERM
Leo Betthauser	Florida State University	Graduate Student	ICERM
Jeffrey Brock	Brown University	Faculty Organizer	VI-MSS
Erin Bugbee*	Brown University	Undergraduate Student	Brown UTRA
Samir Chowdhury	The Ohio State University	Graduate Student/TA	ICERM
Nathaniel Clause	Vanderbilt University	Undergraduate Student	ICERM
Peter Eastwood	Brown University	Undergraduate Student	Brown UTRA
Anna Ellison	MIT	Undergraduate Student	ICERM
Gabrielle Ferra*	Brown University	Undergraduate Student	Brown UTRA
Greg Henselman	University of Pennsylvania	Graduate Student/TA	ICERM
Adam Jaffe	Stanford University	Undergraduate Student	ICERM
Katherine Kinnaird	Brown University	Faculty Organizers	ICERM
Tequania Lake	King University	Undergraduate Student	ICERM
Michael Lin	Princeton University	Undergraduate Student	ICERM
Daniel Lopez	UC Berkeley	Undergraduate Student	ICERM

Melissa McGuirl	Brown University	Graduate Student/TA	ICERM
Facundo Memoli	The Ohio State University	Faculty Organizers	ICERM
Biraj Pandey	University of Texas at Austin	Undergraduate Student	ICERM
Jose Perea	Michigan State University	Faculty Organizer	ICERM
Jose Angel Sanchez	University of Guanajuato	Undergraduate Student	ICERM
Claire Savard	University of Michigan	Undergraduate Student	ICERM
Bonginkosi Sibanda	Brown University	Undergraduate Student	Brown Math Dept/DSI
Yitzchak Solomon	Brown University	Graduate Student/TA	DSI
Timothy Sudijono	Brown University	Undergraduate Student	Brown UTRA
Christopher Tralie	Duke University	Postdoctoral Fellow/TA	ICERM
Jonathan Weisskoff	Brown University	Undergraduate Student	Brown UTRA
Zoe Wellner	Cornell University	Undergraduate Student	ICERM
Yang Xiao	Brown University	Graduate Student/TA	ICERM
Boyan Xu	University of Illinois at Urbana- Champaign	Undergraduate Student	ICERM
Yuwei Xu	Wellesley College	Undergraduate Student	ICERM
Yixuan Zhang	Smith College	Undergraduate Student	ICERM

*Received some ICERM funding to present a poster related to S@I at JMM 2018

Here follows a sample of the most substantive comments from our Summer@ICERM participants.

Some Participant Comments for "Describe the highlight of this workshop":

- *The research process itself and getting to collaborate with a peer from another institution.*
- *Preparing the presentation was insightful. The course on the Gromov-Hausdorff distance on week two was also very interesting.*
- *For me, getting to spend time with all my friends I made there and doing cool math with them was the highlight. All the memories of hanging at Dwight house, and the Met will live in my heart forever. Close second is all the time I spent at ICERM with all the TAs and faculty mentors. (Snack time was also a highlight. Thanks Kellie!) I learnt so much AND had such a good learning experience. This whole summer was a beautiful experience. I can't stop waxing praise about it. It's only been two days since I got back home and I*

already miss all of it! All of it was just perfect. Thank you for organizing this REU. Shout out to Brown and all of ICERM!

- *Being able to do research in math for the first time, working with faculty and TAs, and making many new friendships.*
- *I felt this program was life changing. The highlight for me was feeling myself growing intellectually, through learning about the research process, being challenged, and learning from others including the TAs, faculty, and other students.*
- *The immersion in advanced math courses for 4 weeks. Leaning to use Matlab for my project. Presenting at the end.*
- *The students were a very cohesive group and I felt that I benefitted a lot from interacting with the group.*
- *research portion, working in a group. This research portion should be made a lot longer.*

Summer@ICERM 2017 Scientific Outcomes to Date

Final Student Presentations

- Comparing Songs Without Listening" by Erin Bugbee, Claire Savard, and Jonathan Weisskoff
- Vietoris-Rips Complexes of Regular Polygons" by Adam Jaffe and Bongi Sibanda
- Number Theory, Dynamics and Sliding Windows" by Tequania Lake and Yixuan (Monica) Zhang
- Recurrence in Dynamic Networks" by Biraj Pandey, Timothy Sudijono, and Vivienne Xu
- Recovering Surfaces from Real Valued Functions" by Alice Antia, Michael Lin, and Boyan Xu
- Curvature Sets" by Peter Eastwood and Anna Ellison
- Shape Matching: The case of zeolites" by Gabrielle Ferra and Danny Lopez
- Other Filtrations and Local Persistence Diagrams" by Nate Clause, Jose Angel Sanchez**, and Zoe Wellner

Completed Student Projects

Posters presented at JMM 2018 in San Diego, CA:

- Comparing Songs Using Matrix Pattern Preservation" (Erin Bugbee and Claire Savard)*
- A First Approach to a General Theory of Filtration Functions" (Nathaniel Clause and Jose Angel Sanchez Gomez)*
- Vietoris-Rips Complexes of Regular Polygons" (Adam Jaffee)*
- Shape-Matching: The Case of Zeolites" (Daniel Lopez, Gabrielle Ferra)
- Delay embeddings and topological time series analysis" (Boyan Xu)
- Geometry and Topology of the Curvature Sets of S 1" (Anna Ellison, Peter Eastwood)

*Recipient of the MAA "Outstanding Poster Award" at JMM 2018
**Recipient of a poster prize at LatinX conference at IPAM 2018

Papers:
S. Chowdhury, N Clause, F. Memoli, J. Sanchez, and Z. Wellner. New families of simplicial filtration functors. https://arxiv.org/abs/1712.00696

The Evaluation Process: Measure to Evaluate Progress

Current Program Evaluation

ICERM continues to work with Strategic Research Group (SRG), an external evaluation company, to build upon its current survey data.

ICERM now automates its survey reporting, using templates that display particular variables of interest across participants and over time. In this way, ICERM can easily recognize a pattern of program strengths in certain areas and may be able to tailor aspects of its programs to successfully equip individuals for a thriving and influential research career.

ICERM also successfully creates two and five-year follow-up surveys that are customized to a single participant instead of distributing a broad and generalized survey to all participants. An example of how customized surveys are being used at the institute is the generation of publication lists for each participant. When the survey is sent, Qualtrics reads the unique identification number of the participant stored in the panel database and generates a list of publications previously collected by ICERM staff and assigned to that specific identification number. Then, the surveyed participant is able to identify the publications that can be attributed to his or her time at ICERM. This novel incorporation of a participant-specific generated publication list has been useful in understanding how influential ICERM programs are to one's research career long-term.

Survey response rates

ICERM strives to get the highest response rate for its surveys. The director informs participants that they will receive a survey during the welcoming remarks. In addition, the institute explains within the body of every survey how it handles responses confidentially and why it collects gender and ethnicity data. Reminders are sent one or two weeks after each survey is first sent out. This year, ICERM averaged a 57% response rate on all of its exit surveys.

Measure impact across subgroups

Qualtrics cloud-based software not only aids in creating customizable surveys for participants, but also serves as a platform for analyzing data according to different subgroups of participants e.g., gender, job title, race/ethnicity.

SRG continues to assist ICERM with using the Qualtrics data analysis tools to better understand how the institute's programs impact different subgroups of researchers in both the immediate i.e., program exit surveys and intermediate-/long-term i.e., two- and five-years after program participation. Qualtrics also provides the opportunity to analyze longitudinal data, which will be helpful in the analysis of certain programs over time. Ultimately, these analyses will provide

information as to how ICERM can alter programs to benefit different types of participants who may be at various points in their research career.

Measure long-term outcomes

Since 2014, ICERM has been administering an intermediate - i.e., two-year follow-up survey to past semester program participants. Using the unique identification numbers and in-survey data analyses as described above, these surveys measure the attributable impact of participation in ICERM research programs by gathering data on published papers, invited talks, and funded or pending grant proposals. These follow-up surveys help us understand the far-reaching impact of ICERM's research programs over time. The average response rate for our two-year follow-up surveys is: 58%. The average response rate for our 5-year follow-up surveys is 33%.

ICERM continues to play a large role in gathering and updating participant information for the two and five-year follow-up surveys. Specifically, one question provides participants with a list of their papers, pre-prints, or reports published since their participation at ICERM (or, in the case of the five-year follow-up, since their initial two-year survey). Participants then have the opportunity to include/update publications resulting from their participation in an ICERM program or event. ICERM is responsible for finding and compiling these publications for each participant. Additionally, before implementing each survey, ICERM continues to be involved in editing and testing the survey in order to have an end product that will most effectively provide data aligned with its goals.

It is important to note here that although ICERM has hired SRG as its external evaluation company to aid in reaching their evaluation goals, the institute still plays a vital role in the data collection and survey distribution process. In addition, at weekly management meetings, survey results are reviewed and discussed so that improvements can be made as appropriate.

Based on feedback we received this year from an informal visit from our NSF program officer and from our Scientific Advisory Board, we will begin to create reports based on the follow-up survey data collected from our younger participants (graduate students, Postdocs, and those less than 3 years from having completed their PhDs). Specifically, we are looking to track:

- Evolution of employment roles for young participants (Grad Student to Tenured Professor).
- Across-the-board professional growth. We don't want to just highlight the superstars (i.e., those with lots of publications and funding).
- Long-term perceptions of methodological knowledge gained from ICERM participation (e.g., between the exit survey, the two-year-follow-up, and the five-year follow-up, did perceptions stay stable across time?)
- Perceptions of professional development received (e.g., between the exit survey, the two-year-follow-up, and the five-year follow-up, did perceptions stay stable across time?)
- Number of grant proposals submitted/accepted/rejected over time

- Number of continued collaborations and types of collaboration (e.g., co-author, mentor, job contact)
- Career growth by position type and gender/race

Note: Links to exit survey summaries for programs run during this reporting cycle (May 1, 2017 through April 30, 2018) can be found in Appendix H.

Reported Scientific Outcomes/Projects Initiated

In the past, the Director sent a request to all long-term participants asking for updates on their research projects and/or publications that arose during, or were enhanced by, participation in an ICERM program. With the advent of ICERM's 2-year and soon to be added 5-year follow-up survey for each of its semester programs, scientific outcomes have begun to be collected much more systematically and consistently; ICERM can now report scientific outcomes for past programs in a standardized report.

For the purposes of this report, we have summarized "projects initiated" that were reported on the Fall 2016 and Spring 2017 semester program exit surveys. Participants answered the question, "What, if any, specific projects did you initiate or continue while attending this semester program?" Using unique IDs, ICERM will be able to track the advancement of these initial projects through the subsequent standardized 2-year and 5-year follow-up surveys.

Note: a list of research projects initiated at ICERM during the Fall 2017 and Spring 2018 semester programs can be found in Appendix I.

Corporate and Academic Sponsorship

Several math institutes currently funded by the NSF employ corporate and university sponsored programs with tiered memberships. ICERM launched its own unique corporate and academic sponsorship programs in 2011.

The Corporate Sponsorship program has a $5,000 annual membership fee. To date, ICERM has received $82,500 in corporate sponsorship funds.

Corporate sponsors include:

- Microsoft Research
- Schlumberger Limited

The Academic Sponsorship has an annual membership fee of $1,500 for domestic memberships with small graduate student programs, $3,000 for domestic membership with large graduate student programs, and $5,000 for international membership. To date, ICERM has received $64,875 in academic sponsorship funds.

Academic sponsors include:

- Cornell University, Department of Mathematics
- Georgia Tech, School of Mathematics
- Hong Kong University of Science and Technology, Department of Mathematics
- Indiana University, Bloomington, Department of Mathematics
- Iowa State University, Department of Mathematics
- Korea Advanced Institute of Science and Technology, Department of Mathematical Sciences
- Korea University, Department of Mathematics
- Michigan State University, Department of Mathematics
- Michigan Tech, Department of Mathematical Sciences
- Tufts University, Department of Mathematics
- UMASS Amherst, Department of Mathematics and Statistics
- Worcester Polytechnic Institute, Mathematical Sciences Department

External Support

The institute staff will continue to aggressively work to develop new sources of support for its programs. Manager of Finance and Administration, Juliet Duyster, has duties which include managing both public and private grants, managing the proposal process and ensuring that follow-up reporting is completed. Assistant Director Ruth Crane manages relations with the institute's sponsoring corporations and serves as a liaison to Brown's Division of Advancement, which unites Alumni Relations, Development, and Advancement in a single, focused organization.

In addition to the funding provided by the NSF, ICERM receives substantial in-kind financial support from Brown University. The Director is released from teaching, and two Deputy Directors are released from half of their teaching responsibilities. In addition, ICERM is not charged for the use of its building or for custodial care which Brown values at $670,500. This year Brown gave ICERM over $100,000 ($75K of which is the university operating budget).

Other Funding Support received in 2017-2018

Additional Grants	**Amount**
American Mathematical Society Epsilon Fund	$ 5,000.00
Math for America	$ 5,000.00
MSIDI (MMW)	$ 48,492.00
TRIPODS	$ 15,644.84
Sub-total	**$ 74,136.84**

University Funding Support	
University Research Committee	$ 75,000.00
Supplemental Administrative Costs	$ 27,931.36
Brown UTRA Program for Summer@ICERM	$ 21,000.00
Sub-total	**$123,931.36**

Sponsor Support	
Academic Sponsors	$ 8,000.00
Corporate Sponsors	$ 55,000.00
Individual Sponsors	$ 2,950.00
Sub-total	**$ 65,950.00**
	_____
TOTAL	**$264,018.20**

"Mathinstitutes.org" Supplemental Funding

ICERM handles ongoing basic maintenance for the www.mathinstitutes.org website. This entails hosting the website on Brown servers, providing technical assistance to other institutes uploading data, keeping the diversity program pages and other resources current, and adjusting the video search interface as needed.

ICERM requested this supplement because the institute had been covering the costs of this work through its core grant. The supplement allows ICERM to be more active in keeping the site current and responsive to our peers as they request changes.

The main advantages of this supplement are that: 1) the NSF can quantify the ongoing cost to maintain the site; 2) ICERM staff are able to take on larger and more complex updates to the video search interface; and 3) ICERM can facilitate improvements to the presentation and organization of the diversity program webpages.

To date, work to revamp the Diversity section has been completed. This included the development of the new Mathematical Sciences Institutes Diversity Initiative (MSIDI) logo and supporting materials and templates.

The www.mathinstitutes.org site serves an important role for the Mathematical Institutes program as a whole. This supplement ensures that it evolves to meet the changing needs of each of the institutes and allows ICERM to be pro-active in responding to suggestions from program leadership on how institute activities may best be promoted. ICERM technical staff will continue to provide routine maintenance and end user support.

Diversity and Outreach

Ulrica Wilson, an Associate Professor of Mathematics at Morehouse College, is also ICERM's Associate Director of Diversity and Outreach. Ulrica continues to provide leadership in meeting institutional diversity goals: ensuring diversity throughout ICERM's programs, assisting in the development of policies and procedures, participating in national meetings and conferences, and helping to identify and obtain funding for programs and activities. In 2014, she volunteered to chair the overarching diversity committee of the Math Institutes Diversity Committee.

ICERM strongly supports the National Science Foundation's goals of expanding the numbers and diversity of individuals engaged in mathematical sciences through increased participation. Through its membership in the Math Institutes Diversity Committee, the institute actively seeks best practices for securing the participation of women and under-represented minorities in ICERM's governing bodies and in all scientific programs, workshops and events. Specifically, ICERM policy includes the following:

ICERM's Board of Trustees and Science Advisory Board work to ensure participation of women and under-represented minorities on all ICERM boards and in all scientific programs, respectively. The Director, Deputy, and Associate Directors are proactive in seeking representation of women and minorities in its undergraduate, graduate and postdoctoral programs and on organizing committees of programs and workshops, and work to liaise closely with organizing committees to increase diversity among funded participants. All past and future activities that support these goals and achievements in this area are documented on this page.

ICERM hosts or co-sponsors special events or conferences that serve women and under-represented minorities in the mathematical sciences, including diversity workshops, Blackwell-Tapia conferences, Society for Advancement of Chicanos and Native Americans in Science (SACNAS) conferences, Association for Women in Mathematics (AWM) workshops and events, and is building relationships with academic institutions that serve large minority populations.

ICERM states its commitment to diversity on all informational and promotional materials, and broadly advertises its activities and opportunities for funding. ICERM

ICERM sends diversity guides to all semester program and workshop organizers.

Diversity Events in 2017-2018

- Hosted Modern Math Workshop at SACNAS, Fall 2017 (Salt Lake City, UT)
- Mathematical Field of Dreams Conference, Fall 2017 (St. Louis, MO)
- Joint Mathematics Meeting (JMM), Winter 2018 (San Diego, CA)
- LATMATH, Spring 2018 (Los Angeles, CA)
- Infinite Possibilities Conference, Spring 2018 (Washington, DC)

Other Activities

- Continue to share funds among NSF Mathematics Institutes available for rotating programs like Modern Math Workshop and Blackwell-Tapia
- ICERM is a member of the NSF Institute-wide diversity committee
- ICERM co-supporter the AWM mentor network

Outreach Activities

Public Lectures

ICERM is pleased to be able to present regular public lectures, inviting the Brown and the local community to participate. During this reporting cycle, 3 public lectures occurred, attracting a broad audience, from high school students on up. In October 2017, 115 people attended Musical Geometry, Games, and Multimedia Art", featuring Dmitri Tymoczko (Princeton University). In February 2018, 92 people attended "Sleeping Beauty and Other Probability Conundrums", featuring Peter Winkler (Dartmouth College). And in March 2018, 48 people attended "Crowd Computing: Scientific discoveries by protein-folding game players", featuring Firas Khatib (UMass Dartmouth).

GirlsGetMath@ICERM

For the past 4 years, ICERM has been able to secure funding to run its well-received GirlsGetMath@ICERM program. GirlsGetMath aims to build knowledge and confidence in mathematics ability early in girls' education, ultimately shaping the way the girls view themselves and their mathematical interests and potential. The program hopes to inspire 25-30 girls to love math by:

- demonstrating through hands-on activities, games, and computer simulations that the study of mathematics can be exciting, fun, and useful;
- introducing the high school participants to a variety of career opportunities for which sophisticated mathematical ability plays a key role, with an emphasis on the central role mathematics plays for success in STEM careers; and
- providing the participants with a support group of like-minded peers and mentors.

GirlsGetMath Broader Impact

The mentorship provided to the participants has been specifically designed by those with experience in outreach to meet a key set of needs identified by research as being most likely to make a difference in the way the girls view mathematics and STEM disciplines. The program content is created by mathematicians who collectively have many years of experience as researchers and educators. It is crafted to be at the appropriate level for the participants, but at the same time challenging and practical. The topics are selected to showcase the beauty and depth of mathematics.

The ultimate goal is the creation of an exportable GirlsGetMath mathematics camp prototype for use at other institutions throughout the United States. The hope is that future editions will take place nationally with ICERM as a model.

ICERM is currently developing methodologies for tracking GirlsGetMath alumnae annually in order to determine if they go on to seek a college degree and if they choose to major in a STEM field. Plans for alumnae reunion events are also being developed (STEM career panel, coding party, etc.). We are already aware that a 2015 alumna is currently attending Brown, and a 2016 alumna will matriculate to Brown in fall 2018.

EPSCoR

ICERM supports the National Science Foundation's EPSCoR mission: "to assist the NSF in its statutory function "to strengthen research and education in science and engineering throughout the United States and to avoid undue concentration of such research and education." EPSCoR goals are:

1. to provide strategic programs and opportunities for EPSCoR participants that stimulate sustainable improvements in their R&D capacity and competitiveness;
2. to advance science and engineering capabilities in EPSCoR jurisdictions for discovery, innovation and overall knowledge-based prosperity.

Accepted ICERM participants from EPSCoR States

(May 1, 2017 through April 30, 2018):

EPSCoR State	# of ICERM Participants
Alabama	1
Delaware	2
Idaho	2
Iowa	2
Kentucky	2
Louisiana	5
Maine	1
Mississippi	3
Missouri	7
Montana	1
Nebraska	4
Nevada	2
New Hampshire	8
New Mexico	11
Oklahoma	4
Puerto Rico	1
Puerto Rico	1
Rhode Island	78
South Carolina	5
Tennessee	28
Utah	10
Vermont	3

Administration and Staff

ICERM Directors funded by the grant are: Jeffrey Brock, Jill Pipher, and Bjorn Sandstede. Jeff Brock and Bjorn Sandstede have committed one half summer month of effort to the institute as Associate Directors, Brendan Hassett commits 100% time.

ICERM Staff

Finance Team

Juliet Duyster, Manager of Finance and Administration, hired in August 2011: reports to the Assistant Director. Responsible for managing ICERM's finances, strategic planning, financial staff, and human resources. Provides analysis and options to the Directorate who support the resource allocation and decision process. Works with the Directorate to design and implement a strategic plan and fund-raising plan. Establishes and maintains financial systems, operational policies and human resource policies and procedures. Represents ICERM to Brown administration, government agencies, industrial and academic partners, program participants, and others. Manages ICERM's financial staff.

Nina Succi, Financial Coordinator, hired February 2016: reports to the Financial Manager. Serves as fiscal liaison and primary point of contact for ICERM staff, program organizers, visitors, postdocs, students, customers, and vendors for all financial transactions and related issues. The Financial Coordinator processes and reconciles the day-to-day financial activity for expenses supported by sponsored projects and University appropriated budgets and reconciles the purchasing/accounts payable functions. Processes purchase orders, travel reimbursements, check requests and any other reimbursements.

Events Team

Jenna Sousa, Program Manager hired May 2014: reports to the Assistant Director. Responsible for the implementation of the entire portfolio of ICERM's scientific research programs; manages a program timeline and program guide for each program, adhering to all programmatic deadlines and budgets. Major responsibilities include coordinating the housing, coordinating all communications regarding the arrival and orientation of long-term and short-term visitors; sending and tracking invitations and applications, assisting with creating a program schedule; assisting with creating marketing materials for distribution; coordinating special events; hiring and training student employees as needed to assist with event prep and administrative support.

Teresa Fitzenry, Program Coordinator, hired October 2016: one of two Program Coordinator positions. Coordinates all logistical aspects of the fall semester/later summer programs and workshops. The position coordinates the speaker invitations, housing, arrival details, and orientation of long-term and short-term visitors for assigned programs. Organizes break food and beverage for assigned workshops and semester program. Maintains participant data on ICERM's customized database. Acts as concierge for all visitors. Assist the Program Manager and Assistant Director with other activities, such as social media and other marketing, as needed.

Kellie Shaughnessy, Program Coordinator, hired February 2017: one of two Program Coordinator positions. Coordinates all logistical aspects of the spring semester/early summer programs and workshops. The position coordinates the speaker invitations, housing, arrival details, and orientation of long-term and short-term visitors for assigned programs. Organizes break food and beverage for assigned workshops and semester program. Maintains participant data on ICERM's customized database. Acts as concierge for all visitors. Assist the Program Manager and Assistant Director with other activities, such as social media and other marketing, as needed.

IT Team

Brian Lavall, Technical Support Coordinator, hired April 2014: reports to the Director of IT. The Technical Support Coordinator supports and facilitates the technological needs of ICERM staff, visiting researchers, postdocs and guests 50-100 end-users. Responsibilities include support of administrative IT and A/V equipment. Provides A/V support for the institute's workshops and events. Monitors and actively controls the Echo 360 lecture capture system and provides first level support for technical issues such as wireless connectivity and printing.

Adam Jilling, Application Developer, hired June 2016: reports to the Senior Application Developer. Performs application testing, development, and maintenance, including development/coding, testing, and ongoing maintenance of the department's front-end applications, back-end applications, java application servers, and databases.

Bernadette McHugh, Web Content Editor, hired in September 2012: reports to the Senior Application Developer. Updates and maintain website content and web-based applications used to support and promote ICERM and its activities, including semester programs, workshops, and special events. Assists with quality assurance testing of web content and data systems and routine maintenance and support as needed.

Tori Santonil, Application Developer, hired June 2016: reports to the Senior Application Developer. Performs application testing, development, and maintenance, including development/coding, testing, and ongoing maintenance of the department's front-end applications, back-end applications, java application servers, and databases.

ICERM PI and Director Biographies

Brendan Hassett (Director) joined the Brown faculty the summer of 2015 as a Professor of Mathematics. He assumed the directorship of ICERM in July 2016. Brendan received his Ph.D. from Harvard in 1996 and then spent four years at the University of Chicago before joining the faculty at Rice University in 2000. He was the chair of the mathematics department at Rice from 2009 to 2014. He has also held visiting positions at the Mittag-Leffler Institute in Stockholm, the Chinese University of Hong Kong, and the University of Paris. Brendan's research focus is algebraic geometry - the study of geometric objects that are defined as solutions to polynomial equations. Brendan has written more than 50 research papers and has authored or co-edited six books. His work has been recognized with a Sloan Research Fellowship, a National Science

Foundation CAREER award, and the Charles W. Duncan Award for Outstanding Faculty at Rice. He is a Fellow of the American Mathematical Society.

Mathew Borton was one of ICERM's first employees, hired in December 2011. As the IT Director, he brings big-picture, strategic development skills to the institute. He oversees all daily IT/technology related operational activities and ensures IT security and stability. He acts as the liaison to the Brown University's IT community. Besides supporting the scientific activities within the institute, his responsibilities include overseeing the support of administrative IT and A/V equipment, and the development and support of key web interfaces and databases. Mat received his BS in Information Technology and his MS in Technology – Information Security, both from Purdue University.

Jeffrey Brock is a Professor of Mathematics and the founding director of the Data Science Initiative at Brown University, as well as an ICERM Associate Director. Jeff's research focuses on low-dimensional geometry and topology, particularly on spaces with hyperbolic geometry. He received his undergraduate degree in mathematics at Yale University and his Ph.D. in mathematics from U.C. Berkeley, where he studied under Curtis McMullen. After holding postdoctoral positions at Stanford University and the University of Chicago, he came to Brown as an Associate Professor. He was awarded the Donald D. Harrington Faculty Fellowship to visit the University of Texas, and has had continuous National Science Foundation support since receiving his Ph.D. He was recently awarded a John S. Guggenheim Foundation Fellowship.

Ruth Crane, Assistant Director, joined ICERM in November 2010 as the institute's first employee. She has over 35 years of communications and management experience, ranging from corporate training, health care, and academia. She uses her broad range of experience in order to act as chief-of-staff and oversees the coordination and administrative aspects of all the research programs of the institute. She is the liaison for the institute's fundraising activities and coordinates grant proposals, including proposal writing. Ruth manages all ICERM marketing and oversees ICERM's web content as well as community outreach activities. She works closely with the director and the institute's boards. Ruth received her BS from Emerson College.

Sigal Gottlieb is a Deputy Director at ICERM, and a Professor of Mathematics and Director of the Center for Scientific Computing and Visualization Research at UMass Dartmouth. Sigal graduated from the Division of Applied Mathematics at Brown University (ScB'93, ScM'95, PhD'98). Her research interests include numerical analysis, scientific computing, and high-performance computing. Specifically, the high-order numerical methods for simulation of hyperbolic PDEs with shocks. These methods include WENO, spectral, and pseudo spectral methods, as well as strong stability preserving time discretizations. She is best known for her contributions to the field of high order time-stepping for hyperbolic PDEs, and her research in this area has been funded by the AFOSR continually since 2006; she is currently a PI on an AFOSR grant "High Order Strong Stability Time Discretizations Beyond the Method-of-Lines Framework". Sigal is also interested in reduced basis methods for solving PDEs with many parameters, and is co-PI with Yanlai Chen on NSF grant "Rigorous Development of an Efficient Reduced Collocation Approach for High-Dimensional Parametric PDEs".

J. Elisenda Grigsby is a Deputy Director at ICERM, and a Professor in the mathematics department at Boston College. Her background is in low-dimensional topology, and she uses categorified invariants to study braids, links, and the surfaces they bound in the three-sphere and the four-ball. Eli's work connects and unifies structures in geometric, symplectic, and contact topology, homological algebra, and representation theory. Her research has been funded by the National Science Foundation and the Simons Foundation. In 2015, she was the inaugural winner of the AWM-Birman Research Prize in Topology and Geometry, and in 2016 she was awarded the Presidential Early Career Award for Scientists and Engineers (PECASE) by President Obama. Eli received her PhD from UC, Berkeley in 2006 and has since held visiting research positions as an NSF postdoctoral scholar at Columbia from 2006-2009, a Viterbi-endowed postdoctoral scholar at MSRI (Berkeley, CA) in Spring 2010, and a Simons foundation fellow at the Newton Institute (Cambridge, UK) in Spring 2017.

Jeffrey Hoffstein is a Professor of Mathematics at Brown University, and an ICERM Consulting Director. He received his PhD in mathematics from MIT in 1978. After holding postdoctoral positions at the Institute for Advanced Study, Cambridge University, and Brown University, Jeff was an Assistant and Associate Professor at University of Rochester. He came to Brown as a full professor in 1989. His research interests are number theory, automorphic forms, and cryptography. Jeff has written over seventy papers in these fields, co-authored an undergraduate textbook in cryptography, and jointly holds seven patents for his cryptographic inventions. He was a co-founder of Ntru Cryptosystems, Inc., now merged with Security Innovation, Inc.

Jill Pipher is the Elisha Benjamin Andrews Professor of Mathematics at Brown University and ICERM's founding Director Emeritus. She is Brown University's Vice President for Research. Pipher served as Chair of the Mathematics Department 2005-2008. Jill received her Ph.D. from UCLA in 1985 and came to Brown as an Associate Professor in 1990 from the University of Chicago. Her research interests include harmonic analysis, partial differential equations and cryptography. She jointly holds four patents for the NTRU encryption and digital signature algorithms and was a co-founder of Ntru Cryptosystems, Inc., now owned by Security Innovation, Inc. Her awards include an NSF Postdoctoral Fellowship, Presidential Young Investigator Award, Mathematical Sciences Research Institute Fellowship, and an Alfred P. Sloan Foundation Fellowship. She served as President of the Association for Women in Mathematics in 2011-2013 and was a National Women's History Month 2013 Honoree. She was honored to deliver the 2016 Brown University Presidential Faculty Award lecture. Jill began her term as president-elect of the American Mathematical Society on February 1 — a position which she will hold until she officially becomes president next February 2019. Jill is a Fellow of the American Mathematical Society and a member of the American Academy of Arts and Sciences. She is currently president-elect of the American Mathematical Society.

Caroline Klivans is an Applied Mathematics and Computer Science Senior Lecturer at Brown University, and an ICERM Associate Director. Her focus is on the Institute's mentoring and professional development programs for students and postdoctoral fellows. In particular she

leads the Round-Table discussion sessions building community and career foundations. Carly received a BA degree in mathematics from Cornell University and a PhD in applied mathematics from the Massachusetts Institute of Technology. Before coming to Brown, she held positions at MSRI and the University of Chicago. Her research is in algebraic, geometric and topological combinatorics.

Bjorn Sandstede is Professor of Applied Mathematics, the newly named Director of the Data Science Initiative at Brown University, and an ICERM Associate Director. He studied mathematics at the University of Heidelberg and received his PhD in 1993 from the University of Stuttgart. After holding postdoctoral positions at the Weierstrass Institute in Berlin and at Brown University, he was a faculty member at the Ohio State University from 1997-2004, before moving in 2004 to the University of Surrey in England. In 2008, he joined the Division of Applied Mathematics at Brown University. Bjorn received an Alfred P Sloan Research Fellowship in 2000, was awarded he first JD Crawford Prize of the SIAM Activity Group on Dynamical Systems in 2001 and received a Royal Society Wolfson Research Merit Award in 2004. He is currently the editor-in-chief of the SIAM Journal on Applied Dynamical Systems. Bjorn is a Fellow of the Society for Industrial and Applied Mathematics.

Homer Walker has been a Professor of Mathematics at Worcester Polytechnic Institute since 1997 and previously held faculty appointments at Utah State University, the University of Houston, and Texas Tech University. He is currently a Consulting Associate Director for ICERM after having served as Deputy Director for several years. Homer has held visiting appointments at a number of institutions, including Cornell, Yale, and Rice Universities and Lawrence Livermore and Sandia National Laboratories. His previous administrative experience includes service as department head at WPI 1997-2002 and as program manager for the US Department of Energy Office of Science Applied Mathematics Program 2007-2008. Homer's research interests are in numerical analysis and computational mathematics, especially iterative methods for large-scale linear and nonlinear systems, implementations for high-performance computing, and applications. He has been an associate editor of SIAM Journal on Numerical Analysis and has served as a guest editor for ten special sections in SIAM Journal on Scientific Computing. He has also served on program committees for a number of national and international conferences and workshops, notably the biennial Copper Mountain Conferences on Iterative Methods, as well as on many review panels and site-visit teams for funding agencies in the US and abroad.

Ulrica Wilson is an Associate Professor of Mathematics at Morehouse College. As ICERM's Director of Diversity and Outreach, she provides leadership in meeting institutional diversity goals: ensuring diversity throughout ICERM's programs, assisting in the development of policies and procedures, participating in national meetings and conferences, and helping to identify and obtain funding for programs and activities. Ulrica's primary research has been in noncommutative ring theory and combinatorial matrix theory. Throughout her career, she has integrated opportunities to address diversity issues in the mathematical workforce. A decade of experience includes directing the Enhancing Diversity in Graduate Education EDGE Program and Research Experience for Undergraduate Faculty REUF workshops at the American Institute of

Mathematics AIM and now at ICERM. Ulrica was recently awarded Morehouse College's 2016-2017 Vulcan Teaching Excellence Award.

Facilities

ICERM is located on the 10th and 11th floors of 121 S. Main Street, in a Brown owned building in downtown Providence, RI. Visitors to ICERM are within a 10-minute walking distance of the Brown campus, the train station, major hotels, and a variety of restaurants and historic sites.

The space includes a 100-seat lecture hall, a 20-seat seminar room, a 20-seat conference room, an administrative suite, office space for 40-45 visitors, a kitchen, and three large collaborative areas.

IT Resources

ICERM's information technology group's mission is to provide the necessary tools for research, collaboration, and information dissemination required by the institute's participants and to support the administrative staff. This is accomplished by providing flexible systems that can be quickly reconfigured to meet research needs and efficient administrative tools that allow the institute's staff to maintain operational excellence.

Work Stations

ICERM provides virtual desktop systems to all semester program participants using Redhat Virtualization. The host operating system is Redhat Linux Server, the guests use Redhat Linux workstation or Windows 10, and the client machines are thin clients using a thin version of Linux. Applications are distributed as needed. Application needs differ from program to program and researcher to researcher. Individuals have administrative control over their own virtual desktops. Researchers are also free to provide their own equipment or use their own laptop. The majority of the applications provided to users will leverage existing Brown license agreements.

Web Based Tools

ICERM provides web-based tools for collaboration and to assist research. All previous talks and papers generated in the course of semester programs are archived and available for download and review via the website.

Multimedia Resources

ICERM has state of the art audio/visual capabilities. The 120-seat lecture hall features dual projection screens, a centrally controlled AV system capable of displaying multiple media types, and a lecture capture system with an auto-tracking camera for recording presentations and streaming to the web. A smaller meeting room is equipped with a video conferencing system and includes a digital media projection system. The video conferencing system can also be leveraged to communicate with the lecture hall. A seminar room on the 10th floor provides basic multimedia presentation capability and contains a smart-board system. Digital signage

screens throughout the institute are used to display important information to visitors and can be independently used as a peripheral display from a laptop.

Live Streaming

ICERM provides live, real-time video streaming of all Workshop talks, special events, and tutorial sessions given in the lecture hall.

Video Archives

ICERM digitally records semester and topical workshop talks and special lectures in High Definition using the Panopto lecture capture system. Presentations are then archived and made available for viewing on our website along with a PDF copy of the presenter's slides, when available.

Data Collection and Reporting

ICERM has developed a visitor management system called CUBE to collect and report on participant data. This system will become a central point of data management for both staff and participants as new feature sets are added.

Brown Computing Resources

ICERM participants are encouraged to use other IT resources available at Brown. Chief among these is the high-performance computing cluster hosted by the Center for Computation and Visualization. ICERM provides premium access accounts upon request to all long-term participants and to workshop participants on an as needed basis with approval from the Director.

Participants are also welcome to use the Digital Scholarship Lab at the Rockefeller Library. This room incorporates a high-definition video wall for large-scale visualization and collaboration.

CCV makes other services available to ICERM participants, including access to consultants for code creation and optimization and an immersive display environment.

APPENDIX:

Appendix A: Sample Semester Schedule & Organizer Timeline
Appendix B: Upcoming Programs and Events
Appendix C: Collaborate@ICERM Summary Reports
Appendix D: Minutes from Board of Trustees Meeting
Appendix E: Minutes from Scientific Advisory Board Meetings
Appendix F: Minutes from Education Advisory Board Meeting
Appendix G: 2017 MIDs Meeting Minutes
Appendix H: Survey Summaries May 1, 2017-April 30, 2018
Appendix I: Projects Initiated at ICERM 2017-2018
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