Institute for Pure and Applied Mathematics, UCLA
Annual Progress Report for 2010-2011
Award #0931852
June 2, 2012

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EXECUTIVE SUMMARY

Highlights of IPAM's accomplishments and activities for the fiscal year 2010-2011 include the following.

- IPAM held two long programs:
  - Modern Trends in Optimization and Its Application (fall 2010)
  - Chemical Compound Space (spring 2011)
- IPAM's 2011 winter workshops included:
  - Algorithmic Game Theory
  - Efficiency of the Simplex Method
  - Random Media
  - Mathematics of Information-Theoretic Cryptography
- IPAM held reunion conferences for the long programs Optimal Transport, Kinetic Transport, Combinatorics, and Internet MRA.
- IPAM held its 10th Anniversary Conference on Nov. 2-4, 2010. It included public lectures by Claire Tomlin and Tony Chan.
- IPAM sponsored one additional public lecture this year: S. T. Yau, "The Shape of Inner Space" (January 14, 2011).
- IPAM introduced its membership society at the 10th Anniversary Conference and raised almost $8,000 in donations the first year.
- We recruited 9 industry sponsors and 36 students for RIPS 2011. We collected 365 applications from undergraduate students.
- IPAM offered RIPS-Hong Kong for the first time, in partnership with HKUST. Eight U.S. students were chosen for the program.
- IPAM continued to support five NSF Mathematics Institutes Postdoctoral scholars.
- IPAM ran a series of workshops on Machine Reasoning in fall 2010 in partnership with ONR.
- New Board of Trustees members include David Balaban, Jeff Saltzman, Ron Stern and Pieter Swart. Al Hales began his term as chair.
- IPAM published its second annual newsletter on September 1, 2010.
- With the other NSF math institutes, IPAM co-sponsored the Modern Math Workshop at SACNAS (October 2010) and a reception at the Joint Math Meetings (January 2011).
- IPAM held a women's luncheon during an Optimization workshop in fall 2010, and another during a Chemical Compound Space workshop in May 2011.
- IPAM completed renovations to the library which added three new offices to the building. We also made improvements in the conference room. New office furniture was purchased and installed in many of the visitor offices in September 2010.

- IPAM sponsored the Women in Mathematics Symposium in February 2011, in cooperation with AWM.
- IPAM hosted the Conference for African American Researchers in the Mathematical Sciences (CAARMS) in June 2011. Immediately following it was a two-day Applied Probability Conference.
- IPAM offered the summer school "Probabilistic Models of Cognition" in July 2011.
- IPAM hired a fundraising consultant to evaluate our fundraising efforts in April 2011.

A. PARTICIPANT LIST

A list of all participants in IPAM programs will be provided in electronic form (Excel). The list includes participant lists for programs whose start dates fall between September 1, 2010 and August 31, 2011. This list includes our summer 2011 programs.

B. FINANCIAL SUPPORT LIST

A list of participant support information is provided in electronic form (Excel). The list includes all funded participants of programs that occurred between August 1, 2010 and August 31, 2011. The list includes our 2010 summer school, because they were not included in the financial support list last year due to the change in the reporting period with the new grant.

C. INCOME AND EXPENDITURE REPORT

Introduction: Program year 2010-2011 includes YR 06 of grant # 0439872-013151000, and YR 01 of grant # DMS-0931852. Thus we submit two tables showing income and expenditures; one table for each grant. We believe presenting two tables provides the most complete information.

Grant #0439872-01315100:

	A	B	C	D	E	F
			A-B=C		B+D=E	A-E=F
Budget Category	Appropriation Years 1-6	Actual Expenses as of July 2011	Current Balance as of July 2011	Encumbered Expenses as of July 2011	Total Expenses as of July 2011	Balance as of July 2011
A. Operations Fund	$8,396,893	8,396,884	9	-0-	8,396,884	$ 9
B. Participant Costs	8,636,873	8,636,873	0	-0-	8,636,873	0
C. Postdocs	1,028,098	852,947	175,151	-0-	852,947	175,151
5-Year Total Budget	$18,061,864	17,886,704	175,160	-0-	17,886,704	$175,160

The above table reflects funding through the 6th year of the grant #0439872-01315100. IPAM has received a cumulative total of $18,061,864. This amount consists of five years of funding at

$3,400,000 per year, plus the supplemental funding for program entitled, "Cyber Enabled Discovery & Innovation" (CDI) at $33,766 and the postdoctoral fellowship at $1,028,098.

Expenditures through YR 06 totaled $17,866,703 leaving a balance of $175,160. The carry-forward of funds from YR 05 was approximately $1,790,000. It was used to support the 2010-2011 programs. The carry-forward balance at the end of YR 06 is $175,160.

Expenditures up to July 31, 2011:

A. The Operational fund (salaries, benefits, equipment, supplies, and travel including overhead) for 6-year budget has a cumulative appropriation of $8,396,893 with total expenditures of $8,396,884.
B. Participant Costs for 6-year budget has appropriation of $8,636,873 with total expenditures of $8,636,873 as of July 31, 2011.
C. The supplemental funding for the postdoctoral fellowship was awarded in May 2009 and eight post doctoral scholars were hired with various start dates. The carry-forward for the supplemental is $175,151. The main goal of this supplemental is to support outstanding postdoctoral scholars who had not succeeded in finding permanent positions in the scientific job market due to the poor state of the economy. $175,151 will be used for continued post doctoral scholar support in the 7th and final year of the grant.

Combined expenditures of operational fund, participant cost, and post-doctoral scholar's category resulted in carry-forward funds of approximately $175,100. This amount will be used for continued post doctoral support. Subsequently we received permission from our Program Officer to re-budget $50,000 for participant support costs with our long program entitled, "Computational Methods in High Energy Density Plasmas", after our last post-doctoral scholar found a permanent position in the 7th and final year of the grant.

Grant # DMS-0931852:
This table covers YR 01 of grant #0931852.

	A	B	C	D	E	F
			A-B=C		B+D=E	A-E=F
Budget Category	**Appropriation Year 1**	**Actual Expenses as of August 2011**	**Current Balance as of August 2011**	**Encumbered Expenses as of August 2011**	**Total Expenses as of August 2011**	**Projected Balance as of August 2011**
A. Operations Fund	**2,270,000**	**1,577,515**	**692,485**	**6,898**	**1,584,413**	**685,587**
B. Participant Costs	**2,230,000**	**1,008,153**	**1,221,847**	**22,201**	**1,030,354**	**1,199,646**
5-Year Total Budget	**$4,500,000**	**$2,585,668**	**$1,914,332**	**$29,099**	**$2,614,767**	**$1,885,233**

IPAM received funding of $4,500,000 for the first year of this grant. Expenditures in YR 01 totaled $2,585,668 in which $29,099 is encumbered for a total of $2,614,767 in expenses. The final balance is $1,885,233 at the end of YR 01.

Expenditures for the year ended August 31, 2011:

1. The Operational Fund (salaries, benefits, equipment, supplies, and travel including overhead) for first year budget has an appropriation of $2,270,000 with total expenditures of $1,584,413.

2. Participant Support Costs for the first year budget has an appropriation of 2,230,000 with total expenditures of $1,030,354.

The balance of $1,885,233 as of August 31, 2011 is due to the carry forward of 1,790,000 at the end of the fifth year of grant #0439872. Additionally, IPAM manages its flat annual increments in a non-flat manner over the life of the grant. We expect our participant and operational expenses to increase over the remaining four years of the grant.

D. POSTDOCTORAL PLACEMENT LIST

IPAM appointed 8 postdoctoral scholars through the NSF Mathematical Sciences Institutes Postdoctoral Scholars program. Their positions began in August or September, 2009. Five of them (see table below) continued the position for a second year (2010-2011). IPAM placed the postdoctoral researchers in a research group at a university; one postdoc was assigned to a private, for-profit research group (Placental Analytics) with a UCLA affiliation. All placements were in the U.S. Two of the original eight postdocs were women, and two were Hispanic. All completed their PhDs at a U.S. institution; half of them were U.S. citizens.

IPAM's NSF Mathematical Sciences Institutes Postdoctoral Scholars 2010-2011

Last Name	First Name	Placement Institution	Placement Department	State	Topic
Alonso	Ricardo	Rice	Comp Appl Math	TX	inverse problems
Athavale	Prashant	Placental Analytics/UCLA	Math	CA	placenta imaging
Szlam	Arthur	NYU	Computer Science	NY	machine learning
Vermesi	Brigitta	University of Washington	Math and MS	WA	probability, math phys
Wen	Zaiwen	Rice	Comp Appl Math	TX	optimization

E. INSTITUTE DIRECTORS' MEETING REPORT

Mathematical Institutes Directors meeting
May 6 – 7, 2011
Minutes and Report

You will find the minutes from this meeting, held at AIM on May 6 -7, 2011, in the appendix (Appendix 1).

F. PARTICIPANT SUMMARY

In fiscal year 2010-2011, 2,438 participants enrolled in 2 long programs, 23 workshops, four reunion conferences, and four summer programs. IPAM actively seeks women and members of underrepresented ethnic groups to participate in its programs as speakers and participants. While most participants report their gender and ethnicity, some choose not to do so, and some did not respond to our request for the data. In this year, 11% of IPAM participants were members of an underrepresented minority group (combined), and 21% were women. See table F-1, below.

Table F-1: Total Participants and Underrepresented Groups by Program Type (2010-2011)

Program Type	Total Participants	Female	No. Reporting Gender	Underrepresented Ethnic Groups			No. Reporting Ethnicity
				American Indian	Black	Hispanic	
Long Programs	136	24	136	0	2	6	123
Workshops	1910	384	1872	2	122	76	1684
Summer Programs	290	77	287	2	7	16	251
Reunion Conferences	102	19	101	0	1	3	95
Total	2438	504	2396	4	132	101	2153
Percent of No. Reporting		21.0%		0.2%	6.1%	4.7%	

IPAM also looked at unique participants for 2010-2011. There were 1422 unique participants. Out of 1393 participants reporting gender, 323 of them (23.2%) were female. Out of 1240 reporting ethnicity, 149 of them (12%) reported that they are a member of an underrepresented ethnic group.

IPAM tries to balance the mandate to primarily serve the U.S. community (citizens and permanent residents) with the goal of attracting the best speakers and participants in the relevant fields. See Table F-2.

Table F-2: U.S. Citizen and Permanent Residents by Program Type (09-10)

Program Type	U.S. Citizens & Permanent Residents	No. Reporting Citizenship & Residency	percent
Long Programs	62	135	46%
Workshops	1000	1874	53%
Summer Programs	197	285	69%
Reunion Conferences	43	99	43%
Total	1302	2393	54.41%

Among IPAM's unique participants for the year, 55.7% were US citizens or permanent residents.

The majority (91.5%) of the year's participants of IPAM programs hold academic positions (faculty, postdoc, graduate student, or undergraduate student). Out of the remaining participants, 94 held positions in government or military, and 111 worked in industry. The following sections provide summary data for the requested sub-groups: postdocs, graduate students, and undergraduate students.

G. POSTDOCTORAL PROGRAM SUMMARY

IPAM had five postdoctoral scholars in 2010-2011 (see section D) but they are not included in this summary unless they also attended an IPAM long program, workshop, summer program or reunion conference. Postdocs attended IPAM's workshops, long programs, reunion conferences, and summer school, and a few serve as academic mentors in RIPS.

Table G-1: Postdocs' Gender and Ethnicity by Program Type (2010-2011)

Program Type	Total Participants	Female	No. Reporting Gender	Underrepresented Ethnic Groups			No. Reporting Ethnicity
				American Indian	Black	Hispanic	
Long Programs	27	5	27	0	0	2	25
Workshops	290	68	288	0	7	15	266
Summer Programs	15	1	15	0	0	1	14
Reunion Conferences	14	5	14	0	0	0	13
Total	346	79	344	0	7	18	318
Percent of No. Reporting		23.0%		0.0%	2.2%	5.7%	

Table G-2: Postdocs' Citizenship by Program Type (2010-2011)

Program Type	U.S. Citizens & Permanent Residents	No. Reporting Citizenship & Residency	percent
Long Programs	8	26	31%
Workshops	96	284	34%
Summer Programs	8	15	53%
Reunion Conferences	4	13	31%
Total	116	338	34.32%

H. GRADUATE STUDENT PROGRAM SUMMARY

Graduate Students participated in IPAM's workshops, long programs, reunion conferences, and summer school, and a few serve as academic mentors in our undergraduate summer programs. Graduate students often find a compelling thesis topic at an IPAM program, and also frequently make contacts that lead to their first job. See tables H-1 and H-2.

Table H-1: Graduate Students' Gender and Ethnicity by Program Type (2010-2011)

Program Type	Total Participants	Female	No. Reporting Gender	Underrepresented Ethnic Groups			No. Reporting Ethnicity
				American Indian	Black	Hispanic	
Long Programs	46	7	46	0	2	2	42
Workshops	629	139	622	1	53	25	560
Summer Programs	99	26	99	0	0	1	92
Reunion Conferences	23	7	23	0	0	2	22
Total	797	179	790	1	55	30	716
Percent of No. Reporting		22.7%		0.1%	7.7%	4.2%	

Table F-2: Graduate Students' Citizenship by Program Type (2010-11)

Program Type	U.S. Citizens & Permanent Residents	No. Reporting Citizenship & Residency	percent
Long Programs	17	46	37%
Workshops	250	625	40%
Summer Programs	59	92	64%
Reunion Conferences	6	23	26%
Total	332	786	42.24%

I. UNDERGRADUATE STUDENT PROGRAM SUMMARY

Undergraduate students participated in our summer programs, Research in Industrial Projects for Students (RIPS) in Los Angeles and Hong Kong. RIPS Projects Day is listed as a separate workshop, as we invited undergraduate students and other guests interested industrial applications of math. A detailed description of RIPS-LA and Hong Kong as well as comments from participants is available in section J of this report.

Undergraduate students also attended CAARMS—the conference for African American Researchers in Mathematical Sciences – which IPAM hosted in spring 2011. This is the only program in 2010-2011 in the workshop category that had participation by undergraduate students. No undergraduate students participated in any long programs or reunion conferences.

Table F-1: Undergraduates' Gender and Ethnicity by Program Type (2010-2011)

Program Type	Total Participants	Female	No. Reporting Gender	Underrepresented Ethnic Groups			No. Reporting Ethnicity
				American Indian	Black	Hispanic	
Workshops	18	1	18	0	14	1	18
Summer Programs	79	37	76	0	5	10	73
Total	97	38	94	0	19	11	91
Percent of No. Reporting		40.4%		0.0%	20.9%	12.1%	

Table F-2: Undergraduates' Citizenship by Program Type (2010-2011)

Program Type	U.S. Citizens & Permanent Residents	No. Reporting Citizenship & Residency	percent
Workshops	18	18	100%
Summer Programs	51	79	65%
Total	69	97	71.13%

J. PROGRAM DESCRIPTION

The programs are listed in chronological order by start date. The list includes all IPAM programs from September 1, 2010 through August 31, 2011. IPAM programs included two long programs (three months in length) and the tutorials, workshops, and culminating workshop associated with each long program; four IPAM workshops; three summer programs, four reunion conferences; three public lectures, and other miscellaneous programs sponsored or cosponsored by IPAM.

IPAM offered three **public lectures** in 2010-2011. Public lectures feature a speaker with a national reputation who speaks on a topic of broad interest to an audience that includes non-scientists. Two lectures were associated with IPAM's 10th Anniversary Conference and are listed under that program.

Most IPAM workshops and long program workshops include **poster sessions**; all participants are invited to present a poster, but graduate students are especially encouraged to participate.

LONG PROGRAM: Modern Trends in Optimization and Its Application (OP2010)
September 13 - December 17, 2010

Organizing Committee
Stephen Boyd (Stanford University, Engineering)
Emmanuel Candes (Stanford University, Applied and Computational Mathematics)
Masakazu Kojima (Tokyo Institute of Technology)
Monique Laurent (CWI, Amsterdam, and U. Tilburg)
Arkadi Nemirovski (Georgia Institute of Technology)
Yurii Nesterov (Université Catholique de Louvain)
Bernd Sturmfels (University of California, Berkeley (UC Berkeley), Mathematics)
Michael Todd (Cornell University)
Lieven Vandenberghe (University of California, Los Angeles (UCLA), EE)

Core participants were in residence at IPAM continuously for fourteen weeks. The program opened with tutorials, followed by five workshops plus a culminating workshop at UCLA's Lake Arrowhead Conference Center. Between the workshops there was a program of activities involving the long-term and short-term participants, as well as visitors.

Scientific Overview
Mathematical optimization has experienced tremendous growth in the last 20 years, and today, fundamental advances continue to occur at a furious pace. Spectacular progress has been made in our understanding of convex optimization problems and, in particular, of convex cone programming whose rich geometric theory and expressive power makes it suitable for a wide spectrum of important optimization problems arising in engineering and applied science. We have also learned how to approximate combinatorially hard optimization problems by simpler convex problems, which are tractable and provide solutions guaranteed to be close to the original optimal solution. In a different direction, robust optimization offers new techniques for handling data uncertainty by computing solutions that have a guaranteed regime of stability with respect to parameter perturbations, and prevents solutions to be too sensitive to noise or model errors. On the numerical side, recent remarkable advances in algorithms have made possible solving optimization problems involving tens of thousands of variables and/or constraints---even tens of millions in some instances---in reasonable time. These and other fundamental developments, along with progress in high-quality software, have expanded the scale and complexity of optimization problems that can be addressed in practice, and are leading to a wider adoption of optimization techniques throughout many fields in science and engineering.

This long program was centered on the development and application of these modern trends in optimization. Researchers from mathematics, computer science, operations research, engineering, and other fields, who have a common interest in optimization, gathered at IPAM to develop and exchange ideas about modern optimization which can be influenced by, and influence in turn, progress in engineering and science.

The following are comments from the anonymous Optimization program evaluation surveys:

"As an electrical engineer, I think IPAM is ideal for connecting mathematicians and engineers. For example, the optimization program was co-organized by Lieven Vandenberghe who is in UCLA's EE department."

"I will certainly keep my involvement with IPAM for the years to come. I plan to submit workshop proposals, and I will encourage colleagues at my university, the University of Washington, to keep IPAM in mind as a venue for joint math/engineering workshops."

Examples of the Optimization program's impact on careers and research interests:

Stephen Becker (Calech) met people at IPAM who helped me get my current postdoc position, so it was extremely useful. The IPAM program allowed me to meet the top experts, so it is much easier to collaborate in the future.

Grigoriy Blekherman (Virginia Tech, bioinformatics): My semester at IPAM had a very positive effect on my career. I started one productive collaboration and my semester long stay gave me a chance to have many productive discussions with other participants who arrived for different workshops. It gave me a better perspective on mathematics and applications. I was applying for tenure track positions at the time, and although I cannot quantify it, I think the participation in the program allowed me to better formulate my vision in the application materials and eventually led to a successful job search.

Yoel Drori (Tel Aviv University): My stay at IPAM helped me get a clear view on the research currently being done in the field of optimization, and therefore helped me make an educated choice for my research direction.

Michael McCoy (Caltech): The article "Two Proposals for Robust PCA using Semidefinite Programming", (published in the Electronic Journal of Statistics) was undertaken in part during my, and my coauthor's, stay at IPAM. This publication led directly to a collaboration on more recent work ("Robust Computation of Regression Planes," submitted); both of these works benefitted greatly from my exposure to the topics at the Optimization program. Additionally, as a graduate student, the broad array of optimization topics covered at OP2010 gave me a big-picture perspective on the current state of this field that is hard to gain through reading alone. By the time I finish my Ph.D. work next year, I will have three or more published papers in topics closely related to those discussed at the workshop, not to mention a completed thesis. I expect that my time at OP2010 will have a significant positive impact on my job prospects after graduation.

Michael Todd (Cornell): I became more aware of work on efficient first-order methods for very large-scale specially structured optimization problems, and of applications in compressed sensing and vision.

Examples of collaborations that resulted from the program:

Michal Kocvara (Univ. of Birmingham) and Prof Masakazu Kojima (Tokyo Institute of Technology) started a new collaboration on the solution of linear and nonlinear matrix

inequalities by domain decomposition. This collaboration promises to bring a new, very efficient class of methods for these difficult and important problems.

Jean Lasserre had several discussions with M. Schweighofer and M. Putinar about possible collaborations on research programs on links between real algebraic geometry and optimization in a broad sense.

Dirk Lorenz (TU Braunschweig): I stayed in contact with Stephen Becker and we organized a minisymposium at SIAM LA 2012 in Valencia. Moreover, Stephen Wright visited Braunschweig for a week in 2011.

Shmuel Onn (Israel Institute of Technology)'s collaboration with Susan Margulies on the paper, "On the Complexity of Hilbert Refutations for Partition."

Michael Zibulevsky (Israel Institute of Technology): I have developed a very interesting collaboration with Ewout van den Berg, on extension of LBFGS method towards partially non-differentiable functions. The work is under development. Another collaboration with Michal Kocvara allowed me to build Penalty-Barrier-Multiplier solver for semidefinite programming, which is publicly available on my homepage.

WORKSHOP: Optimization Tutorials
September 14 - 17, 2010

Organizing Committee
Monique Laurent (CWI, Amsterdam, and U. Tilburg)
Bernd Sturmfels (University of California, Berkeley (UC Berkeley), Mathematics)
Lieven Vandenberghe (University of California, Los Angeles (UCLA), EE)
Stephen Wright (University of Wisconsin-Madison, Computer Science)

Scientific Overview
The long program opened with four days of tutorials that provided an introduction to major themes of the workshops: robust optimization, convex methods in algebraic geometry, discrete optimization, sparse optimization, and recent developments in large-scale algorithms for continuous optimization.

Confirmed Speakers
Christine Bachoc (Université de Bordeaux I)
Giuseppe Calafiore (Politecnico di Torino)
Laurent El Ghaoui (University of California, Berkeley (UC Berkeley))
Michael Friedlander (University of British Columbia)
Matthias Koeppe (University of California, Davis (UC Davis))
Jiawang Nie (University of California, San Diego (UCSD))
Marc Teboulle (Tel Aviv University)
Frank Vallentin (Technische Universiteit te Delft)

WORKSHOP: Machine Reasoning Workshops I & II: Mission-Focused Representation & Understanding of Complex Real-World Data
September 20 - 24, 2010

Organizing Committee
James Allen (University of Rochester)
Lawrence Carin (Duke University, Elec and Computer Engineering)
Pedro Domingos (University of Washington, Computer Science & Engineering)
Leslie Greengard (New York University)
Carlos Guestrin (Carnegie-Mellon University)
John Laird (University of Michigan, Computer Science and Engineering)
Josh Tenenbaum (Massachusetts Institute of Technology, Brain and Cog Sc, CS, and AI)
Bob Tenney (BAE Systems)
Claire Tomlin (University of California, Berkeley (UC Berkeley))

Scientific Overview
These two workshops addressed two topics important for efficiently obtaining and utilizing the information inherent in complex real-world data, namely Representation and Understanding. Each is described in detail below.

Workshop I (Sept 20 - Sept 22): Representation of real-world information sources involves development of automated systems for supporting efficient storage, retrieval, conflation and deflation of heterogeneous data. The representations must be linked to the goal of mission-focused autonomy, and therefore must be computationally efficient. Representation products must be useable by machines, humans, and an integrated human-machine system. Compact representations are needed that support conventional sensor data, intelligence, and open-source information; these data might be highly correlated and therefore jointly compressible, but each source is often originally represented in a different alphabet. Additionally, portions of the data vector are often missing or incomplete. The uncertainty and imprecision of the representation must be quantified, while also exploiting all metadata, or side information. Representations are also required for activities, events, and other sources of information that are typically described qualitatively. These representations may be associated with other data types and be supported/ composed by/from the representation of sensor data. The data and information must be constituted at multiple scales and fidelities, linked to specific inference goals and missions. Examples of techniques that may be employed include dimensionality reduction, exploiting the fact that data with high dimensionality may reside on a low-dimensional subspace or manifold, with the latent manifold shared across heterogeneous data types.

Workshop II (Sept 22 - Sept 24): Understanding addresses how, for a given mission, data and information should be combined or fused to achieve mission-aware cognition of the environment, accounting for uncertainty, incompleteness, imprecision, and contradictory data from a disparate variety of sources. This includes methods for aligning in space and time heterogeneous data sets that are statistically related, but often employ distinct alphabets. These heterogeneous data sources must be fused to support mission-focused autonomy. The system must be adaptive, with the ability to support acquisition of new data or information, to improve

both representation and understanding, with required fidelity or precision linked to the mission and inference task. In a multi-scale framework, one must quantify how uncertainties and imprecision at a given scale propagate, and how they impact data interpretation at other scales of analysis. The fidelity and scale of required understanding must incorporate context and mission knowledge. The ability to combine and interpret the data and information must be timely so that important activities and events are not missed; the definition of "important" and the appropriate scale/resolution is linked to the mission. Relative to the mission, methods that define context and importance of particular data and information must be developed. For a given context the system must be capable of providing multiple hypotheses/explanations of the data and information that are consistent with the mission and the context.

Speakers
David Bindel (Cornell University)
Robert Calderbank (Princeton University)
John Doyle (California Institute of Technology)
Dieter Fox (University of Washington)
Emily Fox (Duke University)
Leonidas Guibas (Stanford University)
Henry Kautz (University of Rochester)
Yann LeCun (New York University)
Mauro Maggioni (Duke University)
Robert Nowak (University of Wisconsin-Madison)
Paul Rosenbloom (University of Southern California (USC))
Guillermo Sapiro (University of Minnesota, Twin Cities)
Lawrence Saul (University of California, San Diego (UCSD))
Jack Snoeyink (University of North Carolina)

WORKSHOP: Convex Optimization and Algebraic Geometry (OP workshop 1)
September 28 - October 1, 2010

Organizing Committee
William Helton (University of California, San Diego, Mathematics)
Monique Laurent (CWI, Amsterdam, and U. Tilburg)
Pablo Parrilo (MIT, Electrical Engineering and Computer Science)
Bernd Sturmfels (University of California, Berkeley, Mathematics)
Rekha Thomas (University of Washington)

Scientific Overview
Algebraic geometry has a long and distinguished presence in the history of mathematics that produced both powerful and elegant theorems. In recent years new algorithms have been developed and this has lead to unexpected and exciting interactions with optimization theory. Particularly noteworthy is the cross-fertilization between Groebner bases and integer programming, and real algebraic geometry and semidefinite programming. The latter includes approaches to polynomial optimization that are based on sums of squares, and new approximation hierarchies for hard combinatorial optimization problems.

This workshop focused on research directions at the interface of convex optimization and algebraic geometry, with both domains understood in the broadest sense. The problems and algorithms to be discussed arise from fields as diverse as functional analysis, control theory, probability theory, statistics, numerical algebraic geometry, combinatorics, multilinear algebra, and their applications in engineering and the life sciences. The development of computational benchmarks and the integration of numerical optimization software with symbolic algebra packages was a particular interest.

Speakers
Christine Bachoc (Université de Bordeaux I)
Grigoriy Blekherman (Virginia Polytechnic Institute and State University)
Petter Branden (University of Stockholm)
Etienne De Klerk (Katholieke Universiteit Brabant (Tilburg University))
Jan Draisma (Technische Universiteit Eindhoven)
Ioana Dumitriu (University of Washington)
Joao Gouveia (University of Washington)
Didier Henrion (Centre National de la Recherche Scientifique (CNRS))
Jean Lasserre (Université de Toulouse III (Paul Sabatier))
Lek-Heng Lim (University of Chicago)
Scott Mccullough (University of Florida)
Bernard Mourrain (Institut National de Recherche en Informatique Automatique (INRIA))
Jiawang Nie (University of California, San Diego (UCSD))
Raman Sanyal (University of California, Berkeley (UC Berkeley))
Konrad Schmüdgen (Universität Leipzig)
Markus Schweighofer (Universität Konstanz)
Dylan Thurston (Barnard College)
Levent Tunçel (University of Waterloo)
Victor Vinnikov (Ben Gurion University of the Negev)
Stephanie Wehner (National University of Singapore)

WORKSHOP: Numerical Methods for Continuous Optimization (OP Workshop 2)
October 11 - 15, 2010

Organizing Committee:
Stephen Wright, Chair (University of Wisconsin-Madison, Computer Science)
Don Goldfarb (Columbia University, IEOR)
Renato Monteiro (Georgia Institute of Technology)
Yurii Nesterov (Université Catholique de Louvain)
Michael Overton (New York University)
Kim Toh (National University of Singapore)

Scientific Overview
The field of optimization has recently been challenged by applications that require structured, approximate solutions, rather than the exact solutions that are the traditional goal of optimization

algorithms. Instances of structure include sparsity of the solution vector (as occurs in compressed sensing and support vector machines), low matrix rank (as required in matrix completion, distance matrix estimation, kernel regularization), and low total variation, as needed in image processing applications. Structured solutions can be obtained in some cases by modifying the optimization formulation, for example by adding regularization terms and additional constraints. The algorithms that are appropriate to solve these modified formulations may be quite different from those that work for the original formulations. This happens in part because the regularization terms frequently introduce nonsmoothness, and because highly accurate solutions (even of the regularized formulation) may not be needed by the application. Add to these factors the large size of such applications and the frequent need to solve them in real time, and we have a significant challenge to current optimization methodology.

Experts on techniques that are currently being used (or that could potentially be used) to solve sparse/structured problems and other problem classes of recent interest attended this workshop. We mention in particular techniques for conic optimization formulations (which have applications also in robust optimization), fast gradient and subgradient methods, stochastic approximation techniques, and semismooth Newton and other methods that use second-order information. The workshop also involved nonlinear programming researchers, with a view to making tighter connections between recent research in that area and the emerging paradigms discussed above.

Speakers
Michel Baes (ETH Zürich)
Emmanuel Candes (Stanford University)
Coralia Cartis (University of Edinburgh)
Frank Curtis (Lehigh University)
Alexandre dAspremont (Princeton University)
Maryam Fazel (University of Washington)
Masakazu Kojima (Tokyo Institute of Technology)
Guanghui Lan (University of Florida)
Zhaosong Lu (Simon Fraser University)
Arkadi Nemirovski (Georgia Institute of Technology)
Yurii Nesterov (Université Catholique de Louvain)
Pablo Parrilo (Massachusetts Institute of Technology)
Javier Pena (Carnegie-Mellon University)
Benjamin Recht (University of Wisconsin-Madison)
Katya Scheinberg (Lehigh University)
Nathan Srebro (Toyota Technological Institute at Chicago)
Defeng Sun (National University of Singapore)
Jared Tanner (University of Edinburgh)
Marc Teboulle (Tel Aviv University)
Michael Todd (Cornell University)
Andreas Waechter (IBM Thomas J. Watson Research Center)
Henry Wolkowicz (University of Waterloo)
Yinyu Ye (Stanford University)
Yin Zhang (Rice University)

WORKSHOP: Machine Reasoning Workshops III & IV: Mission-Focused Actions/ Reactions Based on & System Integration of Information Derived from Complex Real-World Data
October 18 - 20, 2010

Organizing Committee:
Lawrence Carin, Chair (Duke University, Elec and Computer Engineering)
James Allen (University of Rochester)
Pedro Domingos (University of Washington, Computer Science & Engineering)
Leslie Greengard (New York University)
Carlos Guestrin (Carnegie-Mellon University)
John Laird (University of Michigan, Computer Science and Engineering)
Josh Tenenbaum (Massachusetts Institute of Technology, Brain and Cog Sc, CS, and AI)
Bob Tenney (BAE Systems)
Claire Tomlin (University of California, Berkeley (UC Berkeley))

Scientific Overview
These two workshops will address two topics important for efficiently obtaining and utilizing the information inherent in complex real-world data, namely Actions/Reactions and System Integration.

Workshop III (Oct 18 - Oct 19): Plan-Replan, Act-React
This workshop focused on adaptivity, with the goal of developing a sound mathematical framework that leads to a system delivering a set of actions/strategies/policies based on existing information and consistent with the mission objectives defined by an external source. The framework must function with uncertain, incomplete, imprecise, and contradictory data, while fine-tuning and adjusting the system and inferences as new information is obtained. The system will be multi-sensor and multi-platform, operating in a scenario with limited communications capacity. The workshop will also address the development of optimal and near-optimal scheduling algorithms for sensor management. The system should recognize which information is relevant for achieving mission objectives, sufficiently reliable to enable actions to be taken, unreliable, and unknown. The system should develop strategies to collect new information that resolves ambiguities or lack of knowledge. The system must act and react in real time, and therefore computational efficiency is critical. In this context, approximate methods are envisioned with provable near-optimal performance.

A particular topic of interest is the exploitation of submodular cost functions that provide performance guarantees relative to optimality, while also yielding computational efficiency. Techniques from control and sensor scheduling are also of interest, including efficient approximations to partially observable Markov decision processes (POMDPs) and related constructs. In addition, ideas from game theory may be of interest for adapting the sensing strategy as the base of information expands. Theory on the adaptive design of optimal and near-optimal experiments is of interest as well.

Workshop IV (Oct 19 - Oct 20): System Integration
This workshop focused on constituting systems constructed from heterogeneous stationary sensors, mobile sensors, and computational resources, integrated with complex software, communication systems and humans, leading to an adaptive system that works in the field. The sensors, communications, and computation support multiple spatial and temporal constants, which leads to a challenging dynamical system. This workshop will investigate mathematical issues related to providing an engineered system with guarantees of performance. We will investigate tradeoffs between incorporating new and partially proven concepts (e.g., algorithms, software) in an adaptive sensing system, addressing the proper balance of new-technology integration with system and performance risk. The adaptive system will also be operated by and in support of humans, with the goal of having the humans perform cognitive functions and not servicing the automated portion of the system. We will also investigate the types of small-scale experiments one may perform with the new system, to test anticipated performance and make refinements. It is of interest to examine the types of experiments that need to be performed so that one may provably make the case that the system achieves the desired program goals, before full-scale testing. This may be viewed as a matrix of possible experiments and tests that need be performed; we are interested in the optimal subset of elements from this matrix that need be tested, such that one may provably assure predicted performance across the full matrix. This component of the workshop may include new ideas on low-rank matrices and matrix completion. The workshop will also encompass ideas from the optimal design of experiments, with the goal of assessing system capabilities, while also accounting for testing costs. Finally aspects of multiscale dynamical systems theory are also of interest for this workshop.

WORKSHOP: Discrete Optimization (OP workshop 3)
October 26 - 29, 2010

Organizing Committee:
Michel Goemans, Chair (Massachusetts Institute of Technology)
Sanjeev Arora (Princeton University)
Gérard Cornuéjols (Carnegie-Mellon University)
Jesus De Loera (University of California, Davis (UC Davis), Mathematics)
Friedrich Eisenbrand (École Polytechnique Fédérale de Lausanne (EPFL))
Matthias Koeppe (University of California, Davis (UC Davis), Mathematics)

Scientific Overview
Discrete optimization brings together techniques from various disciplines to tackle optimization problems over discrete or combinatorial structures. The core problems in discrete optimization (often motivated by applications) span the whole complexity spectrum, and therefore lead to a rich array of concepts and tools. Important recent and ongoing developments in the field include graph-theoretic characterizations, convex programming based relaxations and hierarchies, approximability and its limits, algebraic approaches, online optimization, and computational advances.

Experts on the different facets of discrete optimization with the goal of further improving the cross-fertilization of ideas and techniques attended the workshop. Topics included combinatorial

algorithms and characterizations, polyhedral combinatorics and integer programming, graph theory, matroids and other fundamental combinatorial structures, and nonlinear approaches and problems.

Speakers:
Amitabh Basu (University of California, Davis (UC Davis))
Maria Chudnovsky (Columbia University)
Bill Cook (Georgia Institute of Technology)
Santanu Dey (Georgia Institute of Technology)
Nick Harvey (University of Waterloo)
Elad Hazan (Technion - Israel Institute of Technology)
Volker Kaibel (Otto-von-Guericke-Universität Magdeburg)
Satyen Kale (Yahoo! Research)
Sanjeev Khanna (University of Pennsylvania)
Jon Lee (IBM Thomas J. Watson Research Center)
Susan Margulies (Rice University)
Shmuel Onn (Technion - Israel Institute of Technology)
Harald Räecke (University of Warwick)
Prasad Raghavendra (Georgia Institute of Technology)
Franz Rendl (Universität Klagenfurt)
András Sebő (CNRS, Laboratoire G-SCOP)
Bruce Shepherd (McGill University)
Mohit Singh (McGill University)
Rekha Thomas (University of Washington)

SPECIAL EVENT: IPAM's 10th Anniversary Conference
November 2 - 4, 2010

This conference was organized by the IPAM directorate.

Scientific Overview
The role of mathematics in science has been transformed over the last few decades. Emerging applications in information science, nanosystems, multiscale and multiphysics problems, bioinformatics and other fields have required new kinds of mathematics, both pure and applied. Since its inception in 2000, the Institute for Pure and Applied Mathematics (IPAM) has catalyzed the interaction of mathematics with science. IPAM's programs bring together researchers from both pure and applied mathematics and statistics, and from physical science, information and computer science, life science, engineering, social science, and humanities, to form new research communities. This workshop assessed the current state and the future of interdisciplinary mathematics and science. Speakers from academia, government and industry will present research results related to programs from IPAM's first ten years. Two public lectures and a panel discussion provided an overview of interdisciplinary mathematics and science and IPAM's role in this exciting endeavor.

Speakers
Andrea Bertozzi (University of California, Los Angeles (UCLA))
P. Jeffrey Brantingham (University of California, Los Angeles (UCLA))
Emmanuel Candes (Stanford University)
Tony Chan (Hong Kong University of Science and Technology)
Cecilia Clementi (Rice University)
John Doyle (California Institute of Technology)
Frank Graziani (Lawrence Livermore National Laboratory)
Mark Green (University of California, Los Angeles (UCLA))
Ilya Gruzberg (University of Chicago)
Peter Jones (Yale University)
David Levermore (University of Maryland)
Stanley Osher (University of California, Los Angeles (UCLA))
Rafail Ostrovsky (University of California, Los Angeles (UCLA))
George Papanicolaou (Stanford University)
Yuval Peres (Microsoft Research)
Eitan Tadmor (University of Maryland)
Timothy Tangherlini (University of California, Los Angeles (UCLA))
Joseph Teran (University of California, Los Angeles (UCLA))
Claire Tomlin (University of California, Berkeley (UC Berkeley))

Public Lecture #1
IPAM: Historical, UCLA, NSF and global perspectives
Presented by Dr. Tony Chan
Tuesday November 2, 2010

Abstract:
IPAM's 10th anniversary is an occasion to reflect on its vision, inception and success. Its scientific impact has gone beyond that of the mathematical sciences to reach into many different disciplines. Its influence and contributions at UCLA have reached beyond the Math Dept and Physical Sciences to many other parts of campus. As an NSF national institute, it has served as an important infrastructure for the US mathematical sciences community, especially in acting as a platform to interact with other academic disciplines. Finally, the success of US mathematical institutes, IPAM included, has at least partially inspired many similar endeavors in other nations. I'll give a personal perspective on these aspects of IPAM, from the perspective of a co-Principal Investigator of the IPAM proposal to NSF (and as UCLA Math Department Chair at the time), later as a Dean of Physical Sciences at UCLA, subsequently as an Assistant Director at NSF for the Mathematical and Physical Sciences and now as president of a university in Asia nurturing a new Institute for Advanced Studies.

Public Lecture #2
Mathematics for Air Traffic Control and Other Hybrid Systems
Presented by Dr. Claire Tomlin
Wednesday November 3, 2010

Abstract:
Updating the Air Traffic Control system with new algorithms, automation, and decision making tools is an important problem, yet the transportation needs in the United States today present challenges that are not answered by the kinds of control systems that have been built in the past. First, aircraft today are equipped with accurate sensors, wireless datalink for communication, and fast onboard computers, giving the Air Traffic Control system a set of sensory and computational resources that are distributed throughout the airspace. Second, there is no mechanism for the air traffic system to support the integration of autonomous pilotless aircraft, known as Unmanned Aerial Vehicles (UAVs). A burgeoning industry, these aircraft are used in situations in which it is too dull, or too dangerous, for piloted aircraft. Third, there are strong economic drivers to bring in new, efficient methods for embedded software design for transportation systems, which enable safety critical system verification and validation in a cost effective way.
To address these needs in air transportation, new kinds of control algorithms for automated decision making are needed. They will demand new ways of modeling large scale systems. They will require strict guarantees of safety and efficiency. The technological focus of the research in my lab is a new kind of mathematical model, known as a hybrid system, which combines discrete state and continuous state dynamics. We have developed new control algorithms and software, to both design controllers for hybrid systems that can guarantee system safety, and to optimize system performance. In this talk, I will present some of these algorithms, and give examples of how they have been applied to problems in Air Traffic Control.

WORKSHOP: Robust Optimization (OP Workshop 4)
November 16 - 19, 2010

Organizing Committee
Aharon Ben-Tal, Chair (Technion - Israel Institute of Technology)
Dimitris Bertsimas (Massachusetts Institute of Technology)
Jason Cong (University of California, Los Angeles (UCLA), Computer Science Department)
Laurent El Ghaoui (University of California, Berkeley (UC Berkeley))
Arkadi Nemirovski (Georgia Institute of Technology)

Scientific Overview
The workshop presented an overview of robust optimization, a vibrant field in optimization which addresses uncertainty in optimization problems. Many practical optimization problems involve uncertainty, coming from measurement errors, errors in the variables, or uncertainty about future decisions. It is therefore important to be able to find, in a moderate computing time, solutions that trade-off optimality against some measure of risk involved in the optimal decision.
The robust optimization methodology seeks solutions that are robust (e.g., guaranteed to remain feasible, or achieve some bound on the cost function) despite changes in the problem's data. While most such problems are hard, the methodology now provides computationally efficient approximation schemes that offer a nice balance between performance and guaranteed quality of approximation. The field is relevant to many areas of applied science, including statistical estimation and inference, and control theory.

The workshop provided a guided tour of the area, exploring various ways to describe uncertainty (from parameter bounds to random variables with partially known distributions), approximate the decision problem (with quality estimates), or addressing dynamic (control) problems where the uncertainty is partially revealed as time evolves. The workshop also included several case studies in various application domains, ranging from signal processing, machine learning, communications, graph theory, circuit design, to finance and economics, logistics and operations research.

Speakers:
Chiranjib Bhattacharyya (Indian Institute of Science)
David Brown (Duke University)
Constantine Caramanis (University of Texas at Austin)
Xuan Vinh Doan (University of Waterloo)
Vineet Goyal (Columbia University)
Dan Iancu (Stanford University)
Garud Iyengar (Columbia University)
Daniel Kuhn (Imperial College)
Karthik Natarajan (City University Hong Kong)
Michael Orshansky (University of Texas at Austin)
Pablo Parrilo (Massachusetts Institute of Technology)
Guillaume Roels (University of California, Los Angeles (UCLA))
Sachin Sapatnekar (University of Minnesota, Twin Cities)
Ankur Srivastava (University of Maryland)
Aurelie Thiele (Lehigh University)
Chandu Visweswariah (IBM Systems and Technology Group)
Tao Yao (Pennsylvania State University)
Yinyu Ye (Stanford University)
Yuriy Zinchenko (University of Calgary)

WORKSHOP: Applications of Optimization in Science and Engineering (OP Workshop 5)
November 30 - December 3, 2010

Organizing Committee
Stephen Boyd (Stanford University, Engineering)
Yonina Eldar (Technion - Israel Institute of Technology, Electrical Engineering)
Tom Luo (University of Minnesota, Twin Cities)
Bernhard Scholkopf (Max-Planck-Institute for Biological Cybernetics)
Lieven Vandenberghe (University of California, Los Angeles (UCLA), Electrical Engineering)

Scientific Overview
Recent advances in optimization have made an important impact in a variety of disciplines, including control, communications, signal processing, image processing, machine learning, and computer vision. Conversely, applications in engineering and science have motivated new research directions in optimization. The workshop featured speakers from a range of application

areas. They discussed the role that optimization has played in their fields, opportunities for new applications, and the future challenges they see for optimization theory, algorithms, and software.

Speakers:
Amir Beck (Technion - Israel Institute of Technology)
Kristin Bennett (Rensselaer Polytechnic Institute)
Mung Chiang (Princeton University)
Daniel Cremers (Technische Universtitat München)
Moritz Diehl (Katholieke Universiteit Leuven)
Laurent El Ghaoui (University of California, Berkeley (UC Berkeley))
Yonina Eldar (Technion - Israel Institute of Technology)
Richard Hartley (Australian National University)
Mikhael Johansson (Royal Institute of Technology (KTH))
Michal Kocvara (University of Birmingham)
Juan Meza (Lawrence Berkeley Laboratory)
Manfred Morari (ETH Zürich)
Stanley Osher (University of California, Los Angeles (UCLA))
Asuman Ozdaglar (Massachusetts Institute of Technology)
Daniel Palomar (Hong Kong University of Science and Technology)
Daniel Segre (Boston University)
Suvrit Sra (Max-Planck-Institute for Biological Cybernetics)
Luminita Vese (University of California, Los Angeles (UCLA))
Martin Wainwright (University of California, Berkeley (UC Berkeley))
Wei Yu (University of Toronto)

WORKSHOP: Optimization Culminating Workshop at Lake Arrowhead
December 12 - 17, 2010

The culminating workshop was organized by the long program organizing committee.

The final workshop in the long program, held at Lake Arrowhead Conference Center, provided an opportunity for the program's core participants to report on their work during the past three months and to discuss future projects. Many of the collaborations and interactions that were formed during the program had a chance to deepen.

WORKSHOP: Algorithmic Game Theory
January 10 - 14, 2011

Organizing Committee
Gunes Ercal (University of Kansas, Computer Science)
Allon Percus (Claremont Graduate University, School of Mathematical Sciences)
Vwani Roychowdhury (University of California, Los Angeles (UCLA), Electrical Engineering)
Sudhir Singh (University of California, Los Angeles (UCLA), Electrical Engineering)

Scientific Overview

The wealth of strategic interactions among Internet agents with very diverse interests, in varying degrees of competition and cooperation, naturally calls for a fusion of tools from computer science, game theory and economics. A new research area called Algorithmic Game Theory (AGT) has emerged as a result of such a fusion. However, AGT is not just about applying analytical tools from computer science to game theory/economics or vice versa but primarily about providing new conceptual perspectives at a very fundamental level. For example, while efficient computability of best responses is a natural consideration for an algorithm designer, this in turn lends questionability to the classical economics assumption that agents be fully rational, opening way for study of equilibria under bounded rationality. On the other hand, the desirable game-theoretic solution concepts (e.g. correlated, Nash, truthfulness) for different scenarios must be fundamentally guided by underlying economic principles, and already a richness can be seen in the feedback between the two fields.

While Nash equilibria are difficult to compute even for two player games, there exists an efficient algorithm to compute correlated equilibria for any succinctly representable game. An example of a more lucrative interplay that involves the design of mechanisms guaranteed to satisfy some desirable stability requirements (e.g. truthfulness) all the while also minimizing overpayments has opened way to a boom of sponsored search advertising that dominates much of the internet industry today. Indeed, the scope and diversity of the Internet economy and the social transactions that can be potentially studied and analyzed via algorithmic game theoretic techniques has been exploding exponentially, and there is a need for continued dialogs among the various communities to get a better understanding of the underlying concepts and issues.
Scientists and researchers from various communities such as mathematics, computer science, economics, game theory, information theory, from academia as well as industry provided a joint platform to discuss fundamental issues in the emerging interdisciplinary field of Algorithmic Game Theory.

Speakers:

Shuchi Chawla (University of Wisconsin-Madison)
Fan Chung-Graham (University of California, San Diego (UCSD))
Edith Elkind (Nanyang Technological University)
Lance Fortnow (Northwestern University)
Ashish Goel (Stanford University)
Jason Hartline (Northwestern University)
Nicole Immorlica (Northwestern University)
Kamal Jain (Microsoft Research)
Rahul Jain (University of Southern California (USC))
Anna Karlin (University of Washington)
David Kempe (University of Southern California (USC))
De Liu (University of Kentucky)
Randolph McAfee (Yahoo)
Aranyak Mehta (Google Inc.)
Adam Meyerson (University of California, Los Angeles (UCLA))
Pablo Parrilo (Massachusetts Institute of Technology)

Aditya Ramamoorthy (Iowa State University)
Tim Roughgarden (Stanford University)
Vwani Roychowdhury (University of California, Los Angeles (UCLA))
Walid Saad (Princeton University)
Michael Schwarz (Yahoo! Research)
Éva Tardos (Cornell University)
Vijay Vazirani (Georgia Institute of Technology)
Shing-Tung Yau (Harvard University)

PUBLIC LECTURE
The Shape of Inner Space: String Theory and the Geometry of the Universe's Hidden Dimensions
Presented by Shing-Tung Yau, Professor of Mathematics, Harvard
Friday, January 14, 2011

Abstract:
One of the smallest things you can possibly imagine—six-dimensional geometric spaces that may be more than a trillion times smaller than an electron—could, nevertheless, be one of the defining features of our universe, exerting a profound influence that extends to every single point in the cosmos. In his book, Yau tells the story of those spaces, which physicists have dubbed "Calabi-Yau manifolds." Yau managed to prove the existence, mathematically, of those spaces, despite the fact that he had originally set out to prove that such spaces could not possibly exist. This mathematical proof, which had initially been ignored by physicists (partly because it was steeped in difficult, nonlinear arguments), nevertheless made its way into the center of string theory, which now stands as the leading theory of the universe and our best hope yet of unifying all the particles and forces observed—and yet to be observed—in nature.

WORKSHOP: Efficiency of the Simplex Method: Quo vadis Hirsch conjecture?
January 18 - 21, 2011

Organizing Committee
Margaret Bayer (University of Kansas, Mathematics)
Jesus De Loera (University of California, Davis (UC Davis), Mathematics)
Antoine Deza (McMaster University)
Gil Kalai (Hebrew University, Institute of Mathematics)
Shanghua Teng (University of Southern California (USC))

Scientific Overview
Linear programs are the backbone of computation and theory in mathematical optimization. Linear optimization problems involve maximizing or minimizing a linear function over a domain defined by a set of linear equalities and inequalities. The simplex and primal-dual interior point methods are currently the most computationally successful algorithms for linear optimization. The simplex method can be viewed as a family of combinatorial local search algorithms on the boundary of a convex polyhedron. More precisely, the search is done over a finite graph, the

skeleton of the polyhedron, composed of the vertices and edges of the feasible region. The search moves from a vertex of the skeleton to a neighboring one with a better objective value, according to a chosen "pivot rule". Today, after sixty years of use and despite remarkable progress with competing interior point methods, the simplex method is still widely used and remains important in practice, particularly in combinatorial optimization and integer programming.

However, while the polynomial complexity of interior point methods has been established, we still do not have a complete understanding of the performance of the simplex method, in particular the number of pivots needed to go from a starting vertex to an optimal vertex. In 1957, Hirsch conjectured that the diameter of the skeleton defined by n inequalities in d dimensions is at most n-d. Fifty-three years later this conjecture, this original Hirsch conjecture, remains open. In fact, despite great effort, we still do not know whether there is a polynomial bound on the shortest path between two vertices in the skeleton of a polyhedron. Many authors have tried to approach this variation of the Hirsch conjecture. The best upper bound, due to Kalai and Kleitman, is quasi-polynomial.

The past five years have seen renewed interest and new ideas for these problems. Recent approaches include the smoothed analysis of the simplex method, analogies with interior point methods, explicit constructions and the systematic search for counterexamples through computational tools, and the investigation of combinatorial-topological abstractions of polyhedra. This workshop was devoted to the simplex method and the Hirsch conjecture, bringing together researchers with these various contemporary approaches.

Speakers:
Annamaria Amenta (University of California, Davis (UC Davis))
David Avis (Kyoto University)
David Bremner (University of New Brunswick)
Sergei Chubanov (Universität-GHS Siegen)
Oliver Friedmann (Ludwig-Maximilians-Universität München)
Komei Fukuda (ETH Zürich)
Bernd Gärtner (ETH Zürich)
Nicolai Hähnle (École Polytechnique Fédérale de Lausanne (EPFL))
Fred Holt (University of Washington)
Jonathan Kelner (Massachusetts Institute of Technology)
Edward Kim (Technische Universiteit te Delft)
Jim Renegar (Cornell University)
Francisco Santos (University of Cantabria)
Tamás Terlaky (Lehigh University)
Santosh Vempala (Georgia Institute of Technology)
Yinyu Ye (Stanford University)
Günter Ziegler (Technische Universität Berlin)
Yuriy Zinchenko (University of Calgary)

WORKSHOP: Random Media: Homogenization and Beyond
January 24 - 28, 2011

Organizing Committee:
Guillaume Bal (Columbia University, APAM)
Jim Nolen (Duke University)
George Papanicolaou (Stanford University)
Lenya Ryzhik (Stanford University)

Scientific Overview
Homogenization theory in random media has been an active research area for the last thirty years and has become a fairly large field at the intersection of applied mathematics, probability theory, and PDEs. Traditionally, it addresses questions of the macroscopic description of solutions of PDEs in random media that do not involve the fine details of small scale variations of the medium. Similar questions arise in numerical computations and are related to uncertainty quantification. Despite much progress in this field, various engineering applications drive the current need to understand regimes where standard homogenization either fails completely or requires rigorous understanding of correctors to homogenization. It is an open challenge in mathematical random media to understand how to go beyond the homogenization regime and to study phenomena that arise outside of its range of validity.

The workshop attracted experts in various sub-areas of homogenization, such as wave propagation in random media, stochastic averaging, many-particle systems, numerical homogenization, random Hamilton-Jacobi equations, and stochastic partial differential equations. The workshop sought to bring current practical and numerical issues to the attention of mathematicians knowledgeable in random media techniques. It also addressed pressing issues beyond homogenization theory, including random media models with slowly decaying correlations or without strong separation of scales. Other important questions to be addressed concern the stochastic stability of solutions and understanding their fluctuations and correctors.

Speakers:
Liliana Borcea (Rice University)
Luis Caffarelli (University of Texas at Austin)
Dmitry Dolgopyat (University of Maryland)
Mark Freidlin (University of Maryland)
Irene Gamba (University of Texas at Austin)
Josselin Garnier (Université de Paris VII (Denis Diderot) et Université de Paris VI (Pierre et Marie Curie))
Roger Ghanem (University of Southern California (USC))
Martin Hairer (University of Warwick)
Tom Hou (California Institute of Technology)
Inwon Kim (University of California, Los Angeles (UCLA))
Leonid Koralov (University of Maryland)
Frederic Legolf (Ecole Nationale Des Ponts et Chaussees (LAMI))
Jonathan Mattingly (Duke University)
Graeme Milton (University of Utah)

Stefano Olla (Université de Paris IX (Paris-Dauphine))
Houman Owhadi (California Institute of Technology)
Etienne Pardoux (Université d'Aix-Marseille I (Université de Provence))
Olivier Pinaud (Université Claude-Bernard (Lyon I))
Fraydoun Rezakhanlou (University of California, Berkeley (UC Berkeley))
Boris Rozovsky (Brown University)
Christoph Schwab (ETH Zürich)
Panagiotis Souganidis (University of Chicago)
Chrysoula Tsogka (University of Crete)

WORKSHOP: Women in Mathematics Symposium
February 24 - 26, 2011

Organizing Committee
Lisette dePillis, Co-Chair (Harvey Mudd College)
Suzanne Weekes, Co-Chair (Worcester Polytechnic Institute)
Andrea Bertozzi (University of California, Los Angeles (UCLA), Mathematics)
Alissa Crans (Loyola Marymount University)
Navah Langmeyer (Department of Defense)
Amber Puha (Institute for Pure and Applied Mathematics)
Ami Radunskaya (Pomona College)

Scientific Overview
The Women in Mathematics Symposium 2011 was a forum for encouraging and supporting women preparing for and embarking on mathematical careers. Graduate students and recent PhDs presented their research. It also offered invited talks and panel discussions featuring accomplished women mathematicians. Junior women had many opportunities to interact with their senior colleagues, both individually and in small groups.
One aim of the symposium was to expose new female mathematicians to a wide range of career possibilities and experiences in academia, government, business, and industry. They also participated in presentations and discussion forums addressing career skills such as negotiation, networking, and grant writing. The information and contacts gained by participants during the symposium should prove useful as they start their postgraduate lives, and foster connections between generations of women committed to pursuing careers in mathematics. This workshop was held in cooperation with the Association for Women in Mathematics

Speakers:
Zvia Agur (Institute for Medical BioMathematics (IMBM))
Rosina Becerra (University of California, Los Angeles (UCLA))
Kashi Behrstock (Morgan Stanley)
Andrea Bertozzi (University of California, Los Angeles (UCLA))
Suncica Canic (University of Houston)
Sara Del Valle (Los Alamos National Laboratory)
Rhonda Hughes (Bryn Mawr College)
Tamara Kolda (Sandia National Laboratories)

Navah Langmeyer (Department of Defense)
Helen Moore (Pharsight)
Elizabeth Niese (Virginia Polytechnic Institute and State University)
Kate Okikiolu (Johns Hopkins University)
Catherine O'Neil (RiskMetrics Group, Inc.)
Krista O'Neill (The Aerospace Corporation)
Lerna Pehlivan (Carleton University)
Ami Radunskaya (Pomona College)
Eva Strawbridge (University of Chicago)
Henry Warchall (National Science Foundation)
Manwah Wong (Georgia Institute of Technology)

WORKSHOP: Mathematics of Information-Theoretic Cryptography
February 28 - March 4, 2011

Organizing Committee
Ronald Cramer (CWI Amsterdam & Mathematical Institute, Leiden University)
Yuval Ishai (Technion - Israel Institute of Technology)
Tali Kaufman (Massachusetts Institute of Technology)
Carles Padro (Nanyang Technological University)
Chaoping Xing (Nanyang Technological University)

Scientific Overview
This workshop explored recent, novel relationships between mathematics and information-theoretically secure cryptography, the area studying the extent to which cryptographic security can be based on principles that do not rely on presumed computational intractability of mathematical problems.
Recently, there has been a surge in interactions between this area and several areas in mathematics, mainly algebraic geometry and number theory, coding theory, combinatorics, and probability theory. This is an exciting, promising state of affairs. However, these developments are still taking place in largely disjoint scientific communities, such as CRYPTO/EUROCRYPT, STOC/FOCS, Algebraic Coding Theory, and Algebra and Number Theory, and advances and challenges that arise in one community may go unnoticed in a different yet relevant community.

Leading international researchers from these communities came to the workshop in order to establish a shared view on information-theoretic cryptography as a source of motivation for old and new problems in these areas and to foster collaboration across boundaries. Participants represented such research areas as randomness extraction, list-decoding, locally decodable/testable codes, towers of algebraic function fields, algebraic coding theory, matroid theory, and information-theoretically secure protocol theory. Presentations disseminated the latest developments concerning this bridge function of cryptography and the latest technical results within the relevant mathematical areas. Survey talks were also featured.

Speakers:
Alp Bassa (Nanyang Technological University)
Amos Beimel (Ben Gurion University of the Negev)
Ignacio Cascudo (CWI (Center for Mathematics and Computer Science))
Ronald Cramer (CWI Amsterdam & Mathematical Institute, Leiden University)
Ivan Damgård (Aarhus University)
Yevgeniy Dodis (New York University)
Iwan Duursma (University of Illinois at Urbana-Champaign)
Serge Fehr (CWI (Center for Mathematics and Computer Science))
Juan Garay (AT&T Labs-Research)
Arnaldo Garcia (Institute of Pure and Applied Mathematics (IMPA))
Venkat Guruswami (Carnegie-Mellon University)
Yuval Ishai (Technion - Israel Institute of Technology)
Yael Kalai (Microsoft Research)
Eyal Kushilevitz (Technion - Israel Institute of Technology)
Kristin Lauter (Microsoft Research)
Frantisek Matus (Czech Academy of Sciences (AVCR))
Rafail Ostrovsky (University of California, Los Angeles (UCLA))
Carles Padro (Nanyang Technological University)
Krzysztof Pietrzak (CWI (Center for Mathematics and Computer Science))
Manoj Prabhakaran (University of Illinois at Urbana-Champaign)
Omer Reingold (Microsoft Research)
Leonid Reyzin (Boston University)
Amit Sahai (University of California, Los Angeles (UCLA))
Alex Samorodnitsky (Hebrew University)
Madhu Sudan (Microsoft Research New England)
Amnon Ta-shma (Tel Aviv University)
Luca Trevisan (Stanford University)
Chaoping Xing (Nanyang Technological University)
Sergey Yekhanin (Microsoft Research)
Michael Zieve (University of Michigan)
David Zuckerman (University of Texas at Austin)

LONG PROGRAM: Navigating Chemical Compound Space for Materials and Bio Design (CCS 2011)
March 14 - June 17, 2011

Organizing Committee
Anatole von Lilienfeld, Chair (Argonne National Laboratory)
Jean-Loup Faulon (Université d'Évry-Val d'Essonne)
William Hart (Sandia National Laboratories)
Kendall Houk (University of California, Los Angeles (UCLA))
Peter Jones (Yale University, Mathematics)
Steven Lustig (DuPont Central Research and Development)

Tamar Seideman (Northwestern University)
Mark Tuckerman (New York University, Chemistry and Courant Institute)

Core participants will be in residence at IPAM continuously for fourteen weeks. The program will open with tutorials, followed by four workshops plus a culminating workshop at UCLA's Lake Arrowhead Conference Center. Between the workshops there was a program of activities involving the long-term and short-term participants, as well as visitors.

Scientific Overview
Chemical compound space (CCS) is the combinatorial set which encompasses all chemical compounds. It can be viewed as the high dimensional space spanned by all the possible stoichiometries and configurations of electrons and atomic nuclei which form molecular or condensed matter. Due to the combinatorial nature of CCS, systematic screening for interesting properties or even simple enumeration is beyond any computational capacity. But CCS provides a natural framework in which to construct rigorous mathematical tools for the development of direct and inverse quantitative structure-property relationships, which can be applied to challenges in Materials and Bio design. Diverse scientific areas are involved, which benefit from historically grown experimental insights as well as advances made in theoretical and computational sciences. They include statistical mechanics, liquid and solid state physics, quantum chemistry, graph theory, molecular physics, condensed matter physics, optimization algorithms, data mining, statistical analysis, and others.

Here are a few quotes from participants of the CCS program:

"I would like to thank you for inviting Fabio Parisi, Francesco Strino and me to attend part of the program on Navigating Chemical Compound Space for Materials and Bio Design. We are newcomers to this specific topic and we gained substantial knowledge from participating in this meeting. Importantly, we made four new contacts that may lead to collaborations with speakers who attended the program. The atmosphere in IPAM is fantastic and in addition the people in the administration were very helpful, friendly and efficient." - Yuval Kluger, Yale University

"Because of my involvement in [the] program, I began a collaboration with Prof. Klaus-Robert Mueller, the chair of the Machine Learning department at TU Berlin. After Prof. Mueller's tutorial on Machine Learning, I became interested in the potential applications to my field of Density Function Theory. Together, we have submitted a paper to Physical Review Letters, which is still under review, [which applies] Machine Learning to Density Functional Theory. I also recently received a 2-year NSF grant to continue this research in collaboration with Prof. Mueller." – Kieron Burke, UC Irvine

"IPAM has shown me that "interdisciplinary" is more than a buzzword, and that it actually can work if the people are motivated. When looking for solutions, I also started to take into account methods from other fields I would not have considered before." – Arthur Bialon, ICAMS

"My IPAM collaborations have had a significant impact on my research. Not only do the IPAM workshops lead to unexpected collaborations and new research directions, they have lead to a community with long-term continuity in which meaningful cooperative efforts between

disciplines can be established. It is a great program!" – Graeme Henkelman, University of Texas

"Both IPAM programs [CCS and "Bridging Time and Length Scales in Materials Sciences and Bio-Physics," held in 2005] have had a drastic effect on my research, as well as on my career. Recently, I was awarded a Swiss National Science Foundation professorship thanks to a proposal that was based on research partially carried out at IPAM. Many professional contacts and relationships have been established because of my involvement with IPAM. I also organized and chaired the CCS long program. This effort greatly advanced the field, and spurred many new collaborations. The assistance in the IPAM team before and during the program was outstanding, and crucially contributed towards its success." – Anatole Von Lilienfeld, Argonne National Laboratory

The following are comments from the anonymous CCS program evaluation surveys:

"You have done a great job in organizing such a large and long workshop. [It] is a great place to meet experts within and out of my field of research and I have gained great amount of knowledge from it. I am glad that I have participated in this program and I very much appreciate the funding from IPAM."

"The long program was an excellent experience. My group was able to establish collaborations with other researchers in different fields … which would not happen without the environment provided by IPAM."

Other examples of collaboration that resulted from the CCS program:

Project on the design of discotic liquid crystals for organic semiconductors project on charge equilibration methods (A. von Lilienfeld with an invited speaker, Toon Verstraele)

Graeme Henkelman reports three collaborations that resulted from the program: (i) Dr. Prof. Klaus Meuller's machine learning group at TU Berlin, using support vector machines to find transition states of complex reaction mechanisms; (ii) Anatole von Lilienfield and Jeff Hammond at the advanced computing group at Argonne National Laboratory to develop parallel algorithms for search chemical compound space on large computers; (iii) Jutta Rogal's group at Bochum University in Ralf Drautz's institute to determine the long time dynamics of defects in high-strength metal alloys.

A published article resulted from the collaboration between Alejandro Perez Paz and Dr. O. Anatole von Lilienfeld, both of whom were participants of the IPAM program Chemical Compound Space.

Through IPAM, Marco Rozgic met Christopher Berend Rinderspacher. They continue to work together on a new approach towards minimum energy pathways.

Matthias Rupp reports that he started several new collaborations during the Chemical Compound Space Program with: O. Anatole von Lilienfeld (Argonne National Laboratories), Alexandre Tkatchenko (Fritz-Haber Institute of Max Planck Society), Kieron Burke and John Snyder (University of California at Irvine), Graeme Henkelman and Zachary Pozun (University of

Texas), Daniel Sheppard (Los Alamos National Laboratory), Katja Hansen (now at Fritz Haber institute of Max Planck Society) and Klaus-Robert Müller (TU Berlin).

Mark Tuckerman's group at Courant Institute is currently collaborating with the group of Prof. Cecilia Clementi at Rice University to use enhanced sampling methods and diffusion maps to understand the folding free energy landscape of the TrpZip2 peptide. They met at the CCS program.

In 2011, Anataole Von Lilienfeld started a collaboration with Prof. Chris Anderson from UCLA. They have investigated fractional nuclear charges using his electronic structure code that solves the Schroedinger equation to arbitrary numerical precision.

Other examples of the impact of the program on careers and research interests:

Katja Hansen, who participated in the CCS program as a PhD student, is now doing a postdoc in Alexandre Tkatchenko's group (also a program participant).

Saivenkataraman Jayaraman secured a post-doctoral position at MIT in Prof. Gerd Ceder's group. I also have many contacts now with whom future are possible.

Matthias Rupp: The IPAM program positively affected me via (i) establishment of three new international collaborations and (ii) the resulting publications, (iii) opening up a new direction of research for me, and (iv) providing insights through interdisciplinary workshops and discussions.

Alexandre Tkatchenko: The CCS program has expanded my horizons and I decided to broaden the research directions of my group. In particular, this now includes the analysis of different properties (both ground state and excited state) throughout the chemical compound space.

David Beratan met David Minh at the program and hired him as a post-doc in his group.

WORKSHOP: Navigating Chemical Compound Space Tutorials
March 15 - 18, 2011

Organizing Committee
Kendall Houk (University of California, Los Angeles (UCLA))
Anatole von Lilienfeld (Sandia National Laboratories)

Scientific Overview
The long program opened with four days of tutorials that will provide an introduction to major themes of the entire program and the four workshops. The goal was to build a foundation for the participants of this program who have diverse scientific backgrounds. Topics that will be discussed during the tutorials include

- Electronic structure methods and quantum chemistry
- Algorithms to search configuration space
- Statistical physics based methods

- Rational drug design
- Quantitative structure-activity relationships (QSPR)
- Combinatorial optimization
- Machine learning
- Graph theory
- High performance computing

Speakers:
Pierre Baldi (University of California, Irvine (UCI))
Kieron Burke (University of California, Irvine (UCI))
Jeff Hammond (Argonne National Laboratory)
William Hart (Sandia National Laboratories)
Ken Houk (University of California, Los Angeles (UCLA))
Saivenkataraman Jayaraman (Sandia National Laboratories)
Klaus Mueller (Technische Universität Berlin)
Tudor Oprea (University of New Mexico)
Cynthia Phillips (Sandia National Laboratories)
Matthias Rupp (Technische Universität Berlin)
Mark Tuckerman (New York University)
Anatole von Lilienfeld (Argonne National Laboratory)
Jean-Paul Watson (Sandia National Laboratories)

WORKSHOP: Design of Drugs and Chemicals that Influence Biology (CCS Workshop 1)
April 4 - 8, 2011

Organizing Committee
David Baker (University of Washington)
Cecilia Clementi (Rice University, Physics)
Kendall Houk (University of California, Los Angeles (UCLA))
William Jorgensen (Yale University)
Ursula Roethlisberger (École Polytechnique Fédérale de Lausanne (EPFL))
Jeffery Saven (University of Pennsylvania, Department of Chemistry)

Scientific Overview
Biological space can be thought of as the unabridged complement of gene products. Since it is defined by an organism's genome it is large, but finite. By contrast, the combinatorial manifold of molecular compounds means that chemical compound space (CCS) is essentially boundless. Molecular biology and modern genomics offer unforeseen opportunities to explore CCS for the purposes of drug discovery, and for chemical influences on signaling and metabolic pathways. Methods of computational sciences, such as atomistic molecular dynamics and Monte Carlo schemes, frequently also combined with coarse-grained, continuous or quantum chemical models, have evolved to become powerful tools for tackling biomolecular problems that concern rational drug design, chemical genetics, design of enzyme catalysts, bio-inspired ligand design in organo- and bio-inorganic metal complexes, and control of protein folding.

Speakers:
Dimitris Agrafiotis (Johnson & Johnson Pharmaceutical Research & Development, LLC)
Charles Brooks (University of Michigan)
Cecilia Clementi (Rice University)
William DeGrado (University of Pennsylvania)
Elisa Fadda (National University of Ireland, Galway)
Rich Friesner (Columbia University)
Jiali Gao (University of Minnesota, Twin Cities)
Robert Glen (University of Cambridge)
Kendall Houk (University of California, Los Angeles (UCLA))
William Jorgensen (Yale University)
Amy Keating (Massachusetts Institute of Technology)
Brian Kuhlman (University of North Carolina)
Luhua Lai (Beijing (Peking) University)
Parag Mallick (Stanford University)
Gagerin Papoian (University of Maryland)
Michele Parrinello (University of Lugano)
Carol Post (Purdue University)
Maria Ramos (University of Porto)
Robert Rizzo (SUNY Stony Brook)
Ursula Roethlisberger (École Polytechnique Fédérale de Lausanne (EPFL))
Andrej Sali (University of California, San Francisco (UCSF))
Jeffery Saven (University of Pennsylvania)
Alexandre Tkatchenko (Fritz-Haber-Institut der Max-Planck-Gesellschaft)
Shaomeng Wang (University of Michigan)

WORKSHOP: Optimization, Search and Graph-Theoretical Algorithms for Chemical Compound Space (CCS Workshop 2)
April 11 - 15, 2011

Organizing Committee
Jean-Loup Faulon (Université d'Évry-Val d'Essonne)
William Hart (Sandia National Laboratories)
Peter Jones (Yale University)
Mauro Maggioni (Duke University, Mathematics and Computer Science)
Cynthia Phillips (Sandia National Laboratories)
Jean-Louis Reymond (Universität Bern, Chemistry and Biochemistry)
Cenk Sahinalp (Simon Fraser University)
Mark Tuckerman (New York University, Chemistry and Courant Institute)
Jean-Paul Watson (Sandia National Laboratories, Discrete Math and Complex Systems)

Scientific Overview
This workshop focused on the computational science aspects when navigating, exploring, or optimizing object functions in discrete Chemical Compound Space (CCS). Mathematical aspects of CCS deal with topics such as (i) isomerism and the development of topological descriptors or indices which find application in quantitative structure-property relationships, (ii) group theory,

which finds applications in stereochemistry, quantum mechanics, and crystallography, and (iii) classification and characterization of subsets of CCS. Analysis and exploration of CCS requires computational science technologies like data-mining, organization analysis, optimization, and classification. Applying these techniques requires the development of mathematical formulations that can be effectively analyzed with practical computational techniques. For example, the computational cost of evaluating properties of a compound can depend strongly on the combination of compositional variables that define the compound. Similarly, some CCS analysis problems can be approximated with continuous optimization formulations, which allows for fast analysis. Finally, parallel computing techniques will likely be needed to developing practical computational strategies for combining large-scale calculations of ensembles of compounds with iterative optimization algorithms. This workshop drew experts in the fields of mathematical chemistry, biology, physics, materials sciences, and computational science, to report on recent research efforts that impact CCS analysis.

Speakers:
Tatsuya Akutsu (Kyoto University)
Rolf Backofen (Albert-Ludwigs-Universität Freiburg)
Pierre Baldi (University of California, Irvine (UCI))
Danail Bonchev (Virginia Commonwealth University)
Kyle Camarda (University of Kansas)
Artem Cherkasov (University of British Columbia)
Jean-Loup Faulon (Université d'Évry-Val d'Essonne)
William Hart (Sandia National Laboratories)
Farhad Hormozdiari (University of Washington)
John Irwin (University of California, San Francisco (UCSF))
Mauro Maggioni (Duke University)
Shawn Martin (Sandia National Laboratories)
Mike McKerns (California Institute of Technology)
Markus Meringer (Deutsche Forschungsanstalt für Luft- und Raumfahrt eV (DLR))
Klaus Mueller (Technische Universität Berlin)
Jean-Louis Reymond (Universität Bern)
Berend Rinderspacher (Army Research Laboratory)
Jack Snoeyink (University of North Carolina)
Tamon Stephen (Simon Fraser University)
Mark Tuckerman (New York University)
Venkat Venkatasubramanian (Purdue University)
David Wales (University of Cambridge)
Wei Wang (University of North Carolina)

WORKSHOP: Materials Design in Chemical Compound Space (CCS Workshop 3)
May 2 - 6, 2011

Organizing Committee
Gerbrand Ceder (Massachusetts Institute of Technology)
Vincent Crespi (Pennsylvania State University)

Ralf Drautz (Ruhr-Universität Bochum, Department of Materials)
H. Eliot Fang (Sandia National Laboratories)
Kristen Fichthorn (Pennsylvania State University)
Graeme Henkelman (University of Texas at Austin, Department of Chemistry)
Steven Lustig (DuPont Central Research and Development)
Tamar Seideman (Northwestern University)

Scientific Overview
Investigating and predicting materials behavior can be achieved in various ways, ranging from numerically intensive multi-scale computations to simple analytic methods such as model Hamiltonians. If these materials simulation methods were altered to enable design of new materials, as well as description of existing materials, then a large set of materials and their properties could be addressed. This workshop brought together mathematicians, physicists, chemists, materials researchers and engineers, and others to discuss progress on catalyst design, meta-materials, heat-transfer fluid design, ionic liquid design, designer materials, crystal engineering, and other topics.

Speakers:
Denis Andrienko (Max Planck Institute for Polymer Research)
Volker Blum (Fritz-Haber-Institut der Max-Planck-Gesellschaft)
Emily Carter (Princeton University)
Gerbrand Ceder (Massachusetts Institute of Technology)
Vincent Crespi (Pennsylvania State University)
Stefano Curtarolo (Duke University)
Ralf Drautz (Ruhr-Universität Bochum)
Kristen Fichthorn (Pennsylvania State University)
Bjork Hammer (Aarhus University)
Graeme Henkelman (University of Texas at Austin)
Richard Hennig (Cornell University)
Suljo Linic (University of Michigan)
Steven Lustig (DuPont Central Research and Development)
Vidvuds Ozolins (University of California, Los Angeles (UCLA))
Kristin Persson (Lawrence Berkeley Laboratory)
Jutta Rogal (Ruhr-Universitaet Bochum)
David Rogers (Sandia National Laboratories)
Joachim Sauer (Humboldt-Universität)
Matthias Scheffler (Fritz-Haber-Institut der Max-Planck-Gesellschaft)
Tamar Seideman (Northwestern University)
David Sholl (Georgia Institute of Technology)
Adri van Duin (Pennsylvania State University)
Chris Wolverton (Northwestern University)
Sidney Yip (Massachusetts Institute of Technology)
Alex Zunger (National Renewable Energy Laboratory)

WORKSHOP: Physical Frameworks for Sampling Chemical Compound Space (CCS Workshop 4)
May 16 - 20, 2011

Organizing Committee
Anatole von Lilienfeld, Chair (Argonne National Laboratory)
Paul Ayers (McMaster University)
David Beratan (Duke University)
Edward Maginn (University of Notre Dame)
Peter Politzer (University of New Orleans)
Markus Reiher (Swiss Federal Institute of Technology of Zurich)
Marialore Sulpizi (Johannes Gutenberg-Universität Mainz)
Aidan Thompson (Sandia National Laboratories)
Weitao Yang (Duke University)

Scientific Overview
This workshop concerned the physics of simulation methods that alter chemical composition. For example, using chemical "transformations" (or "alchemical transformations") that walk through chemical compound space (CCS). Such changes can be performed continuously or by jumping among discrete structures. Experts presented and discussed progress in various areas including molecular library design, redox processes, isomolar Monte Carlo or molecular dynamics simulation in the (semi) grand canonical ensemble, generation of grand-canonical ensemble distributions using classical statistical mechanical approaches, or electronic structure theory based frameworks such as conceptual density functional theory, or others. This workshop involved an interdisciplinary community, including researchers physics, mathematics, biology, materials sciences, and engineering.

Speakers:
Igor Abrikosov (Linköping University)
Dario Alfe (University College London)
Paul Ayers (McMaster University)
David Beratan (Duke University)
Jochen Blumberger (University College London)
Carlos Cardenas (University of Chile)
Clemence Corminboeuf (École Polytechnique Fédérale de Lausanne (EPFL))
Michel Cuendet (New York University)
Michael Deem (Rice University)
David Kofke (SUNY Buffalo)
Ping Liu (Brookhaven National Laboratory)
Edward Maginn (University of Notre Dame)
Paul Mezey (Memorial University of Newfoundland)
Olivier Michielin (Swiss Institute of Bioinformatics)
Peter Minary (Stanford University)
Alejandro Perez Paz (New York University)
Herschel Rabitz (Princeton University)
Markus Reiher (Swiss Federal Institute of Technology of Zurich)

Jeffery Saven (University of Pennsylvania)
Marialore Sulpizi (Johannes Gutenberg-Universität Mainz)
Ivano Tavernelli (École Polytechnique Fédérale de Lausanne (EPFL))
Alejandro Toro-Labbe (Pontificia Universidad Catolica de Chile)
Sameer Varma (Illinois Institute of Technology)
Toon Verstraelen (Ghent University)
Anatole von Lilienfeld (Argonne National Laboratory)
Nigel Wilding (University of Bath)
Peter Wipf (University of Pittsburgh)
Weitao Yang (Duke University)

WORKSHOP: 17th Annual Conference for African-American Researchers in the Mathematical Sciences (CAARMS)
June 1 - 4, 2011

The CAARMS 17 (Conference for African-American Researchers in the Mathematical Sciences) program included invited speakers, tutorials, and a graduate student poster session. The conference spotlighted the accomplishments of mathematicians from underrepresented minority backgrounds, and was open to all.

The conference was held at the Institute for Pure and Applied Mathematics (IPAM) at the University of California, Los Angeles (UCLA) from June 1-4, 2011 The CAARMS meetings provide a forum where minority researchers in the mathematical sciences can meet each other and find out about their work across different mathematical fields. This forum also serves as a place to meet and mentor minority graduate students as well as encourage them to obtain doctoral degrees.

Speakers:
Terrence Blackman (Medgar Evers College)
Antwan Clark (University of Maryland)
Todd Coleman (University of Illinois / University of California at San Diego)
Andrea Hairston (Duke University)
Ryan Hynd (Courant Institute)
Monica Jackson (American University)
Otis Jennings (Duke University)
Sean Paul (University of Wisconsin)
Miranda Teboh-Ewungkem (Lafayette College)
Rodney Wallace (IBM)

WORKSHOP: Applied Probability Conference
June 5-6, 2011

The Applied Probability Conference immediately followed CAARMS and was also organized by Bill Massey. Participants discussed the latest developments in the field of applied probability.

WORKSHOP: Chemical Compound Space Culminating Workshop at Lake Arrowhead
June 12 - 17, 2011

The culminating workshop was organized by the long program organizing committee.

The final workshop in the long program, held at Lake Arrowhead Conference Center, provided an opportunity for the program's core participants to report on their work during the past three months and to discuss future projects. Many of the collaborations and interactions that were formed during the program had a chance to deepen.

SUMMER PROGRAM: Research in Industrial Projects for Students (RIPS) 2011
June 26 - August 26, 2011

RIPS Program Director: Michael Raugh

The Research in Industrial Projects (RIPS) Program provides an opportunity for high-achieving undergraduate students to work in teams on a real-world research project proposed by a sponsor from industry or a national lab. Each RIPS team is comprised of four students, an academic mentor, and an industrial sponsor. The research problem is developed by the industrial sponsor in consultation with IPAM; it is always a real problem of serious interest to the sponsor and that offers a stimulating challenge to students. The students, with direction from their academic mentor and industrial sponsor, spend nine weeks learning about the problem, mastering the latest analytical approaches and techniques to solve it, and developing report-writing and public-speaking skills to be able to make professional presentations about the progress and results of their work to a scientific audience. Industry mentors provide regular contact between the team and the sponsor, monitoring and helping to guide student work. Ultimately, RIPS provides valuable real-world technical and managerial experience for students as well as valuable R&D for sponsors.

Projects are selected to have a major mathematical component and to be something that will pose an interesting challenge to talented undergraduates. Recent projects have included how to do a physics-based animation of a lava lamp, how to stitch together two images, how to analyze cancer data using microarrays, statistical data assimilation methods for weather data, modeling particle transport phenomena in reactors, and designing missions to the moons of Jupiter. Some new industrial sponsors join the RIPS Program each year and the same projects are never repeated.

RIPS-LA 2011 Sponsors and Projects	
Company/ Organization	**Title of Project**
Aerospace Corp	Call Blockage and Wait Times for Military Satellite Communication Systems
Arete	Automatic camera geo-location from solar shadows
Disney (with Pixar)	Global Enforcement of Rigid Bodies Articulation
HRL	Volumetric Mode Sorter based on Phase Holography
IBM	Adversary Deception in Planning Under Certainty
LAPD	Data Fusion Algorithms for Mapping Crime
Shoah Foundation	Geo-Temporal Data Mining and Knowledge Discovery
Standards & Poor	Quantitative Modeling of Financial Market Contagion
Symantec	Optimization of Multi-Criteria Decision Analysis Methods

Out of 355 applications, 36 students were chosen for RIPS-LA and 8 for RIPS-Hong Kong. RIPS students are a diverse group; 20.5% of this year's students were members of an underrepresented minority group, and 51% of them were women.

SUBWORKSHOP: RIPS 2011 Projects Day
August 19, 2011

Organizing Committee: N/A

The nine RIPS-LA teams presented their industry-sponsored research on the projects listed above. Representatives of the industry sponsors attend, and the event was open to the public. Prospective RIPS students, math and science majors, family members of the students, and others in UCLA's math and science community attended.

Here are a few quotes from students who participated in RIPS-LA 2011:

"I was really looking forward to this program and it truly exceeded my expectations. The skills I learned are invaluable and I could not have gotten them in a classroom setting." – Anna Kuznetsova, Duke University

"Honestly, RIPS has opened my eyes to a lot of career options that I didn't realize even existed. Having more choices is actually making my decisions harder, but that's not a bad thing." – Margo Smith, Kenyon College

"The best part of RIPS, in my opinion, was the true applicability of our projects and results. Our industrial sponsors had a genuine interest in our work, and truly benefited from the program." – Joseph Durgin, Bowdoin College

"Not only is RIPS of educational and mathematical value, but the experience of both working in industry and in teams is not something you are likely to find in other REUs." – Sabrina Gordon, Oxford University

SUMMER PROGRAM: RIPS-Hong Kong 2011
June 26 – August 26, 2011

IPAM offered RIPS-Hong Kong for the first time in 2011. In collaboration with Hong Kong University of Science and Technology (HKUST), eight U.S. students and eight Hong Kong/Chinese students will work on cross-cultural teams on four projects, each sponsored by a company based in the region. The basic format of the program is the same as RIPS-LA.

RIPS students have offices on the HKUST campus. The HKUST math department provides technical support as well as some social activities, Cantonese lessons, and occasional guest lectures. Students stay in a residence hall on campus. IPAM covers the U.S. students' expenses including round-trip travel to Hong Kong, accommodations, and most meals. Students also received a stipend. English is the only language required for participation.

RIPS-Hong Kong 2011 Sponsors and Projects	
Company/ Organization	**Title of Project**
BGI #1	Metagenomics
BGI #2	Application of a Hill Climbing Algorithm to Parallelize Graph-based Genome Assembly
Huawei	Resource Scheduling in Heterogeneous Networks
MetLife	Risk Aggregation Methods For Insurance

SUMMER PROGRAM: Graduate Summer School: Probabilistic Models of Cognition
July 6 - 16, 2011

Organizing Committee
Noah Goodman (Stanford University)
Josh Tenenbaum (Massachusetts Institute of Technology, Brain and Cog Sc, CS, and AI)
Alan Yuille (University of California, Los Angeles (UCLA), Statistics)

Scientific Overview
Recent advances offer the promise of building rigorous models for human cognition by applying the mathematical and computational tools developed for designing artificial systems. In turn, the complexity of human cognitive abilities offers challenges which test current theories and drive the development of more advanced tools. The goal was to develop a common mathematical framework for all aspects of cognition, and review how it explains empirical phenomena in the major areas of cognitive science: vision, memory, reasoning, learning, planning, and language. The main theoretical theme was the modeling of cognitive abilities as forms of probabilistic

inference over structured relational systems such as graphs and generative grammars. The program focused on how the mind learns complex generative models of the world and how it inverts or conditions these models based on observed data to infer world structure. The emphasis was on vision, currently an area of great activity, but all aspects of cognition were addressed. Other important themes included the combination of logic with probability and the development of probabilistic programming languages.

The first week introduced the basic concepts and techniques, including machine learning and artificial intelligence, and give applications to cognitive modeling. The second focused on more advanced methods including stochastic grammars with examples from natural languages and vision. Technical material was presented in the mornings, applications in the afternoons. The program included breakout sessions, opportunities to meet and talk with the speakers, and additional evening lectures on topics of interest.

Speakers:
Elie Bienenstock, Brown Univ.
Pedro Domingos, Univ. of Washington
Naomi Feldman, Univ. of Maryland
Stuart Geman, Brown Univ.
Sharon Goldwater, University of Edinburgh
Noah Goodman, Stanford Univ.
Tom Griffiths, UC Berkeley
Keith Holyoak, UCLA
Mark Johnson, MacQuarrie University
Charles Kemp, Carnegie Mellon University
Roger Levy, UC San Diego
Percy Liang, UC Berkeley
Larry Maloney, New York University
Brian Milch, Google Inc.
Iain Murray, Univ. of Edinburgh
Timothy O'Donnell, MIT
Judea Pearl , UCLA
Tomaso Poggio, MIT
Ruslan Salakhutdinov, Univ. of Toronto
Stuart Russel, University of California Berkeley
Josh Tennenbaum, MIT
Alan Yuille, UCLA
Jun Zhang, Univ. of Michigan

OUTREACH AND OTHER ACTIVITIES, 2010-2011

Math Institutes' Modern Mathematics Workshop (at SACNAS Annual Meeting), September 29-30, 2010. The NSF math institutes all cosponsored this two-day workshop. IPAM recruited Matteo Pellegrini to give the presentation "Mathematical and Computational Approaches in High-Throughput Genomics," the subject of an upcoming long program.

Math Institutes Open House (at the Joint Mathematics Meetings), January 6, 2011. IPAM was one of 14 math institutes sponsoring this reception at the 2011 Joint Mathematics Meetings in New Orleans.

UCLA Mathematics Festival; April 9, 2011. This one-day program offering challenging math activities to middle-school students in Los Angeles was sponsored by the Curtis Center for Mathematics Education at UCLA and hosted by IPAM.

"UCLA Day" Information Fair; May 15, 2011. IPAM Associate Director Christian Ratsch and Cecilia Clementi (participant in the spring long program on Chemical Compound Space) spoke to alumni about IPAM and distributed publicity materials.

Four RIPS 2010 students presented their RIPS research at the Joint Mathematics Meetings in New Orleans, with IPAM support. Additionally, three students from the Aerospace Corporation team presented their research at the Institute of Navigation's International Technical Meeting (ITM) in January 2011, with support from both IPAM and The Aerospace Corporation.

IPAM held two women's lunches in 2010-2011: one during an Optimization workshop in fall 2010, and another during a Chemical Compound Space workshop in May 2011.

Finally, IPAM supported the AWM MentorNet, which offers an e-mentoring program for undergraduates and graduate students, a résumé database for students, and other resources.

K. PROGRAM CONSULTANT LIST

IPAM consulted a variety of scholars and practitioners in the scientific planning of each program. The list is in chronological order by program. Upcoming programs for which planning had begun by July 2011 are also included. (See also Section O: Committee Membership)

OP2010

Stephen Boyd, Stanford University, Engineering

Emmanuel Candes, Stanford University, Applied and Computational Mathematics

Masakazu Kojima, Tokyo Institute of Technology

Monique Laurent, CWI (Center for Mathematics and Computer Science)

Arkadi Nemirovski, Georgia Institute of Technology

Yurii Nesterov, Université Catholique de Louvain

Bernd Sturmfels, University of California, Berkeley (UC Berkeley), Mathematics

Michael Todd, Cornell University

Lieven Vandenberghe, University of California, Los Angeles (UCLA), EE

OPTUT

Monique Laurent, CWI (Center for Mathematics and Computer Science)

Bernd Sturmfels, University of California, Berkeley (UC Berkeley), Mathematics

Lieven Vandenberghe, University of California, Los Angeles (UCLA), EE

Stephen Wright, University of Wisconsin-Madison, Computer Science

MRWS1

James Allen, University of Rochester

Lawrence Carin, Duke University, Elec and Computer Engineering

Pedro Domingos, University of Washington, Computer Science & Engineering

Leslie Greengard, New York University

Carlos Guestrin, Carnegie-Mellon University

John Laird, University of Michigan, Computer Science and Engineering

Josh Tenenbaum, Massachusetts Institute of Technology, Brain and Cog Sc, CS, and AI

Bob Tenney, BAE Systems

Claire Tomlin, University of California, Berkeley (UC Berkeley)

OPWS1

William Helton, University of California, San Diego (UCSD), Mathematics

Monique Laurent, CWI (Center for Mathematics and Computer Science)

Pablo Parrilo, Massachusetts Institute of Technology, Electrical Engineering and Computer Science

Bernd Sturmfels, University of California, Berkeley (UC Berkeley), Mathematics

Rekha Thomas, University of Washington

OPWS2

Don Goldfarb, Columbia University, IEOR

Renato Monteiro, Georgia Institute of Technology, School of Industrial and Systems Engineering

Yurii Nesterov, Université Catholique de Louvain

Michael Overton, New York University

Kim Toh, National University of Singapore

Stephen Wright, University of Wisconsin-Madison, Computer Science

MRWS2

James Allen, University of Rochester

Lawrence Carin, Duke University, Elec and Computer Engineering

Pedro Domingos, University of Washington, Computer Science & Engineering

Leslie Greengard, New York University

Carlos Guestrin, Carnegie-Mellon University

John Laird, University of Michigan, Computer Science and Engineering

Josh Tenenbaum, Massachusetts Institute of Technology, Brain and Cog Sc, CS, and AI

Bob Tenney, BAE Systems

Claire Tomlin, University of California, Berkeley (UC Berkeley)

OPWS3

Sanjeev Arora, Princeton University

Gérard Cornuéjols, Carnegie-Mellon University

Jesus De Loera, University of California, Davis (UC Davis), Mathematics

Friedrich Eisenbrand, École Polytechnique Fédérale de Lausanne (EPFL)

Michel Goemans, Massachusetts Institute of Technology

Matthias Koeppe, University of California, Davis (UC Davis), Mathematics

OPWS4

Aharon Ben-Tal, Technion - Israel Institute of Technology

Dimitris Bertsimas, Massachusetts Institute of Technology

Jason Cong, University of California, Los Angeles (UCLA), Computer Science Department

Laurent El Ghaoui, University of California, Berkeley (UC Berkeley)

Arkadi Nemirovski, Georgia Institute of Technology, Industrial and Systems Engineering

OPWS5

Stephen Boyd, Stanford University, Engineering

Yonina Eldar, Technion - Israel Institute of Technology, Electrical Engineering

Tom Luo, University of Minnesota, Twin Cities

Bernhard Scholkopf, Max-Planck-Institute for Biological Cybernetics

Lieven Vandenberghe, University of California, Los Angeles (UCLA), EE

AGT2011

Gunes Ercal, University of Kansas, Computer Science

Allon Percus, Claremont Graduate University, School of Mathematical Sciences

Vwani Roychowdhury, University of California, Los Angeles (UCLA), Electrical Engineering

Sudhir Singh, University of California, Los Angeles (UCLA), Electrical Engineering

SM2011

Margaret Bayer, University of Kansas, Mathematics

Jesus De Loera, University of California, Davis (UC Davis), Mathematics

Antoine Deza, McMaster University

Gil Kalai, Hebrew University, Institute of Mathematics

Shanghua Teng, University of Southern California (USC)

RM2011

Guillaume Bal, Columbia University, APAM

Jim Nolen, Duke University

George Papanicolaou, Stanford University

Lenya Ryzhik, Stanford University

WIM2011

Andrea Bertozzi, University of California, Los Angeles (UCLA), Mathematics

Alissa Crans, Loyola Marymount University

Lisette dePillis, Harvey Mudd College

Navah Langmeyer, Department of Defense

Amber Puha, Institute for Pure and Applied Mathematics, Associate Director

Ami Radunskaya, Pomona College

Suzanne Weekes, Worcester Polytechnic Institute

ITC2011

Ronald Cramer, CWI Amsterdam & Mathematical Institute, Leiden University

Yuval Ishai, Technion - Israel Institute of Technology

Tali Kaufman, Massachusetts Institute of Technology

Carles Padro, Nanyang Technological University

Chaoping Xing, Nanyang Technological University

CCS2011

Jean-Loup Faulon, Université d'Évry-Val d'Essonne

William Hart, Sandia National Laboratories

Kendall Houk, University of California, Los Angeles (UCLA)

Peter Jones, Yale University, Mathematics

Steven Lustig, DuPont Central Research and Development

Tamar Seideman, Northwestern University

Mark Tuckerman, New York University, Chemistry and Courant Institute

Anatole von Lilienfeld, Argonne National Laboratory

CCSTUT

Kendall Houk, University of California, Los Angeles (UCLA)

Anatole von Lilienfeld, Argonne National Laboratory

CCSWS1

David Baker, University of Washington

Cecilia Clementi, Rice University, Physics

Kendall Houk, University of California, Los Angeles (UCLA)

William Jorgensen, Yale University

Ursula Roethlisberger, École Polytechnique Fédérale de Lausanne (EPFL)

Jeffery Saven, University of Pennsylvania, Department of Chemistry

CCSWS2

Jean-Loup Faulon, Université d'Évry-Val d'Essonne

William Hart, Sandia National Laboratories

Peter Jones, Yale University

Mauro Maggioni, Duke University, Mathematics and Computer Science

Cynthia Phillips, Sandia National Laboratories

Jean-Louis Reymond, Universität Bern, Chemistry and Biochemistry

Cenk Sahinalp, Simon Fraser University

Mark Tuckerman, New York University, Chemistry and Courant Institute

Jean-Paul Watson, Sandia National Laboratories, Discrete Math and Complex Systems

CCSWS3

Gerbrand Ceder, Massachusetts Institute of Technology

Vincent Crespi, Pennsylvania State University

Ralf Drautz, Ruhr-Universität Bochum, Department of Materials

H. Eliot Fang, Sandia National Laboratories

Kristen Fichthorn, Pennsylvania State University

Graeme Henkelman, University of Texas at Austin, Department of Chemistry

Steven Lustig, DuPont Central Research and Development

Tamar Seideman, Northwestern University

CCSWS4

Paul Ayers, McMaster University

David Beratan, Duke University

Edward Maginn, University of Notre Dame

Peter Politzer, University of New Orleans

Markus Reiher, Swiss Federal Institute of Technology of Zurich

Marialore Sulpizi, Johannes Gutenberg-Universität Mainz

Aidan Thompson, Sandia National Laboratories

Anatole von Lilienfeld, Argonne National Laboratory

Weitao Yang, Duke University

GSS2011

Noah Goodman, Stanford University

Josh Tenenbaum, Massachusetts Institute of Technology, Brain and Cog Sc, CS, and AI

Alan Yuille, University of California, Los Angeles (UCLA), Statistics

GEN2011

Eleazar Eskin, University of California, Los Angeles (UCLA), Computer Science

Phil Green, University of Washington

Stanley Nelson, University of California, Los Angeles (UCLA), Human Genetics

Lior Pachter, University of California, Berkeley (UC Berkeley), Mathematics

Matteo Pellegrini, University of California, Los Angeles (UCLA), Molecular, Cell, and Developmental Biology

Sebastien Roch, University of California, Los Angeles (UCLA), Mathematics

Eric Schadt, Pacific Biosciences

Elizabeth Thompson, University of Washington

Wing Wong, Stanford University, Statistics

GENTUT

Eleazar Eskin, University of California, Los Angeles (UCLA), Computer Science

Matteo Pellegrini, University of California, Los Angeles (UCLA), Molecular, Cell, and Developmental Biology

Sebastien Roch, University of California, Los Angeles (UCLA), Mathematics

GENWS1

Phil Green, University of Washington

Matteo Pellegrini, University of California, Los Angeles (UCLA), Molecular, Cell, and Developmental Biology

Aviv Regev, Broad Institute

Eric Schadt, Pacific Biosciences

Jay Shendure, University of Washington

Yun Song, University of California, Berkeley (UC Berkeley)

DOD2011

Russel Caflisch, Institute for Pure and Applied Mathematics, IPAM Director

Robert Kosut, SC Solutions, Inc.

Stanley Osher, University of California, Los Angeles (UCLA)

GENWS2

Sandrine Dudoit, University of California, Berkeley (UC Berkeley), Biostatistics and Statistics

Lior Pachter, University of California, Berkeley (UC Berkeley), Mathematics

Matteo Pellegrini, University of California, Los Angeles (UCLA), Molecular, Cell, and Developmental Biology

Barbara Wold, California Institute of Technology, Biology Division

Wing Wong, Stanford University, Statistics

MMW2011

Ricardo Cortez, Tulane University

Suzanne Lenhart, University of Tennessee

Christian Ratsch, Institute for Pure and Applied Mathematics, IPAM Associate Director

Ivelisse Rubio, University of Puerto Rico, Computer Science

GENMINI

Stanley Nelson, University of California, Los Angeles (UCLA), Human Genetics

Ben Raphael, Brown University

Jasmine Zhou, University of Southern California (USC)

GENWS3

Cedric Chauve, Simon Fraser University

Scott Edwards, Harvard University

Daniel Huson, Eberhard-Karls-Universität Tübingen

James Lake, University of California, Los Angeles (UCLA), MBI, MCDB, Human Genetics

Sebastien Roch, University of California, Los Angeles (UCLA), Mathematics

GENWS4

Carlos Bustamante, Stanford University

Eleazar Eskin, University of California, Los Angeles (UCLA), Computer Science

Steve Evans, University of California, Berkeley (UC Berkeley), Statistics

Phil Green, University of Washington

Elizabeth Thompson, University of Washington

TRA2011

Alexandre Bayen, University of California, Berkeley (UC Berkeley)

Helene Frankowska, Centre National de la Recherche Scientifique (CNRS)

Jean-Patrick Lebacque, IFSTTAR/GRETTIA

Benedetto Piccoli, Rutgers University-Camden

Michael Zhang, University of California, Davis (UC Davis)

MS2012

Juan Bello, New York University

Samy Bengio, Google Inc.

Ronald Coifman, Yale University

Kristen Grauman, University of Texas at Austin

Yosi Keller, Bar-Ilan University, electrical Engineering

Yann LeCun, New York University, Canadian Institute for Advanced Research

Cordelia Schmid, INRIA

GM2012

David Gamarnik, Massachusetts Institute of Technology, Sloan School of Management

Andrea Montanari, Stanford University

Devavrat Shah, Massachusetts Institute of Technology

Prasad Tetali, Georgia Institute of Technology

Rüdiger Urbanke, EPFL (Ecole Polytechnique Fédérale de Lausanne)

Martin Wainwright, University of California, Berkeley (UC Berkeley)

SAR2012

Brett Borden, Naval Postgraduate School

Margaret Cheney, Rensselaer Polytechnic Institute, Mathematical Sciences

Scott Hensley, Jet Propulsion Laboratory

Eric Mokole, United States Naval Research Laboratory

George Papanicolaou, Stanford University, Mathematics

Edmund Zelnio, Air Force Research Laboratory

PDE2012

Luis Caffarelli, University of Texas at Austin

Rustum Choksi, McGill University

Luis Silvestre, University of Chicago

Dejan Slepcev, Carnegie-Mellon University

Luminita Vese, University of California, Los Angeles (UCLA), Mathematics

PL2012

Christina Back, General Atomics

Andrew Christlieb, Michigan State University, Mathematics

Jill Dahlburg, United States Naval Research Laboratory

Michael Desjarlais, Sandia National Laboratories

Frank Graziani, Lawrence Livermore National Laboratory

Leslie Greengard, New York University

David Levermore, University of Maryland, Department of Mathematics

Warren Mori, University of California, Los Angeles (UCLA), Physics/Engineering

Michael Murillo, Los Alamos National Laboratory

PLTUT

Christina Back, General Atomics

Andrew Christlieb, Michigan State University, Mathematics

Jill Dahlburg, United States Naval Research Laboratory

Michael Desjarlais, Sandia National Laboratories

Frank Graziani, Lawrence Livermore National Laboratory

Leslie Greengard, New York University

David Levermore, University of Maryland, Department of Mathematics

Warren Mori, University of California, Los Angeles (UCLA), Physics/Engineering

Michael Murillo, Los Alamos National Laboratory

PLWS1

Christina Back, General Atomics

John Castor, Lawrence Livermore National Laboratory, Physics

Frank Graziani, Lawrence Livermore National Laboratory

Denise Hinkel, Lawrence Livermore National Laboratory

David Levermore, University of Maryland, Department of Mathematics

Vyacheslav Lukin, United States Naval Research Laboratory

Igor Sokolov, University of Michigan, AOSS

PLWS2

Jeff Candy, General Atomics

Vincent Chan, General Atomics

Jill Dahlburg, United States Naval Research Laboratory

William Dorland, University of Maryland, Physics

James Drake, University of Maryland, Physics

Leslie Greengard, New York University

Vyacheslav Lukin, United States Naval Research Laboratory

PLWS3

Andrea Bertozzi, University of California, Los Angeles (UCLA), Mathematics

Andrew Christlieb, Michigan State University, Mathematics

Phil Colella, Lawrence Berkeley Laboratory

William Dorland, University of Maryland, Physics

Leslie Greengard, New York University

David Levermore, University of Maryland, Department of Mathematics

Warren Mori, University of California, Los Angeles (UCLA), Physics/Engineering

James Rossmanith, University of Wisconsin-Madison, Department of Mathematics

PLWS4

Michael Desjarlais, Sandia National Laboratories

Stephanie Hansen, Sandia National Laboratories

Michael Murillo, Los Alamos National Laboratory

Ronald Redmer, Universität Rostock

Samuel Trickey, University of Florida

GSS2012

Yoshua Bengio, University of Montreal, Canadian Institute for Advanced Research

Geoffrey Hinton, University of Toronto, Canadian Institute for Advanced Research

Yann LeCun, New York University, Canadian Institute for Advanced Research

Andrew Ng, Stanford University, Canadian Institute for Advanced Research

Stanley Osher, University of California, Los Angeles (UCLA)

MD2012

Vasily V. Bulatov, Lawrence Livermore National Laboratory

Jiun-Shyan Chen, University of California, Los Angeles (UCLA), Civil & Environmental Engineering

Kristen Fichthorn, Pennsylvania State University

Nasr Ghoniem, University of California, Los Angeles (UCLA), Mechanical & Aerospace Engr.

Mitchell Luskin, University of Minnesota, Twin Cities

Michael Ortiz, California Institute of Technology, Aeronautics and Applied Mechanics

Tim Schulze, University of Tennessee, Math

Vivek Shenoy, Brown University

Axel Voigt, Technishche Universtitat Dresden

IAG2013

Mario Bonk, University of California, Los Angeles (UCLA), Mathematics

John Garnett, University of California, Los Angeles (UCLA), Mathematics

Ursula Hamenstädt, University of Bonn, Mathematics Institute

Pekka Koskela, University of Jyväskylä

Eero Saksman, University of Helsinki

L. PUBLICATIONS LIST

We changed the way we present publications this year. In the past, we asked all participants of all IPAM programs (of any year) to report up to three publications published in the reporting year that were a result or influence by their participation in an IPAM program. This year we just surveys participants in summer programs and long programs. For this report, it includes participants of the 2010 summer program, Networks and Network Analysis in the Humanities, and the two long programs, Optimization and Chemical Compound Space. The following publications are the participants' responses to "Please list up to three publications of the past year (including preprints and technical papers) that were a result of or influenced by your participation at the IPAM program" which was part of a survey conducted in the spring of 2012.

Networks and Network Analysis for the Humanities (Summer 2010)

Fuller, Michael. East Asian Languages and Literatures, University of California, Irvine (UCI)

CBDB User's Guide
(http://isites.harvard.edu/fs/docs/icb.topic1068612.files/Users%20Guide%20110811.pdf)

China Biographical Database release 20120105CBDBag.mdb (see
http://isites.harvard.edu/icb/icb.do?keyword=k16229&pageid=icb.page76670)

Menczer, Filippo. Indiana University

Visualizing Communication on Social Media: Making Big Data Accessible. In: Proc. CSCW Workshop on Collective Intelligence as Community Discourse and Action. 2012. Karissa McKelvey, Alex Rudnick, Michael Conover and Filippo Menczer.

Tangherlini, Timothy. Germanic Languages and Literatures, Scandinavian SectionUniversity of California, Los Angeles (UCLA)

The Trouble with House Elves: Classification and Computational Folkloristics. CACM (forthcoming)

TrollFinder: Geo-semantic Navigation of a Very Large Folklore Corpus. LREC 2012.

The Foklore Macroscope: Challenges for a Computational Folkloristics. Western Folklore (forthcoming)

Weingart, Scott. Information Science / History and Philosophy of Science, Indiana University

Weingart, Scott. Demystifying Networks, Parts I & II, Journal of Digital Humanities 1:1 – Winter 2011

Guo, Weingart, & Börner. Mixed Indicators Model for Identifying Emerging Research Fields, Scientometrics 89:1 – June 2011

Weingart & Jorgensen. Computational Analysis of the Body in European Fairy Tales, Literary and Linguistic Computing – 2012

Modern Trends in Optimization and Its Application (Fall 2010)

Bachoc, Christine. Mathematics,Université de Bordeaux I

Christine Bachoc, Arnaud Pêcher, Alain Thiéry, On the theta number of powers of cycle graphs, to appear in Combinatorica

Christine Bachoc, Martin Ehler, Tight p-fusion frames, arXiv:1201.1798

Blekherman, Grigoriy. Bioinformatics Institute, Virginia Polytechnic Institute and State University

Nonnegative Polynomials and Sums of Squares (to appear in Journal of the AMS)

Symmetric Nonnegative Forms and Sums of Squares (Preprint Arxiv, with Cordian Riener)

Breckpot, Maarten. Electrical EngineeringKatholieke Universiteit Leuven

Breckpot M., Agudelo M., De Moor B., ``Control of a single reach with model predictive control", submitted to Riverflow 2012

Breckpot M., Agudelo M., De Moor B., ``Model Predictive Control of a river system with two reaches", submitted to CDC 2012

Calafiore, Giuseppe. Politecnico di Torino

L. El Ghaoui, G.C. Calafiore, "Optimization Models," Cambridge University Press, in preparation.

G.C. Calafiore, “Random Convex Programs,” SIAM Journal on Optimization, vol. 20, n. 6, pp. 3427-3464, Dec. 2010.

G.C. Calafiore, L. Fagiano, "Robust Model Predictive Control via Random Convex Programming." In: 50th IEEE Conference on Decision and Control and European Control Conference, Orlando, Florida, December 12-15, 2011. pp. 1910-1915

Drori, Yoel. School of Mathematical Sciences, Tel Aviv University

Amir Beck, Yoel Drori, Marc Teboulle, A new semidefinite programming relaxation scheme for a class of quadratic matrix problems, Operations Research Letters

Friedlander, Michael. Computer Science, University of British Columbia

M. P. Friedlander and M. Schmidt, Hybrid deterministic-stochastic methods for data fitting. April, 2011. To appear in SIAM J. Scientific Computing

M. P. Friedlander, H. Mansour, R. Saab, O. Yilmaz. Recovering compressively sampled signals using partial support information. IEEE Trans. Inform. Theory, 58(2):1122–1134, 2012

Henrion, Didier. Laboratoire d'Analyse et d'Architecture des Systemes (LAAS), Centre National de la Recherche Scientifique (CNRS)

T. Bayen, D. Henrion. Semidefinite programming for optimizing convex bodies under width constraints. To appear in Optimization Methods and Software, 2012.

D. Henrion. Semidefinite geometry of the numerical range, Electronic Journal of Linear Algebra, Vol. 20, pp. 322-332, 2010

D. Henrion. Semidefinite representation of convex hulls of rational varieties, Acta Applicandae Mathematicae, Vol. 115, No. 3, pp. 319-327, 2011.

Kocvara, Michal. School of Mathematics, University of Birmingham

M. Kocvara and M. Stingl. PENNON: Software for Linear and Nonlinear Matrix Inequalities. In: Handbook on Semidefinite,

Conic and Polynomial Optimization, Anjos, Miguel F.; Lasserre, Jean B. (Eds.), Springer, 2012, pp. 755-794, ISBN 978-1-4614-0768-3

M. Kocvara and M. Stingl. Solving stress constrained problems in topology and material optimization. Structural and Multidisciplinary Optimization, 2012, DOI: 10.1007/s00158-012-0762-z

M. Kocvara, M. Kojima and J. Turner: Solving semidefinite topology optimization problems via domain decomposition. In preparation.

Koeppe, Matthias. Mathematics, University of California, Davis (UC Davis)

Velleda Baldoni, Nicole Berline, Jesus A. De Loera, Matthias Koeppe, and Michele Vergne. Computation of the highest coefficients of weighted Ehrhart quasi- polynomials of rational polyhedra. Foundations of Computational Mathematics, 2011. published online 12 November

2011.

Velleda Baldoni, Nicole Berline, Matthias Koeppe, and Michele Vergne. Intermediate sums on polyhedra: Computation and real Ehrhart theory. eprint arXiv:1011.6002 [math.CO], to appear in Mathematika, 2010.

Krishnamoorthy, Bala. Mathematics, Washington State University

T.K. Dey, A.N. Hirani, B. Krishnamoorthy, Optimal homologous cycles, total unimodularity, and linear programming. In SIAM Journal on Computing, 40(4): 1026-1040, 2011.

S. Ibrahim, B. Krishnamoorthy, and Kevin Vixie, Simplicial flat norm with scale. pre-print: arXiv:1105.5104, 2011 (under review currently)

Lasserre, Jean. LAAS-CNRS, Université de Toulouse III (Paul Sabatier)

J.B. Lasserre. A new look at nonnegativity on closed sets and polynomial optimization, SIAM J. Optim. 21 (2011), pp. 864--885

J.B. Lasserre. Bounding the support a measure from its marginal moments, Proc. Amer. Math. Soc. 139 (2011), pp. 3375--3382

Lee, Jon. Mathematical Sciences, IBM Thomas J. Watson Research Center

Jon Lee. Techniques for Submodular Maximization. Invited for: Fields Institute Communications Series on Discrete Geometry and Optimization (Edited by Karoly Bezdek, Yinyu Ye, and Antoine Deza).

Pierre Bonami, Jon Lee, Sven Leyffer, Andreas Wächter, More branch and bound experiments in convex MINLP. Submitted to: Mathematical Programming Computation.

Jon Lee and Leo Liberti, A matroid view of key theorems for edge-swapping algorithms. To appear in: Mathematical Methods of Operations Research.

Lorenz, Dirk. TU Braunschweig

Constructing test instances for Basis Pursuit Denoising

An Infeasible-Point Subgradient Method Using Adaptive Approximate Projections

Solving Basis Pursuit: Subgradient Algorithm, Heuristic Optimality Check, and Solver Comparison

McCoy, Michael. California Institute of Technology

Two Proposals for Robust PCA using Semidefinite Programming

Robust Computation of Regression Planes, or How to Find a Needle in a Haystack

Nemirovski , Arkadi. Georgia Institute of Technology

Juditsky, A., Kilin\c{c} Karzan, F., Nemirovski, A. ``L_1 Minimization via Randomized First Order Algorithms" -- submitted to {\sl Mathematical Programming} E-print: http://www.optimization-online.org/DB_FILE/2010/05/2618.pdf

Juditsky, A., Kilin\c{c} Karzan, F., Nemirovski, A., Polyak, B.T., ``On the accuracy of ℓ_1-filtering of signals with block-sparse structure" -- in: J. Shawe-Taylor, R.S. Zemel, P. Bartlett, F. Pereira, K.Q. Weinberger (Eds), {\sl Advances in Neural Information Processing Systems 24} (2011), 1666-1674

Juditski, A., Kilin\c{c} Karzan, F., Nemirovski, A., Polyak, B. (2011), ``Accuracy Guarantees for ℓ_1 recovery of block-sparse signals" -- submitted to {\sl Annals of Statistics}, E-print: http://www.arxiv.org/PS_cache/arxiv/pdf/1111/1111.2546v1.pdf

Onn, Shmuel. Technion-- Israel Institute of Technology

N-fold integer programming in cubic time (with Raymond Hemmecke and Lyubov Romanchuk), Mathematical Programming, to appear.

On the Complexity of Hilbert Refutations for Partition (with Susan Margulies), preprint

Polynomial Projections of Integer Hulls (with Michal Rozenblit), preprint

Rendl, Franz. Mathematics, Universität Klagenfurt

Semidefinite Relaxations for Partitioning, Assignment and Ordering Problems

Riener, Cordian. Institut fuer Mathematik, Johann Wolfgang Goethe-Universität Frankfurt

Symmetric nonnegative forms and sums of squares (http://arxiv.org/abs/1205.3102)

Exploiting symmetries in SDP-relaxations for polynomial optimization (http://arxiv.org/abs/1103.0486)

Symmetries in Semidefinite and Polynomial Optimization – Relaxations, Combinatorics and the Degree Principle (PhD Thesis)

Tai, Xue-Cheng. Department of Mathematics, University of Bergen

Graph cuts for curvature based image denoising IEEE Transactions on Image Processing, vol. 20, no. 5, pp. 1199–1210, 2011

A modified TV-Stokes model for image processing SIAM Journal on Scientific Computing, vol. 33, no. 4, pp. 1574–1597, 2011

Augmented Lagrangian method for total variation based image restoration and segmentation over triangulated surfaces Journal of Scientific Computing, vol. 50, no. 1, pp. 145–166, 2012

Teboulle, Marc. Mathematical Sciences, Tel Aviv University

Beck A., D. Yoel and M. Teboulle, A new SDP relaxation scheme for a class of quadratic matrix matrix problems. Accepted for publication : Operations Research Letters, --to appear 2012

A. Beck and M. Teboulle, Smoothing and First Order Methods: A Unified Framework, Accepted for publication SIAM J. Optimization--to appear 2012

R. Luss and M. Teboulle, Conditional gradient algorithms for rank-one matrix approximations with a sparsity constraint. Submitted for publication. 09/2011--SIAM Review

Todd, Michael. Cornell University

"A robust robust optimization result," M. Gancarova and M.J. Todd, Operations Research Letters, 40 (2012), 2--5

Wolkowicz, Henry. Combinatorics and OptimizationUniversity of Waterloo

http://orion.math.uwaterloo.ca/%7Ehwolkowi/henry/reports/ABSTRACTS.html#preprocessingSDP

http://orion.math.uwaterloo.ca/%7Ehwolkowi/henry/reports/ABSTRACTS.html#proteins

Yan, Ming. Mathematics, University of California, Los Angeles (UCLA)

M. Yan, Y. Yang and S. Osher, Robust 1-bit compressive sensing using adaptive outlier pursuit, IEEE Transactions on Signal Processing, to appear.

M. Yan, EM-type algorithms for image reconstruction with background emission and Poisson noise, In: Proceeding of 7th International Symposium on Visual Computing, Lecture Notes in Computer Science (LNCS), 6938 (2011), 33-42.

Zibulevsky, Michael. Computer Science, Technion - Israel Institute of Technology

E. Osherovich, M. Zibulevsky and I. Yavneh, Approximate Fourier phase information in the phase retrieval problem: what it gives and how to use it,JOSA A, Vol. 28, Issue 10, pp. 2124-2131 (2011)

E. Osherovich, M. Zibulevsky and I. Yavneh, Designing and using prior knowledge for phase retrieval, Arxiv preprint arXiv:1203.0879, 2012

J. Shtok, M. Elad, and M. Zibulevsky, Sparsity-Based Sinogram for Low-Dose Computed Tomography, International Conference on Acoustics, Speech, and Signal Processing (ICASSP), Prague, Czech Republic, 22-27 May, 2011.

Navigating Chemical Compound Space for Materials and Bio Design (spring 2011)

Andrienko, Denis. Max Planck Institute for Polymer Research

V. Ruehle, A. Lukyanov, F. May, M. Schrader, T. Vehoff, J. Kirkpatrick, B. Baumeier, D. Andrienko, J. Chem. Theory Comput., 7, 3335-3345, 2011

M. Misra, D. Andrienko, B. Baumeier, J.-L. Faulon, O. A. von Lilienfeld, J. Chem. Theory Comput., 7, 2549-2555, 2011

Baumeier, Bjoern. Max Planck Institute for Polymer Research

Victor Rühle, Alexander Lukyanov, Falk May, Manuel Schrader, Thorsten Vehoff, James Kirkpatrick, Björn Baumeier, and Denis Andrienko, "Microscopic Simulations of Charge Transport in Disordered Organic Semiconductors", J. Chem. Theory Comput., 2011, 7 (10), pp 3335–3345

Milind Misra, Denis Andrienko, Björn Baumeier, Jean-Loup Faulon, and O. Anatole von Lilienfeld, "Toward Quantitative Structure–Property Relationships for Charge Transfer Rates of Polycyclic Aromatic Hydrocarbons", J. Chem. Theory Comput., 2011, 7 (8), pp 2549–2555

Björn Baumeier, Falk May, Christian Lennartz and Denis Andrienko, "Challenges for in silico design of organic semiconductors", J. Mater. Chem., 2012, Advance Article, DOI: 10.1039/C2JM30182B

Beratan, David. Duke University

A Virshup, J. Contreras-Garcia, W. Yang and D.N. Beratan, Nature, submitted (2012).

Burke, Kieron. University of California, Irvine (UCI)

Finding Density Functionals with Machine Learning, J. C. Snyder, M. Rupp, K. Hansen, K-R. Mueller, K. Burke, submitted to Phys. Rev. Lett., (2011)

Carloni, Paolo. International School for Advanced Studies (SISSA/ISAS)

Chiriano G., A. Sartini, F. Mancini, V. Andrisano, M. L. Bolognesi, M. Roberti, M. Recanatini, P. Carloni, A. Cavalli, Sequential Virtual Screening Approach to the Identification of Small Organic Molecules as Potential BACE-1 Inhibitors, Chemical Biology & Drug Design 2011. 77(4): p. 268-271.

Biarnes X., Bongarzone S., Vargiu A.V., Carloni P., Ruggerone P., Molecular motions in drug design: the coming age of the metadynamics method, Journal of Computer-Aided Molecular Design 2011. 25(5): p. 395-402.

Bongarzone S., H. N. A. Tran, A. Cavalli, M. Roberti, M. Rosini, P. Carloni, G. Legname, M. L. Bolognesi, Hybrid Lipoic Acid Derivatives to Attack Prion Disease on Multiple Fronts, CHEMMEDCHEM 2011. 6(4) Special Issue: Sp. Iss. SI: p. 601-605.

Dokholyan, Nikolay. University of North Carolina

M. Sparta, F. Ding, D. Shirvanyants, N. V. Dokholyan*, and A. N. Alexandrova, “Hybrid

dynamics simulation engine for metalloproteins" submitted (2012)

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M. INDUSTRIAL AND GOVERNMENTAL INVOLVEMENT

We have significant involvement of industry and government labs in our summer program, Research in Industrial Projects for Students (RIPS). See the program description for RIPS-LA on page 40 for a complete list of sponsors.

This was our first year of RIPS-Hong Kong. Our partner, Hong Kong University of Science and Technology, recruited the sponsors. Beijing Genomics Institute (BGI) sponsored two projects, and Huawei (telecommunications) and MetLife each sponsored one project. See the program description on page 42 for more information.

IPAM received a grant from ONR to conduct a series of workshops on machine reasoning. The workshops were held at IPAM in September and October, 2010. See the program description (page 13 and 17) for more information.

As part of an ongoing effort to increase involvement with industry and government labs, we recruit board members to represent these sectors. Henry Cohn from Microsoft Research joined our Science Advisory Board in 2011, while Matthew Hastings from "Station Q" served his third year. Our Board of Trustees added Al Hales (CCR West), Jeff Saltzman (formerly Merck, now AstraZeneca), Pieter Swart (Los Alamos National Lab), and David Balaban (Amgen) in 2010. Cleve Moler (Math Works) finished his term in 2011. Juan Meza represented Lawrence-Berkeley Labs when he was recruited in 2009, but since took an academic position.

Individuals representing Department of Defense, Sandia National Laboratories, Argonne National Laboratory, BAE Systems, and DuPont Central Research and Development served on organizing committees of several workshops and the spring long program in 2010-2011. Several participants of the Chemical Compound Space (CCS) long program came from national or military research laboratories.

Here are a few comments from representatives of industry and government labs who attended IPAM programs in 2010-2011:

Bill Morokoff, Standard & Poor's: "Support for our RIPS project has provided the basis for discussions with various departments in S&P to better understand various economic risk assessment approaches employed. Additionally, [our participation in RIPS] led to invitation to present related mathematical finance research in a seminar at Johns Hopkins math department."

Jon Lee, IBM Thomas J. Watson Research Center: "[During the Optimization program,] I began to work with Shmuel Onn and others concerning discrete optimization. I also became very interested in certain topics as result of my stay—in particular, rank-sparsity decompositions, which I am now pursuing."

N. EXTERNAL SUPPORT

In addition to the funding listed in Table N below, IPAM receives substantial in-kind financial support from UCLA and other sources. The Director's entire salary and administrative stipend are paid directly by UCLA. The Director of Special Projects is released from two courses at the cost of replacing him by a junior person. IPAM is not charged for the use of its building or for custodial care. The value of these items is considerable. Additionally, senior long-term participants from other universities are usually funded on a teaching replacement-buyout basis, by which they are released from teaching for the cost of hiring a junior person as a replacement.

Table N: Other Funding Support - 2010 to 2011	
Federal Grants	**Amount**
Office of Naval Research (ONR) for Machine Reasoning…	$193,583
Sub-total	193,583
University Funding Support	
Dean Physical Sciences – Information Technology Support	59,883
Vice Chancellor for Research's Support	140,027
Mathematics Department Support – Public Lecture	500
Sub-total	200,410
Industrial Affiliates and Other Support	
Aerospace	15,000
Arete	15,000
Disney	7,500
IBM	16,500
Pixar Corporation	7,500
Microsoft	10,000
Symantec	15,000
HRL Laboratories	15,000
Sub-total	101,500
Others	
Registration Fees-Programs	49,391
Green Family Lectureship Foundation Interest	5,943
Sub-total	55,334
TOTAL	**$ 550,827**

O. COMMITTEE MEMBERSHIP

IPAM's committees include the Board of Trustees and Science Advisory Board. The members of each during the 2010-2011 academic year are listed below. (Some of them have since finished their term or resigned.)

Science Advisory Board

Russel Caflisch	UCLA (IPAM Director)
Mark Green	UCLA

Matthew Hastings	Los Alamos National Laboratory
Peter Jones	Yale University
Yann LeCun	New York University
David Levermore	University of Maryland
Assaf Naor	New York University
Stanley Osher	UCLA (IPAM Director of Special Projects)
Amber Puha	CSU San Marcos (IPAM Associate Director)
Christian Ratsch	UCLA (IPAM Associate Director)
Richard Schwartz	Brown University
Terence Tao	UCLA
Elizabeth Thompson	University of Washington
Claire Tomlin	UC Berkeley
Stephen Wright	University of Wisconsin

Board of Trustees

David Balaban	AMGEN Inc
Russel Caflisch	UCLA (IPAM Director)
Tony Chan	Hong Kong University of Science and Technology
Mark Green	UCLA
Alfred Hales	Center for Communications Research
William Massey	Princeton University
Juan Meza	Lawrence Berkeley Laboratory
Cleve Moler	MathWorks Incorporated
Stanley Osher	UCLA (IPAM Director of Special Projects)
Amber Puha	CSU San Marcos (IPAM Associate Director)
Christian Ratsch	UCLA (IPAM Associate Director)
Jeffrey Saltzman	Merck and Company, Inc
Ronald Stern	University of California, Irvine
Pieter Swart	Los Alamos National Laboratory
Tatiana Toro	University of Washington

P. CONTINUING IMPACT OF PAST IPAM PROGRAMS

We wanted to share with you a few comments from participants of programs prior to the past academic year that testify to the continuing impact their participation had made on their careers and research.

Email received April 2011 from Karianne Bergen, RIPS 2008 student participant:

I wanted to thank you for your assistance in arranging a letter of recommendation from IPAM for my graduate school applications. I received offers from many of the programs to which I applied, and I have decided to attend the ICME program at Stanford University, where I was offered a three-year Stanford Graduate Fellowship.

I also wanted to thank you more generally for the opportunity you provided me through the RIPS program. My participation in the program was among my most memorable undergraduate experiences. I was impressed by the diverse talents and interests of the other students in the program and by the challenging and relevant projects themselves. In particular, I was impressed that, as a member of the JPL team, my project touched on topics from nearly all of my undergraduate applied mathematics courses.

My participation in the RIPS program played an important role in my decision to attend graduate school. The program helped me realized how much I enjoyed working in a research environment and gave me confidence in my ability to be successful in a graduate program.

Thank you again for the support you provided me during my application process and for your continued support for the RIPS program.

Susan Fitzpatrick Behrens, who participated in our 2010 summer program "Network Analysis in the Humanities," wrote this email to Brent Bobley at NEH:

Although I am a historian and have never employed any technology in my research, I was fascinated by the idea of being able to map networks. My current research examines Guatemala, where a 36 year armed conflict devastated the population. This violence was officially concluded by establishing a truth commission that relied largely on testimonies taken from thousands of victims of the violence. Testimonies were useful for attributing responsibility for much of the worst violence to state forces, but less helpful for understanding or "mapping" the temporal and geographic trajectory of the conflict. It struck me that the technology being introduced in the seminar might be useful for employing this testimony in a more empirical way to provide a more detailed analysis and a visualization of what happened.

I have to say that what I learned at the [program] absolutely surpassed anything that I could have imagined for the utility of these new methods and technologies. I went with the hope of thinking about ways to approach truth commissions, but left completely rethinking my own research which focuses on transnational Catholic social networks. I loved learning about the participants' work and was fascinated by how they are engaging new technologies to literally re-imagine everything from relations among literary figures to plays in football. It was a new world for me. The "mini-seminar" gave me a chance to get a glimpse at what seems to me a whole set of emerging fields that transcend disciplines.

I wanted to share my experience with you and to thank Tim Tangherlini and the NEH for introducing scholars in the humanities to technology that I suspect will initiate a paradigm shift across the humanities. I also wanted to express my profound appreciation for his openness in allowing an outsider, who had not been part of the original NEH seminar, to sit in and get a chance to learn about the possibilities that this engagement among humanities, math, and science was engendering.

Susan Fitzpatrick Behrens, Ph.D.
Associate Professor, California State University, Northridge

APPENDIX 1: Meeting of Institute Directors, Minutes and Report

Minutes and Report
Mathematics Institutes Directors Meeting
AIM
May 6 -7, 2011

In attendance May 6, 2011:

Hélène Barcelo MSRI

Estelle Basor AIM

Robert Bryant MSRI

Russel Caflisch IPAM

Brian Conrey AIM

David Farmer AIM

Marty Golubitsky MBI

Leslie Hogben AIM

Sally Koutsoliotas AIM

David Levermore BMSA

Jill Pipher ICERM

Fadil Santosa IMA

Richard Smith SAMSI

Thomas Spencer IAS

1 Welcome and Introductions

2 Diversity Committee Report

David Levermore reported on the observations about diversity contained in the DMS's 2010 Committee of Visitors report.

Leslie Hogben gave a review of the Diversity Committee members, general goals, and recent activities, including involvement with SACNAS, the Alliance program, Blackwell Tapia, and the AWM mentor network.

a. **Modern Math Workshop.** The Modern Math Workshop is a pre-activity of SACNAS. It is now a cooperative effort of all institutes, showcasing the activities of the institutes and offering mini-courses and lectures related to the themes of the institutes.

b. **SACNAS.** Institutes representation at SACNAS includes a booth and reception, but perhaps, there should be more involvement of the institutes in the mathematical aspects.

c. **Alliance Postdoctoral Fellowships.** Another recent activity of the Diversity Committee is the Alliance Postdoctoral program, run by Loek Helminck. The goal is to provide mentoring of postdocs at a research university while also spending a year at an institute. A review of the Alliance postdocs and mentors chosen for this past year was given.

d. **Diversity Workshops.** Leslie reported on the joint effort led by Dave Auckly (MSRI) to secure the collective funding for several diversity workshops. This would alleviate the need to seek individual funding for each activity. Workshops include the Modern Math Workshop, the Spring Opportunities for women and minorities workshops, Blackwell-Tapia conference and the workshop at Infinite Possibilities, which rotate amongst the institutes. In Fall, IPAM will organize the Modern Math Workshop, etc.

e. **AWM Mentor Network.** Leslie described the AWM Mentor Network activities. The report from the 2010 AWM Mentor Network is on the AWM site.

Measures to broaden diversity of institute participants. A number of institutes strive for a minimum 20% participation of women at workshops. Various measures have been implemented, but it was noted that the acceptance rate for women is significantly lower than that for men.

Hélène and Fadil described the possible creation of a database that would be useful for all the institutes in identifying a broader diversity of institute participants. to broaden the diversity of institute participants. There is good cooperation with AWM and the institutes over issues like this, but for organizations such as NAM, communication is more problematic. Some institutes ask for lists of women and minorities at the time of application and allocate more resources to the programs that are diverse. Some institutes help with daycare costs (using private funding) to encourage greater participation.

There was a consensus that this issue needs to addressed on a case-by-case basis and that programs and sub-fields that have a larger proportion of women should support a greater percentage of women participants.

Pipeline concerns. There are indications that the percentages of women in mathematics is decreasing, both at the undergraduate and graduate level. MAA and BMSA are planning to propose that NSF fund a pipeline study. It was noted that this is a complicated matter with many and varied factors.

Diversity Committee recommendation. The Diversity Committee recommended that all institute contributions to diversity efforts be consolidated into a single annual contribution. Funds would support the reception tied to the SACNAS booth, as well as prizes, etc. In this way, all the possible contributions would be identified at the beginning of each year. The Diversity Committee would be charged with overseeing the activities.

MID recommendation. We request that the Diversity Committee prepare an annual budget to be presented at each MID meeting for discussion and review. The budget would identify appropriate diversity activities to be supported by the Institutes.

3 Technical Committee Report

David Farmer gave the Technical Committee Report. Last year there were no action items. David reported that the composition of the Technical Committee restricted its efficacy. In many cases, its members were not in a position to allocate resources or make executive decisions. It was recommended that the directors revisit the scope of the Technical Committee, along with its membership.

Video Collection of Institute Presentations. A discussion of institutes' video-taping of talks followed. The desire to collect both video and PDF versions of the talk was noted. There was discussion of a common mechanism to search all institutes' videos. Each institute would need to submit the information in an agreed upon form.

Highlights on the Joint Institutes' Webpage. The question of when highlights should be removed from the Joint Institute page was raised. Their over-abundance is not yet an issue, and IMA was asked to remind institutes to submit an annual highlight.

MID recommendation 1. The Technical Committee should be disbanded. Items that need to be addressed should be taken on a case-by-case basis.

MID recommendation 2. David Farmer will send a preliminary list of fields for video metadata to each institute as examples. Every institute will then prepare a list of properties (fields) related to its video presentations. The lists will be collected in a reasonable time and these will form the basis of the metadata needed for a database of institutes videos.

4 JMM Institutes' Reception

Format of the 2011 reception was not optimal: the physical setup made it difficult to hear presentations. Another concern was that the JMM schedule lists it only as a social event.

Brian Conrey provided a history of the event: social – display tables – short talks – talks on a theme. This led to a discussion of what math institutes may want to communicate to the mathematics community. Brian suggested that the individual institute tables remain, and have an informational slide show about the institutes as a whole as well as aspects of the individual institutes. Another suggestion was to separate the social event from the presentations by using different rooms at different times. It was also noted that many of the people who visited the institute tables came from small colleges.

Fadil suggested the institutes consider the idea of creating a joint short video about 'math in everyday life' for YouTube.

MID Recommendation for the Joint Reception. The JMM reception shall have no speakers; instead, an entertaining (but silent) slide show will be presented. The slides will highlight the institutes in the form of questions, trivia, pictures, programs, etc. Jill, Fadil, and Richard are co-chairs and will collect and assemble materials from all the institutes for the slide show. The slide show will be first presented at the JMM meeting, with the intention of its possible use at other future meetings, such as MathFest. This recommendation will be presented to representatives of the other institutes not present at MID.

5 MPE 2013

Brian Conrey gave a short history of MPE 2013 and the workshop at AIM in March 2011. A non-public website was created for planning purposes. Themed programs have been planned at some of the institutes: IPAM is planning a program in material science and applications, and other topics; MBI plans a program on bio-sustainability in 2013 with topics on green management, agent based modeling, etc.; SASMI is planning a program for 2012/2013 that will include a workshop on sustainability for spring 2013. SASMI is tentatively considering a 2013/2014 program on sustainability that will include contributions statistics, applied math, and other fields. The Newton Institute, the Canadian Institutes, and others are also planning events.

Brian showed the internal website, the link to the committees, and described the various activities, possible topics, resources, etc.

David Levermore suggested that programs for 2013 should be thought of as the beginning of MPE-type programs and that others would happen for many years to come.

There was additional discussion about possible joint activities, for example, a workshop at one institute that complements another long program. We need to publicize activities that are complementary and let participants know. CSCAMM should also be contacted to be included in the Fields' list so that the activities of CSCAMM are listed.

6 MID Meeting

Brian Conrey gave a short history of the annual MID meeting and the past activities, including the postdoc initiative and CDI projects.

Brian posed the question of what this group should do in the future. There is agreement that this meeting, especially with the size and informality, is very useful for learning about the other institutes, best practices, etc.

For the next meeting, it might be helpful to include discussion time after the meeting with the NSF.

7 Other Business

Institutes' Planning. There was useful discussion about sharing information about upcoming programs (not just MPE-related programs) and how far ahead the planning takes place. Several planned programs were described and discussed.

Inclusion of DDs. There was also discussion of including Deputy Directors during the annual MID meeting with possibly separate parallel session. One advantage is that it would help reinforce cooperation between programs and institutes.

Institute Postdocs. We reviewed the Institutes postdocs initiative. There seemed be a high percentage of postdocs that have positions for next year. Of those reported, 15 out of 20 have positions for next year.

8 Saturday, May 7, 2011

In attendance May 7, 2011:

Hlne Barcelo MSRI

Estelle Basor AIM

Robert Bryant MSRI

Russel Caflish IPAM

Haiyan Cai DMS

Brian Conrey AIM

David Farmer AIM

Marty Golubitsky MBI

Leslie Hogben AIM

Sally Koutsoliotas AIM

David Levermore BMSA

Sastry Pantula DMS

Jill Pipher ICERM

Rosemary Renaut DMS

Fadil Santosa IMA

Richard Smith SAMSI

Thomas Spencer IAS

Christopher Stark DMS

Henry Warchall DMS

Brian Zuckerman STPI

9 Introduction from Sastry Pantula

DMS DD Sastry Pantula gave a review of his vision of the role of institutes in mathematical research and emphasized that he appreciated the efforts and cooperation of the institutes. He also outlined budget considerations. A hard copy of his presentation was given to everyone in attendance.

10 Institute Evaluation

Brian Zuckerman discussed his draft report and answered questions. The recommendation is to evaluate the Long Program Convening Model by using case studies. It was noted that many institutes have short, week-long workshops that are not part of the semester-long programs. These meetings are similar in nature to the AIM workshops. A hard copy of his presentation was given to everyone in attendance.

11 Other Business

Brian Conrey highlighted some of the items from the MID meeting on Friday, including some of the diversity activities, the MID's recommendation for the JMM Joint Institutes' reception, the MPE 2013 initiative, the role of the MIDs, the sharing of future programs, the inclusion of Deputy Directors in the annual meeting, and the technical committee. There was also discussion of the proposed joint database.

Hank Warchall spoke about having organizers of workshops and programs create white papers about the future directions of fields. He emphasized the importance of the white papers. DMS is willing to provide additional funds to Institutes to support this activity. There was a request to see good examples of white papers.

He also reminded us about the needs of plans for self-evaluation and how this should be a back and forth activity between the NSF and the Institutes.

12 Date of the next MID meeting

Friday, May 11 - Saturday, May 12, 2012 at ICERM