Institute for Pure and Applied Mathematics, UCLA
Award/Institution #0439872-013151000
Annual Progress Report for 2008-2009
April 29, 2010

TABLE OF CONTENTS

EXECUTIVE SUMMARY	2
A. PARTICIPANT LIST	2
B. FINANCIAL SUPPORT LIST	2
C. INCOME AND EXPENDITURE REPORT	4
D. POSTDOCTORAL PLACEMENT LIST	5
E. INSTITUTE DIRECTORS' MEETING REPORT	5
F. PARTICIPANT SUMMARY	9
G. POSTDOCTORAL PROGRAM SUMMARY	10
H. GRADUATE STUDENT PROGRAM SUMMARY	11
I. UNDERGRADUATE STUDENT PROGRAM SUMMARY	12
J. PROGRAM DESCRIPTION	13
K. PROGRAM CONSULTANT LIST	34
L. PUBLICATIONS LIST	44
M. INDUSTRIAL AND GOVERNMENTAL INVOLVEMENT	44
N. EXTERNAL SUPPORT	47
O. COMMITTEE MEMBERSHIP	48
P. CONTINUING IMPACT OF PAST IPAM PROGRAMS	49
APPENDIX 1: Publications (self-reported) 2008 – 2009	53
APPENDIX 2: Preliminary Report for FY 2009-2010	79

Institute for Pure and Applied Mathematics, UCLA
Award/Institution #0439872-013151000
Annual Progress Report for 2008-2009
April 29, 2010

EXECUTIVE SUMMARY

IPAM had a productive year. Highlights of IPAM's accomplishments and activities for 2008-2009 include:

- IPAM held two long programs in academic year 2008-09:
  - Internet MRA
  - Quantum and Kinetic Transport
- IPAM's 2009 winter workshops continued the tradition of focusing on emerging topics where Mathematics plays an important role:
  - Quantitative and Computational Aspects of Metric Geometry
  - Numerical Approaches to Quantum Many-Body Systems
  - Laplacian Eigenvalues and Eigenfunctions: Theory, Computation, Application
  - Rare Events in High-Dimensional Systems
- IPAM sponsored reunion conferences for four long programs: Cells and Materials, Random Shapes, Search Engines and Securing Cyberspace
- The third and final workshop with the National Geospatial Intelligence Agency, "Advancing the Automation of Image Analysis" was held in December.
- IPAM sponsored two public lectures, featuring distinguished mathematicians and scientists attending IPAM workshops. David Clark spoke on "The Internets that We Didn't Build" in November 2008. Ken Golden spoke on April 29 on "Climate Change and the Mathematics of Sea Ice." We also cosponsored a lecture with the math department, presented by Gregory Margulis.
- We recruited 9 industry sponsors and 36 students for RIPS 2009.
- IPAM offered RIPS-Beijing, with four projects and 8 U.S. students, in partnership with Microsoft Research Asia (MSRA) and with the support of an IRES grant.
- With the other NSF math institutes, IPAM co-sponsored the Modern Math Workshop and a reception at SACNAS in Salt Lake City (October 2008) and a reception at the Joint Mathematics Meetings in January.
- IPAM will host the "Infinite Possibilities Conference" for minority women mathematicians in March 2010. A meeting of the planning committee was held in March 2009; we held a public panel discussion featuring 10 minority women mathematicians just before the meeting.
- IPAM held two women's luncheons in conjunction with the workshops "Rare Events in High-Dimensional Systems" and "The Boltzmann Equation."

- At the November 2008 meeting, the SAB approved two long programs on Optimization (fall 2010) and Searching Chemical Space (spring 2011) as well as four winter 2010 workshops on finance, privacy, bioimaging and radiation therapy, and metamaterials.
- IPAM was awarded $33K from ONR to support the winter 2009 workshop "Laplacian Eigenvalues and Eigenfuctions."
- IPAM applied for and was awarded grants from ONR (for proposed workshops on Agent-Based Complex Systems and Machine Learning) and NSA (for Combinatorics workshop).
- New members of our Science Advisory Board are Richard Schwartz, Stephen Wright, Elizabeth Thompson, Claire Tomlin, Jill Mesirov, and Matt Hastings.
- New Board of Trustees members are William Massey, Juan Meza, Tatiana Toro, and Sallie Keller-McNulty.
- We hired Amber Puha as IPAM associate director.
- IPAM's Science Advisory Board chair, Peter Jones (Yale), and Director of Special Projects, Stan Osher, were invited to give Plenary Addresses at ICM 2010.
- Three IPAM participants (Alex Gamburd, Michael Elowitz, and Nick Feamster) who participate in NSF's Faculty Early Career Development Program (CAREER) have received an additional distinction as winners of Presidential Early Career Awards for Scientists and Engineers (PECASE).
- Four former IPAM participants were awarded Sloan Fellowships this spring.
- A special issue of NeuroImage, entitled "Mathematics in Brain Imaging," was published in February 2009. This project grew out of the "Mathematics in Brain Imaging" summer school held at IPAM in July 2008.

A. PARTICIPANT LIST

A list of all participants in IPAM programs is provided in electronic form (Excel). The list includes participant lists for programs starting between August 1, 2008 and July 31, 2009. We chose to include the participants of RIPS 2009, which started in June 2009 but ended after July 31, 2009, as well as the associated RIPS 2009 Projects Day, held on August 14, 2009.

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, 2008 and July 31, 2009. We chose to include all financial transactions related to RIPS 2009, which started in June 2009 but ended after July 31, 2009.

C. INCOME AND EXPENDITURE REPORT

	A	B	C	D	E	F
			A-B=C		B+D=E	A-E=F
Budget Category	**Appropriation Years 1-4**	**Actual Expenses as of July 2009**	**Current Balance as of July 2009**	**Projected Expenses as of July 2009**	**Total Expenses as of July 2009**	**Projected Balance as of July 2009**
A. Operations Fund	6,717,388.00	5,596,789.74	1,120,598.26	372,553.22	5,969,342.96	748,045.04
B. Participant Cost	6,916,378.00	6,445,008.60	471,369.40	201,840.00	6,646,848.60	269,529.40
C. Postdocs	1,028,098.00	-	1,028,098.00	37,992.62	37,992.62	990,105.38
4-Year Total Budget	14,661,864.00	12,041,798.34	2,620,065.66	612,385.84	12,654,184.18	2,007,679.82

In the 4th year of the grant, IPAM has received funding at a total of $14,661,864 for the combined $3.4M per year appropriation plus the supplemental funding for CDI at 33,766 and for postdoctoral fellowship at $1,028,098. The actual expenditure as of July 31, 2009 is $12,041,798 giving a balance of $2,620,066. We have projected expenditures of $612,386 which will increase total expenditures to $12,654,184. Since we have been using the carry-forward from year 3 of approximately $1,191,616 towards our 2009-2010 programs, the budget for the 4th year of the current grant is partially spent with an anticipated balance as of July 31, 2009 as carry-forward to year 5 in the amount of $2,007,680.

Expenditures up to July 31, 2009

A. The Operational fund (salaries, benefits, equipment, supplies, and travel including overhead) for 4-year budget has cumulative appropriation of $6,717,388 with total expenditures of $5,969,343 inclusive of outstanding expenses. This will give us an anticipated carry-forward of $748,045 ($485,744 direct cost and $262,301 indirect cost).
B. Participant Cost Category for 4-year budget has appropriation of $6,916,378 with total expenditures of $6,646,849 as of July 31, 2009 inclusive of outstanding expenses with anticipated carry-forward to year 5 of $269,529. The projected carry forward will partially cover the outstanding expenses for RIPS09 ending In August'09, and exploratory programs in 2009-2010.
C. The supplemental for the postdoctoral fellowship was awarded in May 2009 and 8 postdocs were recently hired but they have different start dates. Therefore, the carry-forward is $990,105.

The combined expenditures of operational fund and participant cost category will result in carry-forward funds at approximately $2,007,680 to be used as follows:

A. To augment operational fund category for salaries, benefits, equipment, supplies, and travel expenses. No merit increase was given to the staff. The overall carry-forward will cover for cost of salaries and benefits of IPAM staff, including the partial compensation for the newly appointed second associate director. Part of the carry-forward will also be used for much needed computer system upgrade; supplies and materials; and travel for directors/senior staff. This will sustain and support the growing needs of IPAM's programmatic structure.

B. To augment the increasing cost for the program participants for 2009-2010. There will be additional costs for the increasing number of participants based on the growth trend of participants' applications brought about by continued success of the previous programs. The anticipated carry-forward from the previous years will cover the overall cost of additional programs for the housing and travel costs which have increased by 30-35%. With the growth of the programs and increasing costs, the carry-forward of $269,529 will help sustain the increasing program costs in its 5th year. IPAM plans to co-sponsor programs for women and diversity, public lectures, co-sponsor a graduate summer program 2010, RIPS 2010 in Berlin and Beijing that will be covered by the carry forward amount.

C. The remaining supplemental award of $990,105 for the postdoctoral fellowships will be used during year 5 since the award came towards the end of the 4th year of the grant for 8 postdocs.

D. POSTDOCTORAL PLACEMENT LIST

IPAM does not appoint postdoctoral fellows so we have no data to report in this section.

E. INSTITUTE DIRECTORS' MEETING REPORT

Minutes and Report
Mathematics Institutes Directors Meeting
April 17-18, 2009

***In attendance**:*
Jim Berger SAMSI berger@samsi.info
Robert Bryant MSRI bryant@msri.org
Russel Caflisch IPAM caflisch@math.ucla.edu
Brian Conrey AIM conrey@aimath.org
Marty Golubitsky MBI mg@mbi.osu.edu
Pierre Gremaud SAMSI gremaud@unity.ncsu.edu
Peter Jones Facilitator peterwjones@comcast.net
Alan Karr NISS karr@niss.org
Michael Minion SAMSI minion@email.unc.edu
Fadil Santosa IMA santosa@ima.umn.edu
Nell Sedransk SAMSI sedransk@niss.org
Thomas Spencer IAS spencer@math.ias.edu
Dean Evasius NSF devasius@nsf.gov
Mary Ann Horn NSF mhorn@nsf.gov
Joanna Kania-Bartoszynska NSF jkaniaba@nsf.gov
Deborah Lockhart NSF dlockhar@nsf.gov
Peter March NSF pmarch@nsf.gov
Chris Stark NSF cstark@nsf.gov

I. Review of the Action items from last year's meeting:

1. Technical Committee had no activity this past year.
Action items for IT people and Technical Committee:

- All institutes should enter their events on the institutes' webpage as soon as they are entered on their own webpage.
- Update Wikipedia entries.
- Include the date of submission of highlights so they can be tracked.
- IPAM's IT person will set up a conference call with the technical committee to choose a Chair, to ensure that there is activity by the committee. The committee should address the following issues:
    - Draft a page on in the institutes' webpage with links to subscription pages for all the institutes' newsletters.
    - Set up a secure part of the institutes' website for MIDs minutes, reports, and other documents.
    - Complete all links to institute diversity pages.
    - Investigate a joint searchable video archive for the institutes.
    - Explore sharing best practices, especially in regards to reporting to DMS and production of videos

2. AWM mentoring network: the Institutes will continue their financial support of the AWM Mentor Network at roughly $550/year each.
Action item: Michael Minion will contact Rachel Kuske on the diversity committee to follow up on having the institutes billed, after first checking to see if we have already been billed.

3. Diversity events/committee

- Modern math proposal for SACNAS was turned down by the NSA, but has been submitted to the NSF; there is ongoing discussion as to how to improve the event
- Possibly have conferences other than the Blackwell-Tapia conference rotate among the institutes, such as
    - Conference on Careers for Women in Mathematics and Statistics
    - Promoting Diversity at the Graduate Level in Mathematics
    - Infinite Possibilities Conference (held every 3 years)
    - CAARMS (held every 2 years)

Action item: Michael Minion will ask the diversity committee to propose a plan for possibly sharing these and related conferences.

- Creation of a minority graduate student in mathematics Facebook page is being discussed

II. Discussion of the Joint Postdoctoral Initiative

1. Applicants for the Institutes Postdocs on MathJobs.Org
(90 percent of those people also filled out an Institutes application)

Year PhD	US Citizens	All
2009	183	405
2008	45	114
2007	33	73
2006	36	81
2005	22	43
2004	19	25
Total	359	783

2. Expected numbers supported:

- MSRI: 5 for two years, 4 for one year
- IAS: 5 this year, 5 next year
- AIM: 4 for two years
- IPAM: 6 for two years, 2 for one year
- SAMSI: 7 for two years, 1 for one year
- IMA: 5 for two years
- MBI: 5 for two years

3. Travel of $5K per postdoc is nice, but raises equity concerns with current postdocs.

4. We discussed the value of having all the academically oriented postdocs teach as part of their job preparation. Even when teaching money cannot be obtained, teaching will be strongly encouraged.

5. Mentoring plans were compared and ideas shared.
Action item: When our hiring is done, we each inform David Farmer. When all institutes are done, he will send out an e-mail to the Math Job applicants stating that the hiring is done, and also reporting the number of applicants (783).
Action item: Encourage our new postdocs to attend the AIM 4-day job skills workshop (AIM pays) December 7-10, 2009.

III. New Issues and Brainstorming
1. Joint Institutes diversity participants database; it would be nice to have one, but we understand there are serious issues. To be discussed with DMS.

2. Institutes reception at the Joint Math Meeting needs improvement. Ideas included:
- Perhaps redo presentation as a joint presentation on a given theme, e.g. “diversity” or “what an institute program is like and why to participate.”
- Return to having it simply be a social function, with no presentation.
- How do we get grad students and new researchers to go (“this is lame” said one student)?
- Just have a booth.
- Try for scientific sessions in the program itself, with institute discussion included.
- Talk about the upcoming math awareness month.
- Institutes maybe have a theme planned announcement for a series of joint activities at the JMM.

- Advertise to students as an opportunity to discuss postdoc jobs or
- Participation in an institute program.

3. Sustainability research – possible joint programs such as the proposed Mathematics for Planet Earth workshops in 2013-14 (in advance of the ICM). The institutes have agreed to go ahead with a version of this regardless of the ICM decision.

Action items:

- Think about what we would like to do at our own institute in such a joint program (e.g., a summer school, workshop…).
- We will have a conference call on June 17, 2009 at 3pm (EST) to discuss our ideas; we will use the AIM conference calling system, number to be sent by AIM.

4. Should NIMBioS be a DMS math institute?

IV. MIDs Report to NSF and Discussion

1. Postdoctoral program
   - Discussion ensued concerning the diversity of the offers. There were only 3 individuals who received offers from two institutes.
   - Many of the postdoctoral fellows were placed at universities outside the institutes or at industries, and the geographic coverage was very wide.
   - Institute directors can adjust the $5K in travel funds as needed to accommodate institute concerns, such as providing additional travel for other postdocs at the institute.

2. Diversity activity
   - The institute plans and activities were discussed
   - The issue of trying to share diversity databases was discussed, and it was agreed to be a big problem, not only because of NSF rules but because of local university rules.

3. Results of brainstorming
   - Improving the Joint Math Meetings was discussed
   - Mathematics of Planet Earth activities were discussed. NSF has plans for a workshop in early Fall to focus on "what is the science of sustainability?"
   - DMS and the institutes will stay in close touch on this issue.
   - Should NIMBioS be added as a regular math institute, or simply placed on the institute's page as another DMS supported institute?

Action item: DMS will make a decision as to how to classify NIMBioS V.

V. Old Business

1. Mathematical Sciences 2025
   - The process of forming a committee will begin soon.

Action item: Institute directors should send suggestions for committee members and especially a suitable (non-math/stat) Chair to David Levermore.

2. Institutes will now file only one annual report a year, on their due date in the Spring. This report will consist of:

- the *previous* year's annual report,
- a three page addendum on activities taking place during the current year,
- the participant support spreadsheet for the previous year.

VI. Discussion led by NSF

1. Peter March is staying one more year (applause), so a search for his replacement is being initiated.
Action item: Try to identify suitable candidates for the position, and send suggestions to Jim Berger.

2. The NSF budget and use of stimulus money was discussed.

- It was noted that DMS will be allocating grants to regular and stimulus money by a variety of criteria, and the highest quality grants could be funded via either regular or stimulus funds.

3. The institute competition process was discussed.

4. The DMS response to the 2007 Committee of Visitors Report was discussed.

- The answers to the four COV questions about institutes were presented.
- The NSF summer study of keywords in institute programs was described.
- A possible new professional study to assess the coverage and impact of institutes was vigorously discussed.

Action item: Peter March will send the MIDs the long version of the response to the COV, along with his e-mail from last year concerning the issue. Institute directors should send in ideas and suggestions.

VII. Date and site of next MID meeting: tentatively May 7-8, 2010.

F. PARTICIPANT SUMMARY

In fiscal year 2008-2009, 1,048 participants enrolled in two long programs, 21 workshops, four reunion conferences, and two summer programs. IPAM actively seeks women and members of underrepresented ethnic groups to participate in its programs as speakers and participants. While most participants choose to report their gender and ethnicity, some choose not to do so. About 6% of IPAM participants in the past year were members of an underrepresented minority group, and 20% were women; see table F-1.

Table F-1: Total Participants and Underrepresented Groups by Program Type (2008-2009)							
				Underrepresented Ethnic Groups*			
Program Type	Total Participants	Female*	No. Reporting Gender	American Indian	Black	Hispanic	No. Reporting Ethnicity
Long Programs	105	20	103	0	1	2	100
Workshops	1137	222	1113	1	16	43	1042
Summer Programs	82	24	82	0	4	6	75
Reunion Conferences	84	11	83	1	0	2	80
Total	1408	277	1381	2	21	53	1297
Percent of No. Reporting		20.1%		0.2%	1.6%	4.1%	

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		
Program Type	U.S. Citizens & Permanent Residents	No. Reporting Citizenship & Residency
Long Programs	51	105
Workshops	590	1096
Summer Programs	62	82
Reunion Conferences	53	84
Total	756	1367
Percent of No. Reporting	55.3%	

The majority (92%) of 2008-2009 participants of IPAM programs held academic positions (faculty, postdoc, graduate student, or undergraduate student). The remaining 106 participants (out of the 1334 participants who reported their position) held positions in government, military, or industry. The following sections provide summary data for the requested sub-groups: postdocs, graduate students, and undergraduate students.

G. POSTDOCTORAL PROGRAM SUMMARY

IPAM does not offer a postdoctoral program in the usual sense of multi-year positions. However, researchers at the postdoctoral level participate in all IPAM workshops, long programs, and reunion conferences, and as academic mentors in our undergraduate summer programs.

Table G-1: PostDocs: Total Participants and Underrepresented Groups by Program Type							
				Underrepresented Ethnic Groups*			
Program Type	Total Postdoc Participants	Female	No. Reporting Gender*	American Indian	Black	Hispanic	No. Reporting Ethnicity
Long Programs	28	8	27	0	0	1	27
Workshops	171	46	168	1	2	9	159
Summer Programs	3	0	3	0	0	0	3
Reunion Conferences	13	1	13	0	0	0	13
Total	215	55	211	1	2	10	202
Percent of No. Reporting		26.1%		0.5%	1.0%	5.0%	

Table G-2: PostDocs: U.S. Citizen and Permanent Residents by Program Type		
Program Type	U.S. Citizens & Permanent Residents	No. Reporting Citizenship & Residency
Long Programs	6	28
Workshops	50	171
Summer Programs	2	3
Reunion Conferences	5	13
Total	63	215
Percent of No. Reporting	29.3%	

H. GRADUATE STUDENT PROGRAM SUMMARY

Graduate Students participate in IPAM workshops and long programs, 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: Grad Students: Total Participants and Underrepresented Groups by Program Type							
				Underrepresented Ethnic Groups*			
Program Type	Total Participants	Female	No. Reporting Gender*	American Indian	Black	Hispanic	No. Reporting Ethnicity
Long Programs	26	7	26	0	0	0	25
Workshops	261	58	257	0	2	9	230
Summer Programs	3	1	3	0	0	0	3
Reunion Conferences	14	3	14	1	0	0	13
Total	304	69	300	1	2	9	271
Percent of No. Reporting		23.0%		0.4%	0.7%	3.3%	

Table H-2: Graduate Students: U.S. Citizen and Permanent Residents by Program Type		
Program Type	U.S. Citizens & Permanent Residents	No. Reporting Citizenship & Residency
Long Programs	8	26
Workshops	86	258
Summer Programs	2	3
Reunion Conferences	9	14
Total	105	301
Percent of No. Reporting	34.9%	

I. UNDERGRADUATE STUDENT PROGRAM SUMMARY

Undergraduate students participate in our summer programs, Research in Industrial Projects for Students (RIPS) in both LA and Beijing. RIPS Projects Day is listed as a separate workshop, as we invited undergraduate students who were not part of the RIPS program, in order to expose them to industrial research and encourage them to apply to RIPS in the future. Additionally, we offered the "Infinite Possibilities: A Panel Discussion with Minority Women in Math" in March 2009, which many local undergraduate students attended.

Table I-1: Undergrads: Total Participants and Underrepresented Groups by Program Type							
				Underrepresented Ethnic Groups*			
Program Type	Total Participants	Female	No. Reporting Gender*	American Indian	Black	Hispanic	No. Reporting Ethnicity
Workshops	55	30	54	0	2	7	52
Summer Programs	44	18	44	0	3	5	42
Total	99	48	98	0	5	12	94
Percent of No. Reporting		49.0%		0.0%	5.3%	12.8%	

Table I-2: Undergrads: U.S. Citizen and Permanent Residents by Program Type		
Program Type	**U.S. Citizens & Permanent Residents**	**No. Reporting Citizenship & Residency**
Workshops	31	47
Summer Programs	31	44
Total	62	91
Percent of No. Reporting	68.1%	

RIPS continues to be IPAM's signature program for undergraduate students. In 2009, there were 354 applicants for RIPS (both LA and Beijing), from which 44 were chosen. We had another successful year recruiting women and minority students to RIPS.

A detailed description of each program as well as comments from participants is available in section J of this report.

J. PROGRAM DESCRIPTION

The programs are listed in chronological order by start date. The list includes all IPAM programs from August 2008 through July 2009 (also including RIPS2009 Projects Day, which was held on August 14, 2009 and was associated with the summer program RIPS).

Please note that two of IPAM's workshops in 2008-2009 featured **public lectures**. IPAM periodically invites a workshop speaker with a national reputation to speak on a topic of broad interest to an audience that included non-scientists. The lectures were held in a 200-seat auditorium and were publicized widely. The 2008-2009 public lectures are included in the description of the relevant workshops.

All 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: Internet Multi-Resolution Analysis: Foundations, Applications and Practice
September 8 - December 12, 2008

Organizing Committee:
Paul Barford (University of Wisconsin-Madison)
John Doyle (California Institute of Technology)
Anna Gilbert (University of Michigan)
Mauro Maggioni (Duke University)
Craig Partridge (BBN Technologies)
David Rincon (Universitat Politécnica de Catalunya)
Matthew Roughan (University of Adelaide)
Walter Willinger (AT&T Technologies, Engineering Research Center)

The main focus of this IPAM program was innovations and breakthroughs in the theoretical foundations and practical implementations of a network-centric multi-resolution analysis (MRA); that is, a structured approach to representing, analyzing, and visualizing complex measurements from Internet-like systems that is (i) specifically designed to accommodate the vertical (e.g., layers) and horizontal (e.g., domains) decompositions of Internet-like architectural designs, (ii) flexible enough to account for the highly heterogeneous (i.e., ``scale-rich'') nature of these designs and the high semantic content of the available measurements, and (iii) capable of retaining some of the mathematical elegance of more traditional MRA schemes. Critical capabilities of the envisioned Internet MRA, in particular, and network MRA, in general, include support for the exploration of multi-scale representations of very large and diverse network-specific annotated graph structures, novel techniques for the study of the dynamics of as well as the dynamic processes over these structures, and new methodologies and tools for dealing with aggregated spatio-temporal-functional network data representations and their associated analysis and visualization.

By leading the way towards the development of a mathematical foundation for network-centric MRA techniques, this program was firmly grounded in a number of key Internet MRA target problems (e.g., cyber-security, traffic/network engineering, network control), with close ties to activities that can be expected to arise in the context of a major NSF-led initiative called Global Environment for Networking Innovations or GENI (www.cise.nsf.gov/geni or www.geni.net). At the same time, it was also strongly influenced by developments in other scientific disciplines where informed multiscale approaches to the study of highly engineered or evolved networked systems have proved to be essential for advancing our understanding of their properties, behaviors, and evolution.

Tutorials: Internet Multi-Resolution Analysis
September 9 - 12, 2008

Organizing Committee:
Paul Barford (University of Wisconsin-Madison, Computer Science)
John Doyle (California Institute of Technology, Control and Dynamical Systems)
Anna Gilbert (University of Michigan, Mathematics)
Mauro Maggioni (Duke University, Mathematics and Computer Science)
Matthew Roughan (University of Adelaide)
Walter Willinger (AT&T Technologies, Engineering Research Center, Mathematics)

We offered tutorials during the first week of the program, to provide an introduction to the relevant problems as well as to the relevant concepts from mathematics, statistics, networking, control theory, information theory, economics, and other disciplines, and their applications. The goal was to familiarize participants with the issues and techniques involved in Internet Multi-Resolution Analysis and to create a common language among researchers coming from different fields.

Workshop I: **Multiscale Representation, Analysis and Modeling of Internet Data and Measurements**
September 22 - 26, 2008

Organizing Committee:
Mauro Maggioni, Chair (Duke University, Mathematics and Computer Science)
Paul Barford (University of Wisconsin-Madison, Computer Science)
Anna Gilbert (University of Michigan, Mathematics)
Morley Mao (University of Michigan)
Rob Nowak (University of Wisconsin-Madison)

This workshop brought together a diverse group of researchers and practitioners to discuss several aspects of the structure of the Internet and of network traffic on the Internet. In particular, we discussed the current tools to measure and infer the connectivity structure of the Internet, and to measure and model the statistics of dynamics of the traffic. Another main theme was the modeling of both the emergence of network structures and traffic patterns, through progressive competitive/cooperative growth, and the a posteriori statistical analysis of measured traffic data, with explicit connections and studies on available data sets. Challenges and opportunities in constructing multiscale models for such complex networks and traffic patterns was discussed, from both a mathematical perspective and in view of concrete application to the data sets above.

Inferring connectivity structure of the Internet, and analysis of traffic data.
The connectivity structure of the Internet is complex and mostly hidden. It is challenging to design measurements to infer such structure, and tools to carry them out, that will provide unbiased insight on the structure of the Internet. This has lead to a wide variety of models for the connectivity structure, but the accuracy of such models is often hard to validate. Practitioners from the industry (e.g. ISP's) and academic researchers alike presented their views. Several tools for measuring and analyzing Internet traffic were discussed, as well as current models for interpreting the large data sets collected.

Multiscale representations of large graphs and dynamic patterns.
Generating multiscale representations of large graphs is a problem that arises across a wide variety of disciplines, among which homogenization of PDEs, modeling of physical and biological systems, numerical methods for solving large sparse linear systems or computing eigenvectors of large graphs (e.g. PageRank), exploration of complex graphs and high dimensional data sets by using random walks and spectral graph theory. In this workshop we brought together researchers in these topics together with industry practitioners with the expectation of fruitful interactions, both in the direction of applying existing ideas to the available data sets of Internet measurements, and in the direction of stimulating the development of new ideas for analysis of these measurements.

Workshop II: **Applications of Internet MRA to Cyber-Security**
October 13 - 17, 2008

Organizing Committee:
Bill Aiello (University of British Columbia)
Paul Barford (University of Wisconsin-Madison)
Farnam Jahanian (University of Michigan, Electrical Engineering and Computer Science)
Tal Malkin (Columbia University, Computer Science Department)
Niels Provos (University of Michigan)
Mike Reiter (University of North Carolina)
Matthew Roughan (University of Adelaide)

Internet-security is a large and complex problem space with profound implications for our society. On one side are defenders who are responsible for creating systems, protocols, policies and other mechanisms to protect an IT infrastructure from unwanted access. On the other side are attackers who conduct malicious activity in the Internet for recognition, profit or other more sinister reasons. For this workshop, we brought together a group of leading researchers and cyber-security professionals to discuss several key challenges for defenders, and how a multi-scale approach might shine new light on these thorny issues. In particular, we focused on problems related to distinguishing and filtering malicious traffic, and problems related to protocols and methods for IT security.

Accurate Identification and Filtering of Malicious Traffic

A starting point for the cyber-security domain is that systems and networks will transmit and receive both malicious and benign traffic. The ability to distinguish malicious and benign traffic quickly and accurately enables defenders to understand the attack profile on their infrastructure and adjust their defenses appropriately. This theme encompasses issues in malicious traffic measurement, classification, characterization, anomaly detection, intrusion detection (both host and network-based), signature generation, and traffic filtering methods. Methods, tools, datasets and results on these topics were presented by both researchers and practitioners.

Protocols and Methods for IT Security

The constantly changing nature of cyber-security threats calls for ongoing innovation from those responsible for building and maintaining defenses.

One of the most important components for cyber-defense is the communications protocols that are used for a variety of purposes including data privacy, authentication, anonymity, etc. While these protocols are based on cryptographic algorithms, there are often complicated problems associated with their implementation and use. Another important aspect of cyber-defense is the combinations of systems and policies that are used to create security infrastructures. This theme fostered discussion on the mechanisms for IT security; researchers and practitioners discussed current approaches and the ways an MRA broadens perspective in meaningful (i.e., improving cyber-security) ways.

Workshop III: **Beyond Internet MRA: Networks of Networks**
November 3 - 7, 2008

Organizing Committee:
Walter Willinger, Chair (AT&T Technologies, Engineering Research Center, Mathematics)
David Alderson (Naval Postgraduate School, Operations Research Department)
John Doyle (California Institute of Technology, Control and Dynamical Systems)
Ramesh Govindan (University of Southern California (USC), Computer Science)
Craig Partridge (BBN Technologies)

Activities of enterprises typically involve multiple networks: ranging from (1) transportation of energy, materials, and components to (2) power grids, supply chains, and control of transportation assets, and to (3) communication and data networks. The networks' activities are correlated because they are invoked to support a common task, and the networks are interdependent because the characteristics of one determine the inputs or constraints for another. They are becoming even more correlated and interdependent as they shift more and more of their controls to be information intensive and data network-based.

While this "networks of networks" concept enables enormous efficiency and flexibility (both technical and economical) it also has a dark side -- by requiring increasingly complex design processes, it creates vastly increased opportunities for potentially catastrophic failures, to the point where national and international critical infrastructure systems are at risk to large-scale disruptions due to intentional attacks, unintentional (but potentially devastating) side effects, the possibility of (not necessarily deliberate) large cascading events, or their growing dependence on the Internet as a "central nervous system".

This trend in network evolution poses serious questions about the operation and reliability of these critical infrastructure systems in the absence of an adequate theory. This workshop brought together domain experts from the fields of engineering, biology, mathematics, and critical infrastructure protection to develop the foundation of a nascent theory in support of the networks of networks concept. In particular, we used the Internet as a case study to illustrate how early verbal observations and arguments with deep engineering insight have led via an interplay with mathematics and measurements to increasingly formal statements and powerful theoretical developments that can be viewed as of what we envision to ultimately become a full-fledged "theory" for Internet-like systems.

Topics of interest included (but were not limited to):

- the implications that the original design philosophy behind the DARPA Internet protocols have had on today's Internet and of how that philosophy has constrained it's evolution,
- the importance of measurements for reverse-engineering the Internet; i.e., learning about it's design, functionality, dynamics, and complex feedback regulation by studying its implementation,
- the role of measurement-based networking research to provide profound theoretical explanations of empirical phenomena through innovative multi-scale representations of network traffic and network structure that respect the architectural design principles of the Internet,

- the development of synthesis theories like "layering as optimization decomposition" that allow for forward-engineering of new protocols and architectures.

***Public Lecture*: The Internets We Did Not Build**
November 3, 2008

Public lecture presented by David Clark. This lecture was part of the IPAM workshop "Beyond Internet MRA: Networks of Networks" (above) and was cosponsored by the Institute for Digital Research and Education (IDRE) and the Computer Science Department (UCLA-CSD). Approximately 350 people attended.

***Mini-Workshop*: MRA of Traffic Matrices and Network Topologies**
November 14, 2008

Organizer: Walter Willinger

Speakers**:** John Heidemann (USC) and Zhi-Li Zhang (University of Minnesota)

This Mini-workshop, specifically focused on the MRA of network topologies, traffic matrices and associated problems (inference and analysis, among them), and the new mathematical tools for solving those (diffusion wavelets, matrix factorization techniques such as CUR). The goal was twofold: to report on a few research efforts that had emerged during the IPAM program, and to establish a research agenda for interested core participants. It turned out to be a very good opportunity for an open discussion. Several open research problems were identified, among them the relationship between sparsity and low-rank properties of matrices, the influence of overlay networks on the underlying topology, issues related with sampling, and the need for a good characterization of the dynamics of networks.

***Workshops IV:* New Mathematical Frontiers in Network Multi-Resolution Analysis**
November 17 - 21, 2008

Organizing Committee:
Robert Calderbank (Princeton University)
Anna Gilbert (University of Michigan, Mathematics)
Peter Jones (Yale University, Mathematics)
Steven Low (California Institute of Technology)
Matthew Roughan (University of Adelaide)
Denis Zorin (New York University)

This workshop brought together researchers in mathematics, computer science, electrical engineering, and statistics to develop new mathematical foundations in network-centric multiresolution analysis and to explore and define new mathematical or algorithmic techniques in network MRA. These techniques include methods of analysis, representation, and synthesis of large networks, as well as visualization, analysis, and representation of network measurements.

Some of the speakers were "practitioners" or representatives from industry with both experience and applications, who addressed situations in which novel mathematical techniques are necessary and are already being developed in a real-world setting. Other speakers were academic researchers at the forefront of foundational research. The workshop was broadly successful. It succeeded in bringing together mathematicians and networking experts from around the world. The talks were almost all of a high quality, and the majority of them was carefully presented to be accessible to a good proportion of participants despite their varied backgrounds.

Regarding collaborations between the participants, a number of interesting discussions occurred:

a) Changyun Lee and Patrice Abry discussed the scaling properties of traffic on a congested link.
b) Laura Balzano, Matthew Roughan and David Rincón explored the definition of diffusion operators for analyzing traffic matrices.
c) Yin Zhang, Walter Willinger and Matthew Roughan discussed novel techniques for traffic matrix factorization.
d) Kevin Tang and Krister Jacobsson discussed the control-theory-oriented TCP models.
e) Mauro Maggioni. Walter Willinger and David Rincón are exploring the use of the Diffusion wavelets tool for the MRA representation of network topologies.
f) A group of junior participants (Adam Bender, Krister Jacobsson and Ross McNaughtan among them) are analyzing the topology of on-line social network graphs, with the long-term goal of providing the operator the hidden clusters not explicitly stated by the users.

This list is incomplete, but can perhaps be seen as indicative of the number of interesting research collaborations that may arise from this workshop and the related long-term program.

Culminating Workshop **at Lake Arrowhead for Internet MRA (by invitation only) December 7 - 12, 2008.**

Organizing Committee:

This final workshop at Lake Arrowhead 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.

Affiliate Workshop: **Advancing the Automation of Image Analysis III (with NGA) December 3 - 4, 2008**

Organizing Committee: Robert Rand (NGA) and Paul Salamanowicz (NGA)

This is the third of a series of meetings hosted by IPAM with the scientific participation of the National Geospatial Intelligence Agency (NGA). The goal of the workshops was to facilitate technology issues of interest to NGA by bringing together a targeted group of researchers under contract from NGA together with renowned experts in the areas of image analysis and data visualization, with a view toward aiding NGA in developing its national research agenda in these areas and in making researchers who are capable of making major contributions to NGA's

program aware of the scientific and mathematical issues on which NGA wants to see further advances.

***Reunion Conference*: Cells and Materials: At the Interface between Mathematics, Biology and Engineering**
December 7 - 12, 2008

Organizer: Tom Chou (UCLA)

This was the second reunion conference for participants of the spring 2006 long program "Cells and Materials." It was a timely get-together to continue some of the collaborations that were started during the long program and at the first reunion. Presentations were given by all participants, with plenty of time between talks for discussions and collaborations.

***Reunion Conference*: Random Shapes**
December 7 - 12, 2008

Organizer: Peter Jones (Yale)

This was the first reunion conference for participants of the spring 2007 long program "Random Shapes." It was a timely get-together to continue some of the collaborations that were started during the long program. Presentations were given by all participants, with plenty of time between talks for discussions and collaborations.

***IPAM Workshop:* Quantitative and Computational Aspects of Metric Geometry**
January 12 - 16, 2009

Organizing Committee:
Subhash Khot (New York University)
Bruce Kleiner (Yale University)
Manor Mendel (The Open University of Israel)
Assaf Naor (New York University)
Yuval Rabani (Technion - Israel Institute of Technology)

Following the seminal work on the non-linear theory of Banach spaces in the 1970s and 1980s, we have witnessed a recent revival of interest in the rich structure and profound properties of metric spaces. Much contemporary research on metric geometry is motivated by the discovery of unexpected connections linking fundamental questions in geometry and analysis with combinatorial optimization, computational complexity, and statistics. This has led to the emergence of an impressive and growing repertoire of common problems and techniques.

Some of the most striking examples of this trend evolved from the simple observation that an n-point subset of L_1 is a convex combination of cut semi-metrics, up to scaling. Thus, the

properties of finite subsets of L_1 are closely connected to cut-related graph theoretic optimization problems, such as expansion. In particular, computational methods for bounding the optima of NP-hard optimization problems often lead to the formulation of discrete analogues of embedding problems in Banach space theory. Studying the quantitative properties of Lipschitz and bi-Lipschitz maps into Banach spaces plays a pivotal role in both areas, mutually influencing each other. For example, the notion of padded decompositions gradually got refined through its application to problems in distributed computing, approximation algorithms, construction of embeddings into Hilbert space, and metric Ramsey theory.

In the same vein, the design of hardness of approximation reductions involves examining the cut structure of the binary cube or quotients of the binary cube, using bounds on the Fourier coefficients of Boolean functions. The same tools are extremely useful in proving results on non-embeddability into L_1. A recent breakthrough in geometric analysis studies the structure of cuts of the Heisenberg group. Substantial progress on non-embeddability questions is implied, and this promising direction may bear significant consequences in computational complexity theory.

Group theorists have been studying groups as geometric objects for several decades. The achievements of geometric group theory are numerous and profound. Metric embedding problems for discrete groups are particularly fruitful in the study of the Novikov conjecture, and recent work uses expanders and randomized constructions. The computation of Hilbert compression exponents of finitely generated groups has several algebraic consequences, and recent results are based on applications to these problems of methods from Banach space theory (Markov type), probability, and representation theory.

Finally, it is noteworthy to mention the more obvious relation between quantitative and computational aspects of metric spaces, namely, the study of problems arising in the context of processing data endowed with a geometric representation. Due to the proliferation of massive data sets in commerce, web, molecular biology, and other areas, computationally efficient methods for finding meaningful patterns in such data are acutely needed. Analytic and algorithmic results in metric geometry play a crucial role in this field.

***IPAM Workshop*: Numerical Approaches to Quantum Many-Body Systems**
January 22-24, 2009: Lectures and Tutorials
January 26-30, 2009: Workshop

Organizing Committee:
Ulrich Schollwöck (RWTH Aachen)
Simon Trebst (Microsoft Station Q, Station Q)
Guifre Vidal (University of Queensland)

Quantum many-body systems can give rise to remarkable collective states of matter that have no counterpart in their classical analogs. Archetypal examples include superfluids, superconductors, and insulating quantum liquids in the context of condensed matter physics. But collective quantum phenomena are also ubiquitous in nuclear physics, quantum chemistry, high-energy

physics, traditional atomic physics as well as ultracold atoms. Quantum information technology not only takes quantum effects for granted, but goes a step further and aims at "taming the quantum" by controlling collective quantum states for applications like quantum computing.

In connecting such complex emergent behavior to a microscopic picture in terms of short-ranged interactions between the elementary quantum mechanical degrees of freedom, analytical approaches can often provide qualitative guidance. Unbiased numerical simulations play a crucial role in verifying the underlying assumptions. Quantitative guidance in mapping out phase diagrams (in terms of the microscopic interactions) and the respective phase transitions is often obtained solely by numerical methods. In the interplay between theory and experiment, computational physics has established itself as a vital discipline for quantum many-body physics.

Yet there are a number of outstanding problems that for decades have resisted solution, most prominently the many fermion problem. Other examples include quantum spin systems with frustrating or competing interactions that can suppress any type of ordering and thereby give rise to spin liquid behavior, or quantum systems out of equilibrium. These outstanding problems and the continuing search for new quantum states of matter have made it ever more obvious that the established numerical tools despite their successes are not capable of solving these problems without major breakthroughs.

The continuing demand for new methods has motivated the development of a plethora of novel algorithms over recent years which significantly extend the applicability of well-established techniques such as quantum Monte Carlo (QMC) methods and the density matrix renormalization group (DMRG) approach. In a remarkable interplay between quantum information theory and computational condensed matter physics, time-dependent renormalization group techniques have been developed and reformulations of DMRG in terms of matrix product states (MPS) and extensions to projected entangled pair states (PEPS) have created the intriguing potential to simulate the two-dimensional fermion problem or frustrated quantum spin systems. In classical statistical mechanics it has been realized that extended ensemble sampling techniques can overcome the equilibration problem caused by competing interactions or phases and the resulting rough energy landscapes even when there are no non-local update techniques available. Finally, a new class of continuous-time impurity solvers has recently been developed for dynamical meanfield theory (DMFT) calculations that will allow one to study the many-fermion problem in this approximation at considerably lower temperatures.

This workshop brought together an interdisciplinary group of researchers from mathematics, physics, quantum information, computer science, and other related disciplines, to discuss advances in the computational description of quantum many-body systems.

During the first three days we held a “short course” for young researchers with lectures and hands-on tutorials on state-of-the-art numerical techniques. In the second week, we offered a “regular” workshop with 5 days of lectures and discussions by experts in the field. Participation in the first three days was limited; registration in the 5-day workshop was open.

IPAM Workshop: **Laplacian Eigenvalues and Eigenfunctions: Theory, Computation, Application**
February 9 - 13, 2009

Organizing Committee:
Denis Grebenkov (École Polytechnique, Laboratoire de Physique de la Matiere Condensee)
Peter Jones (Yale University, Mathematics)
Naoki Saito (University of California, Davis (UC Davis), Mathematics)

The investigation of eigenvalues and eigenfunctions of the Laplace operator in a bounded domain or a manifold is a subject with a history of more than two hundred years. This is still a central area in mathematics, physics, engineering, and computer science, and activity has increased dramatically in the past twenty years for several reasons:

- A discovery of many fascinating properties of the Laplacian eigenfunctions such as the localization in small regions of a complicated domain and scarring in quantum chaotic billiards;
- The use of Laplacian eigenfunctions as a natural tool for a broad range of data analysis tasks, e.g., dimensionality reduction of high dimensional data via diffusion maps, or analysis of fMRI data for understanding functionality of brain regions;
- The use of the underlying Laplacian eigenvalues as natural "fingerprints" to identify geometrical shapes, e.g., copyright protection, database retrieval, quality assessment of digital data representing surfaces and solids, and the related inverse spectral problems;
- The spectral analysis of the Laplace operator for a better interpretation of nuclear magnetic resonance measurements of diffusive transport, e.g., experimental determination of the surface to volume ratio in porous media through the asymptotic properties of the heat kernel;
- Numerical computation of the Laplacian eigenfunctions and eigenvalues in irregular, often multiscale domains (or sets, or graphs) that still remains a challenging problem demanding for new numerical techniques.

This workshop provided an opportunity to discuss various aspects of these new or long-standing problems with experts in different fields, including mathematics, physics, biology, and computer sciences.

The following comments by the participants, taken from anonymous evaluation surveys, are evidence of the high quality of this workshop:

> "This was an excellent workshop. Unfortunately, this means that I have no suggestions on how to improve it."
>
> "Fantastic workshop overall. Video taping the lectures to make them available online would be my only request."
>
> "IPAM was very helpful to bring interesting people from different domains. It was brilliant!"

"The workshop is a wonderful environment for learning, discussing the theory and applications related with Laplacian eigenvalues. I appreciate the opportunity in participating in this."

"Excellent workshop, very interdisciplinary. Great interaction with participants."

***IPAM Workshop*: Rare Events in High-Dimensional Systems**
February 23 - 27, 2009

Organizing Committee:
Giovanni Ciccotti (Università di Roma "La Sapienza")
Kristen Fichthorn (Pennsylvania State University)
Ioannis Kevrekidis (Princeton University)
Christof Schuette (Freie Universität Berlin)
Eric Vanden-Eijnden (New York University)
Arthur Voter (Los Alamos National Laboratory, Theoretical Division)

The dynamics of condensed materials is typically characterized by a wide range of time scales, complicating their study with computer simulations. Of particular difficulty are situations with large time-scale gaps which include, for example, conformation changes of macromolecules, nucleation events during first-order phase transitions, chemical reactions in solution and on surfaces, transport in and on solids, and genetic switches displaying bistable behavior. The occurrence of such disparate time scales is often related to dynamical bottlenecks of energetic and/or entropic origin which partition the configuration space of the system into metastable basins. The system spends most of its time fluctuating within these long-lived metastable states and transitions between them only rarely. These rare events then determine the long-time evolution of the system.

It is a significant theoretical and computational challenge to quantify the rates and mechanisms of rare events, especially in complex systems with high dimensionality. While there is a growing consensus on the open questions in the context of rare events, it is still not clear how well these questions are addressed by current theoretical and computational techniques. The workshop addressed these issues through discussions and presentations involving perspectives from mathematicians, chemists, physicists, and engineers.

***Long Program:* Quantum and Kinetic Transport: Analysis, Computations, and New Applications**
March 9 - June 12, 2009

Organizing Committee:
Irene Gamba, Chair (University of Texas at Austin)
Shi Jin , Chair (University of Wisconsin-Madison, Department of Mathematics)
Eric Carlen (Rutgers University, Department of Mathematics)

Pierre Degond (Université de Toulouse III (Paul Sabatier))
Frank Graziani (Lawrence Livermore National Laboratory)
Karl Kempf (Intel Corporation)
David Levermore (University of Maryland, Department of Mathematics)
Peter Markowich (Universität Wien, Institute of Mathematics)
Stanley Osher (University of California, Los Angeles (UCLA), Mathematics)
Christian Ringhofer (Arizona State University, Department of Mathematics and Statistics)
Marshall Slemrod (University of Wisconsin-Madison, Mathematics)

We are at the dawn of the nanotechnology era, where scientific and technological advancements in many fields strongly demand the investigation of problems involving small or multiple scales. In such problems, the hydrodynamic theory is often invalid, and one has to apply the more fundamental laws of physics, such as kinetic theory (Boltzmann equation), molecular dynamics (Newton's second law or the Liouville equation), or even quantum mechanics (Schrodinger equation). This requires the development of new mathematical and computational methods for physical laws at these scales, or a mixture of them, which is facilitated by the improvements of modern computers. Mathematical understanding of the scaling limit from one scale to another plays an important role, and interweaves with the development of new multiscale computational methods. This program focused on the mathematical analysis, computational challenges and new applications of quantum and kinetic transport theory. Both senior leading figures and young researchers were invited to participate. Besides applied mathematicians, we invited researchers in other fields in science and engineering, representing academic, national lab and industrial research.

Tutorials: **Quantum and Kinetic Transport**
March 10 - 13, 2009

Organizing Committee:
Eric Carlen (Georgia Institute of Technology)
Pierre Degond (Université de Toulouse III (Paul Sabatier))
Irene Gamba (University of Texas at Austin)
Frank Graziani (Lawrence Livermore National Laboratory)
Shi Jin (University of Wisconsin-Madison, Department of Mathematics)
Karl Kempf (Intel Corporation)
David Levermore (University of Maryland, Department of Mathematics)
Peter Markowich (University of Cambridge, Institute of Mathematics)
Stanley Osher (Institute for Pure and Applied Mathematics, Mathematics)
Christian Ringhofer (Arizona State University, Department of Mathematics and Statistics)
Marshall Slemrod (University of Wisconsin-Madison, Mathematics)

We offered tutorials in the first week of the long program, to provide an introduction to the relevant problems as well as to the relevant concepts from mathematics, physics, chemistry, and engineering. The goal of these tutorials was to familiarize participants with the issues and techniques involved in quantum and kinetic transport, and to create a common language among

researchers coming from different fields. These tutorials were particularly useful to students and junior participants. The main topics addressed in these tutorials include:

- Mathematical transition from quantum, classical, to hydrodynamics scales.
- Computational methods for mixed scale problems.
- Quantum and kinetic models in emerging new applications.
- Monte Carlo Methods and DSMC.

Workshop I: **Computational Kinetic Transport and Hybrid Methods**
March 30 - April 3, 2009

Organizing Committee:
Pierre Degond (Université de Toulouse III (Paul Sabatier))
Bjorn Engquist (University of Texas at Austin)
Frank Graziani (Lawrence Livermore National Laboratory)
Shi Jin (University of Wisconsin-Madison, Department of Mathematics)
Caroline Lasser (Freie Universität Berlin)
Anna-Karin Tornberg (Royal Institute of Technology (KTH), NADA)

This workshop focused on computational modeling of kinetic transport models that arise in various kinetic transport problems, in particular Boltzmann kinetic or transport equations with applications in astrophysics, planetary atmospheres, medical imaging, semiconductor-devices, and plasmas. The numerical methods discussed included direct simulation Monte-Carlo methods, particle methods, moment closure techniques, deterministic finite difference, finite element, and spectral methods. Hybridization of computational schemes linking multi-scale and multi-physics were also addressed.

Examples are microscopic to mesoscopic linking of quantum systems to semiclassical models for semiconductor device simulations, coupled kinetic and fluid models for hypersonic vehicles, and coupling of Monte Carlo and deterministic numerical methods.

We invited experts from academia, industry and national labs to speak. The workshop examined the current states of computational transport, and aimed to foster interdisciplinary interactions among researchers from mathematics, physics, chemistry, engineering, and related disciplines.

The talks were of very high quality. Breaks between talks allowed many stimulating discussions. There were many graduate students, postdoc and young researchers who reported that the tutorial program prepared them well for the talks of this workshop. There were many interactions between people from academia with people from national labs (Los Alamos, Livermore). There were also people from industry (Intel) who said that they enjoyed the talks. The participating chemists said that they liked the arrangement of the lectures that were separated by break times during which people can discuss in details about the lectures. They are interested in further collaborations with applied mathematicians in this field.

Workshop II: **The Boltzmann Equation: DiPerna-Lions Plus 20 Years**
April 15 - 17, 2009

Organizing Committee:
Irene Gamba, Chair (University of Texas at Austin)
Reinhard Illner (University of Victoria)
David Levermore (University of Maryland, Department of Mathematics)
Laure Saint Raymond (Université de Paris VI (Pierre et Marie Curie))
Marshall Slemrod (University of Wisconsin-Madison, Mathematics)

Over the last two decades there has been significant progress in the mathematical analysis of kinetic equations, in particular the Boltzmann and Vlasov type particle evolution equations. Areas of discussion of this workshop included the spatially homogeneous and inhomogeneous Boltzmann equation, their hydrodynamic limits, and collisionless Vlasov models in plasma in the classical and relativistic framework with the coupling to Maxwell-Poisson systems.

For the space homogeneous collisional problem advances have led to a better understanding of regularity and asymptotic behavior. New tools have emerged, including sharp estimates to control very general collision kernels, analysis of high-energy tails and information on asymptotic behavior.

For spatially inhomogeneous scenarios, there has been progress on the initial-boundary value problem for "small-data" perturbations of Maxwellian solutions to the inhomogeneous Boltzmann and corresponding linearized equation, as well as on shock waves, the study of the long time behavior and decay rates of such solutions to Maxwellian equilibria, and on hydrodynamic limits for a wide class of collision kernels. For plasmas and other related models from statistical physics, such as those involving relativistic Einstein Vlasov Maxwell systems, the workshop focused on issues including existence, stability and long time behavior of solutions.

The workshop brought together scientists from mathematics, physics, statistical physics, and related disciplines. It offered both survey lectures and technical talks.

Workshop III: **Flows and Networks in Complex Media**
April 27 - May 1, 2009

Organizing Committee:
Maria Carvalho (Georgia Institute of Technology, Mathematics)
Karl Kempf (Intel Corporation)
Stephan Mischler (Université de Paris IX (Paris-Dauphine))
Benedetto Piccoli (Consiglio Nazionale delle Ricerche (CNR))
Christian Ringhofer (Arizona State University, Department of Mathematics and Statistics)

This workshop addressed particle flows in complex topologies, either given in the form of networks and graphs, or in the form of random or quasi - periodic media. The aim of the

workshop was to bring together an interdisciplinary group of researchers in different areas such as traffic flow simulation, supply chain management and physical flows in random media. These areas share a number of common challenges and require therefore the usage of similar mathematical toolboxes. These challenges include the incorporation of the stochasticity of the flow and the topology into averaged macroscopic models via appropriate homogenization methods, the existence of intermediate regimes, consisting only of a limited number of cars, clients or particles, and the resulting need to develop hybrid modeling tools linking particle and discrete event simulation models to macroscopic fluid equations.

Public Lecture: Climate Change and the Mathematics of Sea Ice
April 29, 2009

Public lecture presented by Kenneth Goldman. This lecture was part of the IPAM workshop "Flows and Networks in Complex Media" and was co-sponsored by the Institute of the Environment, Joint Institute for Regional Earth System Science and Engineering, Institute of Geophysics and Planetary Physics, Department of Mathematics, and Department of Atmospheric and Oceanic Sciences. The lecture had an audience of about 250.

Workshop IV: **Asymptotic Methods for Dissipative Particle Systems**
May 18 - 22, 2009

Organizing Committee:
Irene Gamba, Chair (University of Texas at Austin)
Eric Carlen (Rutgers University, Department of Mathematics)
Peter Markowich (University of Cambridge, Institute of Mathematics)
Anne Nouri (Université d'Aix-Marseille I (Université de Provence))
Robert Pego (Carnegie-Mellon University)
Mario Pulvirenti (Università di Roma “La Sapienza”)
Cederic Villani (École Normale Supérieure de Lyon)

Asymptotic methods for dissipative particle systems have been emerging over the last decade out of a number of streams of research that involve kinetic and complex particle systems, modeling the evolution of probability distributions of various kinds. In many cases where classical macroscopic models fail, interesting non-classical states have been found. Examples of such systems have been recently reported in rapid granular flows, coalescence-breakage models for jet-bubble flows, coagulation-fragmentation processes, cooling effects in gas mixtures involving chemical reactions, soft condensed matter, social-science-related applications such as the modeling of swarms, opinion formation, wealth distribution, economic models related to decision making, and pedestrian and evacuation dynamics.

It was the goal of this workshop to bring together researchers from diverse areas, including statistical mechanics, particle systems, probability theory and applications, to discuss developing

areas of non-conservative dynamics and the emergence of non-equilibrium statistical states, and to explore potential applications in the natural and social sciences.

***Culminating Workshop* at Lake Arrowhead for Quantum and Kinetic Transport**
June 7 - 12, 2009

Organizing Committee: Shi Jin (U. Wisconsin), Irene Gamba (U. Texas), David Levermore (U. Maryland)

This final workshop at Lake Arrowhead 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.

***Reunion Conference*: Securing Cyberspace: Applications and Foundations of Cryptography and Computer Security**
June 7 - 12, 2009

Organizing Committee: Rafail Ostrovsky (UCLA, Computer Science)

This was the second reunion conference for participants of the fall 2006 long program "Securing Cyberspace." It was a timely get-together to continue some of the collaborations that were started during the long program and at the first reunion. Presentations were given by all participants, with plenty of time between talks for discussions and collaborations.

***Reunion Conference:* Search Engines Reunion Conference I**
June 7 - 12, 2009

Organizers: Karin Verspoor (U. Colorado, Denver), Peter Jones (Yale)

This was the first reunion conference for participants of the fall 2007 long program "Search Engines." It was a timely get-together to continue some of the collaborations that were started 18 months earlier. Presentations were given by all participants, with plenty of time between talks for discussions and collaborations.

***IPAM Summer Program:* Research in Industrial Projects for Students (RIPS) 2009**
June 21 - August 21, 2009

Organizing Committee: N/A

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. RIPS recruits its students from all over the world. Each RIPS team is comprised of four students, a faculty 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 faculty 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.

RIPS 2009 sponsors and projects included:

RIPS2009: Sponsors and Projects	
Industry	**Project Title**
Aerospace Corp	Developing and Comparing Lambert Solvers for Trajectory Design Studies and Space Mission Analyses
Arete	Ship Segmentation for Periscope Imagery
Center for Applied Molecular Medicine	Auto-calibration of MS Proteomic Data
Jet Propulsion Laboratory	Using Level Sets to Represent Invariant Manifolds to Design a Planet Finder Mission
Los Angeles Police Dept.	Algorithm Development for Criminal Geographic Profiling
Los Alamos National Lab	Characterizing locally disrupted synchronization in Langevin molecular dynamics
Pixar-Disney	Parameter Estimation for Constitutive Models of Deformable Objects
Placental Analytics, LLC.	Three Dimensional Surface Reconstruction and Measurement of Placentas
Symantec	Fast Text Detection for Image Spam

Here is a sample of student comments about RIPS from their program evaluations:

Benjamin Sanchez Luengling: “After many years of just learning mathematical theory I was finally able to see it in action!”

Phillip Ho: “The past 9 weeks has been an absolutely exhilarating social and educational experience that I would not trade for anything.”

Derek Lietz: “We worked on an interesting, impactful problem in a great place surrounded by supportive people. My teammates were smart, capable, and fun to work with. Everyone who wants to learn how to do meaningful research should consider RIPS.”

Laney Kuenzel: “RIPS was such an amazing program. We got to spend our days working on challenging and interesting real world projects and our nights having fun with cool math-loving students from around the world.”

Oscar Lopez: “This was the most productive summer of my life.”

Paulina Rodriguez: “[RIPS] provides an opportunity to take mathematics to a whole new level – a level which is interesting and applicable to our lives now. … The diversity was something different and refreshing.”

Godwin Yung: “It’s nice to have research experience as an undergraduate, but to have one under the guidance and support of many experienced individuals (Mike Raugh, mentors, sponsors) is an incredible opportunity.”

Shishir Agrawal: “Yes it was a great experience, not only because of the science content but also for the friendships you build working in teams.”

> ***Subworkshop:*** **Research in Industrial Projects for Students (RIPS) Projects Day August 14, 2009**
>
> Organizing Committee: N/A
>
> The nine RIPS 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.

IPAM Summer Program**:** Research in Industrial Projects for Students (RIPS)-Beijing 2009 June 24 - August 22, 2009.

Organizing Committee: N/A

IPAM offered RIPS-Beijing again in summer 2009. In collaboration with Microsoft Research Asia (MSRA), eight U.S. students and eight Chinese students worked on cross-cultural teams on four projects, each sponsored by an MSRA research group. The basic format of the program was the same as RIPS-LA.

RIPS students from the United States and China formed close professional and personal relationships over the summer. The students had offices at MSRA. MSRA provided technical support as well as some social activities, and informal Chinese lessons. Students stayed in a hotel

within walking distance of MSRA campus in northwest Beijing, ate most meals in the Microsoft cafeteria, and could use the company gym.

English was the only language required for participation. The Chinese students, academic mentors, and industry mentors spoke English.

RIPS-Beijing 2009 sponsors and projects		
MSRA Research Group	**Industry Contact**	**Project Title**
Wireless and Networking	Chuanxiong Guo	Understanding the graph properties of a DCell network
Machine Learning	Jian-Tao Sun	Machine learning approaches to opinion document summarization
Theory	Wei Chen	Influence propagation in social networks
Speech	Zhijie Yan	Modeling Speech Signals via non-uniformly Sub-sampled Trajectory

Here are some comments from RIPS-Beijing 2009 participants:

"I would definitely recommend RIPS-Beijing to other undergraduate students. It is a once-in-a-lifetime experience to work with some of the brightest people in the world in a unique and motivating environment. It is also an invaluable opportunity to experience a completely foreign culture and to integrate yourself into it.
"RIPS-Beijing has a very multi-cultural dynamic which makes the program that much more interesting. It forces you to experience the differences between countries and cultures in a very fun way. It is also a great venue for anyone interested in Chinese language and/or Chinese culture." --Alex Collins, Brown University

"I highly recommend the MSRA RIPS Beijing program. I have done 3 REUs before this one, but this was one was definitely the most rewarding one." --Jason Lee, Duke University

"I would definitely recommend RIPS-Beijing to other students: it was a great way to work on a research project with Chinese students and interact with them both in an out of work. Leading a research team was a new experience for me, and I learnt a lot from it. It was also my first time working on a project from industry. If I had the opportunity I would do it again." --JD Rodriguez, Pomona College

"I would definitely recommend this program to other students. Not only did we gain industry experience, but we also made incredible international friends and got to experience living in another environment. This is definitely once in a lifetime and truly worthwhile.
"I went into this program with the intention to make friends with all the Chinese students, and that turned out to be much easier than I expected… I felt we really did try to understand each other's cultures." --Lynn Lin, UCLA

"RIPS Beijing managed to not only to give me an opportunity to perform meaningful research as an undergraduate, but also a chance to work directly with Chinese students. Both of these are individually sufficient to justify the value of RIPS, but together they've created something unique and very valuable.

"The RIPS program has helped me solidify the areas of math and computer science that are most interesting to me, and I expect to apply to graduate programs in those areas this coming fall. It really helped me to realize that I really enjoy doing research, and has helped to guide me towards a career that will allow for that.

"Even when studying abroad in China, it's rare to have the chance to work on a sustained project with a group of Chinese students. This program is able to provide that chance, which is really fantastic. There are certainly challenges to overcome with language and cultural differences, but the benefits are orders of magnitude greater." --Will Scott, Harvey Mudd College

Outreach and Other Activities, 2008-2009

Scientific Empowerment Movement Conference, September 27, 2008.
IPAM was a co-sponsor of this event for minority high school and college students interested in math and science. IPAM sponsored a RIPS student, Raphiel Murden, to return to UCLA to participate on a panel. IPAM Assistant Director Stacey Beggs also attended to promote RIPS.

Math Institutes' Modern Mathematics Workshop (at SACNAS Annual Meeting)
October 8 - 9, 2008.
The seven math institutes all cosponsored this one-day workshop and sent a speaker. IPAM also sponsored a former RIPS student, Margarita Echavarria, to attend.

Public Lecture: "Homogeneous Dynamics and Number Theory" by Gregory Margulis.
January 13, 2009.
IPAM cosponsored this lecture with UCLA's department of mathematics. It was not affiliated with an IPAM workshop.

Infinite Possibilities: A Panel Discussion with Minority Women Mathematicians.
March 6, 2009.
The planning committee of the Infinite Possibilities Conference, to be held at IPAM in March 2010, met in March 2009 at IPAM. Most of the committee members came a day early to participate in a panel discussion. About 30 students and faculty attended, most of whom were minority women in math or related fields.

Julia Robinson Mathematics Festival. April 23, 2009.
IPAM cosponsored this outreach event which was organized by UCLA's Curtis Center for Mathematics and Education. Core participants of IPAM's Quantum and Kinetic Transport program volunteered as activity leaders.

UCLA Day. May 9, 2009
IPAM and the Department of Mathematics sponsored a reception for UCLA alumns who are interested in mathematics research and activities.

K. PROGRAM CONSULTANT LIST

IPAM consulted a variety of scholars and practitioners in the development of ideas for programs and the organization of each program. The list below is in chronological order by program. Upcoming programs for which planning has begun are also included.

MRA2008

Paul Barford, University of Wisconsin-Madison, Computer Science

John Doyle, California Institute of Technology, Control and Dynamical Systems

Anna Gilbert, University of Michigan, Mathematics

Mauro Maggioni, Duke University, Mathematics and Computer Science

Craig Partridge, BBN Technologies

David Rincon, Universitat Politecnica de Catalunya, Telematics Engineering

Matthew Roughan, University of Adelaide

Walter Willinger, AT&T Technologies, Engineering Research Center, Mathematics

MRATUT

Paul Barford, University of Wisconsin-Madison, Computer Science

John Doyle, California Institute of Technology, Control and Dynamical Systems

Anna Gilbert, University of Michigan, Mathematics

Mauro Maggioni, Duke University, Mathematics and Computer Science

Matthew Roughan, University of Adelaide

Walter Willinger, AT&T Technologies, Engineering Research Center, Mathematics

MRAWS1

Paul Barford, University of Wisconsin-Madison, Computer Science

Anna Gilbert, University of Michigan, Mathematics

Mauro Maggioni, Duke University, Mathematics and Computer Science

Morley Mao, University of Michigan

Rob Nowak, University of Wisconsin-Madison

MRAWS2

Bill Aiello, University of British Columbia

Paul Barford, University of Wisconsin-Madison

Farnam Jahanian, University of Michigan, Electrical Engineering and Computer Science

Tal Malkin, Columbia University, Computer Science Department

Niels Provos, University of Michigan

Mike Reiter, University of North Carolina

Matthew Roughan, University of Adelaide

MRAWS3

David Alderson, Naval Postgraduate School, Operations Research Department

John Doyle, California Institute of Technology, Control and Dynamical Systems

Ramesh Govindan, University of Southern California (USC), Computer Science

Craig Partridge, BBN Technologies

Walter Willinger, AT&T Technologies, Engineering Research Center, Mathematics

MRAWS4

Robert Calderbank, Princeton University

Anna Gilbert, University of Michigan, Mathematics

Peter Jones, Yale University, Mathematics

Steven Low, California Institute of Technology

Matthew Roughan, University of Adelaide

Denis Zorin, New York University

CMRC2008

Tom Chou, University of California, Los Angeles (UCLA), Mathematics

RSRC2008

Peter Jones, Yale University, Mathematics

MG2009

Subhash Khot, New York University

Bruce Kleiner, Yale University

Manor Mendel, The Open University of Israel

Assaf Naor, New York University

Yuval Rabani, Technion - Israel Institute of Technology

QS2009

Ulrich Schollwöck, RWTH Aachen

Simon Trebst, Microsoft Research, Station Q

Guifre Vidal, University of Queensland

LE2009

Denis Grebenkov, École Polytechnique, Laboratoire de Physique de la Matiere Condensee

Peter Jones, Yale University, Mathematics

Naoki Saito, University of California, Davis (UC Davis), Mathematics

RE2009

Giovanni Ciccotti, Università di Roma "La Sapienza"

Kristen Fichthorn, Pennsylvania State University

Ioannis Kevrekidis, Princeton University

Christof Schuette, Freie Universität Berlin

Eric Vanden-Eijnden, New York University

Arthur Voter, Los Alamos National Laboratory, Theoretical Division

KT2009

Eric Carlen, Rutgers University, Mathematics

Pierre Degond, Université de Toulouse III (Paul Sabatier)

Irene Gamba, University of Texas at Austin

Frank Graziani, Lawrence Livermore National Laboratory

Shi Jin, University of Wisconsin-Madison, Mathematics

Karl Kempf, Intel Corporation

David Levermore, University of Maryland, Mathematics

Peter Markowich, Universität Wien, Institute of Mathematics

Christian Ringhofer, Arizona State University, Mathematics and Statistics

Marshall Slemrod, University of Wisconsin-Madison, Mathematics

KTTUT

Eric Carlen, Georgia Institute of Technology

Pierre Degond, Université de Toulouse III (Paul Sabatier)

Irene Gamba, University of Texas at Austin

Frank Graziani, Lawrence Livermore National Laboratory

Shi Jin, University of Wisconsin-Madison, Mathematics

Karl Kempf, Intel Corporation

David Levermore, University of Maryland, Mathematics

Peter Markowich, Universität Wien, Institute of Mathematics

Christian Ringhofer, Arizona State University, Mathematics and Statistics

Marshall Slemrod, University of Wisconsin-Madison, Mathematics

KTWS1

Pierre Degond, Université de Toulouse III (Paul Sabatier)

Bjorn Engquist, University of Texas at Austin

Frank Graziani, Lawrence Livermore National Laboratory

Shi Jin, University of Wisconsin-Madison, Mathematics

Caroline Lasser, Freie Universität Berlin

Anna-Karin Tornberg, Royal Institute of Technology (KTH), NADA

KTWS2

Irene Gamba, University of Texas at Austin

Reinhard Illner, University of Victoria

David Levermore, University of Maryland, Mathematics

Laure Saint Raymond, Université de Paris VI (Pierre et Marie Curie)

Marshall Slemrod, University of Wisconsin-Madison, Mathematics

KTWS3

Maria Carvalho, Rutgers University, Mathematics

Karl Kempf, Intel Corporation

Stephan Mischler, Université de Paris IX (Paris-Dauphine)

Benedetto Piccoli, Consiglio Nazionale delle Ricerche (CNR)

Christian Ringhofer, Arizona State University, Mathematics and Statistics

KTWS4

Eric Carlen, Rutgers University, Mathematics

Irene Gamba, University of Texas at Austin

Peter Markowich, Universität Wien, Institute of Mathematics

Anne Nouri, Université d'Aix-Marseille I (Université de Provence)

Robert Pego, Carnegie-Mellon University

Mario Pulvirenti, Università di Roma “La Sapienza”

Cederic Villani, École Normale Supérieure de Lyon

CMA2009

Noga Alon, Tel Aviv University

Gil Kalai, Hebrew University, Institute of Mathematics

Janos Pach, Renyi Institute of Mathematics, EPFL- Lausanne

Vera Sos, Renyi Institute of Mathematics

Angelika Steger, ETH Zürich

Benjamin Sudakov, University of California, Los Angeles (UCLA), Mathematics

Terence Tao, University of California, Los Angeles (UCLA), Mathematics

CMATUT

Noga Alon, Tel Aviv University

Gil Kalai, Hebrew University

Janos Pach, Renyi Institute of Mathematics, EPFL- Lausanne

Vera Sos, Renyi Institute of Mathematics

Angelika Steger, ETH Zürich

Benjamin Sudakov, University of California, Los Angeles (UCLA), Mathematics

Terence Tao, University of California, Los Angeles (UCLA), Mathematics

CMAWS1

Nathan (Nati) Linial, Hebrew University, Computer Science

Alan Frieze, Carnegie-Mellon University, Mathematical Sciences

Angelika Steger, ETH Zürich

Benjamin Sudakov, University of California, Los Angeles (UCLA), Mathematics

Prasad Tetali, Georgia Institute of Technology

ONR2009

Alethea Barbaro, University of California, Los Angeles (UCLA), Mathematics

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

CMAWS2

Alexander Barvinok, University of Michigan

Gil Kalai, Hebrew University, Institute of Mathematics

Janos Pach, Renyi Institute of Mathematics, EPFL- Lausanne

Jozsef Solymosi, University of British Columbia, Mathematics

Emo Welzl, ETH Zürich, Theoretical Computer Science

CMAWS3

Penny Haxell, University of Waterloo, Mathematics

Dhruv Mubayi, University of Illinois at Chicago

Vera Sos, Renyi Institute of Mathematics

Benjamin Sudakov, University of California, Los Angeles (UCLA), Mathematics

Jacques Verstraete, University of California, San Diego (UCSD)

CMAWS4

Irit Dinur, Weizmann Institute of Science

Ben Green, University of Cambridge

Gil Kalai, Hebrew University, Institute of Mathematics

Alex Samorodnitsky, Hebrew University

Terence Tao, University of California, Los Angeles (UCLA), Mathematics

Van Vu, Rutgers University, Mathematics

MR2009

Peter Jones, Yale University, Mathematics

Wen Masters, Office of Naval Research, Math, Computer & Information Sciences

Tristan Nguyen, Office of Naval Research

Carey Schwartz, Office of Naval Research

OTRC2009

Thomas Laurent, University of California, Los Angeles (UCLA), Mathematics

FIN2010

Rene Carmona, Princeton University, Mathematics

Jaska Cvitanic, California Institute of Technology

Nicole El Karoui, École Polytechnique

George Papanicolaou, Stanford University

Eduardo Schwartz, University of California, Los Angeles (UCLA), Anderson School of Business

Ronnie Sircar, Princeton University, ORFE

Thaleia Zariphopoulou, University of Texas at Austin, Mathematics and IROM

META2010

Susanne Brenner, Louisiana State University

Maria-Carme Calderer, University of Minnesota, Twin Cities

Tatsuo Itoh, University of California, Los Angeles (UCLA)

Robert Kohn, New York University, Courant Institute

Jichun Li, Institute for Pure and Applied Mathematics

Graeme Milton, University of Utah, Mathematics

Chi-Wang Shu, Brown University

Richard W. Ziolkowski, University of Arizona, Engineering

BMED2010

Yair Censor, University of Haifa, Mathematics

Steve Jiang, University of California, San Diego (UCSD), Radiation Oncology

Belinda Seto, National Institutes of Health (NIH)

Lei Xing, Stanford University, Radiation Oncology

Hongkai Zhao, University of California, Irvine (UCI), Mathematics

DATA2010

Stephen Fienberg, Carnegie-Mellon University

Aleksandra Slavkovic, Pennsylvania State University

Adam Smith, Pennsylvania State University

CL2010

Amy Braverman, Jet Propulsion Laboratory

Rupert Klein, Freie Universität Berlin, Mathematics

Andrew Majda, Courant Institute of Mathematical Sciences, Courant Institute of Mathematical Sciences

Olivier Pauluis, Massachusetts Institute of Technology, EAPS

Bjorn Stevens, Max-Planck-Institut für Meteorologie

CLTUT

Amy Braverman, Jet Propulsion Laboratory

Rupert Klein, Freie Universität Berlin, Mathematics

Bjorn Stevens, Max-Planck-Institut für Meteorologie

CLWS1

Simona Bordoni, National Center for Atmospheric Research

Dargan Frierson, University of Washington

Andrew Majda, Courant Institute of Mathematical Sciences, Courant Institute of Mathematical Sciences

Jonathan Mitchell, Institute for Advanced Study

CLWS2

Francis Giraldo, Naval Postgraduate School

Christiane Jablonowski, University of Michigan, Atmospheric, Oceanic & Space Sciences

Rupert Klein, Freie Universität Berlin, Mathematics

Sebastian Reich, Universität Potsdam

BONE2010

John Adams, University of California, Los Angeles (UCLA), Orthopaedic Surgery

Maria-Grazia Ascenzi, University of California, Los Angeles (UCLA), Orthopaedic Surgery

Elena Cherkaev, University of Utah, Mathematics

Paul Dechow, Texas A&M - Baylor College of Dentistry, Biomedical Sciences

Eve Donnelly, Hospital for Special Surgery

Gwendolen Reilly, University of Sheffield, Engineering Materials

CLWS3

Markos Katsoulakis, University of Massachusetts Amherst, Mathematics and Statistic

Alan Kerstein, Sandia National Laboratories

Boualem Khouider, University of Victoria

Olivier Pauluis, Massachusetts Institute of Technology, EAPS

Ole Peters, Imperial College

Pier Siebesma, KNMI, Atmospheric Research Div.

CLWS4

Amy Braverman, Jet Propulsion Laboratory

Illia Horenko, Freie Universität Berlin, Mathematics and Computer Science

Luis Kornblueh, Max-Planck-Institut für Meteorologie

Robert Pincus, University of Colorado, Boulder

HUM2010

Jonathan Berger, Stanford University, CCRMA

Zoe Borovsky, University of California, Los Angeles (UCLA)

Gregory Crane, Tufts University

Tina Eliassi-Rad, Lawrence Livermore National Laboratory

Mark Green, University of California, Los Angeles (UCLA), Mathematics

Peter Jones, Yale University, Mathematics

Lewis Lancaster, University of California, Berkeley (UC Berkeley)

Timothy Tangherlini, University of California, Los Angeles (UCLA), Germanic Languages and Literatures,

OP2010

Stephen Boyd, Stanford University, Engineering

Emmanuel Candes, California Institute of Technology, 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), Electrical Engineering

OPWS1

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

Monique Laurent, CWI Amsterdam, and U. Tilburg

Pablo Parrilo, Massachusetts Institute of Technology

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

Steven Wright, University of Wisconsin-Madison, Computer Science

OPWS3

Sanjeev Arora, Princeton University

Gerard Cornuejols, 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

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

Arkadi Nemirovski, Georgia Institute of Technology

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), Electrical Engineering

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, Du Pont Merck Pharmaceutical Company

Tamar Seideman, Northwestern University

Mark Tuckerman, New York University, Chemistry and Courant Institute

Anatole von Lilienfeld, Sandia National Laboratories

CCSTUT

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

William Hart, Sandia National Laboratories

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

Steven Lustig, Du Pont Merck Pharmaceutical Company

Tamar Seideman, Northwestern University

Mark Tuckerman, New York University, Chemistry and Courant Institute

Alex Zunger, National Renewable Energy Laboratory

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 Bio Chemistry

CCSWS3

Gerbrand Ceder, Massachusetts Institute of Technology

Vincent Crespi, Pennsylvania State University

Ralf Drautz, Ruhr-Universität Bochum, Materials Science

H. Eliot Fang, Sandia National Laboratories

Kristen Fichthorn, Pennsylvania State University

Graeme Henkelman, University of Texas at Austin, Chemistry

Steven Lustig, Du Pont Merck Pharmaceutical Company

Tamar Seideman, Northwestern University

Board of Trustees

Tony Chan, Hong Kong University of Science and Technology, President

Mark Green, University of California, Los Angeles (UCLA), Mathematics

Mac Hyman, Los Alamos National Laboratory

Linda Keen, Lehman College, CUNY, Mathematics

Sallie Keller-McNulty, Rice University, Professor of Statistics, Dean of Engineering

William Massey, Princeton University, Mathematics

Juan Meza, Lawrence Berkeley National Laboratory, High Performance Computing Research

Cleve Moler, MathWorks, Inc.

Arlie Petters, Duke University, Mathematics

Tatiana Toro, University of Washington, Mathematics

Science Advisory Board

Irene Gamba, University of Texas at Austin, Mathematics

Mark Green, University of California, Los Angeles (UCLA), Mathematics

Matthew Hastings, Microsoft Research, Station Q

Yann LeCun, New York University, Courant Institute

David Levermore, University of Maryland, Mathematics

Jill Mesirov, Broad Institute, MIT & Harvard, Broad Institute

Assaf Naor, New York University, Courant Institute

Richard Schwartz, Brown University, Mathematics

Terence Tao, University of California, Los Angeles (UCLA), Mathematics

Elizabeth Thompson, University of Washington, Statistics

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

Peter Wilcox Jones, Yale University, Mathematics

Stephen Wright, University of Wisconsin-Madison, Computer Science

L. PUBLICATIONS LIST

A list of publications, presentations and patents of our participants (self-reported) is provided as an appendix.

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 29-31 for a complete list of sponsors. New sponsors in summer 2009 included Placental Analytics, LLC and the Los Angeles Police Department.

Summer 2009 saw the second year of RIPS in Beijing at Microsoft Research Asia (MSRA). All of the research projects and the majority of the support for RIPS-Beijing came from MSRA, supplemented by funding from a grant from NSF's International Research Experiences for Students (IRES) program.

In November 2008, IPAM held the third (and final) in a series of workshops with the National Geospatial Intelligence Agency (NGA), funded by a grant from NGA. This has been a activity that spawned an injection of modern mathematics into NGA, helped NGA hire several young mathematicians and fostered the creation of a community of mathematicians involved in NGA applications.

IPAM received a grant for $15,000 from the Office of Naval Research (ONR) to support the workshop "Laplacian Eigenvalues" in winter 2009. This helped lead to additional funding for future IPAM programs from ONR.

IPAM co-sponsored the Claremont Colleges Math-in-Industry Workshop held July 24-26 (mini-Camp) and July 27-31 (Workshop) in summer 2009.

IPAM is making a renewed effort to increase involvement with industry and government labs. As part of this effort we recruited Jill Mesirov (Broad Institute) to be on our Science Advisory Board and Juan Meza (Lawrence Berkeley National Laboratory) to be on our Board of Trustees, along with Mac Hyman (Los Alamos National Laboratory, but since moved to Tulane) and Cleve Moler (Mathworks).

Many members of industry and government labs attend IPAM programs. Here are some comments from some of them, as well as a few examples of collaborations that have emerged as a result of their participation:

Tad Hogg (HP Labs): "IPAM has helped expose me to people and results in different fields (particularly related to swarm behaviors in biological and mathematical systems, fluid dynamics relevant for nanotechnology applications and statistical models of social networks). Discussions of social networks have led to collaborative research with USC/ISI. The other topics have not led to joint research, but the IPAM workshops have helped clarify open issues and how approaches from other fields can help."

Yi Jiang (LANL): "I believe a mathematical model can only as good as experimental data. So as a math-modeler interested in biological and biomedical problems, I'm always looking for good experimental collaborators. IPAM workshop facilitated my connection with the experimentalists, who are also open to mathematical modeling. It worked out great. The close collaboration with the experimental teams and experimental data also shifted my research direction from modeling development to more model validation and hypotheses testing."

Marc Robins (Arete Associates): "As an industry mentor working with RIPS at IPAM, I have gained valuable training for managing research projects. The experience has influenced my approach to several internal research and development projects at Arete Associates."

Carolyn Salafia (Placental Analytics): “For over 20 years I have had to explain to parents why their child died or was damaged before birth. I've always done clinical research even at community hospitals, because what keeps you going in this field is being able, every few years, to learn something so that you don't say the same things to parents every year. Slowly, surely, you try to make progress, taking the losses and grief, turning it into research that improves understanding. In the last 2 years, my work with IPAM collaborators has allowed me to make more strides in understanding the basic, fundamental mechanisms of placental growth, and develop improved measures than I'd accomplished in the last decade with "standard" clinical peers. My work at IPAM has altered my career irrevocably and has already and will continue to create leaps, not baby steps, in the growth of our knowledge base. My patients benefit daily from the improved insights and methods of analysis I've developed through my IPAM collaborators.

“I have developed strong and productive collaborations (in no order of importance) with Denis Grebenkov, Dept of Physics, Ecole Polytechnique, Paris; Matthew Sottile, Dept of Computational Sciences, U of Oregon; Dimitri Vvedensky, Blackett laboratory, Imperial College, UK; Michael Yampolsky, Dept of Mathematics, U Toronto, that have enriched my more "standard" collaborations with obstetricians, epidemiologists and physiologists. ”

Igor Yanovsky (JPL): “After attending Graduate Summer School on Mathematics in Brain Imaging in 2004, I developed a strong interest in brain imaging. During this program, I had met several researchers from the Lab of Neuro Imaging (LONI), and have been collaborating with two groups from the Lab since then. The goal of this interdisciplinary collaboration is to develop mathematically and computationally stable, reliable, and efficient models that are useful for the medical imaging community, as well as to prove and analyze the underlying computational and mathematical concepts. I also participated in the Modern Applied Mathematics for the Atmospheric and Oceanic Sciences graduate summer school in IPAM in the summer of 2003, where I have met top researchers and developed appreciation for the field of Atmospheric sciences. In my current position at the Jet Propulsion Laboratory, I have been contributing to four Earth Sciences missions, and have been using knowledge acquired in IPAM's summer program.”

Additionally, here are comments from a few of our industry sponsors of RIPS-LA and RIPS-Beijing 2009:

“The IPAM/RIPS program is top notch. It gives undergraduate students an intense exposure to real-world research that will be valuable as they choose their career path. My experience as an industrial mentor in the program was very rewarding. The students were enthusiastic, motivated, and extremely bright – a joy to work with.”
--- Arthur F. Voter (Los Alamos National Laboratory)

“I am always astonished by the creativity of the students, the great ideas they come up with and ingenious solutions to hard problems.”
--- Martin Lo (JPL)

“The program provides an experience for students that show the multitude of applications that can be solved with math, and it provides researchers and practitioners a fresh perspective.”

--- Andrew Selle (Walt Disney Animation Studios)

"I think this program is a very good chance for young students to know research, try to do research, and probably start their career in research. In this program, perhaps it is the first time for them to get to know a real industrial problem, and try to solve the problem using the mathematics they've learned from school. Also, they have had a colorful summer during this program. As an industrial mentor, I also enjoyed working with them very much."
---Zhijie Yan (Speech group, Microsoft Research Asia)

"It is a great experience for me to work with a group of talented students with mathematical and computer science backgrounds. Together we have achieved more and enjoyed the time as a team."
---Chuanxiong Guo (Wireless and Networking Group, Microsoft Research Asia)

N. EXTERNAL SUPPORT

In addition to the funding listed in Table N-1 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, and IPAM is not charged for the use of its building or for custodial care. The value of these three items is approximately $880K. Additionally, senior long-term participants from other universities are usually funded on a replacement-buyout basis, by which they are released from teaching for the cost of hiring a junior person as a replacement. (See Table N on following page.)

Table N: Other Funding Support, 2008 to 2009		
Federal Grants	**Year**	**Amount**
NSF- IRES RIPS Beijing China	2008-2009	41,000.00
Office of Naval Research (ONR) for LE2009	2008-2009	33,000.00
Sub-total		74,000.00
University Funding Support		
Chancellors Office-Diversity Fund Support for IPC	2008-2009	10,000.00
Dean Physical Sciences Support	2008-2009	60,000.00
Dean Physical Sciences Matching 1/2 IT Wages	2008-2009	42,470.00
Vice Chancellor for Research's Support	2008-2009	65,000.00
Atmospheric & Oceanic Science Support P. Lecture	2008-2009	1,000.00
Computer Science Department-Public Lecture	2008-2009	1,000.00
Institute for Digital Research and Education-Public Lecture	2008-2009	2,029.00
Institute of Geophysics and Planetary Physics-Public Lecture	2008-2009	2,000.00
Institute of the Environment-Public Lecture	2008-2009	100.00
Sub-total		183,599.00
Industrial Affiliates and Other Support		
Aerospace	2008-2009	15,000.00
Arete	2008-2009	10,000.00
USC CAMM	2008-2009	15,000.00
JPL-SURP	2008-2009	15,000.00
JPL	2008-2009	5,500.00
Placental Analytics	2008-2009	15,000.00
Pixar and Disney	2008-2009	15,000.00
Microsoft	2008-2009	5,000.00
Symantec	2008-2009	15,000.00
Sub-total		110,500.00
Others		
Registration Fees-Programs	2008-2009	12,825.00
Green Family Lectureship Foundation Interest	2008-2009	5,952.00
J.B. Berland Foundation	2008-2009	13,000.00
Sub-total		31,777.00
TOTAL		**$399,876.00**

O. COMMITTEE MEMBERSHIP

IPAM's committees include the Board of Trustees and Science Advisory Board. The members of each as of August 1, 2009 are listed here.

Science Advisory Board

Russel Caflisch (UCLA, IPAM; ex-officio member)
Irene Gamba (University of Texas, Mathematics,
Mark Green (UCLA, Mathematics)
Matthew Hastings (Microsoft Research, Station Q)
Peter W. Jones-Chair (Yale, Mathematics)
Yann LeCun (New York University, Computer Science)
David Levermore (University of Maryland, Mathematics)
Jill Mesirov (Broad Institute, MIT & Harvard)
Assaf Naor (New York University, Mathematics and Computer Science)
Stanley Osher (UCLA, IPAM; ex-officio member)
Amber Puha (CSU San Marcos, IPAM; ex-officio member)
Christian Ratsch (UCLA, IPAM; ex-officio member)
Richard Schwartz (Brown University, Mathematics)
Terence Tao (UCLA, Mathematics)
Elizabeth Thompson (University of Washington, Statistics)
Claire Tomlin (UC Berkeley, Electrical Engineering)
Stephen Wright (University of Wisconsin, Computer Science)

Board of Trustees

Russel Caflisch (UCLA, IPAM; ex-officio member)
Mark Green (UCLA, Mathematics)
Mac Hyman-Chair (Los Alamos National Lab)
Linda Keen (Lehman College - CUNY, Mathematics)
Sallie Keller-McNulty (Rice University, Statistics/Engineering)
William Massey (Princeton, Mathematics)
Juan Meza (Lawrence Berkeley National Laboratory)
Cleve Moler (MathWorks, Inc.)
Stanley Osher (UCLA, IPAM; ex-officio member)
Arlie Petters (Duke University, Mathematics)
Amber Puha (CSU San Marcos, IPAM; ex-officio member)
Christian Ratsch (UCLA, IPAM; ex-officio member)
Tatiana Toro (University of Washington, Mathematics)

P. CONTINUING IMPACT OF PAST IPAM PROGRAMS

IPAM chose to add this section which was not requested by NSF. Here are 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. A few examples of new collaborations are also reported.

Veronika Brazdova (U. College, London): “I learned a lot of the basics (the tutorials) and also of state-of-the-art research (the workshops, discussions with other participants). I have several new contacts thanks to IPAM. It really helps to have the program on a CV, too.”

Krzysztof Burdzy (U. Washington): “The stay at IPAM was the source of inspiration, several meaningful discussions, and the starting point of several forthcoming papers. It also allowed me to get familiar with the current cutting-edge research.”

Alexandre Franco (U. New Mexico): “A post-doc position in Emory University was achieved thanks to collaborations initiated at IPAM.”

Sharon Goldberg (Princeton): “Has greatly expanded my network of researchers. The collegial environment has influenced me to focus my research on cryptographic theory. (I do interdisciplinary work, but am now learning heavily towards cryptography, and the inspiring environment at IPAM definitely contributed to this.) I also met Leo Reyzin at IPAM, who is a professor at Boston University. We have maintained contact and he supported my application as a tenure track assistant professor at Boston University. I will be joining BU in fall 2010.”

Ha Quang Minh (Humbold-Universitat): “IPAM has had a very deep impact on my career and research direction! It's where I met my PhD thesis advisor and where I acquired a lot of the knowledge that I am now using in my research. The programs are altogether very stimulating and inspiring, not to mention the very helpful financial support. Please keep up the good work!”

Sabine Hittmeir (U. Wien): “Since it is the last year before my graduation I was thinking a lot about which direction to choose for my future profession. Participating in the IPAM workshop really motivated me to stay in research. This is not only because I got to know highly interesting mathematical problems, but also because especially the senior researchers participating in the program were very encouraging.”

Peter Jipsen (Chapman U): “Because of the very informative Sage Days workshop in February 2008 I have become much more involved in computational mathematics. This meshes well with Chapman University's current research emphasis on Computational Science.”

Katie Kerr (Jackson Laboratory): “The IPAM program gave me a lot of contacts that really helped my transition from a more mathematical statistician to a biostatistician involved in methodological and biological research. Thinking back on the experience after 8 years, it really was very valuable.”

Young-Heon Kim (U Toronto): “As a core participant in the thematic program, "optimal transport", I met a variety of top researchers in my research field, including Yan Brenier and Neil Trudinger. This certainly has broadened my horizon and was crucial benefit for a junior researcher like me. It will continuously help me developing my research program. There have been inspiring discussions and lectures, especially about applications of optimal transportation to practical subjects, such as medical imaging, pattern formation, etc.”

Elizabeth Leicht (UC Davis): “My involvement with IPAM helped to widen the focus of my research on complex networks. My Ph.D. was awarded in physics. Attending the fall 2008 program at IPAM exposed me to the work of computer scientists and mathematicians. This helped me to step away from the more narrow view of networks research that I acquired in graduate school. This was valuable for my work because complex networks research is very much an interdisciplinary field.”

Maureen Morton (Michigan State U): “IPAM has enabled me to have a much broader network of people. It has given me a clearer idea of what certain careers are like and what is necessary for success in those careers so that I can make more informed decisions about my future. IPAM has also opened up new possibilities for altering and applying the numerical methods that I am researching. In some sense, IPAM was like a catalyst in that I could learn about these possibilities much more rapidly than I would have if I had just done a literature search, and the input of the other IPAM participants enabled me to see research directions that were possible which I would not have noticed on my own.”

Fernando Perez (UC Berkeley): “Both topics listed in the previous item are directly my research focus right now. The material I've learned on diffusion geometries at UCLA forms the basis of much of my current research, and I am currently writing an NSF grant proposal for the CDI program based on this (which already successfully passed the preliminary CDI review process). IPAM is one of the most amazingly productive environments I've had the pleasure to work at, and I hope to continue attending events there in the future.”

Stever Ruuth (Simon Fraser U): “I recently attended a superb workshop at IPAM: Laplacian Eigenvalues and Eigenfunctions: Theory, Computation, Application. February 9 - 13, 2009. This workshop brought together experts from many areas of application, as well as algorithm experts and theoretically minded people. I learned a great deal and the materials helped form a very nice paper with Macdonald and Brandman. In particular the workshop was a great benefit in learning the context and practical importance of a class of algorithms we had developed. I cannot think of any other way we could have learned so much on the subject. IPAM is a exceptionally important interdisciplinary resource and I hope it continues its outstanding work on a permanent basis.”

Adam Smith (Penn State U): “The semester at IPAM was a tremendous boost to my career, both because I learned a lot (talks, etc) and because it gave me a chance to present my research and ideas to a broad cross-section of experts in my field.”

Tim Tangherlini (UCLA): “My involvement with IPAM has allowed me to significantly deepen my understanding of what may be possible in computation in regards to humanities research. In particular, the seminar has allowed me to embark on a series of experiments that I believe may lead to the development of a "computational folkloristics" that weds advances in natural language processing, machine learning, and social networks, along with GIS, into an integrated approach to large, heterogeneous humanities collections (largely not in English). It would be hard to express my excitement with these new vistas for my research. Since I am already a professor at a research university, I doubt much future change in my actual career, although I do expect the work deriving from my participation in IPAM will have a quite positive influence on my ability to work in a truly interdisciplinary fashion in the future.”

Comments from previous RIPS participants and sponsors:

Martin Lo (sponsor, JPL): "Rachel Hodos was the RIPS08 JPL Project Manger. This spring she came to work for me as a USRP (NASA program) at JPL for 3 months on computational algebraic topology on climate data and the galactic data I mentioned in the previous email (2mass, Sload Digital Sky Survey). She is deferring going to graduate school for a year and has been interviewing with JPL for a job. It is very likely we will be hiring her for this fall. This came about only because of my involvement with RIPS. Also, I'm still working with a couple of kids from RIPS07 (Jonathan Essen at UCSB and Stephen de Salvo at USC). I don't know how this fits into your statistics for tracking your successes, but here are just a couple of examples. Thanks again for such a great program and for working with me."

Allison Chang (RIPS participant): "Being a project manager for RIPS was a great learning experience for me in terms of showing me the sorts of problems project managers might often have to deal with. If I do lead another project in the future, I will be better prepared to handle organizing my team and meeting deadlines because of my involvement with IPAM. In terms of research direction, I have started to focus on machine learning and data mining since I entered graduate school, and my IPAM project certainly adds to my understanding and appreciation of the area."

Marc Robins (sponsor, Arete Associates): "This past summer Arete Associates hired a summer intern who we met through IPAM several years ago. As an industry mentor working with RIPS at IPAM, I have gained valuable training for managing research projects. The experience has influenced my approach to several internal research and development projects at Arete Associates."

Shafi Sayed (RIPS participant): "My participation in IPAM RIPS has greatly shaped my career and research ambitions. Following the program, I completed my final year of undergraduate studies in Applied Mathematics at UCLA and took a software engineering job at Northrop Grumman before beginning graduate school. The RIPS program significantly expanded my mathematical and professional horizons by exposing me to control systems, estimation theory, and video and image processing. To that end, I will join the MS/PhD program in EECS at UC Berkeley this fall, specializing in the area of Control, Intelligent Systems, and Robotics, with a sub-focus in Communication, Computation, and Statistics."

Christof Sparber (RIPS participant): "At IPAM's RIPS, I worked on a problem concerning remote sensing on an unmanned aerial vehicle. While working on this problem, I developed an interest in machine vision. I have been working for the Sensor Modeling and Analysis group in the Aerospace Systems sector of Northrop Grumman for over a year, where I am assisting in research of automatic target recognition algorithms. In the near future, I plan to pursue a masters degree in computer science in the area of machine vision."