Institute for Pure and Applied Mathematics, UCLA
Award/Institution #0439872-013151000
Annual Progress Report for 2009-2010
August 1, 2011

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EXECUTIVE SUMMARY

Highlights of IPAM's accomplishments and activities of the fiscal year 2009-2010 include:

- IPAM held two long programs during 2009-2010:
  - Combinatorics (fall 2009)
  - Climate Modeling (spring 2010)
- IPAM's 2010 winter workshops continued the tradition of focusing on emerging topics where Mathematics plays an important role:
  - New Directions in Financial Mathematics
  - Metamaterials: Applications, Analysis and Modeling
  - Mathematical Problems, Models and Methods in Biomedical Imaging
  - Statistical and Learning-Theoretic Challenges in Data Privacy
- IPAM sponsored reunion conferences for four long programs: Optimal Transport, Random Shapes, Search Engines and Internet MRA
- IPAM sponsored three public lectures since August. Noga Alon presented "The Combinatorics of Voting Paradoxes" on October 5, 2009. Pierre-Louis Lions presented "On Mean Field Games" on January 5, 2010. David Gross presented "The Coming Revolutions in Fundamental Physics" on February 22, 2010. Kevin Trenberth gave the talk "Global Warming: Coming Ready or Not" on May 5, 2010.
- We selected 32 students for RIPS 2010, plus 8 students for RIPS-Beijing and another 8 for RIPS-Berlin. We collected over 450 applications! New sponsors of RIPS-LA included IBM, Standard and Poor's, and the Shoah Foundation.
- IPAM offered RIPS-Beijing for the third time, with four projects and 8 U.S. students, in partnership with Microsoft Research Asia (MSRA) and with the support of an IRES grant.
- IPAM offered RIPS-Berlin for the first time this summer, with four projects and 8 U.S. students, in partnership with MATHEON.
- IPAM hired 8 postdocs as part of the NSF Mathematics Institutes Postdoctoral program, and placed them in research groups around the US. Their appointments began in August or September 2009.
- IPAM was awarded a grant from ONR for the workshop "Agent-Based Complex Systems" which was held in October 2009.
- The first in a series of workshops on Machine Reasoning, with a grant from ONR, was held in November 2009.
- IPAM was awarded $15,000 from NSA for one of the Combinatorics workshop.
- IPAM had a successful NSF site visit in October 2009 which resulted in a favorable report from the evaluation team, recommending to NSF that they continue to support IPAM.

- 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 Tony Chan, William Massey, Juan Meza, Tatiana Toro, Al Hales and Sallie Keller-McNulty.
- Amber Puha began a two-year term as IPAM associate director on September 1, 2009.
- 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.
- Juan Meza of the Board of Trustees was listed as 100 most influential Hispanics (Hispanic Business magazine) and was elected as a Fellow AAAS.
- Tony Chan (former director, and current member of the Board of Trustees) became president of HKUST in 2009.
- Former IPAM Director and current board member Mark Green was named a fellow of the American Academy of Arts & Sciences (2010).
- The 2010 SIAM Fellows included Andrea Bertozzi, Susanne Brenner, Tony Chan, Bjorn Engquist, Ioannis Kevrekidis, and Fred Wan – all of whom have served on an IPAM board or as an organizer for an IPAM program.
- IPAM published its first annual newsletter in August 2009 and its second in August 2010.
- With the other NSF math institutes, IPAM co-sponsored the Modern Math Workshop and a reception at SACNAS (October 2009) and a reception at the Joint Mathematics Meetings (January 2010).
- IPAM's assistant director and a RIPS student represented IPAM at the Nebraska Conference for Undergraduate Women in Math.
- IPAM hosted and co-sponsored the "Infinite Possibilities Conference"(IPC) for minority women mathematicians in March 2010. Close to 200 women participated.
- Bill Massey organized a one-day "short course" on operations research, which was offered the day before the IPC. There were 41 participants including five speakers.
- IPAM held four women's luncheons in conjunction with its workshops this year.
- IPAM has been invited to host CAARMS in 2011
- "Networks Analysis in the Humanities" summer school was well-received. Tim Tangherlini (UCLA) received an award from NEH to support the program.
- IPAM completed renovations to the library, adding three new participant offices, and made technological improvements to the conference room.
- IPAM's director, associate director, and assistant director spent a day at MSRI in April to learn about fundraising from a more "mature" institute in April 2010. We also discussed opportunities for collaboration.

A. PARTICIPANT LIST

A list of all participants in IPAM programs is provided in electronic form (Excel). The list includes participant lists for programs whose start date falls between September 1, 2009 and August 31, 2010. This list includes our summer 2010 programs.

B. FINANCIAL SUPPORT LIST

A list of participant support information is provided in electronic form (Excel). The list includes all funded participants of programs that occurred between August 1, 2009 and August 31, 2010. This list includes participants of RIPS2009 (June-August 2009), but does not include our 2010 summer programs.

C. INCOME AND EXPENDITURE REPORT

	A	B	C	D	E	F
			A-B=C		B+D=E	A-E=F
Budget Category	**Appropriation Years 1-5**	**Actual Expenses as of July 2010**	**Current Balance as of July 2010**	**Projected Expenses as of July 2010**	**Total Expenses as of July 2010**	**Projected Balance as of July 2010**
A. Operations Fund	$8,396,735	7,713,420	683,315	12,969	7,726,389	$670,346
B. Participant Cost	8,637,031	7,862,096	774,935	129,538	7,991,634	645,397
C. Postdocs	1,028,098	553,557	474,541	-0-	553,557	474,541
5-Year Total Budget	$18,061,864	16,129,073	1,932,791	142,507	16,271,580	$1,790,284

In the 5th year of the grant, IPAM has received funding at a total of $18,061,864 for the combined $3.4M per year appropriation plus the supplemental funding for Cyber Enabled Discovery & Innovation (CDI) at $33,766 and for postdoctoral fellowship at $1,028,098. The actual expenditure as of July 31, 2010 is $16,129,073 giving a balance of $1,932,791. We have projected expenditures of $142,507 which will increase total expenditures to $16,271,580. Since we have been using the carry-forward from year 4 of approximately $2,008,000 towards our 2010-2011 programs, the budget for the 5th year of the current grant is partially spent with an anticipated balance as of July 31, 2010 as carry-forward after year five in the amount of $1,790,284.

Expenditures up to July 31, 2010

A. The Operational fund (salaries, benefits, equipment, supplies, and travel including overhead) for 5-year budget has a cumulative appropriation of $8,396,735 with total expenditures of $7,713,420 inclusive of outstanding expenses. This will give us an anticipated carry-forward of $670,346 (consisting of $435,287 direct cost and $235,059 of indirect cost).
B. Participant Cost Category for 5-year budget has appropriation of $8,637,031 with total expenditures of $7,862,096 as of July 31, 2010 inclusive of outstanding expenses with anticipated carry-forward after year 5 of $645,397. The projected carry forward will partially cover the outstanding expenses for RIPS10 ending in August 2010, and exploratory programs in 2010-2011.
C. The supplemental for the postdoctoral fellowship was awarded in May 2009 and eight post doctoral scholars were hired with various start dates. The carry-forward for the supplemental is $474,541.

The combined expenditures of operational fund, participant cost, and post-doctoral scholars categories will result in carry-forward funds of approximately $1,790,000 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 the cost of salaries and benefits of IPAM staff, including the partial compensation for the second associate director. Part of the carry-forward will also be used for a 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 2010-2011. 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 approximately 30%. With the growth of the programs and increasing costs, the carry-forward of $645,397 will help sustain the increasing program costs after its 5th year. IPAM plans to co-sponsor programs for women and diversity, public lectures, co-sponsor a graduate summer program 2011, RIPS 2011 in Hong Kong that will be covered by the carry forward amount.
C. The remaining supplemental award of $474,541 for the postdoctoral fellowships will be used after year 5 since the award came towards the end of the 4th year of the grant for eight post-doctoral scholars.

D. POSTDOCTORAL PLACEMENT LIST

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

IPAM's NSF Mathematical Sciences Institutes Postdoctoral Scholars 2009-2010					
Last Name	**First Name**	**Placement Institution**	**Placement Department**	**State**	**Topic**
Alonso	Ricardo	Rice	Comp Appl Math	TX	inverse problems
Athavale	Prashant	Placental Analytics/UCLA	Math	CA	placenta imaging
Baskaran	Arvind	UC Irvine	Math	CA	materials science
Duarte	Marco	Princeton	Math and EE	NJ	compressed sensing
Leicht	Elizabeth	UC Davis	Mechanical Eng.	CA	network analysis
Szlam	Arthur	NYU	Computer Science	NY	machine learning
Vermesi	Brigitta	University of Washington	Math and MS	WA	probability, math phys
Wen	Zaiwen	Rice	Comp Appl Math	TX	optimization

E. INSTITUTE DIRECTORS' MEETING REPORT

Mathematical Institutes Directors meeting
April 30 – May 1, 2010
Minutes and Report

Attending:
David Levermore, Chair – BMSA ad University of Maryland
Jim Berger – SAMSI
Robert Bryant – MSRI
Russel Calflisch IPAM
Brian Conrey -AIM
Marty Golubitsky – MBI
Fadil Santosa – IMA
Richard Smith – UNC and director designate of SAMSI
Thomas Spencer – IAS
Jill Pipher – Brown University and proposed ICERM
Brian Zuckerman – STPI
Christina Viola Srivasta- STPI
Dean Evasius – NSF
Mary Ann Horn – NSF
Joanna Kania-Bartoszynska – NSF (Saturday only)
Deborah Lockhart – NSF
Peter March – NSF
Katherine Socha – AAAS/NSF
Christopher Stark – NSF
Gabor Szekely – NSF
Robert McPherson – IAS
Avi Wigderson – IAS (Saturday only)

Brian Zuckerman of STPI gave an *Overview of Feasibility Study* (attached).

--Where do institutes fit in with the balance of the NSF?
--Portfolio analysis of the Institutes within the field of math and in the area of training activities
--There is a range of available tools for self-evaluation. Each institute now has its own way of collecting data. Could processes be shared to improve best practices?
--Request to NSF for MIDs to see aggregate data that has been acquired from all of the math institutes. But there are privacy issues. An argument for use of data would have to be made to NSF counsel.
--Are the institutes the most appropriate place to allocate funds or should the funds be used in another way?
--60 data points suggested that the institutes do not have the same intellectual footprint. Almost no overlap among the participants at the institutes, i.e., very few people attend programs at more than one institute.

There was discussion of what areas of questions would produce useful data.

--How to track participants – some institutes (MSRI and IMA) use an identifier number, as opposed to an email address since email can change.

--The institutes responded quickly when federal funds became available and received a good amount of available funds. How can that be quantified?

--How do you know the effect of being at a particular institute several years down the road?

The institutes "enhance communities" – these relationships grow over the years and lead to collaboration. "Creating new knowledge" is very difficult to measure. Perhaps a qualitative as opposed to a quantitative approach should be used.
David – change Goal 2 to "Increase interaction" (rather than impact) of math in other disciplines. Another goal could be the participation of mathematicians in non-mathematical fields and the participation of non-mathematicians in the math institutes.

How do the institutes effect the choice of where people end up?

It is important to add the collaboration of the institutes as a goal – create synergies. This can be a fifth goal. Add reaching out to the international community.

1A
Change goal 3 from "solving problems" to "address the problems."

Suggested that we not use bibliometrics approach, understanding that it has been 'gamed.'
But some would like to include this - at least compile list of publications. One way to do this is to go through the lists of publications that the institutes provide – self-reporting. Another way is to evaluate journals to get this information. But a lot can be missed and it doesn't really show the influence of the institutes. Also this may leave out people who are doing research in new areas so they are not publishing much right now. After discussion, this approach was rejected, although it was agreed to have a list of publications.

'Expert judgment approach' was rejected: The experts would have to be 'unconflicted" (no conflict of interest) which would mean that they wouldn't really know much about what the institutes do – which renders them "not expert."

1b Stimulate development of new fields/disciplines
Problem – some effects that are cross disciplinary would not be discovered because the publications might be in a different discipline
MSRI uses an exit interview: How many new contacts did you make? Motivation: In order to get their key deposit back, they have to complete the survey!

1d Leveraging new funding
Applying for interdisciplinary grants is fairly new.

4a under-represented groups
Minority participants tend to be younger so if you ask about publications, you aren't going to get

very many.

4b
Effect of participating at an institute on the likelihood of getting an NSF grant.

4c train students and postdocs to become leaders in mathematics
How did participation in an institute result in a different effect than non-participation? Looking at junior faculty, for instance.

Be careful of comparing positions with the same title that in fact may not be on the same level, such as an assistant professor at Princeton compared to an asst. professor at the U. of Maryland.

4d K-12 level and public understanding of mathematics
Not associated with NSF.

Synergies (process evaluation question)

--Across the Institutes (example: quick response to the stimulus money granted through NSF)

--Interchange across NSF
development of/participation in interdisciplinary programs
--NSF used as a community resource

--More broadly, internationally

--Rotation of workshops on diversity that are already taking place

--In 2013 the collaboration on Climate Sustainability

--Joint website

The goal of STPI is to have the feasibility study done by the end of the summer.

Plan for ICERM – Proposed institute that is about interaction of math and computers/Jill Pipher The space is provided by Brown University. Not all higher math. For graduate students and postdocs; also for undergraduates in the summer. Should be operational by 2011. Microsoft, Google and IBM have representatives on the board. Board of Trustees is a governing board. Initially a course in "Connectic theory and computation." Math, Applied Math and Theoretical Computer Science. The programs will be a semester-long. Postdoc positions may be a semester long or a year long.

MSRI tries to pair postdoc with a mentor before they get to campus. And then sometimes they encourage the postdoc to follow their mentor if the mentor leaves after a year.

All of the postdocs at IAS from the stimulus funds got jobs.

David reported on the COV.
COV looked at the entire portfolio – 3,000 proposals. NSF gives a template of questions to look at the DMS portfolio. The purpose was to review the 'health' of the system. This committee was created in 2004. In 2007 it was recommended that the Math Institutes be reviewed, which resulted in STPI being here today. DMS wants to understand the value of the Institutes. They are interested in having some of the Institutes find additional sources of funding. The hope is that the released funding would be used to support new institutes.

David - What is being done in this meeting today is the beginning of a self-study, which will precede a review by DMS.

Peter March wants some hard data so that he can defend the expenditure of funds for the Institutes.

4 items were reviewed:
Looked at the study
Looked in detail at interdisciplinary programs and ARA funding
Looked at previous COV report
There is a wide disparity in the way that the Institutes disseminate information.

It was suggested that the group come up with some ways to get hard data.

Review Action Items from 2009 meeting

IT Committee – Jim Kimmick of IPAM organized this. The goal is to get a common format to search all of the institutes' video archives. The IT group concluded that at this time, this is extremely difficult. It requires the directors to present the IT managers with a task to solve, or a directive. Suggestion: IT person at the host institution would give a report to the MIDs. Because MSRI is getting their videos organized into a usable data base, their IT manager might be able to work on this project for all of the Institutes. The video collections are used extensively. In addition, power point presentations and PDFs could be posted as well. NSF staff agreed to discuss the possibility of funding this.

Action item: Some of the institutes that already have archived videos or are currently working on this (such as IAS, MSRI, MBI) will get together via teleconference to discuss this further. The recommendations will be shared with NSF.

Action Item: Continue to support Association for Women in Mathematics. Contribution was supposed to be $550 per year per institution. Uncertain whether or not those contributions were made. Jill will look into this.

Report by Russel Caflisch (IPAM)
--Plan for possibly sharing diversity programs

--Infinite Possibilities Conference was held in March 2010; approximately 200 attended.
--Modern Math workshop in Dallas was attended by about 120 people, including undergraduates.
--Apply to NSF for support of mini-course. If that isn't funded, each institute would need to fund about $1,000 each for a scaled down version.

Brief report on Joint Postdoctoral Initiative: All of the postdocs at IAS funded by this Initiative found tenure-track jobs. Several of the Institutes had 2-year postdocs so they haven't been job hunting yet. AIM had a workshop last summer that was very successful. The information is on the AIM website. MSRI also had a one-day workshop that was successful.

Recommendation for JMN theme and for organizers: This is a joint meeting with 15 math institutes.
Action item: The topic is 'Information Science.' The recommendation is *Math That Connects the Dots* or *Mathematical Connections* or *Mathematical Networking.* Russel Caflisch and Fadil Santosa volunteered to help organize the event.
Bob Bryant and Marty Golubitsky will send the email with this information to the other math institutes.

Metrics
In collecting data for NSF, what is the definition of 'participant'? IMA has 'supported participants' and 'speaking participants'. The point of the question is how many people are benefiting from a workshop.

The directors want to continue to use surveys of participants/members in order to discern the effect of being at an institute on the participants' careers. It is difficult to standardize questions for participant/members a few years after they have left the institute. Perhaps look at one another's questionnaires.
Action item: The questionnaires can be put on the MID password protected part of the website (MathInstitutes.org.) The MIDs will write a brief description of what is done to collect the questionnaire.

Suggestions for ways to assess:
--Number of new collaborations that can be attributed to the institutes
--Number of new papers
--Has the research become interdisciplinary (use DMS definition of 'interdisciplinary')
--Number of hits on webpage (it was decided this is not useful)

--Number of hits on videos and length of time the videos were viewed

MSRI is tracking undergraduates who take their 6-week courses to see who continues on to grad school and who gets a Ph.D. They appoint a mentor for each class and that person is responsible for writing an annual report.

There was a discussion of efforts to increase diversity.

Tax situation: If someone is not a US citizen, they cannot get a per diem because it is

misleading, making it look as if they are not taxable. NSF has the same problem. NSF gives US citizens and permanent residents a Form 1099. For foreign nationals, it is reimbursement for expenses; taxes are not withheld. NSF staff said that they cannot give tax advice to the institutes.

US/non-US issue: If someone is at a US institution, but is not a US citizen or permanent resident, does that count as US or foreign in terms of gathering data for diversity issues. For NSF it is a research-based determination. The quality of the participants is more important. If the numbers are consistently heavily weighted toward one side or the other, then NSF would look at that. However, for example, if a new idea originated overseas, they would expect the senior people to come from overseas, but would expect participants to be more from the US or to have gotten their degrees from a US institution.

Report to NSF on Postdocs that were funded by the Stimulus Initiative: Most of the postdocs supported by this funding are going to continue for a second year. AIM had a 4-day career workshop for their postdocs that was very successful. MSRI had one as well and their postdocs thought this was something that should be done every year. For the institutes who had postdocs who found a job after one year, their vacant positions will be filled by new postdocs. All of the Institute directors reported on their institute's use of the funding.

There was a discussion of congressional funding for the Institutes.
NSF staff noted that the funding for some of the Institutes is coming to an end and there will be a re-competition for the funding in 2011.

Discussion of Assessment:
STPI said it might be better to recognize that the institutes have different theories of what they are trying to do. For the core activity of bringing individuals together to do research, it is more meaningful to start with the institutes themselves rather than the goals. This addresses the issue of concerns about the bibliometric approach. People who have been participants/members at the institutes are often unwilling to provide information year after year in order to track the effect of their time at the institute.

The NSF solicitations have been different each year-- some years they want the institutes to be broadly focused and some years they want them to be more narrowly focused. They have talked about experimental and more focused institutes, such as a virtual institute or an institute at multiple sites. The institutes have different business models and that is desirable. The NSF doesn't want the institutes to all be the same. NSF staff said that looking at the institutes through the lens of assessment is very different and is useful.

STPI will revise their recommendations for the evaluation process. Is it possible to assemble a publications list? Is it possible to look at postdoc experiences over a longer period of time (not just as soon as they leave the institute)? STPI feels that if there is less than an 85% response rate, the data may not be useful. A way around this is to identify a subset of participants/members and they would be asked more detailed questions on their experience. Is it possible to look at participant information on workshops? The level of collaboration that is taking place will become evident from this data.
It was noted that young people are empowered in a unique way by spending even just a semester

at one of the institutes. It is an effect that lasts through their entire career.
Any survey of this type has to go through a process for approval by the government. It will take about one year.
STPI said they will also use some case study information.

STPI wants to have a draft report for NSF by the end of August so they want to have the data collected by the end of June. The MIDs don't have to do anything at this point, but STPI may ask for some information as it is needed. This is a feasibility study; this is not an assessment. Because STPI is considered a contractor, the raw data of responses cannot be shared legally. Responses can be shared in an annual or semi-annual report if there is no attribution to particular individuals.

This feasibility study if for NSF. STPI will summarize what the feasibility study is and whether or not an assessment of all of the institutes if possible and useful. Then STPI will give a set of recommendations.

NEXT YEAR – The MID will meet at AIM in Palo Alto, date TBD.

F. PARTICIPANT SUMMARY

In fiscal year 2009-2010, 2,207 participants enrolled in 2 long programs, 22 workshops, four reunion conferences, and four summer programs. IPAM actively seeks women and members of underrepresented ethnic groups to participate in its programs as speakers and participants. While most participants report their gender and ethnicity, some choose not to do so. Almost 16% of IPAM participants in the past year were members of an underrepresented minority group (combined), and 31% were women. See table F-1.

Table F-1: Total Participants and Underrepresented Groups by Program Type (2009-2010)

Program Type	Total Participants	Female*	No. Reporting Gender	Underrepresented Ethnic Groups*			No. Reporting Ethnicity
				American Indian	Black	Hispanic	
Long Programs	136	33	136	0	1	4	122
Workshops	1855	589	1838	6	147	132	1671
Summer Programs	140	42	140	1	3	12	123
Reunion Conferences	76	13	75	1	1	1	66
Total	2207	677	2189	8	152	149	1982
Percent of No. Reporting		30.9%		0.4%	7.7%	7.5%	

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

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

Program Type	U.S. Citizens & Permanent Residents	No. Reporting Citizenship & Residency
Long Programs	54	136
Workshops	1068	1821
Summer Programs	110	137
Reunion Conferences	37	76
Total	1269	2170
Percent of No. Reporting	58.5%	

The majority (91%) of the year's participants of IPAM programs hold academic positions (faculty, postdoc, graduate student, or undergraduate student). Out of the remaining participants, 144 held positions in government, military, the nonprofit sector, or industry. Thirty-four were high school students. The following sections provide summary data for the requested sub-groups: postdocs, graduate students, and undergraduate students.

G. POSTDOCTORAL PROGRAM SUMMARY

IPAM had eight postdoctoral scholars in 2009-2010 (see section D) but they are not included in this summary unless they also attended an IPAM long program, workshop, summer program or reunion conference. Additionally, postdoctoral scholars from any institution participate in all IPAM programs, including serving as academic mentors in our undergraduate summer programs.

Table G-1: PostDocs: Total Participants and Underrepresented Groups by Program Type (09-10)

Program Type	Total Postdoc Participants	Female	No. Reporting Gender*	Underrepresented Ethnic Groups			No. Reporting Ethnicity
				American Indian	Black	Hispanic	
Long Programs	26	7	26	0	0	0	25
Workshops	265	57	265	1	6	3	256
Summer Programs	11	6	11	0	0	1	10
Reunion Conferences	14	3	14	0	0	0	14
Total	316	73	316	1	6	4	305
Percent of No. Reporting		23.1%		0.3%	2.0%	1.3%	

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	4	26
Workshops	87	265
Summer Programs	7	11
Reunion Conferences	4	14
Total	102	316
Percent of No. Reporting	32.3%	

H. GRADUATE STUDENT PROGRAM SUMMARY

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

Table H-1: 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	44	14	44	0	0	2	42
Workshops	539	189	533	2	36	44	498
Summer Programs	19	2	19	1	0	1	15
Reunion Conferences	17	4	17	1	0	0	13
Total	619	209	613	4	36	47	568
Percent of No. Reporting		34.1%		0.7%	6.3%	8.3%	

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	14	44
Workshops	227	534
Summer Programs	13	19
Reunion Conferences	7	17
Total	261	614
Percent of No. Reporting	42.5%	

I. UNDERGRADUATE STUDENT PROGRAM SUMMARY

Undergraduate students participated in our summer programs, Research in Industrial Projects for Students (RIPS) in Los Angeles, Beijing, and Berlin. 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 introduce them to industrial research and encourage them to apply to RIPS in the future, and other guests interested in the students' research. Additionally, we offered the "Infinite Possibilities Conference" in March 2010, which many undergraduate students attended.

RIPS continues to be IPAM's signature program for undergraduate students. In 2010, there were 454 applicants for RIPS (for all three programs), from which 48 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.

Table I-1: Undergrads: Total Participants and Underrepresented Groups by Program Type (09-10)

Program Type	Total Participants	Female	No. Reporting Gender*	Underrepresented Ethnic Groups			No. Reporting Ethnicity
				American Indian	Black	Hispanic	
Workshops	106	85	105	2	39	28	102
Summer Programs	48	21	48	0	2	7	45
Total	154	106	153	2	41	35	147
Percent of No. Reporting		69.3%		1.4%	27.9%	23.8%	

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

Program Type	U.S. Citizens & Permanent Residents	No. Reporting Citizenship & Residency
Workshops	84	105
Summer Programs	35	48
Total	119	153
Percent of No. Reporting	77.8%	

J. PROGRAM DESCRIPTION

The programs are listed in chronological order by start date. The list includes all IPAM programs from September 1, 2009 through August 31, 2010. IPAM programs included two long

programs (three months in length) and the tutorials, workshops, and culminating workshop associated with each long program, four IPAM workshops, summer programs, reunion conferences, public lectures, and other miscellaneous programs (this year including a national conference and a short course).

Three of IPAM's workshops in 2009-2010 featured **public lectures**. (We also offered one public lecture that was not affiliated with a workshop.) Public lectures feature a speaker with a national reputation who speaks on a topic of broad interest to an audience that includes non-scientists. The lectures were held in a 300-seat auditorium and were publicized widely. The 2009-2010 public lectures are included in the description of the relevant workshops. The David Gross public lecture is listed as a separate program, since it was not related to a workshop.

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: Combinatorics: Methods and Applications in Mathematics and Computer Science. September 8 - December 11, 2009

Organizing Committee:

Noga Alon (Tel Aviv University)
Gil Kalai (Hebrew University, Institute of Mathematics)
Janos Pach (City College of New York, EPFL- Lausanne)
Vera Sos (Renyi Institute of Mathematics)
Angelika Steger (ETH Zürich)
Benjamin Sudakov (University of California, Los Angeles (UCLA))
Terence Tao (University of California, Los Angeles (UCLA), Mathematics)

Combinatorics is a fundamental mathematical discipline as well as an essential component of many mathematical areas. It studies discrete objects and their properties. Although it is probably as old as the human ability to count, the field experienced tremendous growth during the last fifty years. This program focused specifically on several major research topics in modern Discrete Mathematics. These topics include Probabilistic Methods, Extremal Problems for Graphs and Set Systems, Ramsey Theory, Additive Number Theory, Combinatorial Geometry, Discrete Harmonic Analysis and its applications to Combinatorics and Computer Science. We aim to foster interaction between researchers in these rather diverse fields, to discuss recent progress and to communicate new results. We emphasized the exchange of ideas, approaches and techniques between various areas of Discrete Mathematics and Computer Science and on the identification of new tools from other areas of mathematics which can be used to solve combinatorial problems.

Tutorials: Combinatorics Tutorials. September 9 - 16, 2009

Organizing Committee:

Noga Alon (Tel Aviv University)
Gil Kalai (Hebrew University)
Janos Pach (City College of New York, EPFL- Lausanne)

Vera Sos (Renyi Institute of Mathematics)
Angelika Steger (ETH Zürich)
Benjamin Sudakov (University of California, Los Angeles (UCLA))
Terence Tao (University of California, Los Angeles (UCLA), Mathematics)

We will offer tutorials in the first week of the program, to provide an introduction to several major research topics in modern Discrete Mathematics. These topics include Probabilistic Methods, Extremal Problems for Graphs and Set Systems, Ramsey Theory, Additive Number Theory, Combinatorial Geometry, Discrete Harmonic Analysis and more.

The goal is to familiarize the prospective participants with the techniques which were developed in Combinatorics in the last few decades. Registration for tutorials is free, to encourage broad participation.

Combinatorics Workshop I: Probabilistic Techniques and Applications. October 5 - 9, 2009

Organizing Committee:

Alan Frieze (Carnegie-Mellon University, Mathematical Sciences)
Nathan (Nati) Linial (Hebrew University, Computer Science)
Angelika Steger (ETH Zürich)
Benjamin Sudakov (University of California, Los Angeles (UCLA))
Prasad Tetali (Georgia Institute of Technology)

One of the exciting phenomena in mathematics in recent years has been the wide-spread and surprisingly effective use of probabilistic methods in diverse areas. The probabilistic approach has been strikingly successful in Combinatorics, Graph Theory, Combinatorial Number Theory, Optimization and Theoretical Computer Science. This workshop focused on several main research directions of Probabilistic Combinatorics, including the application of probability to solve combinatorial problems, the study of random combinatorial objects and the investigation of randomized algorithms.

Specific topics discussed included: the application of probabilistic arguments to Ramsey and Turan-type problems and to graph colorings, the semi-random method, tools like the Local lemma, large deviation and correlation inequalities, the classical Erd\H{o}s-Renyi random graphs model and its variations, the investigation of various graph processes and hitting times, random regular graphs, models based on preferential attachment and real world networks, random subgraphs of given graphs and applications to various percolation models, the study of the random k-SAT problem and other random instances of computationally hard problem, applications of randomness to Computer Science, in particular to the design of efficient algorithms, derandomization and pseudo-randomness.

Public Lecture: The Combinatorics of Voting Paradoxes
October 5, 2009
Public lecture presented by Noga Alon, Professor of Mathematics and Computer Science, Tel Aviv University and Microsoft, Israel. This lecture was part of the IPAM workshop "Probabilistic Techniques and Applications" (above) and was cosponsored by the UCLA

Department of Mathematics and the Computer Science Department. Approximately 200 people attended.

Abstract: The early work of Condorcet in the 18th century, and that of Arrow and others in the 20th century, revealed the complex and interesting mathematical problems that arise in the theory of Social Choice, showing that the simple process of voting leads to strikingly counter-intuitive paradoxes. I will describe some of these, focusing on several recent intriguing examples.

Affiliate Workshop*:* Agent-Based Complex Systems. October 12 - 14, 2009.

Organizing Committee: Alethea Barbaro (University of California, Los Angeles (UCLA)) and Andrea Bertozzi (University of California, Los Angeles (UCLA))

Agent-based complex systems feature prominently in many areas of science. These disparate fields are mathematically linked by modeling based on autonomous agents whose relatively simple interactions lead to emergent coherent phenomena. Our discussion focused on the impact of social interactions on the global dynamics of a community, modeling decision-making, the spread of contagion or information via interactions among individual agents, and how the relationships among distinct groups of individuals affect the pairwise interactions of the individual agents and the dynamics of each group considered as a whole. Research areas which give rise to this sort of topic include epidemiology, flocking animals, territorial behavior of wolves, myxobacterial swarming, and crime modeling.

With such a diversity of academic fields represented, we can expect this workshop to have many exciting and beneficial discussions. We focused our efforts on two pursuits: to allow experts in their field to share their research with others examining similar problems in complex systems, and also to encourage discussion among the scientists in order to set the parameters of a new pursuit.

Combinatorics Workshop II: Combinatorial Geometry. October 19 - 23, 2009

Organizing Committee:

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)

Although geometry has been studied for thousands of years, the term of discrete geometry is of quite recent origin. Combinatorial geometry deals with the structure and complexity of discrete geometric objects and is closely related to computational geometry, which deals with the design of efficient computer algorithms for manipulation of these objects. This area is by its nature interdisciplinary and has relations to many other vital mathematical fields and also applications to computer science. The focus of this workshop was the study of discrete geometric objects,

their combinatorial structure, stressing the connections between discrete geometry and combinatorics, number theory, analysis and computer science.

Specific topics will include extremal problems in combinatorial geometry, results on the number of incidence between points and lines (hyperplanes and etc.), applications of incidence bounds to combinatorial number theory and analysis, Erdos' repeated and distinct distance questions, geometric graph theory and graph drawings, computational geometry, covering and packing problems, Helly type theorems and applications to clustering, convex polytopes, hyperplane arrangements, algebraic and topological methods in discrete geometry, combinatorics of convex sets, application of convex geometry to linear programming and optimizations.

Combinatorics Workshop III: **Topics in Graphs and Hypergraphs.** November 2 - 6, 2009

Organizing Committee:

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))

Graph theory is one of the oldest branches of combinatorics, with history going back to the 18 century. This area and the closely related Theory of Hypergraphs experienced the most impressive growth in the last 50 years. During this time Extremal graph theory and Extremal set theory were developed extensively and extremal results found many applications in Computer Science, Information Theory, Number Theory and Geometry. One such result is Szemeredi's regularity lemma, providing a deep structural theorem for large and dense graphs. In addition to numerous applications in combinatorics, this lemma and its recent generalization to hypergraphs, can be used, for example, to prove existence of arithmetic progressions in dense subsets of integers or to obtain algorithms for testing properties of graph. Closely related to the regularity lemma are the recent interesting research on graph limits, bridging between combinatorics and analysis. Other exciting lines of research include the development of the Structural Graph theory, and in particular the celebrated Graph Minor project.

The workshop will focus specifically on several major research directions in modern Graph and Hypergraph theory. These topics included Ramsey theory, Extremal problems for graphs and hypergraphs and in particular Turan-type questions, Extremal set theory and its applications to Information theory, Computer science and Coding Theory, algebraic methods in extremal combinatorics, Szemeredi's regularity Lemma for graphs and hypergraphs and its application to number theory and property testing, Graph sequences and limits of graphs, topological methods for graphs and hypergraphs, Spectral techniques in graph theory, expanders graphs and their applications, structural approach to graph theory, graph minors and application of graph theory to optimization.

Combinatorics Workshop IV: **Analytical Methods in Combinatorics, Additive Number Theory and Computer Science.** December 1 - 4, 2009

Organizing Committee:

Gil Kalai, Chair (Hebrew University, Institute of Mathematics)
Irit Dinur (Weizmann Institute of Science)
Ben Green (University of Cambridge)
Alex Samorodnitsky (Hebrew University)
Terence Tao (University of California, Los Angeles (UCLA), Mathematics)
Van Vu (Rutgers University)

Recently the applications of analytical tools, in particular methods of harmonic analysis and spectral techniques, lead to several major breakthroughs on problems in combinatorics, Discrete Probability, Additive Number Theory and Computer Science. In additive combinatorics there has been much progress in understanding the combinatorial structures arising from arithmetic operations, using techniques from Fourier analysis. It started with the new proofs of Freiman's structure theorem and Szemeredi's theorem on arithmetic progressions that are more efficient and easier to understand than the original ones, culminating with the recent result of Green and Tao on arithmetic progressions of primes. In yet another exciting development Bourgain gave non-trivial estimates for short exponential sums, the question that withstood all previous attempts to solve it.

In computer science Kahn, Kalai and Linial were the first to use harmonic analysis and in particular hypercontractive inequalities to prove some general theorems on boolean functions. Over the years this approach proved itself to be very fruitful leading to numerous results on the complexity of boolean functions, hardness of approximation, lower bounds on distortion for metric embeddings and new results in extremal set theory. Analytical tools were also used efficiently to study the so called threshold phenomena in various random systems. This is a setting when the probability of some event changes rapidly from zero to one as some underlying parameters change. This phenomenon plays an important role in discrete probability, statistical physics, computer science and economics.

This workshop focused on the interplay between Combinatorics, Discrete Probability, Additive Number Theory and Computer Science with emphasis on a wide spectrum of analytical tools that are used there. One of the declared aims of the workshop is to foster interaction between researchers in these areas, discuss recent progress and communicate new results and ideas. We would also like to utilize this forum to make the state-of-the-art analytical techniques accessible to a broader audience, in particular graduate students.

Combinatorics Culminating Workshop at Lake Arrowhead. December 6 - 11, 2009

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.

Participant Comments from the Combinatorics Program

Alexander Kostochka (UIUC): "It helped me a lot. I had time and great environment to work harder and more productively on graph and hypergraph theory. I listened to great talks and talked to many great mathematicians. I worked with some of them. I got new ideas and managed to implement some of them. It was enlightening and inspiring."

Jessica McDonald (grad student, U Waterloo): "My involvement with IPAM has certainly has a positive affect on my career. As a junior participant, it greatly increased my network of people, and I was invited to speak at a large conference in June 2010 by another IPAM participant. I also recently won an NSERC Postdoctoral Fellowship (the Canadian equivalent of an NSF Postdoc), and I believe that my experience at IPAM was a strong point on my application."

John Schmitt (Middlebury College): "Briefly, it has raised my research profile, given me new and more challenging ideas to pursue and put me in contact with the people I need to know to make progress on my projects."

Penny Haxell (U Waterloo): "The long program at IPAM was a very enjoyable and productive period for me, it brought the opportunity to concentrate on research for an extended period and to have so many great colleagues to work with in the same place."

Reunion Conference: Random Shapes Reunion Conference II. December 6 - 11, 2009

This was the second 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 and at the first reunion. Presentations were given by all participants, with plenty of time between talks for discussions and collaborations.

Reunion Conference: Optimal Transport Reunion Conference I. December 6 - 11, 2009

This was the first reunion conference for participants of the spring 2008 long program "Optimal Transport." 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: New Directions in Financial Mathematics. January 5 - 8, 2010

Organizing Committee:
René 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)

Ronnie Sircar (Princeton University, ORFE)
Thaleia Zariphopoulou (University of Oxford)

This workshop brought together accomplished experts, graduate students and young researchers interested in the most recent global developments of quantitative finance in both industry and academia. Experts presented state of the art topics in new developing areas of financial mathematics.

The workshop introduced young researchers and more accomplished mathematicians to two new and exciting fields of research: environmental emissions markets and mathematical models for financial markets. Among the many prestigious talks, two short courses will also be presented. Rene Carmona (Princeton University) will present a short course on the major challenge of the environment and the worldwide attempts to use financial markets to control emissions of green house gases in the most efficient way. Pierre-Louis Lions (Collège de France and Ecole Polytechnique) will also present a short course on agent-based models for financial markets.

A poster session will be organized for PhD students to present their research, and special guests will join invited participants on a panel to discuss the state of the reformed financial markets and the role that mathematical education and academic research should play in this new arena.

Public Lecture: On Mean Field Games

January 5, 2010

Public lecture presented by Pierre-Louis Lions, Collége deFrance and Ecole Polytechnique. This lecture was part of the IPAM workshop "Financial Mathematics" and was co-sponsored by UCLA Department of Mathematics. The lecture had an audience of about 250.

Abstract: This talk will be a general presentation of Mean Field Games (MFG in short), a new class of mathematical models and problems introduced and studied in collaboration with Jean- Michel Lasry. Roughly speaking, MFG are mathematical models that aim to describe the behavior of a very large number of “agents” who optimize their decisions while taking into account and interacting with the other agents. The derivation of MFG, which can be justified rigorously from Nash equilibria for N players games, letting N go to infinity, leads to new nonlinear systems involving ordinary differential equations or partial differential equations. Many classical systems are particular cases of MFG like, for example, compressible Euler equations, Hartree equations, porous media equations, semilinear elliptic equations, Hamilton-Jacobi-Bellman equations, Vlasov-Boltzmann models ... In this talk we shall explain in a very simple example how MFG models are derived and present some overview of the theory, its connections with many other fields and its applications.

IPAM Workshop: Metamaterials: Applications, Analysis and Modeling. January 25 - 29, 2010

Organizing Committee:
Robert Kohn, Co-Chair (New York University, Courant Institute)
Jichun Li, Co-Chair (University of Nevada, Las Vegas)
Graeme Milton, Co-Chair (University of Utah, Mathematics)
Susanne Brenner (Louisiana State University)
Maria-Carme Calderer (University of Minnesota, Twin Cities)
Tatsuo Itoh (University of California, Los Angeles (UCLA))
Chi-Wang Shu (Brown University)
Richard Ziolkowski (University of Arizona, Engineering)

Metamaterials are artificially structured media with unique and exotic properties not observed in natural materials. These include, for example electromagnetic materials with permittivity and permeability both designed to achieve novel effects, such as a negative refractive index, and elastic materials configured to give a negative or anisotropic effective mass density at a given frequency. They are typically constructed from high contrast materials, and the macroscopic fields needed to describe their effective behaviors are not simple averages of the local fields. They frequently gain their properties from microscopic resonances. The potential applications of such materials are growing and include lenses that have subwavelength focussing, and electromagnetic and acoustic cloaks that hide objects and leave incoming waves unscattered. Metamaterials also include materials for which the equations governing their continuum electromagnetic or elastodynamic macroscopic behavior are unlike any found in nature. This workshop brought together physicists and engineers working on metamaterials and their applications; mathematicians who are studying homogenization in high contrast materials and who are providing a greater understanding of the mathematics of metamaterials; and numerical analysts interested in the solving the microscopic and macroscopic equations governing the behavior of metamaterials. Many challenges remain, such as seeking a better understanding of what novel behaviors and applications metamaterials can achieve in practice; exploring what is theoretically possible by homogenization theory; and finding efficient and accurate numerical algorithms for solving the partial differential equations to accelerate progress in the field.

Participant Comments from the Metamaterials Workshop:

John Luginsland (AFOSR): “IPAM plays a critical role in providing close coupling between fundamental science and applied mathematics and engineering applications.”

IPAM Workshop: **Mathematical Problems, Models and Methods in Biomedical Imaging**.
February 8 - 12, 2010

Organizing Committee:
Hongkai Zhao, Chair (University of California, Irvine (UCI), Mathematics Department)
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)

Recent advances in molecular probes, personalized or individualized medicine has raised many interesting and challenging mathematical problems. The workshop's topics included some of the current major technologies and emerging mathematical problems in biomedical imaging. The emphasis was on the interface between Mathematics and Biomedical Imaging, thus, to promote new ideas and research at the frontiers of interdisciplinary studies. The aims of the workshop are to identify important research direction and opportunities in mathematics induced by problems coming from imaging applications as well as to promote collaborations that will lead to mathematically-based better solution of practical problems in biomedical imaging applications. The format of the workshop as designed to encourage communications and collaborations between mathematicians and scientists from these fields of applications. The topics of the workshop included mathematical aspects and practical problems in mathematics for image processing and reconstruction; mathematical problems, models and methods in biomedical imaging technologies; molecular imaging approaches (PET/SPECT/Fluorescence/ Bioluminiscence); mathematical problems, models and methods in intensity-modulated radiation therapy (IMRT); and optimization techniques in inverse problems.

Public Lecture: The Coming Revolutions in Fundamental Physics
February 22, 2010

This public lecture was presented by Dr. David J. Gross, Director of the Kavli Institute for Theoretical Physics and Professor of Physics, University of California, Santa Barbara. The lecture was cosponsored by California NanoSystems Institute and the UCLA Department of Physics and Astronomy. Approximately 300 people attended.

Abstract: I will review the present state of knowledge in elementary particle physics and the questions that we are currently addressing, and discuss the experimental revolutions that might occur at the Large Hadron Collider at CERN. I shall also review the state of string theory. The necessity to go beyond the standard model of particle physics and to understand quantum gravity has led to this ambitious attempt to unify all the forces of nature and all forms of matter as different vibrations of a string-like object. But string theory is still in a pre-revolutionary stage. Although remarkable progress has been achieved in the last decade we still lack a fundamental understanding of the theory. Many string theorists suspect that a profound conceptual change in our concept of space and time will be required for the final formulation of string theory.

IPAM Workshop: Statistical and Learning-Theoretic Challenges in Data Privacy.
February 22 - 26, 2010

Organizing Committee:
Adam Smith, Chair (Pennsylvania State University)
Cynthia Dwork (Microsoft Research, Research)
Stephen Fienberg (Carnegie-Mellon University)
Aleksandra Slavkovic (Pennsylvania State University)

Privacy is a fundamental problem in modern data analysis. Collections of personal and sensitive data, previously the purview of governments and statistical agencies, have become ubiquitous. Increasing volumes of personal and sensitive data are collected and archived by health networks,

government agencies, search engines, social networking websites, and other organizations. The potential social benefits of analyzing these databases are significant: better informed policy decisions, more efficient markets, and more accurate public health data, just to name a few. At the same time, releasing information from repositories of sensitive data can cause devastating damage to the privacy of individuals or organizations whose information is stored there. The challenge is to enable analysis of these databases, without compromising the privacy of the individuals whose data they contain. This problem is studied in several scientific communities and under several names, e.g. `statistical disclosure limitation' `privacy-preserving data mining', and "private data analysis".

The goal of workshop is to establish a coherent theoretical foundation for research on data privacy. This implies work on (1) how the conflicting goals of privacy and utility can or should be formulated mathematically; and (2) how the constraints of privacy---in their various incarnations---affect the accuracy of statistical inference and machine learning. In particular, the goal is to shed light on the interplay between privacy and concepts such as consistency and efficiency of estimators, generalization error of learning, robustness and stability of estimation algorithms, and the generation of synthetic data.

Participant Comments from the Data Privacy Workshop

Jerry Reiter (Duke): "My involvement with IPAM has inspired me to learn more about computer science approaches to data confidentiality. In the past, my research focused exclusively on statistical science approaches."

Long Program: Model and Data Hierarchies for Simulating and Understanding Climate
March 8 - June 11, 2010

Organizing Committee:
Amy Braverman (Jet Propulsion Laboratory)
Rupert Klein (Freie Universität Berlin, Mathematics)
Andrew Majda (New York University, Courant Institute of Mathematical Sciences)
Olivier Pauluis (New York University, Courant Institute of Mathematical Sciences)
Bjorn Stevens (Max Planck Institute for Meteorology)

Simulation has greatly advanced climate science, but not sufficiently to the profit of theory and understanding. How can simulation better advance climate /science/ and what mathematical issues does this raise?

Our hypothesis is that the development of climate science (i.e., theory and understanding) will be best served by focusing computational and intellectual resources on model and data hierarchies. Where "model and data hierarchies" refer to successively more complex models, or data structures, and the relations among them. Classic examples are the equations that emerge at different order in an asymptotic expansion; or microscopic, mesoscopic, macroscopic representations of systems that emerge in statistical physics and material science. In the atmosphere/ocean system such approaches lead to familiar families of equation sets used to explore specific phenomena, and the statistical theories (parameterizations) used to close the

systems which emerge at different orders; but such ideas are also relevant to the data used to test such systems.

By bringing together physicists, mathematicians, statisticians, engineers and climate-scientists, and focusing on several themes that reach across scales and scientific methodologies, our program provided a framework for advancing our use of hierarchical methods in our attempt to understand the climate system. In addition to tutorials and a summary workshop; the program tied together four week-long workshops addressing specific currents in the broader stream of ideas: Equation Hierarchies; Numerical Hierarchies; Simulation Hierarchies; and Data Hierarchies.

Climate Tutorials: Model and Data Hierarchies for Simulating and Understanding Climate: Tutorials. March 9 - 12, 2010

Organizing Committee:
Amy Braverman (Jet Propulsion Laboratory)
Rupert Klein (Freie Universität Berlin, Mathematics)
Bjorn Stevens (Max Planck Institute for Meteorology)

We will offer tutorials in the first week of the program, to provide an introduction to the relevant problems as well as to the relevant concepts from mathematics, physics, atmospheric sciences, computer science, and other disciplines, and their applications.

The goal is to familiarize participants with the issues and techniques involved in Model and Data Hierarchies for Simulating and Understand Climate and to create a common language among researchers coming from different fields. The tutorial was designed to cover the themes of the 4 workshops, which are

- Equation Hierarchies for Climate Modeling
- Numerical Hierarchies for Climate Modeling
- Simulation Hierarchies for Climate Modeling
- Data Hierarchies for Climate Modeling

Short Course: Operations Research or the Mathematics of Strategic Decision Making. March 18, 2010.

Organizer: William Massey, Princeton

In the world of business and commerce, the "operations" are the productions of goods or the delivery of services. The type of mathematics needed to perform these tasks efficiently and effectively is called operations research.

Unlike mathematics for science, where models are created and analyzed to make predictions, our model building and analysis ultimately leads to an policy algorithm for generating strategic decisions. Such decisions are primarily one of chance or choice. Operations research is then

based on the mathematics of probability, to model the typical for decisions of chance, and optimization, to model the exceptional for decisions of choice.

This one-day workshop was offered the day before the Infinite Possibilities Conference (IPC). Participants of IPC were invited to attend.

National Meeting: Infinite Possibilities Conference. March 19 - 20, 2010.

Organizing Committee:
Denise Brewley (Spelman College)
Erika Camacho, (Arizona State University West)
Emille Davie (University of California, Santa Barbara (UC Santa Barbara))
Angela Gallegos (Occidental College)
Lily Khadjavi (Loyola Marymount University)
Tanya Moore (Building Diversity in Science)
Omayra Ortega (Arizona State University West)
Nagambal Shah (Spelman College)

The Infinite Possibilities Conference (IPC) is a national conference that is designed to promote, educate, encourage and support minority women interested in mathematics and statistics. Highlights of conference activities include: Professional development workshop series; Panel discussion on graduate studies in mathematics; Research talks given by professionals; Student poster sessions, special activities for high school students; Roundtable discussions on experiences with mathematics; Awards banquet in honor of the late Dr. Etta Z. Falconer to highlight special achievements in mathematics.

Climate Workshop I: Equation Hierarchies for Climate Modeling. March 22 - 26, 2010

Organizing Committee:
Simona Bordoni (California Institute of Technology)
Dargan Frierson (University of Washington)
Andrew Majda (New York University, Courant Institute of Mathematical Sciences)
Jonathan Mitchell (University of California, Los Angeles (UCLA))

The atmosphere-ocean system is a unique one in science in that the dynamical equations are essentially known. However in order to distill the nonlinearity and turbulence of the forced-dissipative fluid equations on a rotating sphere into a more readily *understandable* system requires a hierarchical approach. This workshop focused on the development, use, and study of "equation hierarchies": sets of equations and models which make idealizations in order to construct progressively simpler (and more understandable), but self-consistent frameworks for the study of climate dynamics.

The use of hierarchies of equations has been remarkably successful in developing understanding of climate and weather phenomena: e.g., the quasi-geostrophic equations for study of baroclinic instability, the semi-geostrophic equations for frontogenesis, and the diffusive energy balance model to investigate ice sheet growth as a function of solar intensity. Since diabatic terms are

fundamentally important in climate dynamics, the topic of equation hierarchies naturally connects to the development of parameterizations to handle convection, clouds, etc., at different scales or levels of complexity within models.

Equation hierarchies are closely connected to the other topics in this program: the choice of equations to use colors the **numerical** methods one would use to integrate the equations, the experimental design in a given set of **simulations**, and influences how one interprets **data** from observations or models. While each of these were discussed within this workshop, the equation hierarchies week focused the discussion on problems including: 1) the development of new balanced systems of equations using techniques such as multiple scales asymptotics, 2) the use of simplified sets of equations as models of the Earth or other planetary climates, 3) balance dynamics and the breakdown of balance, and 4) the role of latent heating in the dynamics of the tropical and extratropical atmosphere and simplified ways to account for condensation in models.

Climate Workshop II: Numerical Hierarchies for Climate Modeling. April 12 - 16, 2010

Organizing Committee:
Francis Giraldo (Naval Postgraduate School)
Christiane Jablonowski (University of Michigan)
Rupert Klein (Freie Universität Berlin, Mathematics)
Sebastian Reich (Universität Potsdam)

Covering processes from the microphysics and turbulence in clouds to planetary motions and the evolution of the climate, Atmosphere-Ocean flows are characterized by an extremely broad range of spatio-temporal scales. Since it is, and will be for some time, neither possible nor interesting to represent this entire scale range in one and the same model, we encounter a *resolution hierarchy* of computational models whose members describe differing ranges of spatio-temporal scales. This workshop focused on advanced computational techniques which allow us to cover a wide range of scales in a single simulation, and which operate reliably at various resolutions. Of particular interest are mechanisms for selecting non-resolved scale parameterizations as a function of grid resolution and for controlling the interplay of numerical truncation with subgrid scale process representations.

This line of thought leads us to a *hierarchy of numerical balances*: As discussed, inter alia, in workshop on ``Equation Hierarchies", processes that can be associated with a specific, relatively narrow scale range generally follow simplified *balanced dynamics* described successfully by related simplified equation sets. Examples are the incompressible Boussinesq, anelastic or pseudo-incompressible, quasi, semi, or planetary geostrophic, and the hydrostatic primitive equation models. Correctly reflecting these balances numerically constitutes a persistent challenge in the construction of computational models. This challenge is severely compounded in scale-adaptive models which must incorporate correctly the balances associated with all the scales that they may dynamically tap into during a simulation.

Closely related is the *parameterization hierarchy*: When deciding, statically or dynamically, to not explicitly represent the spatio-temporal scales below a certain threshold, we must at the same

time incorporate means to capture the net effects of the non-resolved scales on the resolved ones. Whereas it is long-standing practice to develop and implement associated subgrid scale parameterizations in computational models with static resolution, how to do this in models that allow the user to quite freely choose the resolution or in scale-adaptive models is a wide open question.

Finally, there is the *hierarchy of conservation laws*: We know that mass and total energy are preserved in continuum mechanical problems. At the same time, there is a host of derived quantities that are also conserved under particular simplifying circumstances. Examples are potential temperature, potential vorticity, enstrophy, helicity, and linear or angular momentum. We discussed which of these conservation principles are how important in which modeling context, and how to realize them computationally.

The above constitutes the framework of this workshop. To trigger the discussions, we specifically concentrated on the following set of issues:

Formulation of mathematical equations--continuous or discrete, deterministic or stochastic--which jointly represent the dynamics AND physics above some given spatio-temporal scales. Properties of numerical schemes for unstructured grids, structured grids with variable resolution, and dynamically adaptive grids when process resolution becomes marginal.
Interplay of non-resolved scale parameterizations with the numerical schemes of dynamical cores. Among others, we addressed the competition between numerical truncation and subgrid scale closures, techniques for on-the-fly control of parameterizations in dynamically adaptive models, and the consequences of including stochastic parameterization in the construction of dynamical cores.
Coupling of models for different processes, such as atmosphere-ocean; (dry) dynamics-(moist) physics; continuum flows-suspended particles and droplets.

Affiliate Workshop: Bone Tissue: Hierarchical Simulations for Clinical Applications.
April 21-23, 2010

Organizing Committee:
Maria-Grazia Ascenzi (UCLA/Orthopedic Hospital Department of Orthopedic Surgery)
John S. Adams (UCLA/Orthopedic Hospital Department of Orthopedic Surgery)
Elena Cherkaev (Department of Mathematics, University of Utah)
Paul C. Dechow (Professor of Biomedical Sciences, Texas A&M Baylor College of Dentistry)
Eve Donnelly (Mineralized Tissues Laboratory, Hospital for Special Surgery)
Gwendolen Reilly (Engineering Materials, University of Sheffield, United Kingdom)

In partnership with UCLA's Orthopedic Hospital Department of Orthopedic Surgery. The workshop aims to bring together orthopedic surgeons, clinicians, system biologists, mechanical and software engineers, and applied mathematicians to share the latest findings and formulate a plan to develop the next generation of three-dimensional multi-scale virtual rendering of bone tissue able to address specific clinical issues.

Participant Comments from the Bone Tissue Workshop

Yener Yeni (Bone and Joint Center, Henry Ford Hospital): "My interest in the analysis of bone structure using microstructural heterogeneity and texture analysis approaches was renewed by some of the presentations I saw there. I became further interested in Synchrotron x-ray methods and learned more about how resources can be made available for this type of research."

Climate Workshop III: Simulation Hierarchies for Climate Modeling. May 3 - 7, 2010

Organizing Committee:
Markos Katsoulakis (University of Massachusetts Amherst, Mathematics and Statistic)
Alan Kerstein (Sandia National Laboratories)
Boualem Khouider (University of Victoria)
Olivier Pauluis (New York University, EAPS)
Ole Peters (Imperial College)
Pier Siebesma (KNMI, Atmospheric Research Div.)

Our Earth's climate system involves atmospheric processes across an enormous range of scales, ranging from the planetary to the millimeter scale. This includes not only atmospheric dynamical processes such as turbulence and convection but also the physical processes that interact with the dynamics such as clouds and radiation.

As there is no single simulation system that can incorporate the full range of all these processes, there has been a development of a variety of simulation models that attempt to describe specific sets of processes over a subset of relevant scales. These simulation techniques range from the microscale (Direct Numerical Simulation) via the mesoscale (Large Eddy and Cloud Resolving Model Simulations) to the global scale (Global Circulation Model simulations), and form a hierarchy as one attempts to include the statistical behavior of smaller scale processes in larger-scale simulation models.

The main objective of this workshop is to increase our understanding of the climate system across all these scales through developments of better consistent simulation model hierarchies. This raises questions how we can develop mean-field representations of the subgrid fine-scale, fast processes for the range of simulation models. Can these be incorporated either deterministically or stochastically, can they be made scale-adaptive, or to what extend can we employ a multi-model framework, in which high-resolution models serve as a dynamical subgrid representation embedded in a coarser grained simulation simulation. Moreover this workshop also aims exploring to what extend more simplified models and theories can be useful in reproducing, interpreting and conceptualizing the complex dynamics of the climate system. This included models, theories and simulation techniques that have emerged from statistical physics and mathematics such as cellular automata, lattice models, percolation theory, self-organizing critical systems and dynamical systems.

Public Lecture: Global Warming: Coming Ready or Not!
May 5, 2010

Public lecture presented by Kevin E. Trenberth from the National Center for Atmospheric Research. This lecture was part of the IPAM workshop "Simulation Hierarchies for Climate Modeling " and was co-sponsored by California NanoSystems Institute, Institute of the Environment, Joint Institute for Regional Earth System Science and Engineering, and the Department of Atmospheric and Oceanic Sciences. The lecture had an audience of about 300.

Abstract: Global warming is unequivocally happening, according to the IPCC, and is caused by human activities, mostly the burning of fossil fuels. The evidence is now widespread from many variables including global and regional temperatures, sea temperatures, sea level rise, melting ice, changes in precipitation patterns, intensity, and rain versus snow, accompanied by changes in storms and atmospheric circulation and drought. Climate models forced with observed changes in atmospheric composition show that the human influence on climate has exceeded the natural variability since about 1970, and the ability to simulate the changes provides confidence in future projections. The long lifetime of carbon dioxide and the energy infrastructure guarantee future increases in emissions for several decades and thus substantial further global warming. Efforts to control emissions are important and promising but unlikely to make adequate inroads to slow the problem unless there is a major change in attitudes and the political will to implement changes. Our planet is potentially changing into one that will not be recognizable in 50 years and beyond. We must build a more sustainable way of life; we owe it to the future generations.

Climate Workshop IV: **Data Hierarchies for Climate Modeling.** May 24 - 28, 2010

Organizing Committee:
Amy Braverman, Chair (Jet Propulsion Laboratory)
Illia Horenko (University of Lugano, Mathematics and Computer Science)
Luis Kornblueh (Max Planck Institute for Meteorology)
Robert Pincus (University of Colorado, Boulder)

Data provide a lens through which we see the world, but the interpretation of what we see depends crucially on how data are collected, and on modeling assumptions and other decisions we make analyzing them. The climate system itself can be conceptualized in terms of hierarchies of interacting processes acting on different scales in space and time. If analyses of climate data are to help improve understanding of these multiscale physical processes, then data should also be viewed within a commensurate framework.

Data hierarchies are not separate from equation, model, or simulation hierarchies. Rather, they provide a mechanism for examining experimental or observational evidence in order to evaluate and improve them. In this workshop, we examined: 1) basic paradigms for modeling hierarchical relationships, both from a statistical viewpoint and within the dynamical systems approach, 2) the application of these paradigms to facilitate the formulation of hierarchies for understanding climate processes, 3) their application specifically to equation, model, and simulation hierarchies

given a priori, 4) quantification and propagation of data-based modeling errors and uncertainties through the hierarchies, and 5) interdisciplinary issues arising from the massiveness of data collected or generated in modern climate science.

Culminating Workshop at Lake Arrowhead for Climate Modeling Long Program
June 6 – 11, 2010

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.

Participant Comments from the Climate Program

Franco Catalano (U Rome "La Sapienza)
"My participation at the IPAM program was considered a particularly valuable experience by research groups I have been in contact for postdocs and contributed to some interesting offers I received after the PhD. I think the most important aspect of the program was the opportunity to work in such a various environment, which allowed me to widen the research interests and the network of active and possible collaborations."

Peter Düben (Ocean Dept., Max-Planck-Institut für Meteorologie)
"Yes, getting in contact with the world peak model developers brought me a detailed insight to the state of the art research going on in this field and the possibility to get answers to questions that have long been unanswered. Furthermore it was possible to build up personal contact to the most important people working in my (specific) field. Although no direct collaboration has been founded, contacts could be established. Thank you very much, it was a fruitful time!"

Gerhard Hernandez-Duenas (U Michigan)
"My stay at IPAM was a great experience, and has contributed a lot to my academic education."

Peter Lauritzen (NCAR)
"The IPAM workshop (WS2) was the best workshop/conference I have ever attended. The format with long presentations and plenty of time for discussions during the breaks was ideal. My research direction has been modified somewhat based on discussions at the workshop."

Reunion Conference: Search Engines Reunion Conference II. June 6 – 11, 2010

This was the second reunion conference for participants of the fall 2006 long program "Search Engines." 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: Internet Multi-Resolution Analysis Reunion Conference I.
June 6 – 11, 2010

This was the first reunion conference for participants of the fall 2008 long program "Internet MRA." 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)-Berlin 2010**
June 2 - July 31, 2010

IPAM offered RIPS-Berlin for the first time in summer 2010. In collaboration with MATHEON and the Berlin Mathematical School (BMS) at the Free University, eight U.S. students worked with European students on cross-cultural teams on four projects, each sponsored by a MATHEON research group. The basic format of the program was the same as RIPS-LA (see below).

RIPS students from the United States and Europe formed close professional and personal relationships over the summer. The students had offices at BMS. BMS provided technical support as well as some social activities. Students stayed in furnished apartments in the city (accessible to campus by subway), and ate most meals at the University cafeteria. English was the only language required for participation.

RIPS-Berlin 2010 Sponsors and Projects	
Industrial Partner	**Title of Project**
Mental Images	Surface Optimization using Graphics Cards
IBM	Coarse Graining Complex Biological Networks
IBM	Fingerprinting Two-dimensional Mass Spectra using Clustering Algorithms and Decision Trees
JCMWave	Correction of Image Distortions Using an Optimized Perspective Projection Scheme

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

"I learned a lot and was able to gain a lot of knowledge in areas that I was not as proficient in prior to [RIPS-Berlin]. I studied a real world problem and it was also extremely math related. I would say the goal of helping me grow scientifically in a team environment went very well, we even had some problems within our group that we worked out on our own as a team … If anyone ever manages to have as much fun, and gain as much from this experience as I did they are an incredibly lucky person. My entire experience was a joy, and upon reflection it was one of the most rewarding experiences of my life." (James Gill, University of San Diego)

"[RIPS-Berlin] was a wonderful experience: one got one's hands on specialized and familiar mathematical or computational tools, all the while profiting from the cosmopolitan and dynamic Berlin. I would recommend to any math student stimulated by his surroundings."
(Kamron Saniee, Princeton University)

"[RIPS-Berlin] gave me a chance to experience ways of using math outside of the classroom and allowed me to see how I could apply what I have been learning to actual problems faced by companies. It was also wonderful teaming up with people from different universities to see the dynamic between different types of people who all shared the common interest of math. I also enjoyed the opportunity to work and meet non-US students. I think this really enriched the experience because it allowed me to see their perspectives on math and the topics we were working on, and also gave me a rich cultural experience." (Meredith Plumley, Washington University)

"I got to work with real world problems involving 2D mass spectrometry and got to tackle this problem both by focusing on an individual project and by working as a part of a team." (Jonathan Bassen, Macalester College)

IPAM Summer Program: **Research in Industrial Projects for Students (RIPS) 2010**
June 20 - August 20, 2010.

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 2010 sponsors and projects included:

RIPS-LA sponsors and projects 2010	
Company/Organization	**Title of Project**
Aerospace Corp	Navigation Coverage Analysis and Optimization
Arete	Coded Aperture Lensless Imager (CALI)
Shoah Foundation	Algorithms for Finding Relatedness
LAPD	Algorithm Development for Gang Rivalry Event Classification
IBM	Topic Detection & Causal Influence in Blogs
Disney Animation	Targeting-Based Controlled Methods for Physical Simulations
Standards & Poor	Forecasting Electricity Demand and Production Considering CO2 Emissions
Symantec	Markov Modeling with Too Much Training Data

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

"The two biggest merits of RIPS are: allowing students to make important connections for future success and providing work that students can be proud of." (Aaron Mosher)

"I've grown more confident in my research / independent thinking abilities and am now considering graduate school very seriously as a result." (David Puelz)

"RIPS has given me insight into several companies' jobs for mathematicians, and will help me when I'm trying to decide what industry and what kind of job to choose in the future." (Jillian Cairns)

Subworkshop: **Research in Industrial Projects for Students (RIPS) Projects Day August 13, 2010**

Organizing Committee: N/A

The eight 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 2010**
July 1 - August 27, 2010.

IPAM offered RIPS-Beijing again in summer 2010. 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 2010 Sponsors and Projects		
MSRA Research Group	**Industry Contact**	**Project Title**
Internet Media	Feng Wu	Understanding the properties of arithmetic graph code from information theory perspective
Web Search and Mining	Haixun Wang	Probabalistic Matching in Uncertain, Large Graphs
System	Lidong Zhou	Scheduling and Resource Management for Cloud OS
Wireless and Networking	Chuanxiong Guo	Bandwidth Guarantee for Virtual Data Centers in the Hose Model

Here are some comments from RIPS-Beijing 2010 participants:

"RIPS is very unique in providing an opportunity to see industrial research without having to make any sort of long term commitment or any delay in studies. As someone who was planning an academic career before RIPS, I especially appreciated the opportunity – I had always wanted to see what industry work was like, however, I was worried that any time spent exploring it would be time taken away from my academic goals .... RIPS has given me a much broader perspective on my future career options than I ever had before." (Sean Howe, University of Arizona)

"Overall, the program did an excellent job in achieving its goals. The experience was both intense and enjoyable. The work has great significance. We were not pampered. I have definitely learned a lot in both leadership as well as academics." (Funan Shi, University of North Carolina)

IPAM Summer Program: Networks and Network Analysis for the Humanities: An NEH Institute for Advanced Topics in Digital Humanities
August 15 - 27, 2010

Organizing Committee:
Jonathan Berger (Stanford University, CCRMA)
Zoe Borovsky (University of California, Los Angeles (UCLA))
Gregory Crane (Tufts University)
Tina Eliassi-Rad (Rutgers University)
Mark Green (University of California, Los Angeles (UCLA), Director Emeritus)
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, Scandinavian Section)

In recent years, attention has been drawn in both the academic and popular press to the ubiquity of networks in everyday life, from communications networks to investment networks to power

transmission networks to social networks. As a result of this increasing awareness, the study of the different types of networks that link us together, and the analysis of the structure of those networks has risen to greater and greater prominence not only in the mathematical and social sciences but also in the Humanities. Despite this increasing awareness of the importance of networks for theoretical advances in the Humanities, there is a considerable gap between recognizing in the broadest strokes the existence of these complex, dynamic systems and the very hard work of the consistent application of rigorous theoretically sound methods to the study of networks. Computational tools for the discovery and analysis of networks offer the promise of bridging this gap; unfortunately, many of these tools are as complex to work with as the underlying data itself. A main goal of this institute is to teach Humanities scholars some of the most accessible of these techniques.

In broadest terms, the topics to be addressed in the Institute are: (a) the science of networks and networks in Humanistic inquiry (b) preparing and cleaning Humanities data for network analysis (c) internal networks in Humanistic data: networks of characters, networks of texts, networks of language (d) external networks in Humanistic data: networks of influence, networks of production, networks of reception.

The institute, housed at UCLA, features lectures and tutorials from some of the leading scholars in Network Analysis and Visualization. The schedule also allowed participants an adequate opportunity to interact, to experiment and to learn from the institute faculty. The majority of the faculty come from the Applied Math and Computer Science community who have an interest in developing and applying tools for the type of corpora with which Humanities scholars typically work. There is significant time set aside during the institute for two types of important activity: (1) independent and group learning/experimentation with software on test datasets, so that lessons learned are not purely theoretical, but are have an applied component to them as well (2) structured free-time for developing collaborative ideas.

Participant Comments from the Digital Humanities Workshop

Zoe Borovsky (UCLA) “Involvement with IPAM meant that we have developed better collaborations between Humanities and the Sciences. By focusing on research questions, we have introduced Humanities researchers to new methods that directly benefit their research. Because my job combines my own research with providing support to other humanities researchers, it has been crucial to my job to have the support of IPAM in 1)identifying methods--such as network analysis--that have potential benefits for Humanities 2) identifying partners who can assist in developing projects and 3) supporting a collaborative environment such as the Summer Institute where scholars can work together.”

James Danowski (UIUC) “The tools presented have led to my incorporation of some of them into my research designs and analysis. This would not have happened without the IPAM conference. These tools are very important in generating improved results from my current research as well as stimulating new research. Nearly all of my current manuscripts have incorporated tools I learned about at IPAM. I have already presented on of these papers at a conference, and received highly favorable feedback.”

Outreach and Other Activities, 2009-2010

Math Institutes' Modern Mathematics Workshop (at SACNAS Annual Meeting), October 14-15, 2009. The NSF math institutes all cosponsored this one-day workshop. IPAM sent Rajul Pandya to speak to the participants about IPAM's upcoming Climate Modeling program.

Math Institutes Open House (at the Joint Mathematics Meetings), January 13, 2010. IPAM was one of 14 math institutes sponsoring this reception at the 2010 Joint Mathematics Meetings. IPAM Director Russ Caflisch represented IPAM.

UCLA Mathematics Festival, February 13, 2010. This one-day program offering challenging math activities to middle-school students in Los Angeles was held in partnership with the Curtis Center for Mathematics Education at UCLA and held at IPAM.

UCLA Alumni Day "Open House," May 15, 2010. IPAM Associate Director Christian Ratsch and a participant of the Climate Modeling long program spoke to alumni about IPAM and handed out publicity materials.

IPAM supported four RIPS 2009 students to present their RIPS research at the Annual Biomedical Research Conference for Minority Students (ABRCMS 2009), the Nebraska Conference for Undergraduate Women in Math (NCUWM 2010), and MAA's MathFest 2010.

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

K. PROGRAM CONSULTANT LIST

IPAM consulted a variety of scholars and practitioners in the development of ideas for programs and the organization of each program. We first list our board members; after that, the list is in chronological order by program. Upcoming programs for which planning has begun are also included.

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Stephen Wright, University of Wisconsin-Madison, Computer Science

By program in chronological order:

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

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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

Alan Frieze, Carnegie-Mellon University, Mathematical Sciences

Nathan (Nati) Linial, Hebrew University, Computer Science

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)

MR2009

Wen Masters, Office of Naval Research

Tristan Nguyen, Office of Naval Research

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

OTRC2009

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

FIN2010

René 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 Management

Ronnie Sircar, Princeton University, ORFE

Thaleia Zariphopoulou, University of Texas at Austin, Departments of 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, University of Nevada, Las Vegas

Graeme Milton, University of Utah, Mathematics

Chi-Wang Shu, Brown University

Richard 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 Department

DATA2010

Cynthia Dwork, Microsoft Research, Research

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, New York University, Courant Institute of Mathematical Sciences

Olivier Pauluis, New York University, EAPS

Bjorn Stevens, Max Planck Institute for Meteorology

CLTUT

Amy Braverman, Jet Propulsion Laboratory

Rupert Klein, Freie Universität Berlin, Mathematics

Bjorn Stevens, Max Planck Institute for Meteorology

IPC2010

Denise Brewley, Spelman College, School of Science of Technology

Erika Camacho, Arizona State University, Mathematics

Emille Davie, University of California, Santa Barbara (UC Santa Barbara)

Angela Gallegos, Occidental College

Lily Khadjavi, Loyola Marymount University, Mathematics

Tanya Moore, Building Diversity in Science

Omayra Ortega, Arizona State University

Nagambal Shah, Spelman College, Mathematics

CLWS1

Simona Bordoni, California Institute of Technology

Dargan Frierson, University of Washington

Andrew Majda, New York University, Courant Institute of Mathematical Sciences

Jonathan Mitchell, Institute for Advanced Study

CLWS2

Francis Giraldo, Naval Postgraduate School

Christiane Jablonowski, University of Michigan, Department of 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, New York University, EAPS

Ole Peters, Imperial College

Pier Siebesma, KNMI, Atmospheric Research Div.

CLWS4

Amy Braverman, Jet Propulsion Laboratory

Illia Horenko, University of Lugano, Mathematics and Computer Science

Luis Kornblueh, Max Planck Institute for Meteorology

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, Rutgers University

Mark Green, University of California, Los Angeles (UCLA), Director Emeritus

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, Stanford University, Applied and Computational Mathematics

Masakazu Kojima, Tokyo Institute of Technology

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

Arkadi Nemirovski, Georgia Institute of Technology

Yurii Nesterov, Université Catholique de Louvain

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

Michael Todd, Cornell University

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

OPTUT

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

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

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

Stephen Wright, University of Wisconsin-Madison, Computer Science

MRWS1

James Allen, University of Rochester

Lawrence Carin, Duke University, Elec and Computer Engineering

Pedro Domingos, University of Washington, Computer Science & Engineering

Leslie Greengard, New York University

Carlos Guestrin, Carnegie-Mellon University

John Laird, University of Michigan, Computer Science and Engineering

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

Bob Tenney, BAE Systems

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

OPWS1

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

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

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

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

Rekha Thomas, University of Washington

OPWS2

Don Goldfarb, Columbia University, IEOR

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

Yurii Nesterov, Université Catholique de Louvain

Michael Overton, New York University

Kim Toh, National University of Singapore

Stephen Wright, University of Wisconsin-Madison, Computer Science

MRWS2

James Allen, University of Rochester

Lawrence Carin, Duke University, Elec and Computer Engineering

Pedro Domingos, University of Washington, Computer Science & Engineering

Leslie Greengard, New York University

Carlos Guestrin, Carnegie-Mellon University

John Laird, University of Michigan, Computer Science and Engineering

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

Bob Tenney, BAE Systems

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

OPWS3

Sanjeev Arora, Princeton University

Gérard Cornuéjols, Carnegie-Mellon University

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

Friedrich Eisenbrand, École Polytechnique Fédérale de Lausanne (EPFL)

Michel Goemans, Massachusetts Institute of Technology

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

OPWS4

Aharon Ben-Tal, Technion - Israel Institute of Technology

Dimitris Bertsimas, Massachusetts Institute of Technology

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

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

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

OPWS5

Stephen Boyd, Stanford University, Engineering

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

Tom Luo, University of Minnesota, Twin Cities

Bernhard Scholkopf, Max-Planck-Institute for Biological Cybernetics

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

AGT2011

Gunes Ercal, University of Kansas, Computer Science

Allon Percus, Claremont Graduate University, School of Mathematical Sciences

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

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

SM2011

Margaret Bayer, University of Kansas, Mathematics

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

Antoine Deza, McMaster University

Gil Kalai, Hebrew University, Institute of Mathematics

Shanghua Teng, University of Southern California (USC)

RM2011

Guillaume Bal, Columbia University, APAM

Jim Nolen, Duke University

George Papanicolaou, Stanford University

Lenya Ryzhik, Stanford University

WIM2011

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

Alissa Crans, Loyola Marymount University

Lisette dePillis, Harvey Mudd College

Navah Langmeyer, Department of Defense

Ami Radunskaya, Pomona College

Suzanne Weekes, Worcester Polytechnic Institute

ITC2011

Ronald Cramer, CWI Amsterdam & Mathematical Institute, Leiden University

Yuval Ishai, Technion - Israel Institute of Technology

Tali Kaufman, Massachusetts Institute of Technology

Carles Padro, Universitat Politécnica de Catalunya

Chaoping Xing, Nanyang Technological University

CCS2011

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

William Hart, Sandia National Laboratories

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

Peter Jones, Yale University, Mathematics

Steven Lustig, DuPont Central Research and Development

Tamar Seideman, Northwestern University

Mark Tuckerman, New York University, Chemistry and Courant Institute

Anatole von Lilienfeld, Sandia National Laboratories

CCSTUT

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

Anatole von Lilienfeld, Sandia National Laboratories

CCSWS1

David Baker, University of Washington

Cecilia Clementi, Rice University, Physics

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

William Jorgensen, Yale University

Ursula Roethlisberger, École Polytechnique Fédérale de Lausanne (EPFL)

Jeffery Saven, University of Pennsylvania, Department of Chemistry

CCSWS2

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

William Hart, Sandia National Laboratories

Peter Jones, Yale University

Mauro Maggioni, Duke University, Mathematics and Computer Science

Cynthia Phillips, Sandia National Laboratories

Jean-Louis Reymond, Universität Bern, Chemistry and Bio Chemistry

Cenk Sahinalp, Simon Fraser University

Mark Tuckerman, New York University, Chemistry and Courant Institute

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

CCSWS3

Gerbrand Ceder, Massachusetts Institute of Technology

Vincent Crespi, Pennsylvania State University

Ralf Drautz, Ruhr-Universität Bochum, Department of Materials

H. Eliot Fang, Sandia National Laboratories

Kristen Fichthorn, Pennsylvania State University

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

Steven Lustig, DuPont Central Research and Development

Tamar Seideman, Northwestern University

CCSWS4

Paul Ayers, McMaster University

David Beratan, Duke University

Edward Maginn, University of Notre Dame

Peter Politzer, University of New Orleans

Markus Reiher, Swiss Federal Institute of Technology of Zurich

Marialore Sulpizi, University of Cambridge

Aidan Thompson, Sandia National Laboratories

Anatole von Lilienfeld, Sandia National Laboratories

Weitao Yang, Duke University

GSS2011

Noah Goodman, Stanford University

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

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

GEN2011

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

Phil Green, University of Washington

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

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

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

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

Eric Schadt, Pacific Biosciences

Elizabeth Thompson, University of Washington

Wing Wong, Stanford University, Statistics

GENWS1

Phil Green, University of Washington

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

Aviv Regev, Broad Institute

Eric Schadt, Pacific Biosciences

Jay Shendure, University of Washington

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

GENWS2

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

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

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

Barbara Wold, California Institute of Technology, Biology Division

Wing Wong, Stanford University, Statistics

GENMINI

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

Ben Raphael, Brown University

Jasmine Zhou, University of Southern California (USC)

GENWS3

Cedric Chauve, Simon Fraser University

Scott Edwards, Harvard University

Daniel Huson, Eberhard-Karls-Universität Tübingen

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

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

GENWS4

Carlos Bustamante, Stanford University

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

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

Phil Green, University of Washington

Elizabeth Thompson, University of Washington

MS2012

Juan Bello, New York University

Samy Bengio, Google Inc.

Ronald Coifman, Yale University

Kristen Grauman, University of Texas at Austin

Yosi Keller, Bar-Ilan University, Electrical Engineering

Yann LeCun, New York University

Cordelia Schmid, LEAR project-team

PL2012

Tina Back, General Atomics

Jill Dahlburg, United States Naval Research Laboratory

Michael Desjarlais, Sandia National Laboratories

Frank Graziani, Lawrence Livermore National Laboratory

Leslie Greengard, New York University

David Levermore, University of Maryland, Department of Mathematics

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

Michael Murillo, Los Alamos National Laboratory

PLWS1

Tina Back, General Atomics

John Castor, Lawrence Livermore National Laboratory, Physics

Denise Hinkel, Lawrence Livermore National Laboratory

David Levermore, University of Maryland, Department of Mathematics

Slava Lukin, United States Naval Research Laboratory

Igor Sokolov, University of Michigan, AOSS

PLWS2

Jeff Candy, General Atomics

Vincent Chan, General Atomics

Jill Dahlburg, United States Naval Research Laboratory

William Dorland, University of Maryland, Physics

James Drake, University of Maryland, Physics

Leslie Greengard, New York University

Slava Lukin, United States Naval Research Laboratory

PLWS3

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

Phil Colella, Lawrence Berkeley Laboratory

William Dorland, University of Maryland, Physics

Leslie Greengard, New York University

David Levermore, University of Maryland, Department of Mathematics

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

PLWS4

Michael Desjarlais, Sandia National Laboratories

Stephanie Hansen, Sandia National Laboratories

Michael Murillo, Los Alamos National Laboratory

Ronald Redmer, Universität Rostock

Sam Trickey, University of Florida

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 34 for a complete list of sponsors.

This was our third year of RIPS in Beijing with Microsoft Research Asia (MSRA). All of the research projects and the majority of the support for RIPS-Beijing came from MSRA, supplemented with a grant from NSF's International Research Experiences for Students (IRES) program.

An initial grant of $15,000 from the Office of Naval Research (ONR) to support the workshop "Laplacian Eigenvalues" in winter 2009 led to additional funding from ONR for a series of workshops on machine reasoning. The first in the series was held in November 2009 and served as a planning meeting for the subsequent workshops, held in September-October 2010.

As part of an ongoing effort to increase involvement with industry and government labs, we recruit board members to represent these sectors. Our Science Advisory Board includes Jill Mesirov (Broad Institute) and Matthew Hastings (Microsoft Research). Juan Meza (Lawrence Berkeley National Laboratory), Al Hales (CCR West), and Cleve Moler (Mathworks) serve on our Board of Trustees. (Cleve Moler completed his term since then.) Pieter Swart (Los Alamos National Lab), David Balaban (Amgen), and Jeffrey Saltzman (Merck) have since been added.

Individuals representing the National Institutes of Health (NIH), Microsoft Research, Sandia National Laboratories, and the Jet Propulsion Laboratory served on organizing committees of several workshops one long program in 2009-2010.

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:

Eleanor Rieffel (FXPAL) Data Privacy Workshop: "The workshop helped me define my current research direction."

Elaine (Runting) Shi (Xerox PARC): Data Privacy Workshop: "It was extremely helpful for my research efforts in privacy."

Additionally, here are comments from a few of our industry sponsors of RIPS 2010:

Andrew Selle, Disney Animation Studios: "The RIPS program does a great job of introducing gifted mathematics students to the world of applied research, and the industrial partners to a fresh enthusiasm!"

Vikas Sindhwani, IBM Research: "From our perspective, the RIPS program was highly mutually beneficial. The students were exposed to challenging real-world modeling problems of significant current interest within our organization. They asked very good questions and made steady progress on all fronts right from the start. We consciously avoided just giving them code and asking them to run experiments; rather, they spent considerable time on mathematical formulations and understanding connections to existing literature leading up to the point where they could try new research ideas on their own."

Lt. Sean Malinowski, LAPD: "The UCLA RIPS program has enabled the LAPD to better understand the dynamics of gang shootings in the Hollenbeck Area. This work will assist us in developing strategies to stem violence there in the future."

Leo Hsu, Shoah Foundation Institute: "Exposing [the students'] creative, analytical minds to our dataset and problems yielded great results, and the team building they experienced on their own was evident in their interactions."

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 $880,000. 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 on following page.)

Table N: Other Funding Support, 2009 to 2010		
Federal Grants	**Year**	**Amount**
Office of Naval Research (ONR) for Machine Reasoning	2009-2010	$270,745
Office of Naval Research (ONR) for Complex Systems	2009-2010	42,108
National Security Agency (NSA) Combinatorics I	2009-2010	15,000
Sub-total		327,853
University Funding Support		
Dean Physical Sciences Matching 1/2 IT Wages	2009-2010	50,979
Vice Chancellor for Research's Support	2009-2010	140,027
Computer Science Dept. Support – Public Lecture	2009-2010	1,000
Dean of Physical Science Support – Public Lecture	2009-2010	1,000
JIFRESSE Support – Public Lecture	2009-2010	500
Institute of the Environment Support – Public Lecture	2009-2010	250
Atmospheric & Oceanic Dept. Support – Public Lecture	2009-2010	100
Sub-total		193,856
Industrial Affiliates and Other Support		
Aerospace	2009-2010	15,000
Arete	2009-2010	15,000
IBM	2009-2010	16,500
Pixar and Disney	2009-2010	15,000
Microsoft	2009-2010	10,000
Standard and Poors	2009-2010	15,000
Symantec	2009-2010	15,000
Placental Analytics (Postdoctoral Support – Athavale)	2009-2010	18,744
Jet Propulsion Laboratory	2009-2010	15,000
Sub-total		135,244
Others		
Registration Fees-Programs	2009-2010	21,503
Green Family Lectureship Foundation Interest	2009-2010	5,948
J.B. Berland Foundation	2009-2010	4,675
Sub-total		32,126
TOTAL		**$689,079**

O. COMMITTEE MEMBERSHIP

IPAM's committees include the Board of Trustees and Science Advisory Board. The members of each during the 2009-2010 academic year are listed below.

Science Advisory Board

Russel Caflisch (UCLA, IPAM; ex-officio member)
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)
Tony Chan (President, HKUST)
Mark Green (UCLA, Mathematics)
Alfred Hales (CCR-West)
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.

Anne Schilling (UC Davis) Sage Days 2008
"I attended Sage Days 7 held at IPAM in February 2008. This has had a lasting impact on my research as I am now using and developing code for Sage. Furthermore, this established new collaborations with for example Dan Bump from Stanford University."

Bjorn Ostman (Michigan State U) attended CM2006
"I started a Ph.D. with a professor I met while I was at IPAM, which enabled me to work in evolutionary computational biology."

Steven Low (Caltech) CN2002, MRAWS4
"Less than a decade ago, there was not a mathematical framework for analyzing and designing TCP congestion control for large scale networks such as the Internet. In the last few years, such a framework has been established based on convex optimization and dynamical system theory. Our group, with others around the world, has been an active contributor, and a critical event that triggered/accelerated the theory development was exactly an IPAM Workshop in 2002, and subsequent workshops, that brought together the leading researchers at the intersection of applied math and Internet engineers, co-organized by John Doyle, Frank Kelly, Walter Willinger, etc. This was a pivotal moment for us that motivated the FAST TCP project at Caltech. My career and my group have been pursuing that direction ever since. It has led to great successes from academic research to industrial development (a startup FastSoft was build on the research developed along this line). IPAM has had great impact not just on my own group's research, but the entire TCP research community and hopefully the industry through FastSoft."

David Snyder (Texas State U – San Marcos) DS2006; TQC2007; SEWS4; MGAWS3; SGPTUT
"The IPAM seminars I've attended gave my research a more practical bent and helped me to get immediate feedback from more experienced researchers to help me get started in my new interests. More follow-up contact would have been helpful in my case. The variety of participants in the seminars I attended was also useful so that I exposed to a diverse set of opinions and interests. Thanks to my IPAM experiences, I have collaborated with a chemist, a biologist, and a computer scientist."

Gilad Lerman (U Minnesota) FG2000; SDM2002; MGA2003; GSS2005; SEWS4
"I recently received the NSF career award and I have no doubt that my earlier involvement in IPAM had a strong effect on my development which is reflected in this award"

Matthew Sotile (U Oregon) GSS2005; RIPS2006; RS2007; RIPS2007; OT2008
"I have found my participation in workshops and conferences with IPAM to be very useful in terms of keeping on top of current topics relevant to my work. I typically leave with a number of new ideas to look at when I get home based on what I hear in talks and discussions with people."

Shubao Liu (Brown) GSS2007
"The IPAM program I participated solidified my knowledge on probabilistic graphical models, and opened my eyes on its wide applications. This helps me a lot in my research on using these mathematical models to solve challenging computer vision problems."

Marcus Grote (U Basel) HU2007; CLWS4
“By bringing together researchers from different fields, in particular from statistics and partial differential equations, I have become more aware of recent work in statistics that will be useful in my future research. In that sense the IPAM interdisciplinary workshop certainly improved the flow of information between different fields.”

Kevin Head (Pediatrics, UC Irvine) MBI2004
“Just the single IPAM conference I attended has a great influence on me, and exposed me to a number of analysis techniques I would not have otherwise been exposed to.”

Laura Balzano (U Wisconsin) MRA2008
“IPAM meetings are the main source of ideas for the direction of my research. I haven't published a lot so far, but the next couple of years will see a lot of publications due to IPAM interactions.”

Mathew Roughan (U Adelaide) MRA2008, CNTOP
“"IPAM has strongly influenced the direction of my work over the last year, particularly in leading to us using and extending a number of new mathematical techniques we learnt about at IPAM.”

Jun He (Nanajing Institute of Meterology)
“While I was in IPAM for the MRA2008 program, I was deeply affected by the interdiscipline collaborations between mathematics and other research fields. And I cannot help to learning some new ideas which help me to make clear the future research direction and my PhD research work. I am currently focusing on exciting online social network research and working with Prof. John C.S. Lui.”

Helen Lei (Caltech) RS2007; KT2009
“Most importantly, Random Shapes happened at an early but very critical time in my career and it was truly instrumental in sealing my decision to become an academic.”

Tim Tangherlini (UCLA) SE2007; NSF2008; NSF2009; SER2010; HUM2010; ANN2010
“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:

Mike Hughes (Brown) RIPS 2008
"I had a blast at RIPS 2008 and was inspired to pursue graduate studies in computer science. I'm now a first-year PhD student at Brown University. My experience at RIPS helped me decide that CS research with a mathematical bend was the ideal career for me, and gave me the confidence and experience to apply (and be accepted) into graduate school (especially since I come from a teaching-focused undergraduate school with few research opportunities in CS). I'm also grateful to RIPS for helping me earn an Honorable Mention for the NSF Graduate Research Fellowship this past spring.

Jacob Macke (Oxford) RIPS2003; MBI 2004; GSS2005
"I attended RIPS 2003, during my undergraduate studies in Mathematics at Oxford. I worked in a group modeling micro-array data from yeast, and this was my first experience of applying mathematical techniques to scientific questions from biology. This experience has substantially impacted my research direction, as I subsequently decided to do a PhD in computational neuroscience. As I consequence, I am now a researcher in the interface between statistical modeling and computational neuroscience."

Sarah Milne (Oxford) RIPS2005
"I am now working as a high school math teacher. The experience of working abroad at IPAM with colleagues from many different countries was a factor in my decision to work in Japan for two years (post-graduation). I am now considering work in international schools."

Rachel Hodos (JPL) RIPS2008
"It has truly kicked off my career in applied mathematics! I am currently applying to grad schools for applied mathematics, which I probably wouldn't have done without IPAM. My participation in IPAM's RIPS program lead to an internship at JPL which has now turned into a full-time position as a software engineer for JPL."

Ryan Ritch (VPISU) RIPS2009
"I decided to pursue graduate school in applied mathematics partially based on my experience at IPAM."

Will Scott (Harvey Mudd) RIPS2009
"It is a big factor in why I'll be heading back to graduate school next year. I'm working at Google, and have stayed in touch with Alex Collins who is also here."

Rachel Cummings (USC) RIPS-Beijing2009
"I began working with my current undergraduate research advisor (David Kempe) as a direct result of my work at IPAM, because my RIPS project was an extension of his work. Upon returning to USC, he and I began working on a related project in theoretical computer science… I am now applying to PhD programs in Computer Science, thanks in part to my experience with RIPS and IPAM. I my experience with IPAM has had a profound effect on my future directions thus far, and I anticipate that it will continue to do so."

Appendix 1: Publications, Presentations and Patents (self-reported) 2009-2010

Limited to three entries per participant

Aboubacar, Marcos, Mathematics, Institut de Mathematiques et de Sciences Physiques (IMSP-UAC)

Solvability of a one-dimensional quasilinear problem under nonresonance conditions on the potential, EJQTDE, 2009, 57, p 1-29

Maximum Principle and existence results for elliptic systems on R^N, Elec. J. Diff. Equat, 2010,(2010) ,60 p1-13

Maximum Principle and existence result for a nonlinerar cooperative systems on a bounded domain(submitted for publication in EJDE))

Alon, Noga, Tel Aviv University

N. Alon, B. Bukh and B. Sudakov,Discrete Kakeya-type problems and small bases, to appear.

N. Alon and A. Kostochka, Dense uniform hypergraphs have high list chromatic number

Ashburner, John, Functional Imaging Lab, Institute of Neurology

Ashburner J. "A Fast Diffeomorphic Image Registration Algorithm". NeuroImage 38:95-113 (2007). This work makes a very approximate diffeomorphic registration approach widely available to the users of SPM5. A 3D implementation of a version with time-varying velocity is now work in progress, and will hopefully be made available in a future SPM release.

John Ashburner, Stefan Klöppel. "Multivariate models of inter-subject anatomical variability". NeuroImage (in press)

Ballantine, Cristina, Mathematics and Computer Science, College of the Holy Cross

"Ramanujan bigraphs associated with SU(3) over a p-adic Field" - Cristina Ballantine and Dan Ciubotaru

Beimel, Amos, Ben Gurion University of the Negev

A. Beimel and I. Orlov. Secret Sharing and Non-Shannon Information Inequalities. In Proc. of the 6th Theory of Cryptography Conference, volume 5444 of Lecture Notes in Computer Science, pages 539–557, Springer-Verlag, 2009.

A. Beimel, N. Livne, and C. Padró. Matroids Can Be Far From Ideal Secret Sharing. In Proc. of the fifth Theory of Cryptography Conference, 2008.

A. Beimel, S. P. Kasiviswanathan, and K. Nissim. Bounds on the Sample Complexity for Private Learning and Private Data Release. In the Seventh Theory of Cryptography Conference, volume 5978 of Lecture Notes in Computer Science, pages 437-454, 2010.

Binder, Ilia, Department of Mathematics, University of Toronto

(with L. Chayes and H. K. Lei) " On Convergence to SLE6 I: Conformal Invariance for Certain Models of the Bond--Triangular Type", accepted to Journal of Statistical Physics

(with L. Chayes and H. K. Lei) " On Convergence to SLE6 II: Discrete Approximations and Extraction of Cardy's Formula for General Domains", accepted to Journal of Statistical Physics.

(with M. Braverman) "The rate of convergence of the Walk on Spheres Algorithm", accepted to Geometric and Functional Analysis.

Birnbaum, David, University of Pittsburgh

Orthodox saints as Facebook friends: Social networking and medieval manuscripts

Birnir, Bjorn, Mathematics, UC Santa Barbara

Bjorn Birnir and Julie Rowlett, Erosion and Optimal Transport, Geophysical Research AbstractsVol. 12, EGU2010-14211, 2010EGU General Assembly 2010

Blanchet, Adrien, DAMTP, Universite de Toulouse I

Agueh Martial, Blanchet Adrien, Carrillo José, Large time asymptotics of the doubly nonlinear equation in the non-displacement convexity regime, Journal of Evolution Equations, 10 (1), pp. 59-84. (2010)

Borchers, Brian, Mathematics, New Mexico Tech

J. K. MacCarthy, B. Borchers, and R. C. Aster. Efficient stochastic estimation of the model resolution matrix diagonal a nd generalized cross validation for large geophysical inverse problems. October 14, 2010. Submitted for publication in Geophysical Research letters.

Borovsky, Zoe, Center for Digital Humanities, UCLA

http://www.balisage.net/2009/Program.html#ThursdayRight1145

http://dh2010.cch.kcl.ac.uk/academic-programme/abstracts/papers/html/ab-673.html

Busse, Friedrich, Physics, Universität Bayreuth

Homologous onset of double layer convection, Phys. Rev. E 80, 046316 (2009) with M. Petry

Zonal flow induced by longitudinal librations of a rotating cylindrical cavity.

Buttazzo, Giuseppe, Università di Pisa

G. BUTTAZZO, G. CARLIER: "Optimal spatial pricing strategies with transportation costs". AMS Series Contemporary Mathematics, 514 (2010), 105-121.

G. BUTTAZZO, E. MAININI, E. STEPANOV: "Stationary configurations for the average distance functional and related problems". Control Cybernet., 38 (4A) (2009), 1107-1130.

G. BUTTAZZO, C. JIMENEZ, E. OUDET: "An optimization problem for mass transportation with congested dynamics". SIAM J. Control Optim., 48 (3) (2009), 1961-1976.

Caravenna, Laura, functional analysis and applications, International School for Advanced Studies (SISSA/ISAS)

On the extremality, uniqueness and optimality of transference plans, joint work with S. Bianchini, Bull. Inst. Math. Acad. Sin. (N.S.), 4(4):353–455, 2009

On optimality of c-cyclically monotone transference plans, joint work with S. Bianchini, C. R. Math. Acad. Sci. Paris (in press)

Carlen, Eric, Mathematics, Rutgers University

Long time asymptotic, function inequalities, and Patlak-Kernel-Segel model, with JA Carillo, A Blancet

Proof of the Kac Conjecture for Hard sphere collisions, with M. Carvallis, M Loss

Catalano, Franco, Hydraulics, Transportations and Roads, Università di Roma "La Sapienza"

Catalano F. and Moeng C.-H., 2010: Large-Eddy Simulation of the daytime boundary layer in an idealized valley using the Weather Research and Forecasting numerical model. Boundary-Layer Meteor. 137, 49-75. DOI: 10.1007/s10546-010-9518-

Catalano F., Moroni M., Dore V. and Cenedese A.: Insights on the convective boundary layer scaling via numerical and experimental modeling. (in preparation)

Censor, Yair, Mathematics, University of Haifa

S.N. Penfold, R.W. Schulte, Y. Censor and A.B. Rosenfeld, "Total variation superiorization schemes in proton computed tomography image reconstruction", Medical Physics 37: 5887--5895, (2010).

Y. Censor, W. Chen, P.L. Combettes, R. Davidi and G.T. Herman, "On the effectiveness of projection methods for convex feasibility problems with linear inequality constraints", Technical Report. http://arxiv.org/abs/0912.4367.

Y. Censor, A. Gibali and S. Reich, "The subgradient extragradient method for solving variational inequalities in Hilbert space", Journal of Optimization Theory and Applications 148 (2011), to appear.

Cho, Min Hyung, Mathematics and Statistics, University of North Carolina Charlotte

M.H. Cho and W. Cai, "A wideband fast multipole method for two dimensional complex Helmholtz Equation", Computer Physics Communications, 181, 12, 2086-2090, 2010.

Chowdhury, Ameerah, UC San Diego

On a Conjecture of Frankl and Furedi, The Electronic Journal of Combinatorics, Volume 18(2), 2011

Christlieb, Andrew, Mathematics, Michigan State University

1. Weno AMR accepted to JCP
2. Parallel integral deffered correction
3. Semi-implicit integral deffered correction 4. Apply IDC to correct splitting errors in semi-lagrangian VP

Chudnovsky, Maria, Columbia University

Simplicial cliques in claw-free graphs (joint with Paul Seymour), in preparation

Coja-Oghlan, Amin, University of Edinburgh

Amin Coja-Oghlan, Charilaos Efthymiou: On independent sets in random graphs. To appear in Proc. SODA 2011.

Conlon, David, University of Cambridge

An approximate version of Sidorenko's conjecture, with Jacob Fox and Benny Sudakov

On two problems in graph Ramsey theory, with Jacob Fox and Benny Sudakov

Cruz-Aponte, Maytee, School of Human Evolution and Social Change, Arizona State University

Herrera-Valdez, Marco Arieli, Cruz-Aponte, Maytee and Castillo-Chavez, Carlos. MULTIPLE OUTBREAKS FOR THE SAME PANDEMIC: LOCAL TRANSPORTATION AND SOCIAL DISTANCING EXPLAIN THE DIFFERENT "WAVES" OF A-H1N1PDM CASES OBSERVED IN MÉXICO DURING 2009. Mathematical Biosciences and Engineering (MBE) (Accepted for Vol 8 Issue 1)

Cummings, Rachel, Mathematics, Economics, University of Southern California (USC)

W.Chen,A.Collins,R.Cummings,T.Ke,Z.Liu,D.Rincon, X. Sun, Y. Wang, W. Wei, and Y. Yuan. Influence maximization in social networks when negative opinions may emerge and propagate. Technical report, Microsoft Research, Oct. 2010.

Danowski, James, University of Illinois at Chicago

Meanings of New Media in Public Relations: Strategic Management of Corporate Communication, paper reviewed for presentation to the International Communication Association

Potential versus Actual Collaborative Innovation Networks, presented to the International Collaborative Innovation Networks Conference, to be published in Elesiver Procedia

LDA Topic Modelling for Indexing Online Posters' Similarity, a forthcoming chapter in Open-Source Intelligence

Daw , Nathaniel , New York University

Glascher, J., Daw, N.D., Dayan, P., and O'Doherty, J.P. (2010), "States versus Rewards: Dissociable neural prediction error signals underlying model-based and model-free reinforcement learning," Neuron 66: 585-595.

Daw, N.D. (in press), "Trial-by-trial data analysis using computational models," in: Phelps E.A., Robbins T.W. and Delgado M. (eds.) Affect, Learning and Decision Making, Attention and Performance XXIII, Oxford University Press.

Deserno, Markus , Carnegie-Mellon University

Martin M. Müller and Markus Deserno, Progr. Theor. Phys. Suppl. 184, 351-363 (2010).

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