Final Report for Period: 08/2007 - 07/2008   **Submitted on:** 06/16/2008

Principal Investigator: Lacey, Michael T.   **Award ID:** 0135290

Organization: GA Tech Res Corp - GIT

Submitted By:

Lacey, Michael - Principal Investigator

Title:

Vertical Integration of Research and Education in the Mathematical Sciences - VIGRE: VIGRE/GT: Vertical Integration of Research & Education at Georgia Tech

Project Participants

Senior Personnel

        Name: Lacey, Michael

        Worked for more than 160 Hours: Yes

        Contribution to Project:

        Name: Duke, Richard

        Worked for more than 160 Hours: Yes

        Contribution to Project:

        Name: Thomas, Robin

        Worked for more than 160 Hours: Yes

        Contribution to Project:

        Name: Landsberg, Joseph

        Worked for more than 160 Hours: Yes

        Contribution to Project:

        Name: Pelesko, John

        Worked for more than 160 Hours: Yes

        Contribution to Project:

Post-doc

Graduate Student

Undergraduate Student

Technician, Programmer

Other Participant

Research Experience for Undergraduates

Organizational Partners

Other Collaborators or Contacts

Activities and Findings

Research and Education Activities:

The final report will be included as an attachment in order to include tabulated statistical data.

Tabulated data include:

* Postdocs recruited under VIGRE program
* Graduate students recruited with VIGRE funds
* Undergraduate enrollment figures, from 1999 to 2007
* Undergraduate placement into graduate programs
* REU statistics
* 2002-08 postdocs placement
* 2000-08 PhDs with placement
* Placement of math majors in graduate school
* Awards and fellowships received by Georgia Tech undergraduates

Findings: (See PDF version submitted by PI at the end of the report)

The main contributions of the VIGRE award to the School that are detailed in the attached report are:

* The School is training more, and better undergraduates than when the program started, with the number of majors almost doubling. These students are integrated into the Schools research program of the School.

* More undergraduates pursuing graduate study; there is a strong record of placement in graduate school, and majors being awarded nationally significant fellowships and awards.

* An enormous increase in REUs, with a large fraction of both the undergraduates and the faculty participating in the REUs, leading to substantive results, that are being published in leading research
journals.

* An increase in the number of US citizens in the graduate program, and a higher level of student overall.

* A number of other enhancements to the graduate program, including increased stipends, recruitment and travel funds.

* The graduate students are an integral part of the School's education and training, and are being placed in postdoctoral positions of the first rank.

* An increase in the number of US citizens as postdocs, and a very substantial increase in the participation in the postdoc program overall. There is a strong record of placement of postdocs.

Training and Development:

The VIGRE award has lead to a dramatic increase in the number of postdocs recruited, trained, and placed by the School of Mathematics (see Table 1 in attached report).

Over the period 2000-07, the School has graduated on average 7 PhDs a year. These students are listed in Table 2, with the name of the student, date admitted, date of PhD, and placement information.

Undergraduate enrollment figures are shown in Table 3 in the attached report.

Outreach Activities:

The Georgia Tech High School Math Competition and the Distance Learning Program, described in detail in the report, are two very successful outreach recruitment programs.

Journal Publications

Books or Other One-time Publications

Web/Internet Site

Other Specific Products

Contributions

Contributions within Discipline:

Contributions to Other Disciplines:

Contributions to Human Resource Development:

Contributions to Resources for Research and Education:

Contributions Beyond Science and Engineering:

Categories for which nothing is reported:

Organizational Partners
Any Journal
Any Book
Any Web/Internet Site
Any Product
Contributions: To Any within Discipline
Contributions: To Any Other Disciplines
Contributions: To Any Human Resource Development
Contributions: To Any Resources for Research and Education
Contributions: To Any Beyond Science and Engineering

VIGRE PROGRAM AT
THE GEORGIA INSTITUTE OF TECHNOLOGY:
FINAL REPORT

1. Overview

This is the final report of the VIGRE program at the School of Mathematics at the Georgia Institute of Technology. This is a program that has had a substantial impact on all levels of trainees at the School, as well as all levels of education, training and research central to the Schools core missions.

The main contributions of the VIGRE award to the School that we will detail in this report are:

- The School is training more, and better undergraduates than when the program started, with the number of majors almost doubling. These students are integrated into the Schools research program of the School.
- More undergraduates pursuing graduate study; there is a strong record of placement in graduate school, and majors being awarded nationally significant fellowships and awards.
- An enormous increase in REUs, with a large fraction of both the undergraduates and the faculty participating in the REUs, leading to substantive results, that are being published in leading research journals.
- An increase in the number of US citizens in the graduate program, and a higher level of student overall.
- A number of other enhancements to the graduate program, including increased stipends, recruitment and travel funds.
- The graduate students are an integral part of the School's education and training, and are being placed in postdoctoral positions of the first rank.
- An increase in the number of US citizens as postdocs, and a very substantial increase in the participation in the postdoc program overall. There is a strong record of placement of postdocs.

2. Georgia Institute of Technology

The Georgia Institute of Technology, typically referred to simply as Georgia Tech, is a unit of the public University System of Georgia. Its engineering program is routinely ranked among the five best in the country, while the Institute as a whole has been placed among the top ten public universities in America. It has an enrollment of over 12,500 undergraduate,

and just over 6,000 graduate students. It has Colleges of Architecture, Computing, Engineering, and Sciences, Management and the Ivan Allen College (Social Sciences). Of these, the Engineering has over 7300 majors, the largest number of majors by a wide margin.

The Institute maintains a highly selective admissions policy, with the undergraduate students matriculating Fall 2007, having an average SAT score of 1356. A large fraction of the student body is also from out of state, making the student body more geographically diverse than is common among public institutions. The Institute also places highly in the percentage of its students who are National Merit and National Achievement Scholars, within the top five among public universities.

The Georgia Tech student body is also ethnically diverse. Nationally, Georgia Tech ranks first in the number of Degrees, undergraduate or graduate, in engineering, computer science and mathematics awarded to African Americans. It is also becoming a leader in the training of Hispanic students.

The Institute's reputation as a leading research center is well established. Its 860 faculty members include 19 members of the National Academy of Engineering, and 3 in the National Academy of Sciences. The recruitment of young faculty is aggressive. Georgia Tech has the third highest number of National Science Foundation CAREER Award winners in the country. In addition, externally sponsored research expenditures total approximately $350 million per year, making Georgia Tech and the Georgia Tech Research Institute leaders in this category as well.

3. The School of Mathematics

The School of Mathematics has about 60 faculty members, including those who are emeritus, working in a variety of areas of pure and applied mathematics. The School is one of only three Group I departments at public institutions in the Southeastern United States.

By other measures, the amount of research activity is also high. There are approximately 30 research grants awarded to the School of Mathematics each year. Five faculty currently hold CAREER awards. Three-quarters of the full professors are funded. Funding agencies are dominated by the National Science Foundation, but have also included NSA, DOD, and NIH funding.

As a component of a primarily technological university, the School of Mathematics plays a central role in almost all of the instructional programs of the Institute. Every undergraduate degree program at Georgia Tech requires mathematics at the level of the calculus or higher, with 70% of the students taking three semesters of Calculus and Differential Equations. In addition, upper division classes and graduate courses in Mathematics have a substantial audience among the Engineering and Computing graduate students, with most courses having more students from these disciplines than mathematics students.

4. Postdoctoral Program

The VIGRE award has lead to a dramatic increase in the number of postdocs recruited, trained, and placed by the School of Mathematics.

TABLE 1. Postdocs Recruited under VIGRE Program

Name	Start	Mentor	Placement
Erin Terwilleger (Missouri)	'02	Lacey	U Conn
Brody Johnson (Wash U)	'02	Heil	St Louis U
Ravi Montenegro (Yale)	'02	Tetali	U Mass Lowell
Mason Porter (Cornell)	'02	Bunimovich	Caltech/Oxford
Daniel Fox (U Wash)	'03	Landsberg	Instituto de Matematicas, Madrid
Jason Metcalfe (JHU)	'03	Lacey	NSF postdoc/U North Carolina
Tommaso Pacini (U Pisa)	'03	McCuan	Imperial College of London
Mark Demers (NYU)	'03	Bunimovich	Fairfield Univ
Nathan Geer (Oregon)	'04	Garoufouldis	Max Planck-Bonn/Utah State
Svetlana Krat (Penn State)	'04	Belegradek	Univ of Georgia
Dmitry Gerenrot (Penn State)	'04	Bellisard	

At the time of the initial VIGRE award, there was no established postdoctoral program, in the School. In the time period of the award, the School has funded two postdocs entirely from School funds, as well as initiated a matching program for postdocs. With these two changes, the School has funded a large number of postdocs outside the VIGRE program. Table 7 lists 37 Postdocs who have been at the School in the years 2002—08, with PhD Institution, and placement information. This is inclusive of the 11 Postdocs recruited with VIGRE funds, who are also listed in Table 1.

Of these 37 postdocs, six are women. Providing high-quality training to all postdocs, but especially women and minorities is an on-going concern, in all aspects of the School's activities. In the next year, additional women are being hired in postdoctoral positions, and the School has hired three women into tenure-track positions over the past two years. This is an indication of further improvements that we expect to make in the training of women in the next few years.

With the VIGRE providing unrestricted funds for postdocs, the value and merit of post-doctoral positions is firmly in the mind of many faculty members. The sponsored postdoc program will continue, and the School is seeking additional resources to create unrestricted funds for additional postdocs.

5. GRADUATE PROGRAM

Over the period 2000—07, the School has graduated on average 7 PhDs a year. These students are listed in Table 8, with the name of the student, date admitted, date of PhD, and placement information.

The graduate students, upon entry into the program, are assigned a faculty mentor close to their interests in Mathematics. The first major hurdle to the PhD are two comprehensive exams, of which we return to below. They are expected to finish both within two years of entry into the program. Following that, the students should begin formalizing a thesis topic,

select an adviser, and pass an oral exam on subjects related to the Thesis topic. In addition to course work in Mathematics, the PhD requires a minor in a second subject. Minors in Computing, Engineering, and Physics are very popular. Mathematics PhDs interview for positions in business on the strength of their minors. Each graduate student receives an annual review from the graduate committee, noting their progress towards the degree.

Besides the PhD in Mathematics, the School participates in three additional interdisciplinary PhD programs.

ACO: Algorithms, Combinatorics and Optimization. This selective admission program is run jointly with the College of Computing and the School of Industrial and Systems Engineering. The program is designed to train mathematicians, computer scientists, and operations research professionals, for academic careers or work in government and the private sector. We are responsible for the C in the acronym ACO and the vast majority of the students from Mathematics who study for a PhD in ACO study Graph Theory and Combinatorics.

BINF: Bioinformatics. This program begun 2003, and is joint with the Schools of Chemistry, Biology, Biomedical Engineering, and the College of Computing. The program is designed to train students for jobs in academia and the private sector, and is directed towards students who have interest in fundamental biology, genomics, drug discovery, and personalized medicine.

CSE: Computational Sciences and Engineering. The first students will enter this program in the Fall of 2008. This is a joint program with several other schools from the Colleges of Sciences, Engineering, and Computing. The program is designed to provide students with practical skills and theoretical understandings needed to become leaders in the field of computational science and engineering, and it emphasizes the integration and application of principles from mathematics, science, engineering and computing to create computational models for solving real-world problems.

The VIGRE grant has helped Mathematics in a special way in these programs. The ACO students can very frequently get RA support in other units, decreasing the participation of mathematics graduate students in the program. Two of the VIGRE recruited students are in the ACO program, as indicated in Table 2.

During the last several years, we have taken several steps to ensure that our students find a scientific environment at the SOM which will be conducive to excellent results. Within the resources available to us, among other measure undertaken, we have

- Created and steadily increased travel funds for our doctoral students.
- Supported the creation of, and financing for, the 'Research Horizons Seminar' where students listen to Faculty, or more advanced graduate students, presenting research topics in a broadly accessible format.
- Improved the physical plants and computing facilities, to the point where we have a 'doctoral wing' in the Mathematics building.
- Created two prizes to recognize our doctoral students: Best PhD Thesis award, and Best Teaching Assistant Award.

- Decreased the teaching load for Teaching Assistants, to four contact hours per week, with tutoring hours.
- Increased recruiting funds for both domestic and international students .
- Created a 'Graduate Student Library' for the exclusive benefit of our students.

Our students are responding to these changes, and are progressing better than ever in their studies. To witness, in Academic Year 2006-07 about 20 of our PhD students had submitted (or published), scholarly work ahead of their PhD theses, and about 25 had presented a talk at a conference or workshop. Our ability to continue attracting the best doctoral students is leading us to compete with institutes who are able to use resources not available to us, such as 'Research Assistant' positions for incoming students, as State Funds are not available for this purpose. The VIGRE grant was helpful in increasing our appeal to domestic students, and has resulted in a higher level of student being recruited over all.

Two students hold NSF Graduate Fellowships, having been awarded the Fellowship after starting the graduate program at GT. One of these students, Adam Marcus receive '2008 SIAM Denes Konig Prize for a junior researcher for outstanding research in an area of discrete mathematics' and is taking a postdoctoral position at Yale.

Recent PhD's have been awarded Humboldt Fellowships, have had postdocs at Yale, and placed with DE Shaw, with subsequent postdoc at Princeton. This last student, Serguei Norine, received his PhD in combinatorics. But was introduced to a question in algebraic combinatorics through an end-of-summer GT-REU symposium. He solved the initial form of the REU question over the weekend, which lead to collaboration with faculty member Matthew Baker, and publications on the Riemann-Roch theorem on graphs, published in Advances in Mathematics.

The Graduate Program is particularly aware of the importance of a diverse student body. From the data in Table 8, 26% of PhD recipients during 2000-2007 are Females, 3 out of 54 are Black, originally from Africa, all were placed in postdoctoral positions, and two of these hold tenure-track positions in the USA (Carnegie Mellon, U of Maryland) and 10 of 54 are Hispanic, with 8 of them holding academic or industrial positions in the USA.

We continue to pay particular attention to gender and diversity issues. To witness, the entering class in Fall of 2008 will have 5 out of 12 students who are Female, which is a noticeably higher percentage than that of female applicants to our doctoral programs (for Fall 2008, 30% of our applicants were females).

6. The Undergraduate Program

There are approximately 140 majors, in two B.S. degree programs, Applied Mathematics and Discrete Mathematics, with the majority pursuing the Applied Mathematics degree. Approximately one fifth of the majors are pursuing two undergraduate degrees. At Georgia Tech, this means that the student must complete the degree requirements of both degrees, and take an additional 36 hours of credit. These students are then finishing their degree in 5 years typically, and have a broad and rigorous undergraduate training. The culture of the undergraduates is one of heavy course loads, and seeking extra challenges.

TABLE 2. Graduate Students Recruited with VIGRE Funds

Name	Start Yr	U	Note
Patricia Pichardo	'02	GT/ Gouizeta	Company
William McClain	'02	Missouri	
Stephen Young	'02	Rose-Hulman	ACO/PF/NSA
Christina Carroll	'02	Nebraska	
John Pearson	'02	Dartmouth	
Derrick Hart	'03	Missouri	Missouri PhD
Ian Palmer	'03	William & Mary	
Adam Marcus	'03	Wash U	ACO/PF/Fulbright/Yale Postdoc
Mark Bilinski	'03	Cal Tech	
Svetlana Bukharina	'03	Rochester Tech	company
Radleigh Santos	'03	MIT	
John Boggan	'04	UGA	Bioinfo
Evan Borenstein	'04	UVA	
David Howard	'04	CMU	
Mitch Keller	'04	N Dak SU	

Year	'99	'00	'01	'02	'03	'04	'05	'06	'07
Undergraduate (in 000s)	10.2	10.7	11.0	11.4	11.2	11.5	11.8	12.3	12.4
Math Majors	77	85	88	100	108	121	139	149	143
Female Math Majors	29	23	21	29	34	38	48	48	44

TABLE 3. Undergraduate enrollment figures, from 1999 to 2007.

The School of Mathematics has one staff person, Rena Brakebill, one academic professional, Enid Steinbart, Director of Undergraduate Advising, and the Associate Chair for Undergraduate Studies, faculty member Michael Loss with principal oversight of the undergraduates, advising, and undergraduate program offerings. With the School of Mathematics carrying a very large service course load, these three people are kept very busy attending to a number of details associated with the undergraduate courses and majors.

In the period 1999-07, the number of majors has doubled, while the overall student body has increased by 20%. The percentage of mathematics majors to the total enrollment is a little over 1% currently. The percentage of women mathematics majors is approximately 30%, which is reflective of the overall male-to-female ratio of the Georgia Tech student body. See Table 6.

Over the same time period the placement of majors in Science-Technology-Engineering-Mathematics graduate programs has increased dramatically. In the years 2003–08, 28% of the students who complete a BS at Georgia Tech have gone into a STEM graduate program. See Table 4. These students have received a number of nationally significant scholarships at both the undergraduate and graduate level, see Table 6.3 for the list of placements by

Year	'02	'03	'04	'05	'06	'07	'08
Majors Placed	8	6	8	7	9	12	4
Women	2	3	0	4	3	2	0
Minority	1	0	1	1	0	1	1
Total BS Awarded		26	18	16	24	29	12

TABLE 4. Undergraduate Placement into Graduate Programs. Women and Minority data refers to those students who went into a Graduate Program. 2008 data reflects only data through May.

name and year. We are pleased with the high level of placements of these students, as well as the high percentage placed. At the same time, our women students are not going into STEM graduate programs at the same rates as the men. We are not sure of the root causes of this. Still, there are striking individual cases, such as Blair Dowling Simpson, now a Princeton PhD, with appointment at Oak Ridge National Labs. Next year, Nicole Larsen, a double major who has already received an Astronaut Scholarship, will be applying to STEM graduate programs, and we anticipate a very high placement for her.

6.1. **Recruiting Additional High-Quality Students.** The School has two programs in place to recruit additional high-quality students.

Distance Learning Program. High School students are enrolled in a Georgia Tech Calculus class—*but they do not come to campus, nor does the Professor go to their High School.* The students participate in the class *from their High School* through real-time video conferencing technology.

The target audience consists of highly advanced high school students, whose educational abilities exceed what High Schools can typically offer. This program, which begins its third year in Fall 2008, shows great promise in terms of providing high level instruction to these students, and recruit them to study Mathematics.

The second program is the annual **Georgia Tech High School Math Competition** (GT-HSMC). This is a one day event, drawing about 400 students from a multi-state region. Top prizes are generous scholarships for undergraduate study at Georgia Tech. Besides multilevel math competitions, organized by graduate and undergraduate students at Georgia Tech, other events are held for students, teachers, coaches and parents in attendance. These include talks by faculties as well as experts in industry to emphasize the importance of mathematics and career opportunities for math majors. We envision the GT-HSMC to be an important vehicle for identifying mathematically talented students, especially female students (each year we have a number of female winners and semifinalists). We aggressively recruit the contestants with scholarships and by building strong ties with their high school math coaches. Funds to support these scholarships are being sought at the Institute level, as this evolving into an important recruiting tool for a wide variety of disciplines at GT.

TABLE 5. REU Statistics

Year	GT-REU	Other REU	Women	Minorities	GT Faculty Mentors
'01	6		3	0	6
'02	12		1	2	10
'03	7		0	0	5
'04	9		4	0	8
'05	14	6	3	1	14
'06	14	8	5	0	12
'07	5	3	2	1	5
'08	14	5	4		11

TABLE 6. Participation in REU, by year, including undergraduate and faculty participation. The Summer '07 REU was funded by Institute Funds and REU supplements to individual grants.

The effect of these programs on recruitment of undergraduate majors is just being felt, and should accelerate with a recent MCTP grant, and the funds it provides for the support of the undergraduate program and these two initiatives.

6.2. **Undergraduate Research.** Interest in undergraduate research among the majors has increased dramatically over the period of the VIGRE grant, driven by several factors.

- The dedicated funds for the REU lead to a broadening of the expectation of an REU among the majors, and permitted the faculty to add an REU to their portfolio of activities devoted to instructing undergraduates.
- Changes in the undergraduate degree programs coincided with the VIGRE grant. A Senior Project is a degree requirement for the Discrete Mathematics Major.
- GT, as a whole, has multi-faceted initiatives to increase the particpation of all majors in REUs, including Institute funds for the same, and campus-wide REU symposiums.

The REU program, advertised nationally, operates in a much more decentralized way than do most REU programs. Most of the participants are GT students who work singly or in pairs with faculty mentors, with projects largely incremental to faculty research initiatives. Students are now adopting a pattern of continuing to work on the projects into the fall semester. As a result, the range and sophistication of the results obtained has increased significantly, and is a particular strength of this model of the REU. See the list of publications arising from the REU below.

The majors have also been more involved with enrichment activities at other universities in increasing numbers.

Interest in undergraduate research among the majors has increased dramatically over the last three years, driven by several factors. Georgia Tech, as a whole, has a sizable initiative to increase the participation of undergraduates in research. There is an established fund to sponsor the research of any GT undergraduate. Senior projects, and other research oriented

activities are degree requirements—this is the case for the BS in Discrete Mathematics. GT students are increasing recognizing an REU as an essential part of a successful graduate school application in a variety of disciplines. And finally, the VIGRE REU program, paying the undergraduates who are US citizens has evolved in a way to increase the students participation.

6.3. **Published Research From the GT-REU.** We include a list of publications associated with REUs produced over the course of the grant. These publications include Journal of Number Theory, the Notices of the AMS, and the PNAS.

In addition, a number of GT undergraduates, have presented posters at conferences, such as Sigma Xi conferences, undergraduate research conferences, and Dyanamics Days. These include: Corbett, Snyder, Lansel, Chua, Bjornstad, Diaz and Dachevski.

The REU project of Thomas Callaghan is a model of VIGRE related activities. Callaghan, the undergraduate, Mason Porter, VIGRE postdoc, and Professor Peter Mucha propose a novel method of ranking college football, based upon a naive random walk algorithm. Their paper consists of an analysis of the algorithm, and a calculation of the the rankings provided by this algorithm in a number of recent college football seasons. Their conclusion is that this naive method works as well as the complicated numerical schemes currently used to select football teams for the top bowl games. This piece of work has been reported by ESPN the magazine, Nature Update Online, the Chronicle of Higher Education, and the Notices of the AMS.

[1]   Thomas Callaghan, Peter J. Mucha, and Mason A. Porter, *The bowl championship series: a mathematical review*, Notices Amer. Math. Soc. **51** (2004), no. 8, 887–893.

[2]   ———, *Random Walker Ranking for NCAA Division I-A Football*, Amer Math. Monthly, to appear (2007).

[3]   Thomas Callaghan, Evgeniy Khain, Leonard M. Sander, and Robert M. Ziff, *A stochastic model for wound healing*, J. Stat. Phys. **122** (2006), no. 5, 909–924.

[4]   Ryan Hynd and John McCuan, *On toroidal rotating drops*, Pacific J. Math. **224** (2006), no. 2, 279–289.

[5]   Vivien Chua and Mason A. Porter, *Spatial resonance overlap in Bose-Einstein condensates in superlattice potentials*, Internat. J. Bifur. Chaos Appl. Sci. Engrg. **16** (2006), no. 4, 945–959.

[6]   Casey Warmbrand, Peter J. Mucha, M. E. J. Newman, and Mason A. Porter, *A network analysis of committees in the U.S. House of Representatives*, PNAS **102** (2005), 7057-7062.

[7]   Steven Lansel and Leonid A. Bunimovich, *One-particle and few-particle billiards*, Chaos **16** (2006), no. 1, 013129, 12.

[8]   Steven Lansel and Mason A. Porter, *Mushroom billiards*, Notices Amer. Math. Soc. **53** (2006), no. 3, 334–337.

[9]   ———, *Software: A Graphical User Interface to Simulate Classical Billiard Systems* (2004), available at `arXiv:nlin.CD/0405033`.

[10] A. J. Friend, Mason A. Porter, Peter J. Mucha, and M. E. J. Newman, *Community Structure in the United States House of Representatives*, Amer. Math. Monthly, to appear (2006), available at `arXiv.org:physics/0602033`.

[11] ———, *Community Structure in the United States House of Representatives [winning poster entry in the Gallery of Nonlinear Images at the 2006 APS March Meeting]*, Chaos **16** (2006), 041106.

[12] George Anders Steele, *Carmichael Numbers in Extension Fields of* $\mathbb{Q}$, J. Num. Th., to appear (2007).

TABLE 7. 2002—08 Postdocs Placement. V=VIGRE Postdoc, F=Female

Postdoc	Start	End	PhD	Mentor	Placement
De-Jun Feng	2002/08/16	2004/05/15	Wuhan U	Yang Wang	Hong Kong
Erin Terwilleger (V,F)	2002/08/16	2003/08/16	U MO-Columbia	Lacey	U Conn
Brody Johnson (V)	2002/08/16	2003/08/16	WashU-STL	C Heil	St Louis U
Mason Porter (V)	2002/08/16	2005/05/16	Cornell U	Chow/Mucha	Caltech/Oxford
Martijn van Noort	2002/08/16	2004/05/15	U Groningen	K. Mischaikow	Imperial College
R Montenegro (V)	2003/01/01	2005/05/16	Yale U	Tetali	U Mass Lowell
Mark Demers (V)	2003/08/16	2006/05/12	NYU	L. Bunimovich	Fairfield
Daniel Fox (V)	2003/08/16	2005/07/15	UWashington	S. Garoufalidis	Inst Mat Madrid
Jason Metcalfe (V)	2003/08/16	2005/08/14	Johns Hopkins	A. Swiech/Lacey	NSF-Postdoc, Berkeley
Tommaso Pacini (V)	2003/08/16	2006/05/12	UNaples	W Gangbo	Imperial College
Thierry Zell	2003/08/16	2006/05/12	Purdue U	Saugata Basu	Ga Perimeter C
Wen Huang	2004/04/01	2005/03/31	U Sci & TechChina	Yingfei Yi	U Sci Tech, China
Nathan Geer (V)	2004/08/16	2008/05/15	UOregon	S. Garoufalidis	Max Planck
Giovanni Pisante	2004/08/17	2005/05/16	UNaples	W Gangbo	U Napoli
Jiansheng Geng	2005/01/01	2006/05/12	Nanjing U	Yingfei Yi	Nanjing U
D Gerenrot (V)	2005/01/01	2007/05/16	Penn State U	Bellisard	
Svetlana Krat (V,F)	2005/01/01	2007/05/16	Penn State U	I Belegradek	UGA
Julia Garibaldi (F)	2005/07/01	2007/05/16	UCLA	M. Lacey	family
Dmitriy Bilyk	2005/08/15	2008/05/15	UMO-Columbia	Lacey	IAS Postdoc/U SCarolina
Marcio Gameiro	2005/08/15	2006/08/15	Georgia Tech	K. Mischaikow	Hokkiado U
Katherine Hurley (F)	2005/08/15		UC-SC		
Sang-il Oum	2005/08/15	2006/12/31	Princeton U	Thomas	KAIST, Korea
Pawel Pilarczyk	2005/08/15	2006/08/15	Jagiellonian U	K. Mischaikow	Kyoto U
Zsolt Talata	2005/08/15	2007/05/16	Budapest UTech.	Koltchinskii	Kansas U
Adrian Tudorascu	2005/08/15	2008/05/15	Carnegie Mellon U	W Gangbo	UW-Madison
T.V. Nguyen	2006/01/01	2007/05/16	Temple U	W Gangbo	Vietnam U
Serguei Norine	2006/06/15	2007/06/30	Georgia Tech	R Thomas	Princeton, Postdoc
Anar Ahmadov	2006/08/17	2008/05/15	UC-Irvine	J Etnyre	U Zurich
Kenneth Baker	2006/08/17	2008/05/15	UTexas-Austin	J Etnyre	U Miami
SV Borodachov	2006/08/17	2008/05/31	Vanderbilt U	Y. Wang	Towson U
Philippe Rigollet	2007/01/01	2008/05/31	Ecole Polytechnique	V. Koltchinskii	Princeton, Tenure-track
Luz Vela-Arevalo (F)	2007/01/01		Caltech		
Zdenek Dvorak	2007/08/17	2008/06/14	Charles U-Prague	R Thomas	Charles U
Ioannis Parissis	2007/08/17	2007/12/17	U Crete	M Lacey	Fields/KTH-Sweden
Hao Wang	2007/08/17		Arizona State U	H Weiss	
Shuguan Ji	2007/10/01		Jilin U	Yingfei Yi	
Zhenxin Liu	2007/10/01		Jilin U	Yingfei Yi	
G Stojanovic (F)	2007/10/22		Penn State U	M Ghomi	

[13] I. Soran and D. S. Lubinsky, *Weights whose biorthogonal polynomials admit a Rodrigues formula*, J. Math. Anal. Appl. **324** (2006), no. 2, 805–819. MR 2265082

[14] Brian Bensen and Yang Wang, *The Three Hat Problem*, Amer. Math. Monthly, submitted (2007).

[15] J. Widloski, R. O. Grigoriev, and D. L. Vainchtein, *Mixing properties of steady flow in thermocapillary driven droplets*, Phys. Fluids, submitted (2006).

[16] ———, *Resonant Chaotic Mixing in a Cellular Flow*, Phys. Rev. Letters, submitted (2006).

TABLE 8. 2000—08 PhDs with Placement

Student	Advisor	Admitted	Graduated	Placement	Undergrad
Kerce, James	Carlen	1995	Apr-00	Max Plank	GT
Bloomer, Lisa (F)	Hill	1994	Apr-00	Scientist, Navy	Goucher C.
Heckman, Christopher	Thomas	1994	Apr-00	ASU	UNL
Weedermann, Marion (F)	Hale	1995	Apr-00	UW-Green Bay	Hungary
Vougalter, Vatali	Loss	1995	Aug-00	Postdoc, UBC	Nizhny Novgorod
Labate, Demetrio	Heil	1993	Aug-00	Postoc, Wash U-Stl	Politech Torino
McShine, Lisa (F)	Tetali	1996	Aug-00	Consultant	
Baker, Anthony	Mischaikow	1995	Aug-00	Postdoc, FAU	GT
Harrelson, Dyana (F)	Hill	1995	Aug-00	Hope College	Clemson
Rivera, Roberto	Robinson	1995	Dec-00		GT
Thomson, Jan (F)	Thomas	1995	Dec-00		BYU
Gonzalez, Luis Espinoza	Cain	1995	Apr-01	U Venezuela	Venezuela
Jacobs, Denise A. (F)	Heil	1995	Apr-01	USMA, Westpoint	GT
Burer, Samuel	Monteiro	1995	Aug-01	Univ Iowa	UGA
Stoyanov, Tsvetan	Houdre	1994	Aug-01	Asset Modeling Group	Bulgaria
Martin, Russell A.	Randall	1995	Dec-01	Warwick	
Murali, Shobhana (F)	Houdre	1995	Dec-01	Lehigh Univ	India
Sitton, David	Hill	1995	Dec-01	Planning Systems, Inc	U South. MS
Agueh, Martial	Gangbo	1996	Aug-02	Postdoc, UBC	Benin
Kelome, Djivede A.	Gangbo	1997	Aug-02	Postdoc, UMass-Ahmerst	Benin
Del Magno, Gianluigi	Bunimovich	1997	Aug-02	Postdoc, Lisbao Portugal	Italy
Rebaza-Vasquez, Jorge	Dieci	1996	Aug-02	Asst. Prof. SWMoSU	Peru
Maroofi, Hamed	Gangbo	1996	Aug-02	Postdoc Toronto	Hamburg Univ
Boczko, Erik M.	Mischaikow	1995	Dec-02	Asst. Prof., Vanderbilt	Manhattan C.
Wang, Xuelei	Shi	1996	Dec-02	Verizon	China
Curran, Sean J.	Yu	1998	Apr-03	Dept. of Defense	UGA
Khlabystova, Milena (F)	Bunimovich	1997	Apr-03	notnow.com	Russia
Day, Sarah (F)	Mischaikow	1998	Aug-03	Postdoc, Amsterdam	Emory
Okoudjou, Kasso	Heil	1997	Apr-03	Postdoc Cornell	Benin
Shepppardson, Laura (F)	Yu	1997	Aug-03	Asst. Prof., U MS	Univ of Michigan
Kreslavsky, Dmitry	Bunimovich	1997	Dec-03	Retek, Inc.	GT
Rasmussen, Bryan	Dieci	1999	Dec-03	Dynetics	UAH
Figueroa-Lopez, Jose	Kertz	1998	Apr-04	Postdoc, Purdue	UNAM, Mexico
Song, Zixia (F)	Thomas	2000	Aug-04	Postdoc, OSU	China
Hernandez-Urena, Luis	Kertz	1996	Apr-05	Bank	Costa Rica
Sammer, Marcus	Tetali	1999	Apr-05	UW	Adventist
Sanchez, Jose Luis	Chow	1998	Apr-05	U Venezuela	Venezuela
Chen, Jian	Yi	1999	Aug-05	Software	China
Gameiro, Mario	Mischaikow	1999	Aug-05	Postdoc, Rutgers	Sao Paulo
Moeller, Todd K.	Mischaikow	1998	Aug-05	Los Alamos	St.Olaf College
Norine, Serguei	Thomas	2001	Aug-05	D.E. Shaw/Princeton	Russia
Wollan, Paul	Thomas	2001	Dec-05	Humboldt Fellowship	Univ. of Chicago
Hedge, Rajeneesh	Thomas	1997	Apr-06	Microsoft	
Hohenegger, Christel (F)	Mucha	2001	Apr-06	Postdoc, UNC & NYU	Switzerland
Komedarczyk, Rafal	Symington	1999	Aug-06	Postdoc, UPenn	Poland
Jiang, Wen (F)	Yu	2001	Dec-06	Citigroup	China
Ulusoy, Suleyman	Carlen	2001	Aug-07	Postdoc, Univ Oslo	METU (Turkey)
Kampel, Guido	Goldsztein	2003	Dec-07	Marketrx	Buenos Aires
Kettner, Michael	Basu	2001	Dec-07	Software	Germany
Lessard, Jean-Philippe	Mischaikow	2002	Dec-07	Postdoc, Rutgers	Canada
Viveros, Jorge	Yi	1997	Dec-07	Tarleton TX	Unam, Mexico
Carroll, Teena (F)	Tetali	2002	Apr-08	St.Norbert Coll.	Kenyon College
Inkmann, Torsten	Thomas	2002	Apr-08	Consultant	TU Berlin
Marcus, Adam	Tetali	2004	May-08	Postdoc, Yale	WU-STL

TABLE 10. Placement of Math Majors in Graduate School

Name	Year	University	Award
David Vener	'01	MIT	NSF Grad, PhD06
Nick Bronn	'02	Cambridge	Gates/NSF Grad
Andy Wand	'02	Berkeley	NSF Grad
Blair Dowling (F)	'03	Princeton	Homeland PhDO8
Wai-Jing Law (F)	'03	Duke	
Yakov Kerzhner	'03	NYU/Courant	PhD08
David Skoog	'03	GT	
Clark Alexander	'03	Northwestern	
David Eger	'03	CMU (CS)	Fulbright
Ganesh Sundramoorthi	'03	GT (EE)	
Nathan Bell	'03	UIUC (CS)	
Brandon Meredith	'03	Boston	
Casey Warmbrand	' 04	Arizona	
Andrew Stimpson	'04	Stony Brook	
Ryan Hynd (M)	'04	Berkeley	ATT, NSF Grad
Boris Kerzhner	'04	GT (Bio Eng)	
Sang Chu	'04	Harvard (Physics)	
Alex Olshevsky	'04	MIT (EE)	NSF Grad
Stephanie Bent (F)	'05	Florida State/ Higher Ed	
Emily Kennedy (F)	'05	UGA/Math Ed	Knowles Fellow
Steven Lansel	'05	Stanford/EE	
Vivien Chua (F)	'05	Stanford/Applied Math	
Thomas Callaghan	'05	Stanford/Applied Math	Goldwater
Caroline Seabrook (F)	'05	NC State/Stats	
Matthew Block	'05	UCSB, Physics	
Miles Stoudenmire	'05	UCSB, Physics	
Brittany Hughes (F)	'06	GT CoC	
Corina Saxton (F)	'06	GT Oceanography	Presidental Fellow
Nick Cotton	'06	UMD	
Brian Swanagan	'06	UGA/Math Ed	Knowles Fellow
Randy Heaton	'06	FSU	
Julie Bjornstad (F)	'06	UNC City Planning	
Stephen Pounds	'06	GT Quant Finance	
James Sanders	'06	Cornell-OR	
Leo Dachevski	'06	GT ACO	
Charles Martin	'07	UCSB	
Bethany Page (F)	'07	USC-Stats	
Brian Nakamura	'07	Rutgers	
Anders Steele	'07	Boston U	
William March	'07	GT-CS	
Emanuel Indrei	'07	UT-Austin	(RTG fellowship)
Darshan Bryner	'07	GT-Math	
Andrew Tart	'07	GT-ISyE	Mitchell
Alan Diaz (M)	'07	GT-Math	(Minority Fellowship)
Alexander Block	'07	UIUC	
Mike Young	'07	UCLA-Atmospherics	
Nguyen Truong	'07	UC Berkeley-OR	
Ioan Saron (F)	'07	GT-QCF	
Brian Benson	'08	UIUC	
Gokhan Civan,	'08	UMd	
Julian Dawson (M)	'08	UCF	
Steven Britt	'08	UNC	

TABLE 11. Placement of Majors. (F) means a Female student, (M) means a Minority Student.

TABLE 12. Awards and Fellowships Received by GT Undergraduates

Name	Year	Placement	Award
David Vener	'01	MIT	NSF Grad
Nick Bronn	'02	Cambridge	Gates+NSF Grad
Andy Wand	'02	Berkeley	NSF Grad
Nick Bronn	'02	MIT	NSF Grad
Blair Dowling	'03	Princeton	Homeland
David Eger	'03	CMU/Budapest	Fulbright
Ryan Hynd	'04	Berkeley	ATT
Ryan Hynd	'04	Berkeley	NSF Grad
Alex Olseshky	'04	MIT (EE)	NSF Grad
Thomas Callaghan	'04		Goldwater
Emily Kennedy	'04	UGA Math Ed	Knowles Teaching Fellowship
Brian Swanagan	'05	UGA Math Ed	Knowles Teaching Fellowship
A.J. Friend	'07		Goldwater
Nicole Larsen	'08		Astronaut Scholarship
Adam Tart	'08	GT-ACO	Mitchell Scholarship