

University of Washington VIGRE Grant
Annual Report for 2004–05
Douglas Lind, VIGRE Director

Building on the strong foundations created by our first VIGRE grant, the three mathematical sciences departments at the University of Washington have closely collaborated to create an even richer and more stimulating environment for their students. During the first year of our new grant, VIGRE has funded numerous undergraduate research projects in all three departments, K-12 outreach activities to local schools, 24 graduate fellows creating exciting new activities through cross-departmental committees, professional development forums, two graduate summer schools, travel for students to attend conferences and workshops, and our first VIGRE Distinguished Lecturer (Barry Mazur of Harvard). The impacts have included a continued increase in the number of majors in the mathematical sciences, better success in recruiting top graduate school candidates, a higher level of involvement by faculty in VIGRE-related efforts, and a palpable feeling of excitement among our students.

Our VIGRE website at <http://www.ms.washington.edu/vigre/> contains detailed information on our activities.

Undergraduate Projects. VIGRE funded 33 undergraduate quarter-long projects generally supervised by faculty. One strong group of five undergraduates worked with Steffen Rohde in Mathematics and VIGRE Graduate Fellow Joan Lind on the stochastic Loewner equation during Spring and Summer quarters. Another group of two students worked with Nathan Kutz in Applied Mathematics on phase-locked lasers. June Morita in Statistics supervised undergraduate Ryan May in efforts to build strong connections with local schools. Henry Cohen at Microsoft Research worked with two of our undergraduates on a project about sphere packing via potential energy minimization. Tatiana Toro in Mathematics initiated a very interesting project involving four undergraduates to use math games at a local school to create excitement about math. We also funded two undergraduate assistants for the summer REU program in inverse problems supervised by Jim Morrow (these are students who are alumni of the program, and return to help new students master the mathematics involved and generally provide guidance to them). A complete list of these projects is available on our website.

As a personal aside, I supervised four undergraduate projects this year, including a team of three students working on fractals and dynamics. It was the first time I have ever done this, and it was remarkably stimulating. This experience really changed my attitudes, and I'm eager to continue doing projects like this in the future, even after VIGRE funding expires.

Undergraduate Mathematical Sciences Seminar. As part of our efforts to involve undergraduates across the spectrum of the mathematical sciences, we initiated a broadening of our undergraduate seminar (formerly the ACMS Seminar) to appeal to students across all three departments. We now call this the Undergraduate Mathematical Sciences Seminar, and it is organized and run by a committee of VIGRE graduate students. The talks are typically given by graduate students from the three departments, spiced up with an occasional visiting scientist. Topics this year included: *Numerical Modeling of Tsunamis* by David George (grad student in AMath), *Probabilistic Weather Forecasting* by McClean Slougher (grad student in Statistics), *Blowing Stuff Up and Looking for Oil in Silly Putty: The One Dimensional Seismic Inverse Problem for Viscoelastic Media* by Kirk Blazek (grad student in Math), *The Spontaneous Geometry of Spiral Circle Packings* by Prof. Ken Stephenson of the University of Tennessee, and *Quaternions and Applications to Computer Graphics* by Matt Klassen (DigiPen Institute of Technology).

Graduate Fellow Committees. One outcome of the third-year review of our previous VIGRE grant was the suggestion by graduate students themselves that they would like to work more closely together across departments. We developed the idea of having groups of VIGRE students working together on committees targeting various areas. We have developed and refined this idea over several years, and it has proved quite effective in not only initiating and carrying out ideas, but also in building collaborations across departments and in informing our students of different cultures in the mathematical sciences.

The committees this year were for Professional Development (organizing professional development forums), VIGRE Distinguished Lecturer (inviting and organising visits by outstanding researchers with a view to their interactions with our graduate fellows), Web Site (updating and maintaining the site), Undergraduate Projects (encouraging and publicizing the availability of VIGRE funding for undergraduate projects, both in the three departments and also other locations around campus), Undergraduate Recruitment (encouraging more beginning students to major in the mathematical sciences), and Undergraduate Mathematical Sciences Seminar (described previously).

Graduate Student Travel. We feel very strongly that our graduate students, and even undergraduates, benefit enormously by travelling to conferences and workshops. They can present their own research to experts in the area, make informal contacts with faculty and students from other universities, and begin to form the networks of personal connections so important for professional development. Normally funds for student travel are severely limited, but VIGRE has enabled us to support many more students on such trips (and also allowing scarce travel funds to be used for international students). This year VIGRE funded 53 trips by students in our three departments. These included eight graduate students going to the national AMS/MAA

meeting (where they not only gave talks but also experienced the job hunting lay of the land before the time they will be applying for jobs), a Statistics grad student going to a conference in image processing in Berkeley, several students attending workshops in Banff, a Math student going to a conference in Stockholm, and an AMath students giving a paper at a PDE conference in Houston. We also funded an undergraduate Emily Price to attend the Nebraska Conference on Undergraduate Women in Mathematics (in our previous grant, we funded another undergraduate Terri Moore to the same conference, and she ended up going to Nebraska for graduate study in mathematics!). Often VIGRE travel support was leveraged with support from individual grants.

VIGRE Distinguished Lecturers. An idea developed during our first VIGRE grant was to let a group of VIGRE graduate fellows invite, organize, and run a visit by a distinguished researcher of particular interest to them. Not only does this provide our students with scientific contacts, it also trains them in the nuts and bolts of organizing such events, including budgets and support details.

Our first VIGRE Distinguished Lecturer was Barry Mazur of Harvard. During his week's stay, he gave a VIGRE-sponsored public lecture on *Imagining Numbers* (the topic of his recent book) to a packed auditorium of over 200 (another 50 had to be turned away). He also had informal lunches with our students, gave a research seminar and a colloquium talk, participated in our annual awards ceremonies, and even agreed to an hour-long interview on our local PBS radio station (the idea for this coming from one of our VIGRE fellows). This was a highly successful initial visit, setting a high standard for future events.

The committee also invited four scientists to be VIGRE Distinguished Lecturers in future years: Steve Strogatz of Cornell, Hendrik Lenstra of the University of Leiden, Margaret Wright of the Courant Institute, and Ron Graham of UC San Diego. Much to everyone's amazement, all four accepted! Several said that one of the most attractive features of the invitation was that it came from students. Strogatz is scheduled for 2005-06, Lenstra for 2006-007, and Wright and Graham will be here some time during 2006-08.

Graduate Student Summer Schools. One new feature of our proposal was to use VIGRE funds, in cooperation with PIMS (the Pacific Institute of Mathematical Sciences) to run summer schools and workshops, with of course University of Washington students participating. The first two of these occurred in the summer of 2005.

Algebraic Geometry Boot Camp. Every ten years or so the algebraic geometry community holds a huge conference, the most recent being a three-week conference in the summer of 2005 at the University of Washington. Sandor Kovacs in Math suggested that we run a "boot camp" for graduate students the week before the main conference, primarily intended to get students up to speed so that could take full

advantage of the conference talks. We initially thought we would get perhaps 25 students to come, and committed \$10K in VIGRE funds plus a corresponding amount from PIMS. This turned out to be a wild underestimate of interest. As word spread, and more applications poured in, we quickly realized we would need more funding. Using VIGRE and PIMS as seed funding, we were able to attract an additional \$20K from the Clay Mathematics Institute, another \$20K from the NSF, and \$10K plus some travel support from MSRI (which included this as one of its summer graduate student programs for Academic Sponsors). About 130 students were supported, and we had to turn away another 70! They were assisted by 14 faculty mentors (supervised by Herb Clemens), who lectured, held sessions in small groups, and generally helped the students understand the essential problems and new directions of this vast area of mathematics. A complete description of lectures is available at http://math.stanford.edu/~vakil/agbc/ac_prog.html. The survey and expository lectures were taped, and using VIGRE support will be turned into DVDs suitable for distribution to the mathematical community.

Summer School on Inverse Problems. Held August 1–5, 2005, in conjunction with the PIMS Collaborative Research Group on Inverse Problems, this summer school attracted 44 graduate students (23 from the University of Washington). During the week William Symes of Rice University gave the PIMS Distinguished Lectures on *The Mathematics of Seismic Imaging*. In addition, minicourses consisting of three one-hour lectures covering a broad range of topics were given by Guillaume Bal (Columbia), Joyce McLaughlin (RPI), Gary Margrave (Calgary), Plemen Stefanov (Purdue), and Gunther Uhlmann (UW). A detailed account is available at <http://www.pims.math.ca/science/2005/05inverse/>.

Postdoc Recruitment. We learned of VIGRE funding too late to appoint postdocs for 2004-05. However our search for the next year was very successful, with Aravind Asok being appointed a VIGRE Postdoc in Mathematics and Helga Schaffrin Huntley in Applied Mathematics.

Impacts. VIGRE continues to have large positive impacts on all three departments. Our undergraduate programs continue to attract students of very high quality, and in increasing numbers. The chart on the next page shows the dramatic increase in the numbers of majors and degrees before and during our VIGRE funding.

Our undergraduates are winning national and even international recognition, including Goldwater and other awards. A team of three undergraduates were designated Outstanding Winners in the 2005 Mathematical Contest in Modeling, and also received the INFORMS Award. We now have five Outstanding Winners in the last four years, a remarkable streak! Mathematics Department was recognized this year by receiving the University-wide Brotman Award for Instructional Excellence. The quality of our graduate applicants has increased, as well as our ability to recruit them to come.

VIGRE has contributed in essential ways to our joint efforts to build a far more stimulating environment for our students and faculty.

