

DEPARTMENT OF MATHEMATICS

# VIGRE Funding Report

(due 30 days after semester of support)

Semester/Summer and Year:

Fall 2006

Name: Lisa Berger

List the graduate courses you have taken this semester (including independent studies), your grades, and the instructors:

Course	Title	Grade	Instructor
920	Dissertation	K	Doug Ulmer

List the title, date and location of any talks you have given, either here or elsewhere:

"Rational Surfaces and Ranks of Elliptic Curves"

University of Arizona Number Theory Seminar--November 7

Arizona State University Preparing Future Faculty Seminar--November 13

University of Nebraska, Omaha Mathematics Colloquium--December 6

"Simple Cyphers"

California State University, Monterey Bay Mathematics Colloquium--December 11

If you are working on your dissertation, include a one paragraph description of your research progress. If you have not yet begun dissertation research, describe your progress toward finding a dissertation topic and advisor and beginning that research.

My research project is an explicit geometric construction of smooth surfaces dominated by products of curves. Key to the construction is to establish conditions for which the DPC property is retained in towers of field extensions. Taking our surfaces defined over a finite field, we exploit the DPC property to study the ranks of the Jacobians of the generic fibers of our smooth surfaces. Specifically, we have produced a parameterized family of elliptic curves over the field  $F_q(t)$  that satisfy the rank conjecture of Birch and Swinnerton-Dyer. Further, we have applied known results on analytic ranks to show that our curves obtain large rank over function field extensions.

List publications, if any.

Check all activities you completed during the funded period:

Academics:

- Independent Study
- Oral Comprehensive Exam
- Commence Thesis Research
- Conference attendance
- Conference participation
- Complete PhD

Professional development and outreach:

- AP Calculus Visit
- High School Workshops
- Undergraduate Research Project
- Undergraduate Research Seminar
- Super TA
- Mentoring junior graduate students for the qualifying exams
- RTG (help organize)
- Research Seminar (help organize)

Other (please specify)

- 1) I paired senior graduate students with those first year students who requested a mentor for their first year.
  - 2) Sheree Leverage, Ksenija Simic, and I have received funding for a second Sonia Kovalevsky high school math day. We completed the initial planning during the fall semester. The workshop is planned for February 15, 2007.

Attach a brief statment about your academic progress and professional development during the period of support.

Lisa Berger  
VIGRE Final Report  
Fall 2006

## Research

During the fall semester of 2006 I received a VIGRE research grant to help me continue my thesis research project. My research involves the construction of elliptic curves and higher dimensional abelian varieties defined over function fields that obtain large rank in field extensions. Key to the project is the explicit construction of smooth surfaces dominated by products of curves, so that this DPC property is retained in towers of field extensions. I have, this semester, acquired a much better understanding of the geometry in our construction. Specifically, each of our surfaces may be realized as a quotient of a blow-up along a subvariety of a product of curves. We completed work early in the semester on computing the genus of a non-singular model of the generic fiber of each of our surfaces. Additionally, we apply some known results on variable separated polynomials to establish irreducibility of many families of our curves. During the spring semester, while writing up our current results, I plan to continue work on establishing high ranks of the Jacobians of some of our curves of genus greater than one.

On November 7 I presented our preliminary results in the number theory seminar. Also in November I presented my work in the “preparing future faculty seminar” at Arizona State University. This was my first opportunity to present my work to “non-specialist” mathematicians outside of the Arizona Mathematics Department. Additionally, my talk at ASU supports the departmental VIGRE goal of developing academic relationships with mathematics departments in the Southwestern Network. Alejandra Alvarado, a PhD student at ASU, and John Kerl, would be good choices for students to establish regular academic interaction among the mathematics graduate students from our two schools.

## Vertical Integration

Sheree LeVarge, Kesenija Simic, and I have received funding from AWM for a second Sonia Kovalevsky High School math day, to be held February 15, 2007. During the fall semester we completed preliminary plans. First, we finalized the participants who will be presenting the workshops, involving graduate students from both the mathematics department and the program in applied mathematics. Last year 6 graduate students participated in the organization and teaching. This year 9 graduate students are involved, in addition to one PhD student from ASU. Last year we focused recruitment efforts at one school. This year we are focusing on three.

As a part of my job search, I gave a research talk at the University of Nebraska, Omaha, and an introductory talk for undergraduates on “simple cyphers” at the mathematics colloquium at California State University, Monterey Bay.