PROPOSAL: SIAM ACTIVITY GROUP ON ALGEBRAIC GEOMETRY

We propose to create a SIAM Activity Group on the topic of Algebraic Geometry. While this grew out of the 2006-2007 topical year on Applications of Algebraic Geometry at the IMA in Minneapolis, the catalyst for this proposal was a suggestion by Douglas Arnold to the organizers of that year who were SIAM members.

1. Focus Area : Algebraic Geometry

We consider this area quite broadly, at the minimum including the topics represented during the year at the IMA (`http://www.ima.umn.edu/2006-2007/`), but also applications of mathematics that use methods and ideas from algebra, geometry, and topology. For example, the workshop topics during the IMA program year were Algorithms in Algebraic Geometry; Software for Algebraic Geometry; Algebraic Algorithms in Optimization; Emerging Applications in Biology, Dynamics, and Statistics; Complexity, Coding Theory, and Communications; and Non-linear Computational Geometry.

We choose the name "Algebraic Geometry" for this activity group as an umbrella term, because algebraic geometry, as we understand it, uses or informs many of these methods and ideas. These methods include but are not limited to: algebraic geometry, commutative algebra, noncommutative algebra, symbolic and numeric computation, algebraic and geometric combinatorics, representation theory, and algebraic topology. These have already seen applications in biology, coding theory, cryptography, computer graphics, quantum computing, control theory, geometric design, complexity theory, machine learning, optimization, robotics, computational geometry, and statistics. We will welcome participation from both theoretical mathematical areas and application areas not on this list which fall under this broadly interpreted notion of algebraic geometry and its applications. The year at the IMA and activities before and since reveal a coherence to the topics of this proposed activity group. The organizers and officers of this activity group will work to ensure that it remains both focused and open to new ideas and directions.

2. Target Community

The target community of the activity group are those researchers who are using and developing algebraic and geometric tools for applied mathematics. Some of the spectrum of activity we hope to represent can be found in other professional societies, particularly the ACM Special Interest Group in Symbolic and Algebraic Manipulation (SIGSAM), to which many of us who work in symbolic and numerical computation belong, and the Foundations of Computational Mathematics (FoCM), which represents a related stream of activities. To some extent these societies specialize on the important theoretical and practical work of creating and understanding the algebraic and computational tools that form a foundation for many of the applications that we hope this SIAG will represent. Another is gound in the IEEE groups on codoing theory or on control. However, the entirety of the activity we envision for this group, and in particular much of the activity focused on applications

to science and technology, is not represented in any professional society. A SIAM Activity Group in Algebraic Geometry would provide a Societal home for this emerging field. As a result, we anticipate that the SIAG will lead to many new members of SIAM.

The discussions leading up to this proposal have already drawn new people to SIAM. For example, Bernd Sturmfels joined when he learned of this effort, as did Monique Laurent, Chris Peterson, and Seth Sullivant. David Eisenbud, Joe Brennan and others who have been lapsed SIAM members have indicated their willingness to rejoin SIAM to participate in this activity group. We anticipate many others joining SIAM out of interest in this activity group. A list of people we have contacted who have indicated their interest or willingness to join is found at the end of this proposal.

3. Overlap with other SIAM Activity Groups

There will be some overlap with existing SIAM activity groups, but it will be complementary. Some members of our planning group, including Lasserre and Sottile, are associate editors of SIAM journals (Optimization and Discrete Mathematics, respectively), and there will be further overlaps with Control Theory and with Geometric Design. However, the algebraic and geometric tools which will be the focus of the activity group have generally not been represented in SIAM or its activity groups. For example, at the 2008 SIAM Conference on Discrete Mathematics (philosophically, the closest SIAG to Algebraic Geometry) of the 40 concurrent sessions none were on algebraic geometry, and only two had algebra in the title.

4. Activities of the SIAG

Among the activities we would plan would be regular biennial meetings. In years that did not have a meeting, we would organize mini-symposia at the SIAM annual meeting and perhaps also at the SIAM sectional meetings. Joint SIAM-AMS sessions at the January Joint Mathematics Meetings would be arranged. For example, at the 2009 January Joint meetings, there were two AMS special sessions in the topics of this SIAG, and there is one scheduled on "Applications of Algebraic Geometry" at the 2010 Joint meetings. We also expect participation in, or sponsorship of, a regularly occurring meeting on topics related to this SIAG, such as MEGA (Méthodes Effectives en Géométrie Algébrique) or ISSAC (the influential annual meeting organized by the ACM SIGSAM). We have already had preliminary discussions about possible joint activities with SIGSAM. This SIAG would also interact with other large-scale activities such as the European networks "SAGA : ShApes, Geometry and Algebra" (current) and a pending network on the geometry of complexity and statistics, some of whose organizers are among our endorsers. In fact, they suggested the possibility of a SIAG component to their network activities.

We will have a website and newsletter, which will serve as a catalyst/clearing house for meetings and other activities for this subject.

We plan in the late summer/early autumn of 2011 a week-long international meeting on applications of algebraic geometry held somewhere in the United States. This would follow the Spring 2011 semester at the Institut Mittag-Leffler on "Algebraic Geometry with a view towards applications". Because of the lead time needed to plan such a meeting, we will soon form a preliminary program committee to help decide on a venue for the meeting, to

invite some plenary speakers and to seek funding. We will keep the SIAM board infomed of this activity and welcome its input. Sottile has twice served on the program committee for the SIAM Discrete Mathematics meetings, so he is familiar with some of the SIAM requirements for speakers.

5. Algebraic Geometry and SIAM

This activity group will enhance SIAM goals by showcasing the emerging applications of algebraic geometry and related areas of pure mathematics, as well as the breadth of mathematics that can be brought to bear on applications. In return, having a SIAM activity group in algebraic geometry will provide these efforts additional legitimacy. Many who expressed interest in such an activity group pointed out that this would help them gain recognition within their academic departments. Since many of us have roots in and retain connections to pure mathematics, this SIAG would also help to minimize the perception of a gap between pure and applied mathematics. We emphasize, however, that our goals and activities will be focused squarely on applications.

6. Assessing the Activity Group

At the end of the first five year period of the activity group, we will assess its progress by analyzing the SIAG's membership size, monitoring attendance at the biennial meeting and at minisymposia organized at the joint and sectional meetings. Precise metrics will be negotiated with the SIAM Board.

7. Draft "Rules of Procedure"

This is contained in a separate document enclosed with this application.

8. Suggested Officers

- Chairperson: Frank Sottile, Professor of Mathematics, Texas A&M University.
- Vice-Chairperson: Elizabeth Allman, Associate Professor of Mathematics, University of Alaska–Fairbanks.
- Secretary: Seth Sullivant, Assistant Professor of Mathematics, North Carolina State University.
- Program Director: Daniel Bates, Assistant Professor of Mathematics, Colorado State University.
- Advisory Board:
    - Reinhard Laubenbacher, Professor, Virginia Bioinformatics Institute Professor, Department of Mathematics, Virginia Tech.
    - Pablo Parrilo, Finmeccanica Career Development Professor of Engineering, Dept. of Electrical Engineering and Computer Science, MIT.
    - Joachim Rosenthal, Professor of Applied Mathematics, Universität Zürich.
    - Andrew Sommese, Director, Center for Applied Mathematics, Professor of Mathematics, Notre Dame University.
    - Bernd Sturmfels, Professor of Mathematics, Statistics and Computer Science, University of California at Berkeley.

9. Thirty SIAM Endorsers

Gene Allgower	Dept. Mathematics, Colorado State University
Elizabeth Allman	Dept. Mathematics and Statistics, University of Alaska-Fairbanks
Chandrajit Bajaj	Director of Center for Computational Visualization, University of Texas, Austin
Daniel Bates	Dept. Mathematics, Colorado State University
Carl de Boor	Dept. Computer Science and Member NAS, University of Wisconsin
Tor Dokken	Chief Scientist, SINTEF, Universitet Oslo
Robert M. Fossum	Dept. Mathematics, University of Illinois, Urbana-Champaign
Marshall Hampton	Dept. Mathematics and Statistics, University of Minnesota-Duluth
Jonathan Hauenstein	Dept. Mathematics, Notre Dame/Texas A&M
William Helton	Dept. Mathematics, University of California, San Diego
Abdul Jarrah	Virginia Bioinformatics Institute, Virgina Tech
Erich Kaltofen	Dept. Mathematics, North Carolina State University
Sanjay Lall	Depts. Electrical Engineering, Aeronautics and Astronautics, Stanford University
Jean-Bernard Lasserre	CNRS Toulouse
Reinhard Laubenbacher	Virginia Bioinformatics group, Virginia Tech
Monique Laurent	Centrum Wiskunde & Informatica, Amsterdam
Tien-Yien Li	Dept. Mathematics, Michigan State University
Jesus DeLoera	Dept. Mathematics, University of California at Davis
Jiawang Nie	Dept. Mathematics, University of California, San Diego
Peter Olver	Dept. Mathematics and Institute of Technology, University of Minnesota
Pablo Parrilo	Finmeccanica Career Development Professor of Engineering Dept. Electrical Engineering and Computer Science, MIT
Chris Peterson	Dept. Mathematics, Colorado State University
John Rhodes	Dept. Mathematics and Statistics, University of Alaska-Fairbanks
Joachim Rosenthal	Dept. Mathematics, Universität Zürich
Phillip Rostalski	Control Lab, Swiss Federal Institute of Technology Zürich
Andrew Sommese	Director, Center for Applied Mathematics, Notre Dame University
Frank Sottile	Dept. Mathematics, Texas A&M University
Bernd Sturmfels	Depts. Mathematics, Statistics, and Computer Science, University of California, Berkeley
Madhu Sudan	Fujitsu Professor, Dept. of Electrical Engineering and Computer Science, MIT
Seth Sullivant	Dept. Mathematics, North Carolina State University

Appendix A. Non-members of SIAM expressing interest

Hélène Barcelo	Dept. Mathematics, Arizona State University, Deputy Director, MSRI
Saugata Basu	Dept. Mathematics, Purdue University
Joseph Brennan	Dept. Mathematics, University of Central Florida
Peter Bürgisser	Dept. Mathematics, Universität Paderborn
Gunnar Carlsson	Anne & Bill Swindells Professor, Dept. Mathematics, Stanford University
Marta Casanellas	Dept. Mathematics, Polytechnical University of Cataluña
Jan Draisma	CWI Amsterdam
Mathias Drton	Dept. Statistics, University of Chicago
David Eisenbud	Dept. Mathematics, University of California at Berkeley
Luis Garcia–Puente	Dept. Mathematics and Statistics, Sam Houston State University
Robert Ghrist	Depts. Mathematics & Electrical/Systems Engineering, University of Pennsylvannia
Ron Goldman	Dept. Computer Science, Rice University
Venkat Guruswami	Dept. Computer Science, University of Washington
Serkan Hosten	Dept. Mathemataics, San Francisco State University
Manfred Husty	Dept. Applied Geometry, Universität Innsbruck
Etienne de Klerk	Dept. Econometrics and Operations Res., Tilburg University
Anton Leykin	Dept. Mathematics, University of Illinois Chicago/Georgia Tech
Peter Malkin	Dept. Mathematics, UC Davis
Michael E. O'Sullivan	Dept. Mathematics and Statistics, San Diego State University
Dima Pasechnik	School of Physical & Mathematical Sciences, Nanyang Technological University, Singapore
Sonja Petrovic	Dept. Mathematics, Statistics, and Computer Science, University Illinois Chicago
Ragni Piene	Dept. Mathematics, University of Oslo
Victoria Powers	Dept. Mathematics, Emory University
Maurice Rojas	Dept. Mathematics, Texas A & M
Boris Shekhtman	Dept. Mathematics, University of South Florida
Hal Schenck	Dept. Mathematics, University of Illinois Urbana-Champaign
Peter Stiller	Assistant Director Institute of Scientific Computation Depts. Mathematics and Computer Science, Texas A&M
Thorsten Theobald	Dept. Mathematics, Universität Frankfurt
Rekha Thomas	Dept. Mathematics, University of Washington
Frank Vallentin	Centrum Wiskunde & Informatica, Amsterdam
Jan Verschelde	Dept. Mathematics, Statistics, and Computer Science, University of Illinois Chicago
Charles Wampler	General Motors Technical Center
Shmuel Weinberger	Dept. Mathematics, University of Chicago
Ruriko Yoshida	Dept. Statistics, University of Kentucky
Josephine Yu	Dept. Mathematics, MIT