

## CHARTER RENEWAL APPLICATION

This CHARTER RENEWAL APPLICATION applies to the SIAM Activity Group on Algebraic Geometry. The SIAG/AG was originally formed under the aegis of SIAM in July, 2009 by the SIAM Council and Board of Trustees. Its initial operating period began January 1, 2010 and ends December 31, 2011. This will be the first charter renewal for this activity group. SIAG/AG had 250 members as of December 31, 2010.

According to its Rules of Procedure, it is the purpose of the SIAM Activity Group on Algebraic Geometry to provide a research community gathering point for research in applications of algebra and geometry. The activity group will welcome participation from both theoretical mathematical areas and application areas not on this list which fall under these broadly interpreted notion of algebraic geometry and its applications.

Its purposed functions were to:

- (1) Organize minisymposia at the SIAM Annual Meeting in years where there is no SIAG Conference.
- (2) At least once every five years either organize a track of at least six minisymposia at the SIAM Annual Meeting or have an activity group meeting held jointly with the annual meeting. The VP for Programs and the VP at Large will coordinate the scheduling with the SIAG chair.
- (3) Organize a biennial SIAM Conference on Algebraic Geometry. The SIAG will consider dovetailing specialized workshops and conferences with the SIAM Annual meeting or other SIAG conferences. The chair of the conference organizing committee shall be either the program director or the chairperson of the SIAG or their designee. The organizing committee must be approved by the VP for Programs at least 16 months before the conference.
- (4) With the approval of the SIAM Program Committee, the SIAG may organize special sessions at SIAM meetings, and conduct special one- or two-day meetings immediately before or after a regular SIAM meeting. Other SIAG meetings may be organized only with the approval of the SIAM president and vice president for programs.

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The SIAG has complemented SIAM's activities and supported its proposed functions. The answers to the questions below indicate how this was accomplished and what the officers propose as the future directions for the SIAG.

1 How is the field covered by the activity group doing? Is it growing, is the focus shifting? What have been the significant advances over the last two years?

*This SIAG covers under one umbrella several rapidly-growing areas at the boundary of algebra/geometry/topology and applications. These areas have seen a steady influx of new researchers coming from less applied backgrounds while also finding many new areas of application. Given that there are several areas involved, each with their own focus, it is difficult to say whether the focus is shifting, but all areas are growing, both in population and, accordingly, in breadth and depth.*

*Given the diversity of the SIAG and our own limited knowledge, we cannot provide all significant advances. Here are four which represent some of the different research areas of the group. This is not comprehensive, but reflects more the scientific expertise of the current officers. These all came up in recent conferences. The first is just outside of the 2-year window.*

*a) Fazel, Recht and Parrilo extended compressed sensing to the matrix setting. This appeared in*

*the SIAM review, and involved notions from convex algebraic geometry.*

*b) De Loera, Sanyal, Sturmfels, and Vinzant recently used algebraic methods to describe completely the 'central path' in polyhedral interior point methods, obtaining better bounds on the length and curvature, and hence complexity of employing interior point methods for linear programming. The main value of this paper is the resulting theoretical understanding.*

*c) Using geometric methods, Landsberg and his coauthors have given the first lower bound on the determinantal complexity of the permanent. In Valiant's algebraic complexity theory  $N \neq NP$  is equivalent to exponential determinantal complexity, Landsberg's group have given a (low-degree) polynomial lower bound. Despite much activity an interest in this question, there have been no lower bounds until now.*

*d) In numerical algebraic geometry: Until last year, homotopy methods could provide the complex solution sets of polynomial systems without any sort of numerical certification. Over the past two years, algorithms have been developed to find the real solution sets (Hauenstein) and to certify at least nonsingular, isolated solutions (Beltran/Leykin and Hauenstein/Sottile). These two advances make homotopy methods far more useful to scientists and engineers with polynomial systems to be solved and to algebraic geometers seeking certified solutions, respectively.*

2. How is the activity group doing? Is it remaining vibrant? Is the size of the SIAG stable or increasing? How is the SIAG keeping up with the changes in the field? How are the broader interests of SIAM reflected in the activities of the SIAG?

*The activity group is continuing to grow rapidly, and we expect that it will have a burst of growth in the wake of our inaugural meeting. We had about 250 members as of December 31, 2010. There is still a significant buzz about the SIAG in the community, undoubtedly helped by the fact that many researchers from the fields represented by the SIAG met together at Institut Mittag-Leffler for a special semester in Spring 2011. Young researchers (late grad students - assistant professors) are very active in the group, as evidenced by the large number of them organizing minisymposia for and/or speaking at AG11. We hope that after the meeting in October, the membership will swell; there are many fields represented at the meeting with few SIAG members. This is particularly true of coding/cryptography and applications of topology, areas with plenary speakers and organized sessions at that meeting. With over 270 talks in minisymposia, we believe this analysis is correct.*

*The SIAG is easily keeping up with changes in the field as most of the leaders of the various fields are strongly connected to the SIAG and/or AG11. This SIAG serves as a portal through which mathematicians who have not yet developed applied interests can interact with those who have, often bringing fresh ideas to the areas represented by the SIAG. We are also working to bring in researchers from the broad spectrum of areas we represent into the SIAG. Because the SIAG originated from a core group of people with related interests, this is an ongoing process.*

*We feel that by showcasing these newer applications of mathematics, we are bringing new people into contact with SIAM, both with respect to areas of mathematics, but also internationally. The meeting in October will be the largest meeting in algebraic geometry since 2005 (which was a 3-week affair), and it will have significant international participation, particularly from Europe; without checking, I can recall 9 or 10 (of 55) minisymposia organized from Europe. The application areas represented by the SIAG are also benefitting enormously from our affiliation within SIAM; simply put it gives additional legitimacy to our research activities.*

3. Please list conferences/workshops the activity group has sponsored or co-sponsored over the past two years, and give a brief (one sentence or phrase) indication of the success or problems with each.

*The SIAG/AG is organizing the SIAM Conference on Applied Algebraic Geometry (AG11) which will meet in Raleigh, NC, in October 2011. See <http://www.siam.org/meetings/ag11/> for details. We have 55 minisymposia lined up, with around 300 attendees, not all of whom are SIAM members yet. We are expecting a diverse and enjoyable meeting. One problem that has come to pass and should be remembered in the future is that AG11 was scheduled over the weekend of Yom Kippur, limiting the availability of some participants. Sottile takes responsibility for this blunder.*

4. Please indicate the number of minisymposia directly organized by the activity group at the two SIAM Annual Meetings. When did the SIAG last organize a track of minisymposia at an annual meeting?

*Three, both double, in 2010 (Algebraic statistics (Yoshida), Numerical algebraic geometry (Bates/Wampler), and convex algebraic geometry (Sottile)). We did not organize any in 2011 since we have our SIAG conference in October and this year is the ICIAM. We have not yet organized a track at an annual meeting, but are scheduled to do so in 2012. Sottile is in charge of that.*

5. Please indicate other activities sponsored by the activity group, to include newsletters, prizes and web sites. Have each of these been active and successful?

*We send an e-newsletter approximately quarterly. We have received little feedback on the newsletter as the goal of the newsletter is simply to pass along information about upcoming events and such. We have had a similar experience with our SIAM wiki page.*

*We are also considering a prize for the AG11 poster session.*

6. What activities are planned and proposed for the next period of the charter? Please describe scheduled and suggested future activities in detail.

*Since the next set of officers will be elected before October, we are anticipating discussing this with them at AG11. However, we are planning on holding another SIAM Conference on Applied Algebraic Geometry in Fall 2013 (location as yet undetermined), a track of minisymposia at AN12, and another at AN14 (see purpose (2) above).*

*We have corresponded with the Optimization and the Geometric Design SIAGs about including minisymposia in one another's biennial meetings. We have several at our meeting in optimization and geometric modeling, but the Geometric Design meeting is too close to our October meeting, and the Optimization was too early for us to reciprocate this year. There was however a minisymposium at the Optimization SIAG meeting in May related to convex algebraic geometry, and several at the 2010 Discrete Mathematics meeting. There should be much more of this in the future, once we become more experienced, and develop deeper connections within SIAM.*

7. How can SIAM help the activity group achieve its goals?

*SIAM has already been most helpful, and the leaders of our community look forward to continuing our relationship with SIAM.*

8. How can the activity group help SIAM in its general role of promoting applied mathematics and computational science?

*As discussed previously, we are an obvious SIAG to escort not-so-applied mathematicians to the door of applied mathematics. Many of us work at the boundary between very applied people and not-so-applied people, so we naturally support this transition on an individual basis. We also maintain close ties to the pure sides of algebraic geometry, commutative algebra, number theory, and topology, and will therefore be a conduit for a healthy spectrum of theory and applications to flow laterally in those fields. On a community scale, the existence of our biennial meetings provides an opportunity to invite fresh faces to give talks to our community, exposing researchers to applied problems that might catch their interest.*

This SIAG requests that the SIAM Council and Board of Trustees renew its charter for a two-year operating period beginning January 1, 2012.

Signed  
Frank Sottile  
Daniel Bates  
22 June 2011