

## CHARTER RENEWAL APPLICATION - SIAG/AG

- > 1. List all current officers of the activity group (including > advisory board, if relevant).

Chair: Seth Sullivant (1/1/12 - 12/31/13)

Vice Chair: Iwan Duursma (1/1/12 - 12/31/13)

Program Director: Anton Leykin (1/1/12 - 12/31/13)

Secretary: Jan Draisma (1/1/12 - 12/31/13)

Advisory Panel: Gunnar Carlsson, Reinhard Laubenbacher, Pablo Parrilo, Joachim Rosenthal, Andrew Sommese, Bernd Sturmfels

- > 2. 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/three] years?

Applied algebraic geometry is a vibrant and growing field. Evidence of this is that the AAG2013 meeting will be significantly larger than the AAG2012 meeting. Part of that expansion is in areas already covered in the previous meeting, for example, there appear to be more sessions on numerical algebraic geometry in the upcoming meeting, and an area that is undergoing significant expansion. Also, some areas that were not previously represented will have sessions in the upcoming meeting (e.g. coding theory). All of this bodes well for the health of the activity group and the areas it represents.

Some significant advances in the past few years are highlighted in the plenary talks at the AAG2013 meeting in August. For example, the work of Blekherman and collaborators have related to fundamental classification theorems in algebra (varieties of minimal degree and sums of square characterization of positive polynomials). Sandra Di Rocco will discuss advances in numerical methods for algebraic geometry that allow for the computation of complex invariants of algebraic varieties. Carsten Wiuf will discuss how methods from algebraic geometry can be used to analyze properties of dynamical systems from systems biology.

List of Session Titles 2011 and 2013 meetings.

AG11 (29)

Advances in Numerical Algebraic Geometry.  
Algebraic aspects of quantum computing.

Algebraic Complexity.  
Algebraic Geometry Applied to Celestial Mechanics.  
Algebraic Geometry in Convex Optimization.

Algebraic Geometry of Tensor Decompositions and its Applications.  
Algebraic Geometry, Moments and Optimization.  
Algorithms in Real Algebraic Geometry and their Applications.  
Applications in Mathematical Biology.  
Applications of Algebraic Geometry to Coding Theory and Cryptography.

Application of Algebraic Geometry to Image and Signal Processing.  
Applications of Numerical Algebraic Geometry.  
Approximate Algebraic Methods.  
Arithmetic Aspects of Numerical Solving.  
Biochemical Reaction Networks.

Categorical Data: Contingency Tables and Network Structures.  
Combinatorial Structures in Algebraic Statistics.  
Exact Linear Algebra.  
Graphical Statistical Models.  
Infinite-dimensional systems of polynomial equations with symmetry.

Interactions Among Algebraic Geometry, Geometric Modeling, and Approximation Theory.  
Locally Refined Splines, Spline Space and Isogeometric Analysis.  
Persistent homology: applications, computation, recent developments.  
Persistent homotopy: point clouds, filtrations and homotopies.  
Riemann Theta Functions.

Sparse Statistics and Optimization.  
Subdivision Methods in Numerical Algebraic Geometry.  
Symbolic Combinatorics.  
Tropical Geometry.

AG13 (44)

Algebraic Aspects of Biochemical Reaction Networks.  
Algebraic Aspects of Large-Scale Statistics.  
Approximation Theory, Geometric Modeling, and Algebraic Geometry.  
Algebraic Geometry and Phylogenetics.  
Algebraic Geometry of Tensors.

Algebraic geometry, moment problems and applications.  
Algebro-geometric approaches to tensor spaces, tensor decomposition, and identifiability.  
Algorithms in Numerical Algebraic Geometry.

Algorithms in Real Algebraic Geometry and its Applications.  
Applications of Computational and Numerical Algebraic Geometry to Theoretical Physics.

Applications of Numerical Algebraic Geometry (2013).  
Applications to image processing and shape analysis.  
Applications to phase retrieval and low-rank matrix recovery.  
Applied and Computational Topology.  
Arithmetic Geometry.

Coding Theory.  
Combinatorial Algebraic Statistics.  
Combining Convex and Algebraic Geometry in Singular.  
Complexity of Polynomial System Solving.  
Computational aspects of moving frames.

Computations and effective bounds in commutative algebra.  
Computing Sparse Approximate Models from Values.  
Developments in Cylindrical Algebraic Decomposition and Quantifier Elimination.  
Exact Certificates in Nonlinear Global Optimization.  
Effective methods in D-modules and singularities.

Exact Linear Algebra Algorithms.  
Formulas in Interpolation.  
Geometry of Statistical Models.  
Hyperbolic Polynomials.  
Hypergeometric Differential Equations and Statistics.

Identifiability Problems in Biology and Statistics.  
Number Theory and Algebraic Curves.  
Numerical and Classical Algebraic Geometry.  
On Coppersmith's heuristic algorithm for finding roots of multivariate polynomials.  
Polynomial problems in computer vision.

Post-Quantum Cryptography.  
Real algebraic geometry and optimization.  
Singular Learning Theory.  
Software for Algebraic Geometry: Macaulay2.  
Symbolic Combinatorics (2013).

Symbolic-numerical Methods for Approximate Polynomial Interpolation.  
Tensor Networks.  
Toric geometry, Lattice points, and Applications.  
Tropical Geometry and Combinatorics in Dynamical Systems.

> 3. 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?

250 members, including 156 student members, as of 12/31/2010

281 members, including 144 student members, as of 12/31/2012

> 4. Please list conferences/workshops the activity group has  
> sponsored or co-sponsored over the past three years, and give a brief  
> (one sentence or phrase) indication of the success or problems with  
> each. The SIAG on Algebraic Geometry organizes the biennial conference on  
> Applied Algebraic Geometry. This list of conferences may be found at:  
> <http://www.siam.org/meetings/archives.php#AAG>.

2011 SIAM Conference on Applied Algebraic Geometry (29 minisymposia topics, 55 sessions,  
365 attendees)

290 paying attendees and 75 students

2013 SIAM Conference on Applied Algebraic Geometry (44 minisymposia topics, 87 sessions,  
around 400 attendees)

> 5. Please indicate the number of minisymposia directly organized by  
> the activity group at the last two SIAM annual meetings. When did the  
> SIAG last organize a track at an annual meeting or meet jointly with the  
> SIAM Annual Meeting?

11 minisymposia (around 40 talks) organized as a track at SIAM AN12  
0 minisymposia organized at the SIAM AN11/ ICIAM11.

> 6. Please indicate other activities sponsored by the activity  
> group, to include newsletters, prizes and web sites. Have each of these  
> been active and successful?

Newsletters were sent out in March 12, June 12, November 12, March 13.

(Successful as forum for announcing news about the group and upcoming  
conferences)

Web site <http://www.siam.org/activity/ag> and  
wiki [http://wiki.siam.org/siag-ag/index.php/Main\\_Page](http://wiki.siam.org/siag-ag/index.php/Main_Page)

(Successful as a homepage for the group and to post announcements and links, but probably not very well used. How to advertise better?)

- > 7. What activities are planned and proposed for the next period of the charter? Please describe scheduled and suggested future activities in detail.

Two different sites have submitted plans to host the

2015 SIAM Conference on Applied Algebraic Geometry

The actual site will be decided shortly after this years conference

- > 8. How can SIAM help the activity group achieve its goals?

The group is interested in starting a dedicated SIAM journal. We plan to bring this up for discussion at the business meeting of AAG13 in August to gauge interest from the membership. We would be interested in learning more about what is involved from SIAM.

- > 9. How can the activity group help SIAM in its general role of promoting applied mathematics and computational science?

Through its meetings and other activities the group bundles various research topics within the general area of applied algebraic geometry.

On their own these topics would need to meet as smaller specialized workshops or as part of larger general conferences.

Bundling the topics through the activity group has made it possible to organize large coherent conferences that have benefitted the connections and that make the overall impact of the various topics much more visible.