

CHARTER RENEWAL APPLICATION FOR THE SIAM ACTIVITY GROUP ON LINEAR ALGEBRA

This CHARTER RENEWAL APPLICATION applies to the SIAM Activity Group on Linear Algebra. The SIAG/LA was originally formed under the auspices of SIAM on July 19, 1982 by the SIAM Council and July 20, 1982 by the SIAM Board of Trustees. Its initial operating period began January 1, 1983 and ended December 31, 1985. Its charter has been renewed by the Council and Board ten times thereafter. This SIAG has 816 members, including 415 student members, as of 12/31/2017.

According to its Rules of Procedure, the objectives of the SIAM Activity Group on Linear Algebra are to identify and explore the links between linear algebra and other applied sciences, to stimulate the applications of linear algebra, and to foster research in linear algebra and its applications. Within the framework of SIAM, the group will conduct activities that implement its purposes.

Its purposed functions are:

The SIAG/LA will organize activities in Linear Algebra. The SIAG is expected to:

- (1) Subject to the conditions of ARTICLES III and IV, the SIAM Activity Group on Linear Algebra will conduct sessions at regular SIAM meetings, conduct special meetings, and participate in organizing publications in the areas of linear algebra and its applications.
- (2) The SIAG shall not present awards or otherwise recognize scientific achievement, professional service, or the like without prior approval by both the SIAM Major Awards Committee and the SIAM Council of the award criteria; the method of selection of recipient(s), the nature of the award, and all other aspects, if any, of each such award must have the prior approval of the SIAM Board of Trustees.

Other activities can include:

- (3) Organize minisymposia at the SIAM Annual Meeting in years where there is no SIAG conference.
- (4) 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.
- (5) Organize a triennial SIAM Conference on Applied Linear Algebra. 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.

- (6) 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.
- (7) Award the triennial SIAG Linear Algebra Prize, established in 1987.
- (8) Award the triennial SIAG Early Career Prize, established in 2017.
- (8) Maintain a website for the activity group (<http://siags.siam.org/siagla/>).

Since the last Charter renewal, the SIAG has complemented SIAM's activities and supported the above mentioned 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) List all current officers of the activity group (including advisory board, if relevant).

Chair: James Nagy

Vice Char: Alison Ramage

Program Director: Melina Freitag

Secretary: Jennifer Pestana

- (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 three years?

Applied Linear Algebra is fundamental to most areas of computational science and remains as a very active research area. The discretization of an optimization problem or a partial differential equation almost always leads to a matrix computation. Large scale computational problems prevail: Internet, data analysis and machine learning applications give rise to linear systems and eigenvalue problems whose matrix dimensions are in the hundreds of billions. Data-intensive applications in biology, chemistry, nuclear engineering, and data mining give rise to high dimensional tensors that overwhelm the computational capabilities of current systems. Many model reduction and data compression ideas fall within the domain of numerical linear algebra and are recurring themes throughout scientific computing. Structure preserving matrix methods are crucial for the reliable solution of practical scientific and engineering problems, including image processing. Nonlinear eigenvalue problems from civil and mechanical engineering pose substantial theoretical and algorithmic challenges.

Core problems in applied mathematics with active research in areas covered by the SIAG/LA (e.g., numerical linear algebra and matrix analysis) include:

- *Nonlinear eigenvalue problems*
- *Tensor algorithms and analysis*
- *Domain decomposition and multilevel methods*
- *Krylov space methods for linear systems and eigenvalue problems*
- *Algorithms for structured matrices*

- *Linear techniques in model order reduction*
- *Computation of matrix functions*
- *Randomized algorithms*
- *Inverse problems*
- *Application to optimization, differential equations, signal and image processing, control, electronic structure calculations, data analysis, information retrieval, bioinformatics, as well as structural, mechanical and aerospace engineering.*

Future directions that are likely to receive substantial attention by researchers in Applied Linear Algebra include:

- *The contribution of numerical linear algebra to the development of efficient methods in machine learning, including deep convolutional neural networks.*
 - *The contribution of numerical linear algebra to the development of efficient methods in data mining, search engine technology, and information retrieval.*
 - *The contribution of numerical linear algebra to network science, and computations of matrix functions.*
 - *The steadily increasing importance of parallel computing and algorithms that can reliably achieve exascale computing.*
 - *Fundamental role of numerical linear algebra in designing communication avoiding algorithms.*
 - *The severe limitations imposed by floating point accuracy on extreme matrix computations, such as those arising in search engine applications.*
 - *The development of numerical methods in multilinear algebra for pattern identification, low rank approximations in high-dimensional data sets, and efficient solutions of matrix equations.*
 - *The contribution of numerical linear algebra to the development of efficient methods in the area of Uncertainty Quantification, e.g. data assimilation, Bayesian inverse problems, optimization under uncertainty.*
- (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?

The activity group had 816 members at the end of 2017, up from the 600 at the end of 2014. The increase was mainly due to increased efforts to recruit student members, which currently number 317 (up from 197 at end of 2014). The SIAG has been very active, with involvement in several conferences, including the Householder Symposium HHXIX (see below), Gene Golub SIAM Summer School, the SIAG/LA Prize, the newly established SIAG/LA Early Career Prize, the Newsletter, etc. The SIAG/LA is keeping up with changes in the field by organizing and soliciting minisymposia and tracks at SIAM conferences on emerging topics, by selecting researchers at the forefront of these fields as plenary speakers at the SIAM Applied Linear Algebra Conference (as well as ILAS), and by soliciting proposals

for the Gene Golub SIAM Summer School. The broader interests of SIAM are served by the SIAG in various ways, for instance organizing minisymposia on applications of linear algebra that have considerable overlap with other areas of applied and industrial mathematics, such as optimization, inverse problems, image processing, uncertainty quantification (UQ), data mining, PDEs, etc. Finally, the SIAG/LA solicits submission of articles on linear algebra to SIAM News.

- (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/LA organizes the triennial conference on Applied Linear Algebra. A list of these conferences may be found at: <http://www.siam.org/meetings/archives.php#LA>.

Since the last charter renewal application was approved, two SIAM ALA Conferences have been organized: one in Atlanta, Georgia, the Twelfth SIAM Conference on Applied Linear Algebra, October 26-30, 2015, and the second in Hong Kong, the Thirteenth SIAM Conference on Applied Linear Algebra, May 4-8, 2018. Both conferences were extremely successful, each having more than 400 registered participants (the only SIAM ALA conference to have more participants was the 2012 meeting in Valencia, Spain, which had a little over 500 registered participants).

A highlight of the conference is awarding of the SIAG/LA Linear Algebra Best Paper Prize, and the newly established SIAG/LA Early Career Prize (the first award was presented at the 2018 conference in Hong Kong).

The vibrancy of the field is reflected in the success of the Householder Symposium, which continually has more applications than can be accommodated in the traditional small conference setting (in 2014 157 invitations were made from 289 applications, and in 2017 158 invitations were made from 184 applications). The SIAG/LA maintains its active involvement in the ILAS Conferences which usually consists of selecting one of the plenary speakers, to be identified as “the SIAG/LA Speaker” on the conference materials; SIAM covers all the expenses for this speaker. The SIAG/LA sponsored Fernando de Terán for ILAS 2016, and Stefan Güttel for ILAS 2017.

The SIAG/LA endorsed (“in cooperation”) the conferences: Sixth IMA Conference on Numerical Linear Algebra and Optimization, University of Birmingham, UK, June 27-29, 2018; Householder Symposium XX, The Inn at Virginia Tech, Blacksburg, Virginia, June 18-23, 2017; International Conference On Preconditioning Techniques For Scientific And Industrial Applications, Eindhoven, The Netherlands, June 17-19, 2015.

- (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 of minisymposia at an annual meeting or meet jointly with the SIAM Annual Meeting?

The SIAG/LA solicited minisymposia at the following meetings: SIAM AN14 (five minisymposia - ten sessions), and ICIAM 2015 (five minisymposia).

The SIAG/LA organized a track of minisymposia at SIAM AN16, which included five minisymposia and one minisymposium (Françoise Tisseur was representing the SIAG/LA on the Scientific Committee).

Although the SIAG/LA held its triennial SIAM ALA Conference in May 2018, the Annual Meeting organizers still requested that we solicit minisymposia and minisymposteria for the meeting in Portland. We managed to recruit 6 different SIAG/LA minisymposia, with 11 parts total, and one minisymposterium (with 5 different posters).

There has never been a SIAM ALA meeting held jointly with a SIAM AN meeting.

- (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?

The SIAG/LA Prize for the best paper in the field of applied linear algebra is awarded every three years at the SIAM ALA meeting.

The 2015 prize was awarded to David Bindel and Amanda Hood [“Localization Theorems for Nonlinear Eigenvalue Problems”, SIMAX, 34(4), 1728-1749, 2013]. James Nagy was Chair of the Prize Committee.

The 2018 prize was awarded to Jiawang Nie [“Generating Polynomials and Symmetric Tensor Decompositions”, Foundations of Computational Mathematics 17(2): 423-465 (2017)]. Alison Ramage was Chair of the Prize Committee.

The SIAG/LA Early Career Prize (established in 2017) is awarded every three years at the SIAM ALA meeting to recognize an individual who has made outstanding, influential, and potentially long-lasting contributions to applicable linear algebra.

The 2018 prize was awarded to Alex Townsend, Assistant Professor, Cornell University. James Nagy was Chair of the Prize Committee.

Jennifer Pestana manages the SIAG/LA website and compiles and sends out the newsletter. The SIAG/LA web site is located at: <http://siags.siam.org/siagla/index.html>.

The website automatically lists upcoming conferences, job postings, SIAG/LA paper awards, and recent SIMAX papers based on simple text data files in a publicly accessible repository.

The SIAG also maintains a Twitter account (@siagla) which also alerts members to upcoming conferences, job postings and other relevant announcements.

In 2008 the SIAG/A sponsored the first International Summer School on Numerical Linear Algebra (ISSNLA); see <http://siags.siam.org/siagla/meetings/summer.html>. The purpose of ISSNLA, which was initiated in 2008, is to focus on Numerical Linear Algebra (NLA), with the idea that an ISSNLA would occur approximately every three years.

The Gene Golub SIAM Summer School (G2S3) was initiated in 2010 and occurs every year. It is not required to have an NLA focus, but often does. Specifically: “If there are two consecutive years without a school in numerical linear algebra, then in the following year preference will be given to a proposal with a computational linear algebra theme, provided there is a meritorious proposal, but proposals in all areas will be considered.”

Note that G2S3 comes with a substantial amount of funding (approximately \$100,000), but in the case of ISSNLA it is up to the organizers to secure funding. However, it is often the case (2010, 2013, and 2017) that the ISSNLA and G2S3 were formally paired, and so the main source of funding for ISSNLA actually came from G2S3. In addition, the 2015 G2S3 had a strong NLA focus.

With this background in mind, in 2017 the SIAG/LA officers proposed to the SIAG/LA members that the ISSNLA be formally discontinued so that the SIAG/LA could focus only on soliciting and backing G2S3 proposals of interest to SIAG/LA members. If SIAG/LA members wish to submit a proposal to G2S3, and would like to have formal backing of the SIAG/LA, then they must request this backing before the G2S3 submission deadline, so that the SIAG/LA Officers have sufficient time to review all such requests. Feedback was solicited from members via the SIAG/LA News Digest, and the overwhelming response was in favor of this proposal.

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

The main events planned are: SIAM ALA 2021. The SIAG/LA Officers solicited input from all members on proposed locations for the meeting, and had further discussion during the SIAG/LA Business Meeting at the SIAM ALA 2018 conference. A formal proposal to host the meeting in Leuven Belgium was received, and various cities in the U.S. have been proposed. The SIAG/LA Officers will complete the work on finalizing location, date and conference co-chairs in summer, 2018.

In addition, the SIAG/LA is involved in the 2019 ILAS Conference (Rio de Janeiro, Brazil, July 8-12), and the 2020 Householder Symposium (Selva di Fasano Italy, June 14-29). As previously mentioned, SIAG/LA members have submitted minisymposia proposals for the SIAM Annual meeting in 2018, and will continued to do this in future annual meetings.

It should be mentioned that the four current SIAG/LA officers are reaching the end of their term in December 2018; a nominating committee will be formed to identify candidates for the four officer positions. Election of new officers will take place in the Fall of 2018.

- (8) How can SIAM help the activity group achieve its goals?

It would be helpful to be prompted about important to-do items, such as when to form the nomination committee for the next election of SIAG officers.

In addition, when a SIAG has a whole new set of officers, it is difficult for them to know precisely all of the critical activities that should be addressed during their term. It would be helpful if SIAM could work with SIAG officers to prepare a list of critical items, which could be continually updated, archived by SIAM, and passed on to newly elected officers. We initiated such a list for internal SIAG/LA use, but formally coordinating with SIAM would be helpful in making sure the list remains current. This list of critical activities could also serve SIAM as a mechanism for sending out reminders to SIAG officers when certain critical activities need to be done.

It would be helpful if the new secretary was immediately given administrative rights for the electronic mailing list. In the previous transition, the out-going secretary had to deal with posts to the mailing list for the first six weeks or so.

- (9) How can the activity group help SIAM in its general role of promoting Linear Algebra?

The SIAG/LA has been very active in terms of conference organization and co-sponsorship, minisymposia and tracks at other meetings, the award of the SIAG/LA Prize, the Summer Schools, the web site and the Newsletter. The SIAG/LA web site and Newsletter are

particularly important for providing mechanisms to advertise conferences, summer schools, workshops, and jobs related to Linear Algebra.

This SIAG requests that the SIAM Council and Board of Trustees renew its charter for a three year operating period beginning January 1, 2019.



James G. Nagy
SIAG/LA Chair
1 June 2018