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 twelve times thereafter. This SIAG has 585 members, including 216 student members, as of 12/31/2023.

According to its Rules of Procedure, the objective(s) of the SIAM Activity Group on Linear Algebra is 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 were:

The SIAG on 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/).

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

> *Chair: Melina A. Freitag*
> *Vice Char: Silvia Gazzola*
> *Program Director: Agnieszka Międlar*
> *Secretary: Arvind K. Saibaba*

(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 a very active research area, as it is fundamental to most areas of computational science and engineering. The discretization of a (stochastic) partial differential equation almost always leads to a matrix computation. Moreover, large scale computational problems arise in data intensive problems, such as the optimisation problem for training of deep neural networks. Morover, graph and network analysis, as well as 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 order 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) includes:*
>
> - *Randomized algorithms*
> - *Tensor algorithms and analysis, with applications to temporal and multi-modal data*
> - *Numerical linear algebra in the continuous with application to learning, e.g., to learn operators*

- *Machine learning for numerical linear algebra*
- *Mixed-precision arithmetic for more efficient computations*
- *Quantum algorithms and their practical applications in numerical linear algebra*
- *Nonlinear eigenvalue problems*
- *Domain decomposition and multilevel methods*
- *Krylov subspace methods for linear systems and eigenvalue problems*
- *Algorithms for structured matrices*
- *Dimension reduction for high dimensional problems.*
- *Computation of matrix functions*
- *Inverse problems*
- *Network analysis*
- *Application to optimization, differential equations, Bayesian methods, signal and image processing, control, electronic structure calculations, data science, 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 data science and machine learning, including data assimilation and physics-based machine learning.*
- *The contribution of numerical linear algebra to Bayesian inference, in particular in hierarchical settings.*
- *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 development of numerical methods in multilinear algebra for pattern identification, low rank approximations and dimension reduction in high-dimensional data sets.*

(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 585 members at the end of 2023, down from the 779 at the end of 2020. There has been a decrease in both the non-student and student members, the latter being more noticeable and consistent in the past three years. Overall the size of the SIAG has been decreasing almost linearly in the past six years, except for a small increase between 2019 and 2020. The SIAG has been very active in harvesting nominations for, and running, both the SIAG/LA Prize and the SIAG/LA Early Career Prize. Emerging from the pandemic,

with many well-established conferences resuming in presence or in a hybrid format, 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 data science, optimization, inverse problems, image processing, uncertainty quantification (UQ), 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.

The SIAM Conference on Applied Linear Algebra will be organised by SIAM and the Co-Chairs Laura Grigori and Daniel Kressner at Sorbonne University in Paris, France, from May 13-17 2024.

A highlight of the conference will be the award of the SIAG/LA Linear Algebra Best Paper Prize, and the SIAG/LA Early Career Prize.

The E-NLA online seminar series, dedicated to topics of Numerical Linear Algebra continued until May 2022. https://sites.google.com/view/e-nla/home *It was started by members of the SIAG in April 2020 was endorsed by SIAM, and featured many eminent speakers in NLA. The channel* https://www.youtube.com/channel/UCl3AmvN5JwD4FUJn2aLKDZQ/videos *on youtube with an archive of the talks is still popular.*

In addition, the SIAG/LA has co-sponsored or endorsed several other linear algebra conferences over the last three years:

The XXI Householder Symposium on Numerical Linear Algebra (June 12-17, 2022 in Selva di Fasano, Italy), the 7th IMA Conference on Numerical Linear Algebra and Optimization (June 29 - July 1, 2022 in Birmingham, UK), the 24th ILAS Conference in Galway, Ireland (June 20-24, 2022) and the 2th ILAS Conference in Madrid, Spain (June 12-16, 2023).

The SIAG/LA maintains its active involvement in the ILAS Conferences with 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 Misha Kilmer for ILAS in 2022 in Galway and Elias Jarlebring for ILAS 2023 in Madrid. Haim Avron will be the SIAG/LA Speaker at the 26th ILAS conference in Kaohsiung, Taiwan (June 23-27, 2025).

(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 organized a track of minisymposia at SIAM AN22 in Pittsburgh, which included five minisymposia. ICIAM 2023 in Tokyo had eleven minisymposia.

There has never been a SIAM ALA meeting held jointly with a SIAM Annual 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 2024 prize will be awarded to Nicolas Boullé (University of Oxford, UK) & Alex Townsend (Cornell University, USA) for their paper ["Learning Elliptic Partial Differential Equations with Randomized Linear Algebra," Foundations of Computational Mathematics, Volume 23, pages 709–739, (2023)]. Silvia Gazzola 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 2024 prize was awarded to John Urschel (Massachusetts Institute of Technology, USA). Melina Freitag was Chair of the Prize Committee.*

Arvind Saibaba manages the SIAG/LA website which is located at: http://siags.siam.org/siagla/index.html. *No newsletters are sent out as the SIAM Engage platform is used for announcements. A presence on X (formerly Twitter) is maintained to announce news, meetings and other activities. However, we are planning to transition from X to LinkedIn which we feel is more suitable to SIAG/LA.*

In 2024 the Gene Golub SIAM Summer School is on "Iterative and Randomized Methods for Large-Scale Inverse Problems", a topic very much of interest to the SIAG. It takes place in Quito, Ecuador from 22 July - 2 Aug, 2024. Most of the organizers are members of our SIAG.

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

The SIAG/LA program officers are in the planning stages of SIAM ALA 2024, which will be tentatively held in the US. The SIAG/LA Officers will solicit input from all members on proposed locations for the meeting during the SIAG/LA Business Meeting, to be held at SIAM ALA 2024 in Paris. The officers are currently identifying program chairs and plan to continue working on finalizing location, date and conference co-chairs in 2023.

Additionally, the SIAG/LA will be involved in the planning stages of the following conferences:

> – *2025 ILAS Conference (Taiwan, June 23-27, 2025)*
> – *2025 Householder Symposium (Cornell, June 8 – June 13, 2025)*

The four current SIAG/LA officers are reaching the end of their term in December 2023; 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 2023.

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

We would like to SIAG/LA to have an institutional memory, that can serve incoming officers. For example, SIAM could work with SIAG officers to prepare a list of critical items, and a calendar, which could be continually updated, archived by SIAM, and passed on to newly elected officers.

It would be good to have greater transparency regarding how the SIAG/LA membership fees are used, and for the officers to have a say in how the fees are being used.

While we understand SIAM itself is facing some decrease in membership, the SIAG/LA officers are concerned of losing membership to other SIAGs that have overlapping interests with SIAG/LA (e.g., Computational Science and Engineering, Data Science, Equity Diversity and Inclusion, Uncertainty Quantification). This "competition" has led to a reduced pool of participants at all levels of our SIAG, including nominations for and committee members of the prizes. We hope for a greater participation in our SIAG, which we believe has a wider interest than is currently reflected by our membership.

(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 current composition of SIAG/LA is very Europe and North-American centric. We would like to see increased participation from other areas of the world, where we know linear algebra-related activities are pursued.

This SIAG requests that the SIAM Council and Board of Trustees renew its charter for a three year operating period beginning January 1, 2025.

Melina A. Freitag, Silvia Gazzola and Arvind K. Saibaba
SIAG/LA Chair, Vice-Chair and Secretary
1 May 2024