SIAM Activity Group Applied and Computational Discrete Algorithms

Charter Renewal Application

This CHARTER RENEWAL APPLICATION applies to the SIAM Activity Group on Applied and Computational Discrete Algorithms. The SIAM Activity Group (or SIAG) to which this renewal applies was originally formed under the aegis of SIAM in December by the SIAM Council and December 8, 2018 by the SIAM Board of Trustees with its initial operating period beginning January 1, 2019 and ending December 31, 2020. Its charter has been renewed by the Council and Board twice thereafter.

This SIAG has 395 members, including 264 student members, as of December 31, 2023.

According to its Rules of Procedure, the objective(s) of the SIAG are to foster activity and collaboration on the computational solution of combinatorial problems arising in many application areas. It seeks to promote the formulation of computational problems from application areas in terms of combinatorial models, the development of theory and algorithms to solve these problems, the implementation of the algorithms in software, and the deployment of the software in the application domains. The SIAG will bring together mathematicians, computer scientists, statisticians, scientists, and engineers from academia, the national and other research labs, and industry to promote research in applied and computational combinatorics. The SIAG will organize a biennial conference on Applied and Computational Discrete Algorithms, sponsor minisymposia at the SIAM Annual Meeting, and maintain an electronic discussion group.

Its purposed functions were:

1. Organize minisymposia at the SIAM Annual Meeting and ICIAM in years where there is no SIAG conference.
2. At least once every seven 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 Applied and Computational Discrete Algorithms. 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. Other SIAG meetings may be organized only with the approval of the SIAM president and vice president for programs.

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.

List all current officers of the activity group
Chair: Blair D. Sullivan
Vice Chair: Michael Bender
Program Director: Bora Uçar
Secretary: Kathrin Hanauer

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?

The areas covered by the SIAG (applied discrete mathematics, combinatorial scientific computing, algorithm engineering, combinatorial optimization, algorithmic differentiation, parts of theoretical computer science, and others) are growing in importance as graph and other discrete/combinatorial algorithms become a significant component of many emerging applications. There has been a notable shift over the last decades from development of scalable discrete methods being primarily in support of other computational problems (e.g. CSC and AD) to targeting large network/data analysis problems directly. Applications beyond scientific computing include data analytics, scientific machine learning, computational biology, computational social science, and cyber-security. As with many other research areas in computing, the significant work in the areas of machine learning and artificial intelligence has had an unavoidable impact – in particular, there is significant discussion in the ACDA community about how shifts in hardware architecture to better support AI tasks impact performance and scalability of graph algorithms. The field is active and new applications for discrete algorithms continue to gain importance.

The activity group covers a very broad set of fields and research communities, making it challenging to identify "the" significant advances. One trend that has emerged is the blending of AI (really machine learning) into the field of discrete optimization – which historically has not embraced these techniques (in part due to the lack of explainability). The future impact on both theory and practice in the area is still unclear. In the area of algorithmic differentiation, work on the Enzyme framework (which allows compiler-specific code generation) won Best Student Paper at Supercomputing in 2022 (SC22); there was also new work – published in the SIAM Journal on Scientific Computing 2024 – on matrix-free Newton methods (enabling scalable exact solutions without computing non-linear residuals). In graph algorithms, the work of the ExaGraph collaboration provided a new toolset and GPU-capable implementations for a number of combinatorial problems (Intl. Journal of HPC Applications 2021). In general, there has been significant work in architecture-aware graph algorithm design, as well as on dynamic and streaming algorithms (see the survey by Hanauer et al in ACM Journal of Experimental Algorithmics, 2022). We note that co-authors on all of these advances are members of the SIAM ACDA community.

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 membership numbers of the SIAG have seen a small decline during the peak of the pandemic, as have many other SIAGs. The effect has likely been amplified by the absence of an ACDA conference in 2022, which causes many members to let their membership lapse. In the last 1.5 years, the numbers have been rising again, but they haven't yet reached the pre-pandemic level.

As of December 2023, the SIAG has 395, among them 264 student members, which corresponds to 67%. This ratio has remained relatively stable over the last years and can be regarded as a good base for sustainable growth. 66% of the SIAG members, overall as well as in the group of students, are located within the US. Among the student members, 33% identify as female or non-binary, but only 18% among the non-student members. Although both percentages have increased in the last years, we will pay close attention to these developments and explore suitable activities for consolidation and further growth. 77% of all SIAG members are from academia, 8% from laboratories, and 7.5% from industry. The relative number of members from laboratories and industry have decreased in the last year, likely for the same reasons as for the overall development of membership numbers.

3. 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.

SIAM Conference on Applied & Computational Discrete Algorithms 2023 (ACDA23), Seattle, Washington, July 2023*. OC co-chairs: Lenore Cowen, Uwe Naumann; PC co-chairs: Jon Berry, David Shmoys. The conference attracted high-quality papers from the SIAG's topical areas, and had a robust program of plenaries, paper talks, contributed presentations, and a poster session. The submission format for all talks was a 10-page paper, and some members felt this length was prohibitive for non-archival submissions. The community appreciated the single-track nature and the mixing across communities that it affords, but also believes we must balance inclusivity (in terms of accepting more contributed presentations) with controlling parallelism.*

Dagstuhl Seminar 24201: Discrete Algorithms on Modern and Emerging Compute Infrastructure, Wadern, DE, May 2024*. Co-organizers: Kathrin Hanauer, Uwe Naumann, Alex Pothen, Robert Schreiber. https://www.dagstuhl.de/en/seminars/seminar-calendar/seminar-details/24201. This seminar gathered SIAG members with many non-members from related communities, and provided an excellent opportunity for cross-pollination between research fields. The SIAG chair ran a brief business meeting as an outreach effort, focused on collecting suggestions and ideas for the activity group and upcoming conference.*

Minisymposium on Applied & Computational Discrete Algorithms at ICIAM 2023, Tokyo, Japan, August 2023*. Co-organizers: Alex Pothen, Bora Uçar. https://iciam2023.org/registered_data?id=02600 This was a mini-symposium with 8 talks, one of which was canceled at the last minute. Three of the talks were on-site and others were online. Attendance on-site was sizable including both members and non-members. We polled audience members about their experience, and hybrid mode was appreciated (as opposed to all on-line.)*

***ACDA Workshop in Aussois September 5--9, 2022**, https://sinews.siam.org/Details-Page/reflecting-on-the-first-siagacda-workshop organized by Michael Bender, Aydin Buluç, and Bora Uçar. This was the first meeting we had as SIAG ACDA without a conference. There were 60 participants with 32 high-quality research presentations from academia, national laboratories, and industry, all of which reflected ACDA's broad scope and focus on cross-community interactions.*

4. 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?

The SIAM Conference on ACDA was co-located (virtually) with the SIAM Annual Meeting in 2021 and will again be co-located with AN in 2025 (Montreal). The activity group is organizing a two-part minisymposia at SIAM Discrete Math 2024, which is co-located with the SIAM Annual Meeting 2024 in Spokane, WA (co-organizers: Nate Veldt, Bora Uçar).

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?

The inaugural SIAM Early Career Prize was awarded to Nate Veldt (TAMU), and presented at ACDA23. The group uses the Engage portal sparingly, and is in a state of uncertainty regarding the SIAG Twitter account.

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

The 3rd SIAM Conference on ACDA is being organized for July 30 - Aug 1, 2025, co-located with the Annual Meeting in Montreal, Canada. Bora Uçar (CNRS) and Martin Farach-Colton (NYU) will be co-chairing the meeting (leading both the OC and the Program Committee, a change from previous structure). The organizing committee members are Erik Boman (Sandia); John Gilbert (UCSB); Illya Hicks (Rice); Vahab Mirrokni (Google); Alex Pothen (Purdue); Kathrin Hanauer (U. Wien); Sabine Storandt (U. Konstanz); Maria Blesa (U. Politecnica de Catalunya). The meeting will continue to experiment with changes to format and methods of participation to try and meet the needs of the disparate communities represented within ACDA, in particular offering both a peer-reviewed publication venue as well as an opportunity for presenting early-stage results or relevant advances that are being published elsewhere. Given the large number of student members, we also anticipate incorporating a structured activity for increasing mentoring and interaction between junior and senior participants, possibly similar to the invited speakers luncheon held at the annual meeting.

In 2026 (when there will be no SIAM Conference on ACDA due to the biannual schedule), the group intends to organize another Seminar/Workshop similar to the previous ones in Aussois (Sept 2022) and Dagstuhl (May 2024).

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

There is still significant discussion in ACDA around the need for a regularly available (at least annual) publication venue. There are ongoing discussions with SICOMP around the possibility of a special issue in the area, but this is not a long-term solution. Other possibilities discussed included having an annual deadline for peer-reviewed proceedings papers (with immediate review/decisions/online publication), but accumulating talks to occur at the biannual SIAM Conference on ACDA, considering collaboration with other journals, or alternating with another related meeting which has conference proceedings (of which no clear candidates were identified). The group could use SIAM's assistance in meeting the needs of the community for a clear and continuous path for publication of their work in a SIAM-affiliated venue (conference or journal). A recurring segment/special issue of an existing SIAM journal might be a reasonable opportunity to explore, possibly in addition to the "accumulating" model of papers appearing at the SIAM Conference on ACDA (though this poses both technical challenges, as well as service ones, given the need to maintain a PC and run a review process annually in a relatively small community).

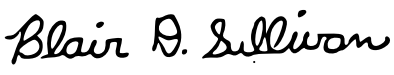
The SIAG also feels that a default two-year membership term would be advantageous for many participants, as it would prevent lapses in activity group membership that can make it more challenging to identify candidates for leadership and other positions within the group.

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

This SIAG has already had a significant impact for researchers across many areas of applied mathematics and computational science by offering a professional home and sense of community. It has also created opportunities for cross-pollination and collaboration across research areas that traditionally had limited interaction, for example parameterized algorithms and algorithmic differentiation or hypergraph analytics. We believe that by fostering these relationships and the exchange of ideas, the SIAG will catalyze practical advances that otherwise might not have had an opportunity to develop. Further, the group can help SIAM attract new members whose work sits at the intersection of applications and combinatorial methods, but who come from fields where the primary professional society has a different focus (e.g. computer scientists). ACDA is still a very young activity group, but we are encouraged by its growth and impact thus far, and anticipate it will continue to provide significant benefit to the broader research community.

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

Signed,



Blair D. Sullivan, SIAG/ACDA Chair
May 20, 2024