

SIAG Supercomputing (SC)
Charter Renewal Application

This CHARTER RENEWAL APPLICATION applies to the SIAM Activity Group on Supercomputing. The SIAM Activity Group Supercomputing was originally formed under the aegis of SIAM on July 16, 1984 by the SIAM Council and on July 17, 1984 by the SIAM Board of Trustees. Its initial operating period began January 1, 1985 and ended December 31, 1987. Its charter has been renewed by the Council and Board eleven times thereafter. This SIAG had 748 members as of December 31, 2018; of these, 354 were students.

According to its Rules of Procedure, the objectives of the SIAG are to provide an environment for interaction between developers of large-scale applications programs, applied mathematicians, algorithm designers, and computer architects, to foster the development of analytic methods, efficient algorithms, and applications software in context with advances in computer architecture as applied to high performance computing.

Its proposed functions are to:

- 1) Organize minisymposium at the SIAM Annual meeting in years when there is no Parallel Processing Conference.
- 2) Organize a track of at least six minisymposia at the SIAM Annual Meeting at least once every five years.
- 3) Organize a biennial SIAM Conference on Parallel Processing. 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.

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

- *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 field of high-performance computing (or “supercomputing”) remains a vibrant and active area of research. Continued work and investments are sustained by the international ramp-up to pre-exascale and exascale systems, the large commercial interest in high-performance data analysis and machine learning, and new research in post-Moore’s Law Era computing.

Of these factors, the latter (post-Moore computing) led to the emerging trend of *hardware specialization*, that is, special types of processing and memory units designed to give performance boosts to specific—as opposed to general-purpose—computations. Examples include reconfigurable processors (i.e., FPGAs), low-precision floating-point units, analog processor accelerators, near-memory processing and specialized memory and storage systems, and “exotic” processing elements like analog and quantum processors.

All of these factors combined pose a critical question for the field of HPC, namely, how to design algorithms and software that are portable, robust, and scalable despite the changing hardware landscape. The last two years have seen advances in algorithmic thinking (e.g., scalable solvers for data and ML problems, innovations in high-order methods, multi-precision computation) and software (e.g., performance-portable backends, new code generation infrastructure, data movement-centric programming).

- *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 has remained stable in terms of growth, relative to data from the previous charter renewal. After a boost in membership to close 2016 (797 members as of December 31, 2016), the current size is holding steady (748 members in December 2018), with a slight up-tick in student membership over this period (316 → 354 student-members). If this trend can be maintained and student members retained, we can hope for steady longer-term growth.

To keep up with changes in the field and reflect the broader interests of SIAM, SIAG/SC has encouraged participation from “across the computing stack,” to include hardware and numerical algorithms and software. This “encouragement” is reflected in the makeup of the organizing committees for our flagship conference, SIAM Parallel Processing (PP), as well as the calls-for-contributions, which highlight topics that directly reflect trends in the field.

An additional major change introduced during this charter period is the decision to solicit technical papers for a peer-reviewed archival proceedings to be associated with the PP conference. Members expressed (cautious) support for such a move at the PP18 business meeting. The three aims for creating a new publication venue may be summarized as follows.

1. **Creating a forum for the distinctive work happening within the SIAG-SC.** Research happening within SIAG-SC and the PP conference focuses on the design of numerical and discrete algorithms in the context of modern parallel computer architectures, covering both theoretical and practical aspects. While there exist other avenues where this type of research can appear, such as the ACM-IEEE Supercomputing or IEEE IPDPS conferences, it is often only a small part of a much larger program that broadly covers computer science-focused problems in, for instance, systems, performance, programming languages, architecture.
 2. **Increasing opportunities for timely career-enhancing recognition, particularly among students and junior researchers with a computing focus.** Just over half of SIAG-SC members are students, and a PP Proceedings creates a new opportunity for them to publish. A competitive technical papers submission process can generate excitement around their research. Attaching the proceedings to the PP meeting helps encourage timely, rapid dissemination of this work. In addition, just over one-quarter of all SIAG-SC members come from computer science departments, where publication in conferences carries considerable weight in evaluation and promotion.
 3. **Maintaining the overall health of SIAG-SC, particularly with respect to its prizes.** In the steady-state, the PP Proceedings can feed into the SIAG-SC's prize nomination process, especially for its existing Best Paper Prize. This element is just one (not the only) important component of the SIAG-SC's overall strategy to maintain the health of these prizes.
- *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 three major activities in which SIAG/SC has focused its efforts during this charter period are as follows.

1. SIAM Parallel Processing 2018, which was the second PP to have been held outside the United States (specifically, in Tokyo, Japan)
 2. Gene Golub SIAM Summer School 2019, on High-Performance Data Analytics
 3. SIAM Parallel Processing 2020, which will bring PP back to the US (Seattle, Washington)
- *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?*

SIAG/SC last organized tracks with the SIAM Annual Meeting in 2017, during the **prior** charter period. However, 50 members of SIAG/SC participated as co-organizers, speakers, or poster presenters in 40 sessions (including minisymposia, contributed talks, and posters) at SIAM AN 2018.

The following is a list of these sessions; sessions prefixed by an asterisk (“*”) are formally organized by *other* SIAGs but involve members of SIAG/SC.

- [MS157: Developments in WENO and Discontinuous Galerkin Methods for Gas Dynamics](#)
- [*MS13: Recent Advances in Eigenvalue Solvers - Part I of II](#)
- [MS130: Fast Algorithms for Integral Equations and their Applications - Part II of II](#)
- [MS45: Numerical Discretizations of Nonlinear Hyperbolic and Parabolic Partial Differential Equations - Part I of II](#)
- [MS62: Numerical Discretizations of Nonlinear Hyperbolic and Parabolic Partial Differential Equations - Part II of II](#)
- [MS121: Nonlinear Waves, Long-time Dynamics, and Stability - Part I of II](#)
- [MS108: Numerical Methods for Mesoscale Modeling of Complex Fluids and Soft Matter - Part I of III](#)
- [MS127: Numerical Methods for Mesoscale Modeling of Complex Fluids and Soft Matter - Part II of III](#)
- [MS36: Recent Trends in Discretization for Linear and Nonlinear Problems - Part I of II](#)
- [MS52: Recent Trends in Discretization for Linear and Nonlinear Problems - Part II of II](#)
- [MS159: Lessons from Early Applications Success on Quantum Computers](#)
- [MS145: Innovations in Linear & Eigen Solvers: From Algorithm to HPC](#)
- [MS111: Graph-enabled Science Applications at Scale - Part I of II](#)
- [MS129: Graph-enabled Science Applications at Scale - Part II of II](#)
- [MS154: Math Tools for Optimization, Uncertainty Quantification, and Sensitivity Analysis in Numerical Simulations](#)
- [MS25: Coupled Scales, Processes, and Data in Geosciences - Part II of III](#)
- [MS81: New Methodologies for Uncertainty Quantification and Applications to the Geosciences](#)
- [MS38: Coupled Scales, Processes, and Data in Geosciences - Part III of III](#)
- [MS31: Unstructured Meshing and Simulations](#)
- [MS66: Recent Advances in Optimization Modeling and Algorithms](#)
- [MS39: DOE High-performance Mathematical Software - Part I of II](#)
- [MS56: DOE High-performance Mathematical Software - Part II of II](#)
- [*MS143: Advances in Preconditioned Iterative Methods for Linear Systems - Part II of II](#)
- [*MS19: PinT - Parallel-in-Time Methods for Large Scale Problems](#)
- [*MS122: Geophysical Flow Modeling in Natural Hazards - Part I of II](#)
- [*MS139: Geophysical Flow Modeling in Natural Hazards - Part II of II](#)
- [MS150: Low Precision Arithmetic for Dense Numerical Linear Algebra](#)
- [MS20: Tutorials for Students: Accessible Introductions to Active Research Areas – Part I of II](#)
- [MS90: Student Days: An Informal Meeting with the Co-chairs and Invited Speakers](#)
- [IP11: The Future of Scientific Computation](#)
- [*MS50: Machine Learning for Scientific Computing - Part II of II](#)
- [PP5: Minisymposium: Numerical Methods for Graph and Matrix Algorithms Using Kokkos](#)
- [*PP8: Minisymposium: Software for Numerical Linear Algebra](#)
- [PP6: Minisymposium: Student Days Student Chapter Posters](#)
- [PP4: Minisymposium: DOE High-Performance Mathematical Software](#)
- [CP6: Inverse Problems](#)
- [CP15: Linear Algebra I](#)

- [CP16: Numerical Methods for PDEs](#)
- [CP21: PDEs II](#)
- [PP1: Annual Meeting Poster Session and Dessert Reception](#)

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

Since 2010, SIAG/SC awards the SIAG/Supercomputing Career Prize and the SIAG/Supercomputing Earlier Career Prize. Since 2016, SIAG/SC also awards the SIAG/Supercomputing Best paper prize for the most outstanding paper, as determined by the prize committee, published in a peer-reviewed journal bearing a publication date within the four calendar years prior to the year of the award.

During the prior charter period, these prizes were not offered. However, there is an active and renewed effort to solicit nominations during the present charter period, with the hopes of making awards at PP20. The creation of a proceedings, as noted above, is part of a longer-term strategy to maintain the viability of these prizes.

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

As noted above, the main upcoming activities are G2S3 2019 (Aussois, France) and PP20 (Seattle, Washington, USA).

For the upcoming charter period, SIAG/SC should seek ways to capitalize on the fact this discipline cuts across mathematics and computing in ways that are unique among SIAM's activity groups. As noted above, aspects of the computing stack that have implications for higher-level parallel numerical algorithms include new approaches to hardware.

One possible activity that SIAG/SC could undertake in the next charter period is to work more closely with other SIAGs on joint activities that aim to build inter-disciplinary communities around new thematic topics. For instance, SIAG/SC jointly organize MS at the AN20 meeting with SIAG/DMA on specialized hardware and algorithms for data analysis and machine learning, a current hot-topic within computing. Going beyond, a jointly organized multi-SIAG workshop in 2020 or G2S3 for 2021 might also help broaden the reach of SIAG/SC across SIAM.

- *How can SIAM help the activity group achieve its goals?*

Overall, SIAM provides an excellent level of support to SIAG/SC in achieving our goals of building and sustaining a community our HPC and supercomputing. However, one area where SIAG/SC has not made significant strides is in attracting and retaining a more diverse member community. We had some success in promoting diversity through our 2019 G2S3, where the gender balance among student

participants is exactly 50-50. But beyond that, we would welcome SIAM's help in identifying concrete activities that would improve our group in this regard.

Another area where SIAG/SC would like to expand is in connecting to overlapping technical communities. In particular, there are strong connections and likely membership overlaps with the Association of Computing Machinery's Special Interest Group on HPC (ACM SIGHPC) and IEEE Computer Society's Technical Committee on HPC (IEEE-CS TCHPC). Perhaps there are ways SIAM can help us think about whether it makes sense to incentivize cross-society memberships or co-organize meetings with such groups and determine the feasibility of doing so. We would see, as a significant benefit, exposure of SIAM to these "adjacent" groups.

A more minor improvement may be with the timeliness of handling the organizational logistics associated with our flagship meeting, the PP conference. Due to other overlapping meetings and challenges in identifying cities to host PP20, for instance, it took longer than anticipated to finalize the location, and the location was still not determined as of the "sister" meeting, SIAM CSE. Assisting us in determining and stick to a timeline that can avoid this situation in the future would be of great help.

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

One area in which SIAG/SC may be able to help SIAM promote applied mathematics and computational science is through its unique connections to computing more broadly.

Another area is topical: SIAG/SC is a natural home for algorithms and applications on candidate post-Moore computing systems, including quantum computing, neuromorphic systems, probabilistic systems, and reconfigurable systems. Coordinated workshops, meetings, or "summer school" type activities with ACM and IEEE-CS, as noted above, would help promote applied math and computational science in these domains.

This SIAG requests that the SIAM Council and Board of Trustees renew its charter for a two-year operating period beginning January 1, 2019 through December 31, 2020.

Signed

Richard Vuduc, Chair of the SIAG on Supercomputing

Date

May 12, 2019