

**SIAG Dynamical Systems (DS)**  
**Charter Renewal Application**

The SIAG/DS was formed under the aegis of SIAM by the SIAM Council on December 2, 1988, and by the SIAM Board of Trustees on December 3, 1988. Its initial operating period began January 1, 1989, and ended December 31, 1991. Its charter has subsequently been renewed by the Council and Board every two years.

In accordance with the Rules of Procedure, the SIAG/DS aims to bring together researchers who are interested in the theory and applications of dynamical systems. Interests can range from the fundamental mathematics of dynamical systems to data analysis involving dynamical-systems principles, software development for use in the study of dynamical systems, and applications in disciplines such as physics, chemistry, engineering, and the life and social sciences. The activities of the SIAG are designed (1) to foster interactions between the academic community and researchers in industry and government laboratories and (2) to stimulate cross-disciplinary activities between people with similar interests but often different backgrounds. The SIAG had 1071 members (of whom 436 were students) as of 12/31/22.

The SIAG/DS is currently responsible for the following activities:

- Organize a biennial Activity Group meeting (the SIAM Conference on Applications of Dynamical Systems);
- Sponsor the Jürgen Moser Lecture at the biennial Activity Group meeting by an individual who has made distinguished contributions to nonlinear science;
- Award the J.D. Crawford Prize at the biennial Activity Group meeting to an individual for a recent outstanding publication on a topic in dynamical systems and nonlinear science;
- Award "Red Sock" Prizes at the biennial Activity Group meeting for up to four poster presentations in dynamical systems and nonlinear science by students or postdocs at the meeting;
- Organize minisymposia at the SIAM Annual Meeting in years when there is no Activity Group meeting;
- 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; and
- Maintain and enhance the Dynamical Systems Web portal ("DSWeb") (<http://www.dynamicalsystems.org/ap/ca/>) for members of the Activity Group and the public at large. Along with DSWeb, the Activity Group maintains and disseminates content through social-media accounts, such as Twitter and Facebook accounts.

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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.

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

Executive Board

Chair, Mason A. Porter

Vice Chair, Emily Stone

Program Director, Claire Postlethwaite

Secretary, Zachary Kilpatrick

Advisory Board

Peter Bates

Ulrike Feudel

George Haller

Ana Mancho

Shane Ross

- 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 program for May 2023 conference (DS23) gives a good overview of research by SIAG members. The research topics are extremely diverse and range from pure mathematics to applications in engineering, physics, the life sciences, and more. Research on connections between dynamical systems and data analysis continues to grow in prominence, in concert with the growth of machine learning throughout mathematics and science. Traditional dynamical-systems topics are well-represented. They include, but are not limited to, multiple-scale perturbation theory and asymptotic analysis, nonlinear waves, pattern formation, fluid dynamics, stochastic systems, non-smooth dynamical systems, spatially extended systems, network dynamics, applications in the life sciences (e.g., in cardiac dynamics, ecology, and neuroscience), bifurcation theory, topological data analysis, Hamiltonian systems, and chaos.

New areas are constantly being explored and developed. For example, the program for the DS23 conference includes an even further increase in prominence in machine learning and data-driven methods in dynamical systems. There are also several sessions on applications to social systems, which continue to increase in prominence in applied mathematics. Other noteworthy topics include immunotherapy models, network analysis applied to fluid dynamics, graphon systems, hybrid modeling with both mechanistic modeling and data, and simulation on quantum platforms.

Beyond topics we are already seeing at our biennial conference, we expect several additional areas in the computational sciences and machine learning to soon have a growing impact on our SIAG. Notable examples of such topics include neural ODEs and physics-informed neural networks (PINNs), as ideas from dynamical systems are particularly important in these topics.

- 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 remains vibrant, with a strong community fostered by the SIAM infrastructure for meetings, publications, and communications. These venues allow Activity Group members to publicize and hear about new developments in the field.

By its very nature, the subject of dynamical systems is inherently interdisciplinary, and our membership has strong ties with other activity groups, including Life Sciences, Nonlinear Waves and Coherent Structures, Mathematics of Planet Earth, Analysis of Partial Differential Equations, and most recently Data Science. Our membership is international and spans industry, government, and academia. The Activity Group has smaller industry and national-lab connections than some other SIAGs, but we are optimistic that the increased prominence of data analysis in our subject will help strengthen these connections.

Our Activity Group remains the 3<sup>rd</sup>-largest SIAG, although its decreased numbers over the last two years are somewhat concerning. At the end of 2020, the Activity Group had 1354 members (including 631 students), and now those numbers are 1071 members and 436 students. This decrease may be COVID-related, and we expect that most other SIAGs have experienced similar membership decreases. We note that was an even steeper decrease in numbers from 2011 to 2014, but the SIAG quickly recovered and again grew to its previous size, so perhaps some of the initiatives that grew our SIAG numbers then can also be implemented now. (We do not ourselves know what efforts were made by SIAM at that time.)

- 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.

This SIAM conference on applied dynamical systems is generally accepted to be the most important international conference in this research area. Attendance has grown steadily over the years since its inception in 1988. Attendance surpassed 1000 people for the first time in 2019, and the virtual 2021 conference (which was originally scheduled to be in Portland, OR, as a move from the longstanding location in Snowbird, UT) had more than 1300 attendees. The 2023 conference will be in Portland, OR, and the 2025 conference will be in Denver, CO.

We expect that the recent change to begin rotating the location of the biennial conference will help reach a broader dynamical-systems audience and potentially also help further expand membership of our Activity Group. There is a substantial international component of the Activity Group's membership currently, but there is also plenty of room for growth.

The 2021 SIAM Conference on Applied Dynamical Systems (23–27 May 2021, held virtually): Unfortunately, this conference was held virtually because of the COVID-19 pandemic, even though an in-

person event was planned initially. The engagement of listeners was diminished in comparison to an in-person meeting. That said, the virtual format of the event did lead to a record 1370 conference attendees. The Mentoring Session, which was aimed at supporting a diverse and inclusive environment, was expanded from one session (in 2019) to two (in 2021), and the response of both mentors and mentees was generally positive.

2023 SIAM Conference on Applied Dynamical Systems (to take place 14–18 May 2023): In 2023, we return to a fully in-person conference and the usual format. Notably, 5 of the 9 invited plenary talks are being given by women. The conference includes minitutorials on spatial patterns in nature and on topological signal processing. The conference also includes 176 minisymposium sessions (with 4 talks each), 195 contributed talks, and more than 80 posters. The special events at the conference include the awarding of the Jürgen Moser Prize (to Yoshiki Kuramoto) for career achievements in nonlinear science and the J. D. Crawford Prize (to Victoria Booth) for recent work in nonlinear science. There are also various sessions that are important professionally to advance junior scholars and also members of underrepresented groups. These sessions include a student and postdoc icebreaker session, a minisymposium that is organized in collaboration with the Women in Network Science society, a mentoring session, and a workshop celebrating diversity (WCD).

Although DS23 returns the SIAG to in-person conferences, we note that it is desirable to advance hybrid options for our biennial conference, as well as for other SIAM conferences. We hope for more support from SIAM to advance these options and make the conferences more accessible to a broader set of participants.

- 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 SIAG last organized a track at SIAM AN18, with six minisymposia and eight total sessions. In the past 2 years, although the SIAG had no formal participation, its membership was well-represented. The SIAG is currently organizing a track at SIAM AN24, with Emily Stone the associated SIAG representative on the AN24 organizing committee.

- 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 DSWeb portal, which publishes a quarterly online Dynamical Systems Magazine, has been a very successful promoter of dynamical systems, a website to advertise open positions and upcoming workshops, a place to publish tutorials and striking visual media, and a place to disseminate dynamical-systems software. Book reviews, editorial opinions, and vignettes of early-career researchers and other SIAG members are also featured on the site.

- The SIAG maintains an active Twitter account (@DynamicsSIAM), which has more than 8,300 followers as of April 2023.
- The SIAG also maintains an active SIAG Facebook group, which has more than 1,100 followers.
- The SIAG has a strong and healthy relationship with *SIAM News*. Its Editor-in-Chief is a longstanding and active member of our Activity Group. The SIAG's representative on *SIAM News* is Korana Burke, who is also on its editorial board.
- The SIAG/DS gives out three awards at its biennial conference:
  - (1) The Jürgen Moser Lecture, which was established in 2000, is awarded to a person who has made distinguished contributions to nonlinear science (interpreted broadly). The prize consists of a special lecture along with a cash prize. The 2023 Jürgen Moser Lecture is awarded to Yoshiki Kuramoto for many pioneering contributions, with far-reaching impact, to the understanding of emergent phenomena in nonlinear systems, especially for oscillatory dynamics, synchrony, chemical turbulence, and spatiotemporal chaos.
  - (2) The J.D. Crawford Prize, which also was established in 2000, is awarded to a person for a recent outstanding publication on a topic in nonlinear science (interpreted broadly), as evidenced by a publication (in English) in a peer-reviewed journal within the last four years. The 2023 J.D. Crawford Prize is awarded to Victoria Booth for her exceptional research in mathematical biology and in particular the formulation, analysis, and interpretation of dynamical systems models of sleep-wake cycles.
  - (3) The Red Sock Award, which was elevated to the status of a recognized SIAM prize in 2012, is awarded for the best poster presentations at our biennial SIAG conference by a student or postdoc. This award contributes to the success of the poster sessions at the conference. These poster sessions are engaging, very well-attended, and an extremely positive experience for its attendees. The poster sessions are where networking occurs and collaborations are built.

Note: For the first time, the SIAG had a canvassing committee (in addition to the formal prize selection committees) for the Moser Lecture and Crawford prizes. This committee was charged with ensuring a strong and diverse candidate pool, and we encourage other SIAGs to also use such canvassing committees as best practice for SIAM prizes.

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

The key activity for the period is organizing our biennial conference DS25, which will take place in Denver, CO (ideally with an additional hybrid format to increase participation). The usual Activity Group

prizes will be awarded at DS25 (with the usual prior work to form the selection committees and a canvassing committee).

The SIAG is also organizing a track at SIAM AN24, with Emily Stone the associated SIAG representative on the AN24 organizing committee. We hope the track to include topics in the overlapping areas of dynamical systems and data science. This will hopefully lead to further interaction between industry, other SIAGs, and our Activity Group. It also provides an opportunity for specific research areas in our SIAG to have a concentrated meeting to share ideas and work together. Current planned minisymposia for AN24 are “Dynamical-Systems Tools for Space-Debris Mitigation and Planetary Defense” (organized by Elisa Maria Alessi), “Non-Autonomous Dynamics and Critical Transitions” (organized by Ulrike Feudal), and “Data-Driven Model Reduction for Nonlinear Dynamical Systems” (organized by George Haller).

Continued support and expansion of our social-media presence is part of our commitment to be an information nexus for the worldwide dynamical-systems community. Beyond Facebook and Twitter, we hope to move into more social-media platforms (such as Instagram and TikTok), and below we suggest the creation of a Social Media officer position for the SIAG.

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

For the first time this period, the SIAG had a canvassing committee (in addition to the formal prize-selection committees) for the Moser Lecture and Crawford prizes. This committee was charged with ensuring a strong and diverse candidate pool. We suggest that this canvassing committee be a formal committee for each prize cycle for these prizes.

We would also like SIAM to consider the addition of an officer for Activity Group that is dedicated to maintaining and expanding our social-media presence. The current secretary is in charge of overseeing the existing DSWeb portal with its quarterly Dynamical systems magazine, as well as with moderating SIAM Engage. A new officer in charge of overseeing, coordinating, and expanding our social-media accounts would lend stability to that side of the operation. This has been done in an ad hoc way, and it would be best to instead have a SIAG Social-Media Manager as a formal office. Additionally, SIAM Engage only allows dues-paying members of the dynamical-systems SIAG to post directly to it. We request that members of other SIAGs also be allowed to post to our Engage forum. This would reduce some redundant steps for the moderator of the discussion board. We also believe that going to an unmoderated discussion board is not a good idea, and we request that the SIAG secretary be retained as moderator.

We would warmly appreciate SIAM’s assistance in connecting our Activity Group with the new SIAG on Equity, Diversity, and Inclusion. Our SIAG has many efforts — both by us and through grassroots initiatives, such as the Women in Network Science minisymposium — for mentoring junior researchers and to support members from underrepresented groups at our biennial conference. It would be good for these efforts to also engage with the new EDI SIAG, and SIAM can be helpful for promoting and supporting such engagement.

Finally, we would like help from SIAM for facilitating hybrid participation in future versions of our biennial conference. We believe that a major advantage of such models is to increase access to those that otherwise may not have the time, money, or other resources to attend in person. The massive carbon cost of many people flying long distances is another concern. However, we are aware that there are issues with hybrid models, and we want to make sure that the following points are taken into account in any planning:

- There needs to be sufficient online content to ensure engagement of remote participants
- Consideration should be given to time zones to ensure that there is sufficient content available for worldwide participation.
- We are also interested in pursuing alternatives, such as satellite meetings, online-centric events, and online-only sessions. (Note: In 2021, a group in New Zealand were able to collectively watch the online talks for the DS21 conference; this worked very well.)
- We are in favor of having in-person participants subsidize lower registration pricing for remote participants, even if remote actually costs more, due to the differential conference experiences of the two groups.

The following recent *Nature* article provides some useful ideas for guiding hybrid-meeting principles: <https://www.nature.com/articles/d41586-022-01797-7>

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

We will continue to promote dynamical systems, nonlinear science, and more broadly applied mathematics and computational sciences through DSWeb, our presence on social media, and contributions to *SIAM News*. Our large biennial meeting hosts members from all over the world. It is a melting pot of different application areas and different mathematical techniques, leading to a great cross-fertilization of ideas that can, in turn, generate innovative collaborations and projects. The interdisciplinary nature of dynamical systems makes our SIAG a community of ambassadors to the mathematical world. Through our events and publications (and also the research journal *SIADS*), we are committed to building and supporting these bridges to other areas of mathematics and the sciences.

We are also committed to supporting students and early-career researchers with special events at our meeting (e.g., the Red Sock Award, mentoring sessions, and special panel discussions). Developing the expertise of our membership and increasing its size is part of our mission. In the future, we will explore more ways to encourage participation of underrepresented groups in our field and continue to develop diversity in our membership and our leadership.

For the first time, the dynamical-systems Activity Group had a canvassing committee (in addition to the formal prize-selection committees) for the Moser Lecture and Crawford prizes. This committee was charged with ensuring a strong and diverse candidate pool, and we encourage other SIAGs to also use such canvassing committees as best practice for SIAM prizes. We will be happy to work with other SIAGs and overall SIAM leadership to help encourage these efforts.

This SIAG requests that the SIAM Council and Board of Trustees renew its charter for a two-year operating period beginning January 1, 2024.

Signed

Mason A. Porter, Chair of the SIAG on Dynamical Systems

Date