

SIAM Activity Group on Nonlinear Waves and Coherent Structures Charter Renewal Application

This CHARTER RENEWAL APPLICATION applies to the SIAM Activity Group on Nonlinear Waves and Coherent Structures. The SIAG/NWCS was originally formed under the aegis of SIAM on December 7, 2002 by the SIAM Board of Trustees and on March 26, 2003 by the SIAM Council with its initial operating period beginning January 1, 2003 and ending December 31, 2005. Its charter has been renewed by the Council and Board eight times thereafter.

This SIAG has 227 members, including 59 student members, as of December 31, 2023.

According to its Rules of Procedure, the purpose of the SIAG is to foster activity in the area of Nonlinear Waves and Coherent Structures. Its goals are:

- To foster collaborations among applied mathematicians, physicists, fluid dynamicists, engineers, biologists, and economists in those areas of research related to the theory, development, and use of nonlinear waves and coherent structures.
- To promote and facilitate Nonlinear Waves and Coherent Structures as an academic discipline.

The SIAG on NWCS will promote and facilitate research in the area through a variety of activities, including:

1. Organize a biennial SIAM Conference on NWCS. The SIAG also will consider dovetailing specialized workshops and conferences with the SIAM Annual meeting. In particular, it is planned to have the biennial meeting alternate loosely between university-style meetings, ones dovetailed with SIAM Annual Meetings, and joint meetings with other SIAGs.
2. Broker partnerships between academia, industry, and government laboratories. The SIAG will seek to facilitate the establishment of academic programs in NWCS to foster its development as an academic discipline. The SIAG also will facilitate the placement of undergraduate and graduate students in internships in industry and government laboratories.
3. The SIAG will work with other professional societies to promote NWCS. For example, SIAM and another society might organize a workshop on a topic of mutual interest. The SIAG also would attempt to increase government support for NWCS through various outreach activities.
4. Organize minisymposia at the SIAM Annual Meeting in years where there is no SIAG conference.
5. 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 SIAM meeting.
6. The VP for Programs and the VP at Large will coordinate the scheduling with the SIAG chair.
7. 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.
8. Award of the biennial Martin Kruskal Lecture Prize, established in 2012.
9. Award of the biennial T. Brooke Benjamin Prize, established in 2016.

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: Gino Biondini

Vice Chair: Jens Rademacher

Program Director: Anna Vainchtein

Secretary: Manuela Girotti

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 study of nonlinear waves and coherent structures as a sub-discipline of applied mathematics continues to be a very strong, diverse, and active area, encompassing both mathematical foundations and a broad range of physical applications. The health of the field is testified by the fairly large number of national and international conferences that take place regularly in the US and abroad in addition to the biannual SIAM Conference on Nonlinear Waves and Coherent Structures.

Following the Covid-19 pandemic, several online seminars, organized by activity group members and advertised through the NWCS Engage community, have flourished (e.g., the NWCS webinar organized by S Charalampidis, C Chong and P Kevrekidis; the UW Applied Math PDE seminar organized by J Cisneros and B Deconinck; the Waves in One World webinar organized by D Ratliff in conjunction with ICMS Edinburgh, just to mention a few examples).

An area that has been attracting more and more attention in the last few years is the field of dispersive hydrodynamics, which has emerged as a unified mathematical framework for the description of multiscale nonlinear wave phenomena in dispersive media, encompassing both dynamic and stochastic aspects of wave propagation. This exciting new area had a large exposure in the recent, dedicated 6-month research program at the Isaac Newton Institute (INI) for Mathematical Sciences in Cambridge, UK, from July to December 2022, which was extremely successful. A follow-up month-long program, also sponsored by INI, will take place in Newcastle, UK, in July–August 2024.

Some emerging areas of growing interest are the statistical study of interacting nonlinear wave systems and the theory of soliton and breather gasses and integrable turbulence. Traditional areas of interest include the stability analysis of nonlinear waves and applications to water waves/fluid dynamics, low-temperature physics and Bose-Einstein condensation, granular media, and nonlinear optics remain of fundamental importance to the field.

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 NWCS SIAG remains a vibrant and active community even though it is one of the smallest SIAM activity groups. Membership in the NWCS SIAG hovered at around 300 members for several years before the pandemic, but, like with many other SIAGs, our SIAG experienced a post-pandemic drop in membership with 227 members in 2023. Notably, however, non-student membership has remained comparably steady (168 in 2023 compared to 191 in 2020), and the overall drop is almost exclusively due to the decrease in the number of student members (59 in 2023 compared to 141 in 2020). This suggests that the decrease in the number of student members could be reversed with some outreach effort.

Another factor attesting to the health of the SIAG is the steady attendance at the biannual NWCS conference. Indeed, the 2022 edition of the conference (in Bremen) had 256 registered participants, compared to 224 for the 2018 edition (in Orange County), 254 for the 2016 edition (in Philadelphia) and 263 for the 2010 edition (also in Philadelphia). (The 2020 edition was canceled due to covid-19, and the peak attendance was 416 participants for the 2014 edition in Cambridge, UK. No data is available for the 2012 edition in Seattle.)

The SIAG attempts to keep up with changes in the field primarily by soliciting plenary lectures or minitutorials at the biennial meeting that relate to new or emergent areas of interest. Another activity that aims to enhance the interest in nonlinear waves for young researchers and/or students is the organization of a “hot topics” session at the biennial meeting. Although the fraction of SIAG NWCS members from industry or government labs is low compared to other SIAGs, a deliberate attempt is made to have representation from these sectors in prominent roles of the organization (e.g., in the prize committees) and invited presentations at the biannual meeting.

3. Please list conferences/workshops the activity group has sponsored or co-sponsored over the past two years, and give a brief (one sentence or phrase) indication of the success or problems with each. The SIAG NWCS organizes the biennial conference on Nonlinear Waves and Coherent Structures.

Since 2004, the NWCS SIAG has been organizing the biannual SIAM Conference on Nonlinear Waves and Coherent Structures. The complete list of NWCS conferences is of course available on the SIAM website. The 2020 NWCS conference was canceled due to the pandemic, but the 2022 NWCS conference was held in Bremen from Aug 29 – Sep 2, 2022 using a hybrid format, with 45 mini-symposia (4 speakers each session), 43 contributed talks, and 7 posters. Workshops germane with the conference include “Analysis of dispersive systems” (Sep 5-9, Isaac Newton Institute for Mathematics) and “Spatial dynamics and related approaches” (Sep 5-7, University of Stuttgart).

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?

The activity group organized a track of minisymposia at the 2021 SIAM Annual Meeting (AN21):

“Recent Advances in Dispersive Hydrodynamics” (3 parts)

“Advances in Integrable Systems and Inverse Scattering Transform” (3 parts)

“Nonlinear Waves in Lattice Dynamical Systems” (2 parts)

“The Unified Transform Method and its Applications”

“Water Waves: Instabilities, Singularities and Solitons” (2 parts)

“Asymptotics and Numerics in the Theory of Nonlinear Waves” (2 parts)

“Nonlinear Waves, Dynamics and Singularities in Hydrodynamics and Physics” (2 parts)

Tom Trogdon, University of Washington, was the designated SIAG member of the AN21 organizing committee. SIAG vice-chair Mark Hoefer delivered a plenary invited talk on “Dispersive Hydrodynamics: Dispersive Shock Waves, Solitons, and (Non)Convexity”.

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?

Since 2012, the NWCS SIAG awards the Martin J. Kruskal Prize/Lecture, and, since 2016, the T. Brooke Benjamin Prize, the latter of which is specifically targeted at honoring the achievements of mid-career researchers. The 2022 Kruskal Prize and Benjamin Prize were awarded at the 2022 NWCS conference in Bremen respectively to Roberto Camassa and Toan Nguyen, while the 2024 Kruskal Prize and Benjamin Prize will be awarded at the 2024 NWCS conference in Baltimore respectively to Thanasis Fokas and David Lloyd.

In 2018 the SIAG introduced a newsletter, aimed at highlighting the research and activities of the members, as well as communicating upcoming opportunities. The second issue of the newsletter was distributed to SIAG members via the mailing list in December 2019, and the third issue was made available to the community via the Engage platform in December 2020. The current SIAG officers plan to send out a new edition of the newsletter in 2024. The current officers would also be very happy to assist in transferring the templates and other materials for preparing the newsletter to the next set of officers.

Finally, the SIAG is also active in the Engage NWCS community, which is currently moderated by SIAG officer Manuela Girotti.

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

The 2024 NWCS conference (co-chaired by Anna Vainchtein and Panos Kevrekidis) will be held in Baltimore, MD (June 24-27, 2024). The program includes 52 minisymposium sessions (4 speakers each), 30 contributed talks, 21 poster presentations, 6 plenary talks, Martin D. Kruskal and T. Brooke Benjamin Prize in Nonlinear Waves award presentations and Martin D. Kruskal prize lecture. Presentations will cover a wide range of topics, from pattern formation in biological systems to nonlinear waves in optics. In addition, there will be three mini-tutorials. One of these will be dedicated to the truly fundamental contributions of Vladimir Zakharov (who passed away in 2023) to nonlinear science. The two other mini-tutorial sessions will address two research topics that have attracted a lot of attention in the community: dispersive hydrodynamics and data-driven methods for dynamical systems.

A solicitation from members to propose a location for the 2024 meeting will be sent out shortly to the community through Engage, with a June 20, 2022, deadline. Proposals will be discussed at the business meeting to be held as part of the upcoming NWCS conference in Baltimore. It will be important to select the next location carefully to reflect the interests of the broader SIAG membership in terms of physical location and venue type (e.g., hotel or university) while balancing them with the utility and advantages of SIAM staff expertise, which favors urban locations and hotel venues.

Another very significant activity for the NWCS SIAG will be the launch of a new scientific journal, the “Journal of Nonlinear Waves”, which will be published by Cambridge University Press and which will open for submission in the second half of 2024. The journal will help to further promote the scientific

activity of the SIAG, which could in turn increase membership. Notably, there are a few other venues in the SIAM journal system for different types of papers written by NWCS SIAG members (e.g., SIAM Journal on Mathematical Analysis for more mathematically-oriented papers on partial differential equation models, or SIAM Journal on Scientific Computing for numerical simulations of nonlinear waves) but there is no coherent publication home for the SIAG within SIAM. The success of the activity group has been limited by the lack of a dedicated dissemination venue with a faster cadence. The new journal, exclusively focused on the field of nonlinear waves, will source its content from applied mathematics in a rich variety of areas and physical settings, with an emphasis on excellence.

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

SIAM could significantly help the NWCS SIAG by helping to promote the new Journal of Nonlinear Waves at the upcoming NWCS conference in Baltimore.

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

Members of the SIAG can help SIAM promote the general area of nonlinear waves research by writing and/or proposing articles for SIAM News, or in the case of longer and more detailed articles, SIAM Review. Apart from this, the SIAG could maintain its efforts to make the biennial conference and other SIAG activities relevant to student members so that they remain active in SIAM when they enter the profession.

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,



Gino Biondini, SIAG/NWCS Chair

May 7, 2024