

SIAM Activity Group Orthogonal Polynomials and Special Functions Charter Renewal Application

This CHARTER RENEWAL APPLICATION applies to the SIAM Activity Group on Orthogonal Polynomials and Special Functions (SIAG - OPSF). The SIAM Activity Group (SIAG - OPSF) to which this renewal applies was originally formed under the aegis of SIAM on July 15, 1990 by the SIAM Council and July 19, 1990 by the SIAM Board of Trustees with its initial operating period beginning January 1, 1990 and ending December 31, 1992. Its charter has been renewed by the Council and Board eight times thereafter.

This SIAG has 174 members, including 45 student members, as of December 31, 2015

According to its Rules of Procedure, the objective(s) of the SIAG are:

- The purpose of the SIAG is to promote basic research in orthogonal polynomials and special functions; to further the application of this subject in other parts of mathematics, and in science and industry; and to encourage and support the exchange of information, ideas, and techniques between workers in this field, and other mathematicians and scientists.
- The activity group is concerned with the following topics and their applications: orthogonal polynomials (general systems, Askey scheme, asymptotic analysis, recurrence relations, numerical quadrature), harmonic analysis, approximation theory, representations of compact groups, quantum mechanics, combinatorics, coding and design theory, orthogonal polynomials in several variables, hypergeometric functions and their q-analogues and elliptic analogues, special functions in connection with Lie groups, tomography, optics, wave functions in crystals, classical special functions (for example, Bessel, gamma, beta, theta, spheroidal wave, etc.), non-linear special functions (Painlevé equations), random matrices, solutions of ordinary and partial differential equations, statistical mechanics, integral transforms, number theory. Within the framework of SIAM, the SIAG will conduct activities that implement its purposes.

Its purposed functions were:

The SIAG on Orthogonal Polynomials and Special Functions will organize activities in orthogonal polynomials. The SIAG is expected to:

- 1) Organize mini symposia at the SIAM Annual Meeting on years where there is no SIAG conference.
- 2) Organize a track of at least six mini symposia at the SIAM Annual Meeting at least once every five years. The VP for Programs and the VP at Large will coordinate the scheduling with the SIAG Chairs.

And others may include:

- 3) Dissemination of information about upcoming conferences and sponsoring special sessions at SIAM meetings. Also, the group will assist researchers in the use of symbolic computer calculations by publicizing available software for special functions. Another goal is to establish some working relationships with the various SIAM journals, especially the one on mathematical analysis, with the view of sporadically sponsoring some invited or contributed Articles.
- 4) 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.
- 5) Award the SIAG-OPSF Gábor Szegő prize every two years to an early-career researcher for outstanding research contributions, as determined by the prize committee, in the area of orthogonal polynomials and special functions.

SIAG meetings, workshops, and conferences may be organized only with the approval of the SIAM President and the SIAM 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.

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

Elected

- Chair: Walter Van Assche (KU Leuven, Belgium)
- Vice-Chair: Jeff Geronimo (Georgia Institute of Technology, Atlanta, GA, USA)
- Program Director: Diego Dominici (State University of New York, New Paltz, NY, USA)
- Secretary: Yuan Xu (University of Oregon, Eugene, OR, USA)

Appointed

- OP-SF Talk moderators: Diego Dominici, Bonita V. Saunders
- OP-SF NET Co-editor: Kerstin Jordaan
- OP-SF NET Co-editor: Howard Cohl
- OP-SF NET Co-editor: Sarah Post
- OP-SF Webmaster: Bonita V. Saunders

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?

The field of orthogonal polynomials and special functions continues to have a lot of ongoing activities in mathematics, physics and engineering, where special functions, and in particular orthogonal polynomials, are still needed for various models and applications. Researchers in the fields of random matrices and integrable systems have also realized that special functions are very useful there. The Riemann-Hilbert approach to orthogonal polynomials and the steepest descent analysis of oscillatory Riemann-Hilbert problems have been used and extended by various members of the SIAG-OPSF. Multiple orthogonal polynomials have become an important new focus, with applications in (simultaneous) rational approximation, number theory, random matrix theory, and non-intersection random paths. The latter two are examples of determinantal point processes and various important cases turn out to be using (multiple) orthogonal polynomials and various special functions. Matrix-valued orthogonal polynomials and their use in representations of Lie groups is receiving renewed attention. The non-linear special functions arising as solution of the Painlevé equations turn out to play a remarkable role in the asymptotics of orthogonal polynomials and determinantal point processes. Another important development are the elliptic hypergeometric functions, which are under investigation by several members of SIAG-OPSF.

An important and significant new addition to the literature was the NIST Handbook of Mathematical Functions (edited by F.W.J. Olver, D.W. Lozier, R.F. Boisvert, C.W. Clark), with an online companion: The Digital Library of Mathematical Functions (<http://dlmf.nist.gov>). Several members of the SIAG-OPSF were involved in the handbook and the digital library.

Interest in the field of “Orthogonal Polynomials and Special Functions” is high: the book “Special Functions” by G.E. Andrews, R. Askey and R. Roy (Cambridge University Press, 1999) already has more than 1360 citations, and the Digital Library of Mathematical Functions had 413883 visits in 2015 (by 239513 unique visitors), which is an average of 1134 visits per day.

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?

Membership of the activity group has increased by 23%. This is most likely the result of the fact that the latest international conference OPSFA-13 was organized by SIAM. Furthermore we have announced multiple times that there are interesting offers for membership for student members, academic membership, and outreach members. The SIAG-OPSF Gábor Szegő Prize also attracted a number of early career researchers. The list of people receiving our electronic newsletter OPSF-NET is much larger than the membership. The main reason that many people are not a member seems to be the high membership fee for SIAM.

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.

4.1. Our SIAG-OPSF is strongly involved in the biennial meetings on “Orthogonal Polynomials, Special Functions and Applications” (OPSFA). The last meeting (OPSFA-13) was June 1-5, 2015 at NIST in Gaithersburg, MD. This meeting was a SIAM meeting. There were 194 registered participants, which makes it one of the most attended OPSFA conferences.

4.2. There is a steering committee for the OPSFA meetings which consists of three local organizers of the last five meetings and a representative of the SIAG-OPSF (not necessarily the chair). This committee makes the selection where the next OPSFA meeting will be. The upcoming OPSFA-14 meeting will be held at the University of Kent in Canterbury, UK, from 3 to 7 July 2017.

4.3. A mini symposium on *Special Functions and Orthogonal Polynomials* was organized during the Foundations of Computational Mathematics (FoCM’14) meeting in Montevideo, Uruguay (December 11-20, 2014) by members of our SIAG-OPSF. A special session will be organized by people of our SIAG at the FoCM’17 meeting in Barcelona, Spain.

4.4. A special session *Orthogonal Polynomials and Special Functions* was organized during the joint meeting of the Royal Spanish Mathematical Society, the Belgian Mathematical Society and the Luxemburg Mathematical Society, June 6-8, 2016, Logroño, Spain.

4.5. Several members of SIAG-OPSF have organized special sessions at the American Mathematical Society meetings:

- Applications of Special Functions in Combinatorics (April 11-13, 2014, Lubbock, Texas)
- Complex Function Theory and Special Functions (April 11-13, 2014, Lubbock, Texas)
- Special Functions and their Applications (October 18-19, Halifax, Nova Scotia, Canada)
- Orthogonal Polynomials and Integrable Systems (July 10-13, 2015, Porto, Portugal): joint AMS-EMS-SPM meeting
- Special Functions and q-series (January 6-9, 2016, Seattle, Washington)

- Recent Advances in Orthogonal Polynomials and Special Functions (January 6-9, 2016, Seattle, Washington)

4.6. Several members of the SIAG-OPSF were in the organizing committees of international conferences

- Orthogonal Polynomials and Quadrature (OrthoQuad), January 20-24, 2014, Tenerife
- Constructive Functions, May 26-30, 2014, Nashville, Tennessee (in honor of E.B. Saff)
- Orthogonal Polynomials, Integrable Systems, and their Applications, October 25-29, 2014, Shanghai and Shaoxing, China (in honor of M.E.H. Ismail)
- Orthogonal Polynomials and q-series, May 10-12, 2015, Orlando, Florida (in honor of M.E.H. Ismail)
- Dunkl operators, Special Functions and Harmonic Analysis, August 8-12, 2016, Paderborn, Germany (in honor of Charles Dunkl, the founder of SIAG-OPSF)

4.7. Several workshops were organized by members of the SIAG-OPSF

- Exceptional Orthogonal Polynomials and Exact Solutions in Mathematical Physics, September 7-12, 2014, Segovia, Spain.
- Recent Advances in Orthogonal Polynomials and its Interactions with Integrable Systems, September 18, 2014, Canterbury, UK.
- Orthogonal and Multiple Orthogonal Polynomials, August 9-14, 2015, Oaxaca, Mexico.
- The Real World is Complex, August 26-28, 2015 Copenhagen, Denmark (in honor of C. Berg)

5. Please indicate the number of mini symposia 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?

Because of the number of Activity Groups, the current guidelines are that an Activity Group should organize a track about every seven (7) Annual Meetings or meet jointly with the Annual Meeting within a seven (7) meeting period.

We regret to say that our SIAG-OPSF has not organized any mini symposia at the annual meeting of 2014 in Chicago.

In 2015 there was one mini symposium *Orthogonal Polynomials, Special Functions and their Applications* (3 parts) on the ICIAM in Beijing, China (August 10-14).

At the annual meeting of 2016 in Boston there will be one mini symposium MS98: *Computational Aspects of Special Functions*.

The last time we organized a track was at the 2013 SIAM annual meeting in San Diego, CA (July 2013).

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?
 - 6.1. The most visible activity of our SIAG is the electronic newsletter OPSF-Net. There are six issues every year, containing information about conferences, workshops, symposia in field of Orthogonal Polynomials and Special Functions. The newsletter also has reports of recent meetings, obituaries, new books and book reviews. There is also a list of papers on OPSF which appeared on arXiv.org during the last two months. The mailing list of OPSF-Net is much larger than the membership, but this is partly caused by multiple entries and entries of people no longer active.
 - 6.2. The activity group has a website which is hosted at NIST (<http://math.nist.gov/opsf/>). The website contains a calendar, an archive of all the newsletters since 1990, a list of useful books, tools, obituaries, history, available positions, and links to useful places on the internet. Many of the links redirect to the SIAM webpage
<http://www.siam.org/activity/opsf/>
 - 6.3. The SIAG-OPSF award the Gábor Szegő Prize every two years to an early-career researcher for outstanding research contributions, as determined by the prize committee, in the area of orthogonal polynomials and special functions. The first prize was awarded in 2011, the second prize in 2013 and the latest in 2015. The next prize will be awarded in 2017 at the OPSFA-14 meeting in Canterbury, UK.
 - 6.4. Our activity group has strong connections with the *Society for Special Functions & Their Applications* in India, and in particular we are consulted for their annual international conferences (ICSFA). The SIAG supports the International Conference on Mathematical Analysis and its Application (ICMAA) in Roorkee, India (November 28 – December 2, 2016) and SIAM made travel grants for students and early career researchers available for this conference.
 - 6.5. Some members of SIAG-OPSF are involved in the Iberoamerican Workshops on Orthogonal Polynomials and Applications (EIBPOA), with workshops in Bogotá, Columbia in 2014 and Mexico City, Mexico in 2015. There were about 60 participants, mostly early career researchers, interested in topics covered by 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.
 - 7.1. The SIAG-OPSF will continue to support the organization of the OPSFA conferences. One of the elected officers will be part of the steering committee of the OPSFA meetings. These meetings are an important tradition in our community and we

try to organize them in various locations around the world, with a list of plenary speakers containing specialists in the field, early career researchers and with a diversity in geography and gender. The award ceremony for the Gábor Szegő Prize includes an invited lecture by the award winner.

7.2. The SIAG-OPSF also wants to revitalize the OPSF summer schools, which were organized annually from 2000 to 2004. This year there will be a summer school (OPSF-S6) at the University of Maryland in College Park, Maryland from July 11 to 15. In 2017 there will be a summer school (OPSF-S7) at the University of Kent in Canterbury, UK, in the week before the OPSFA-14 meeting. The plan is to have a summer school every year, or if this is not possible, to have one in the years between two OPSFA conferences.

7.3. The SIAG-OPSF wants to strengthen its contacts with the *Society for Special Functions & their Applications* in India. We believe that a designated liaison person will facilitate our relationship with SSFA. Another liaison person for the contacts with the Iberoamerican workshops in South America (EIBPOA) will simplify working relations with that community.

7.4. We will get more involved with the organization of mini symposia at the annual SIAM meetings. In particular we will try to organize a track of at least six mini symposia at one of the SIAM annual meetings, with a preference for the annual meeting in 2018 (since we already have our OPSFA-14 conference in 2017).

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

The SIAM journal which is closest to our activity group is SIAM J. Math. Anal. (SIMA). We regret that special functions do not appear in the journal description and that there is so much emphasis *that every paper relates to a model for natural phenomena in such areas as fluid mechanics, materials science, quantum mechanics, biomathematics, mathematical physics, or to the computational analysis of such phenomena*. This makes the distinction with SIAM J. Appl. Math. (SIAP) very small. We would like to see the topic *Special Functions* in the journal description and to have more members of the SIAG-OPSF on the editorial board of SIMA.

One of the main obstacles for people to attend the SIAM annual meetings is the high registration fee, even as a speaker in a mini symposium. To support young researchers interested in our field, it would help to have a reduced registration, in particular for early career researchers who give a talk in a mini symposium.

9. How can the activity group help SIAM in its general role of promoting Orthogonal Polynomials and Special Functions?

The activity should get more involved in contributing news items for the monthly SIAM News. We will more actively look for news items related to OPSF and encourage SIAG-OPSF members to write a text for a general audience (SIAM News readership).

In our own newsletter (OPSF-Net) we should emphasize the links between our SIAG and other SIAG's that have some intersection with our research field, e.g. discrete mathematics (SIAG-DM), dynamical systems (SIAG-DS), linear algebra (SIAG-LA). In particular we have plans to submit a proposal for the Gene Golub summer school 2018.

This SIAG requests that the SIAM Council and Board of Trustees renew its charter for a three operating period beginning January 1, 2017.

Signed

Walter Van Assche, SIAG-OPSF chair
[Date]