

## **SIAG Control and Systems Theory (CST)**

### **Charter Renewal Application**

This CHARTER RENEWAL APPLICATION applies to the SIAM Activity Group on Control and Systems Theory. The SIAM Council and the SIAM Board of Trustees originally formed the SIAG/CST under the aegis of SIAM on July 20, 1986. Its initial operating period began January 1, 1987 and ended December 31, 1989. Its charter has been renewed by the council and board thirteen times thereafter. This SIAG had 627 members including 312 students as of December 31, 2018.

According to its Rules of Procedure, the objective of the SIAG is to foster activity and interaction between mathematicians, engineers and other scientists interested in control and systems theory. The SIAG plans to encourage further development of theory and methods for the estimation and control of systems.

Within the framework of SIAM, the SIAG will conduct activities that implement its purposes.

Its purposed functions are to organize activities, including conferences, sessions at SIAM meetings, sessions at meetings of other organizations cooperating with SIAM, and publications, to (1) promote interaction between mathematicians, engineers and other scientists interested in control and systems theory, (2) keep SIAM membership up to date on developments in this area, (3) facilitate the development of control and system theory and (4) encourage its application.

The activity group awards two prizes: (1) the SIAM Activity Group on Control and Systems Theory (SIAG/CST) Prize, established in 1997, is awarded every two years to a junior researcher for outstanding research contributions, as determined by the prize committee, to mathematical control or systems theory and (2) the SIAG/CST Best SICON Paper Prize established in 2007. The prize is awarded every two years to the author(s) of the two most outstanding papers, as determined by the prize committee, published in SICON in the two calendar years before the year of the award

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).

Chair: Kirsten Morris (1/1/18-12/31/19)

Vice Chair: H el ene Frankowska (1/1/18-12/31/19)

Program Director: Richard Stockbridge (1/1/18-12/31/19)

Secretary: Michael Demetriou (1/1/18-12/31/19)

SIAG/CST Advisory Committee:

John Burns (1/11/2017 – 12/31/2019)

Qing Zhang (4/20/2015 – 12/31/2020)

Michael Demetriou (1/11/2017 – 12/31/2019)

SIAG/CST Conference Steering Committee:

Gang Ying (1/1/2018 – 12/31/2019)

- Previous Chair 1/1/2014 – 12/31/2015

Bozenna Pasik-Duncan (1/1/2018 – 12/31/2019)

- Previous Program Director 1/1/2014 – 12/31/2015

William McEaney (1/1/2018 – 12/31/2019)

- Previous Chair 1/1/2012 – 12/31/2013

Michael Demetriou (1/1/2018– 12/31/2019)

Catherine Bonnet (1/1/2018 – 12/31/2019)

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 two years?

Control and systems theory is an inherently interdisciplinary field, with strong connections to both mathematics and engineering. More recently, there has been research in system theory applied in both biology and finance. Stochastic control which has long been an area of interest in the mathematical control community, is of increasing interest in applications due its importance in biological systems, finance and quantum control. A growing area of interest is control of networks and this area often uses graph theory. The importance of large networks means that computational issues are also important. Computation for large-scale systems is also important in control of systems governed by partial differential equations.

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?

The activity group membership declined in 2011-2014, but increased until 2017 and held constant in 2018 at 435 members. CST is one of the smaller SIAGs. Although this is an important and active area, many researchers in the field are more active in other organizations such as IEEE Control Systems Society (CSS) and/or International Federation on Automatic Control (IFAC).

We maintain connections with other control focused organizations. We have membership in American Automatic Control Council, “an association of the control systems divisions of nine member societies to represent the United States to the world control community”. The CST chair recommends editors for the reviewing of papers submitted to ACC, and we are also involved with reviewing for the CDC. Additionally, there is a SIAM liaison position to CSS, appointed by CSS, and a liaison member appointed by the chair of SIAG/CST to the Conference on Decision and Control organized by CSS.

Encouraging researchers active in the mathematics of control and systems theory to be SIAG members is a continuing issue. Also, unlike IFAC and IEEE, SIAM is viewed as an American organization and about 2/3 of members are affiliated with US universities. Membership is listed as “domestic” and “foreign” by SIAM, which reflects the US bias.

4. 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 major conference organization of SIAG/CST is the biennial conference SIAM Conference on Control and its Applications. The 2017 meeting was held in Pittsburgh, with the SIAM Annual Meeting. Routinely, every second meeting is held concurrently with the SIAM Annual Meeting. Attendance at the 2017 meeting was handicapped by the fact that it was held the same week as the IFAC World Congress, a major control conference with about 2000 attendees held every 3 years. Nevertheless, attendance was good; 233 attendees. This compares well with the figures in 2011 (205) and 2013 (201). Our most successful conference was the 2015 conference held in Paris, with 464 participants and 437 submissions. It was followed by an increase in membership.

Starting with CT13, we began publishing conference proceedings. This adds to the workload and cost. However, it has contributed to larger participation in CT meetings. This is because many departments and performance indicators regard proceedings as critical to the significance of a conference. Publication of a paper in the proceedings is optional and we plan that this practice will continue.

For reference, web pages of past CT meetings can be found at, letting “xx” indicates the year of the conference,

<https://archive.siam.org/meetings/ctxx/>

Our activity group regularly organizes sessions at the American Control Conference (sponsored by AACC). In 2016 4 sessions were organized, 2017 5 sessions, 2018 4 sessions and in 2019 3 sessions. This activity brings about US\$10,000/year to our organization. For 2019, \$10,000 will be directed to the CT19

and we expect that future income from organization of sessions at ACC will be directed to our biennial conference. This will help to reduce conference registration fee and/or provide travel support which should help with attendance and the success of the meeting.

We also organize sessions for the Conference on Decision and Control (sponsored by IEEE CSS). In 2016 5 sessions, 2017 4 sessions, 2018 4 sessions. For the 2019, 9 sessions were proposed and likely 4-5 will be accepted.

5. 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 2018 SIAM Annual Meeting was held at the same at the Conference on the Mathematics of Networks and Systems, a significant world conference on the mathematics of control and systems theory. Many SIAM members attended the MTNS. There was 1 minisymposium organized by CST at the 2018 SIAM Annual Meeting.

The 2017 CT conference was held concurrently with the SIAM Annual Meeting. As written above, our practice has been that every second CT meeting is held concurrently with a SIAM Annual Meeting.

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?
  - The SIAG has distributed a newsletter by email since 2014. This seems to be an effective method of communication.
  - There have a number of articles in SIAM News. In addition to a special issue on control and systems theory there were:
    - \* Allen Tannebaum, *Robustness of Complex Networks with Applications to Cancer Biology*, 2018: <https://sinews.siam.org/About-the-Author/allen-tannenbaum>
    - \* Naomi Leonard., *Multi-Agent Decision-Making in Design*, 2019: <https://sinews.siam.org/About-the-Author/multi-agent-decision-making-in-design>
  - SIAM is a member of the American Automatics Control Council. We have a member on the board and organize sessions at the Annual Meeting, as well as serving an editorial role.
  - SIAM is a sponsoring society for the IEEE CSS Conference on Decision and Control and we organize sessions at this conference and serve an editorial role.
  - SIAM Activity Group on Control and Systems Theory (SIAG/CST) Prize has been instrumental in promoting rising young researchers. Recipients of the awards can be found at: <https://www.siam.org/prizes/sponsored/siagcst.php>.
  - SIAG/CST Best SICON Paper Prize honors the work of mathematical researchers in controls. Recipients of the awards can be found at: <https://www.siam.org/prizes/sponsored/bestsicon.php> .
  - W. T. and Idalia Reid Prize. This major career prize is jointly administered by SIAG/APDE and SIAG/CST. It is generally awarded to someone in the control theory field.

- The impact of all these awards: CST Prize, best SICON paper and Reid prize is enhanced by plenary prize lectures at the CT conference.
7. What activities are planned and proposed for the next period of the charter? Please describe scheduled and suggested future activities in detail.

The CT19 conference will be held in Chengdu, China. We are hoping that it will lead to an increase in Chinese members. However, the number of submissions has been disappointing. The number of submissions to the 2017 conference was 240, while submissions for 2019 are currently 175. We suspect travel to China, and the requirement to obtain a visa was a detraction to a number of non-Chinese members, and the cost of registration discourages Chinese attendees.

We plan to continue solicitation of articles for SIAM News to improve our visibility in the applied mathematics community.

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

In both 2016 and 2018 the SIAM Annual Meeting coincided with the Mathematical Theory of Networks and Systems (MTNS). As written above, many CST members actively participate in MTNS meetings, which are important international meetings in mathematical systems theory. The 2017 Annual Meeting coincided with the triennial IFAC world congress, the largest meeting in the world in the controls field.

The CST community is multidisciplinary and there are societies with overlapping interests. There is heavy competition for attendance at other conferences. The recent effort of SIAM to collect the dates and locations of relevant controls meeting to avoid conflict with other major conferences is important.

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

Control and systems theory is sometimes called the “hidden science”. Its methodology and results have an impact in many areas, including computational science, optimization, dynamical systems, stochastic systems, networks... Similarly, other fields have an impact on control and systems theory.

Our strong links outside of mathematics, particularly in engineering, present a challenge in terms of membership and conference attendance. However, it is also a resource in terms of promotion of applied mathematics and computational science.

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

Signed

Kirsten Morris, Chair of the SIAG on Control and Systems Theory

April 29<sup>th</sup>, 2019