

## SIAG IMAGING SCIENCES CHARTER RENEWAL APPLICATION

This CHARTER RENEWAL APPLICATION applies to the SIAM Activity Group on the Imaging Sciences (hereafter called SIAG/IS). The SIAG/IS to which this renewal applies was originally formed under the aegis of SIAM on December 11, 1999 by the SIAM Board of Trustees and via electronic voting by the SIAM Council in January 2000. SIAG/IS began its operations on January 21, 2000. Its charter has been renewed by the SIAM Council and Board five times thereafter. The SIAG has 745 members as of Dec 2010.

According to its Rules of Procedure, the objective of the SIAG/IS is to: 1) provide a forum for conferences and scientific interaction between imaging science researchers and practitioners in academia, industry, medicine and government; 2) encourage research that will provide a rigorous mathematical foundation for imaging science; 3) foster research in mathematics and computation that has the potential for solving real-world problems in imaging science, and leads to new methods and techniques useful in this subject; 4) provide the means for rapid publication and dissemination of novel methods in imaging science.

The SIAG/IS 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/IS.

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 three years?

Imaging science is a vibrant and growing field in applied and computational mathematics. Progress in sensor technology has dramatically increased our ability to collect new types of data and vast amounts of it, and this in turn has led to exciting developments in the field of imaging. New methods are emerging (hybrid imaging methods like thermo/photo-acoustic tomography, network tomography, array imaging in random media, imaging with ambient noise, two-photon imaging), and new algorithms are being developed and put in clear mathematical frameworks (random and compressed sensing, robust principal component analysis, inpainting, array data filters of clutter effects for imaging, etc.). Moreover, research in inverse problems (a particular area in imaging) has led to important and fascinating advances in cloaking, and the development of wormholes that are capable of bending light. Imaging science has a broad range of applications in medicine, biology, machine vision, materials science, particle physics, internet search, remote sensing and communications, geophysics, homeland security, and so on.

The importance of imaging as a field in applied and computational mathematics has been recognized by the extraordinary attendance at the last SIAG Imaging Science Conference: There were 389 attendees, just slightly below the number in 2008, when the conference was held jointly with the SIAM Annual Meeting in San Diego.

Here are other examples of important events in imaging. (SIAG members were involved as organizers and participants.) 1) MSRI Semester on Inverse Problems and Applications, Fall 2010. Three SIAG/IS members were among the main organizers and the semester was attended by more than 125 researchers, graduate students and postdocs. 2) International Conference on Applied Inverse Problems, College Station, Texas, May 23-27, 2011. Four

SIAG/IS members are in the Scientific Organizing Committee and SIAG/IS members give invited addresses and minisymposia talks. 3) Semester on Inverse Problems at the Isaac Newton Institute Cambridge UK, Fall 2011. Three SIAG/IS members are in the Scientific Advisory board, three SIAG/IS members will give mini-courses in the introductory workshop, and many SIAG/IS members will speak in the other four workshops. 4) IPAM Workshop, Mathematical problems, models and methods in biomedical imaging, February 2010. 5) IMA Hot Topics workshop, Large scale inverse problems and uncertainty quantification, June 2011.

Links to other conferences and workshops in Imaging Sciences can be found at the SIAG/IS webpage: <http://siags.siam.org/siagis/>

2. How is the activity group doing? Is it remaining vibrant? Is the size of the SIAG/IS stable or increasing? How is the SIAG/IS keeping up with the changes in the field? How are the broader interests of SIAM reflected in the activities of the SIAG/IS?

The SIAG is growing. As of now there are 745 members (there were 592 at the last charter renewal). 373 members are students. 28% of the student members and 15% of the non student members are female. 53% of the members are from Math Sciences, 14% from engineering (not including computer science), 16% in computer science. The rest are in other fields (physics, earth sciences, statistics). Roughly 24% of the members are foreigners, and 41% of those are students.

Efforts have been made to advertise the SIAG and its activities to colleagues around the world by e-mail, and by linking to other societies, such as the IPIA (Inverse Problems International Association).

The SIAG activities continue the educational aspect of the mission by having more student members as participants. Moreover, SIAG/IS members continue to give mini-tutorials and summer courses that are intended to introduce students and young researchers to imaging sciences.

The SIAG/IS has a new SIAM News liaison that is working to advertise broadly the scientific activities in imaging science. The SIAM News (Volume 43, Numbers 6 and 7) had three articles by two plenary speakers at the biennial SIAM Imaging Science Conference in Chicago, 2010 (M. Bronstein and G. Shapiro) and by one mini-tutorial lecturer (J. Garnier).

3. 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 SIAG organizes the biennial SIAM Conference on the Imaging Sciences. The list of past conference may be found at <http://www.siam.org/meetings/archives.php#imaging>*

*The last conference was in Chicago, in April 2010. There were 389 attendees. Most of them were from academia (318). There were 32 attendees from the industry and 29 from Government labs. The conference had 6 invited speakers, 3 mini-tutorials, 65 minisymposia and 8 sessions of contributed talks.*

*The previous conference was in San Diego, in 2008. It coincided with the SIAM annual meeting.*

*The SIAG is co-sponsoring the Gene Golub Summer School in July 4-15, 2011, UBC, Vancouver, on Waves and Imaging.*

*The Waves 2011 Conference at Simon Fraser University, Vancouver, July 25-29, 2011 is sponsored by SIAM. There are 2 SIAG/IS members in the scientific committee and some speakers are also SIAG/IS members.*

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?

*At the SIAM Annual meeting in 2010: Gunther Uhlmann (SIAG/IS member) gave a plenary talk on cloaking and transformation optics. David Donoho gave a plenary talk on compressed sensing. In addition there were minisymposia and contributed presentations on various aspects of imaging and inverse problems as they arise in: compressed sensing, parameter estimation, uncertainty quantification, geosciences, optimization, control, wave scattering.*

*At the SIAM Annual meeting in 2009: Karl Kunisch gave an invited address on Newton methods in function spaces and applications to problems in optimal control and imaging. There were minisymposia on: statistical methods in inverse problems, inverse problems in electromagnetics, cloaking and invisibility, inverse problems.*

*At the ICIAM 2011: Vincent Caselles will give a plenary talk on exemplar-based image inpainting and applications. Ron Kimmel will give a plenary lecture on metric geometry in action. There will be minisymposia on: optimal parameter sampling and model reduction, composites and inversion, regularization methods for inverse and ill posed problems, shape reconstruction in impedance tomography and inverse scattering, theoretical and numerical aspects in variational-PDE methods for solving inverse problems in imaging sciences, multiscale phenomena in calculus of variations and inverse problems, uncertainty quantification, reconstruction algorithms and stability for electrical impedance tomography, tomography, recent advances in inverse problems for PDE's, recent techniques and developments on inverse problems, Sturm-Liouville direct and inverse problems, applications of wavelet methods to meteorology and oil exploration, inverse problems in cardiovascular mathematics, fast optimization algorithms in image processing and its applications, hybrid methods in medical imaging*

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?

SIAG on Imaging Science Prize (SIAG/IS Prize) was established in 2010. It is to be awarded to the authors of the best paper, as determined by the prize committee, on mathematical and computational aspects of imaging, broadly interpreted. Imaging includes image formation, inverse problems in imaging, image processing, image analysis, image interpretation and understanding, computer graphics, and visualization. The prize is awarded every two years, at the SIAG/IS biennial conference. The first prize committee has been approved by SIAM and assembled in November, 2010.

SIAG/IS has a website at: <http://siags.siam.org/siagis/>

SIAG/IS is publishing a newsletter. The last one was in June 2010.

Various announcements of conferences, workshops, jobs, etc., are periodically made via email.

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

*The SIAM Conference on the Imaging Sciences will be held in Philadelphia, May 20-22, 2012. The conference chairs are: Peter Kuchment and Jennifer Mueller.*

The first SIAG/IS prize will be awarded there as well.

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

SIAM could help the SIAG by fostering connections with the large societies that have a significant overlap with the SIAG. Examples of such societies are IEEE, SPIE, Acoustical Society, SEG. Activities, such as conferences that are run jointly with such societies and joint publications will increase the visibility of the SIAG and it will diversify and increase the membership.

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

The SIAG/IS will continue its efforts to attract students and scientists from applications such as medicine, geophysics, optics, material sciences, etc., to imaging and therefore to applied and computational mathematics.

The SIAG/IS requests that the SIAM Council and Board of Trustees renew its charter for a two-year operating period beginning January 1, 2012.

Signed

Liliana Borcea  
Chair, SIAM Activity Group on Imaging Sciences  
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