

Report on the PIMS Period of Concentration in Scientific Computing 2003-2005

Benefits of the period of concentration

The major goal of the period of concentration was to develop the group's common research programmes, and to promote research in scientific computing and increase related interdisciplinary collaboration within the region and on an international level. In addition, this period of increased activity in scientific computing provided a focus to solidly establish SFU's Centre for Scientific Computing (CSC). The majority of the activity of this concentration period took place at the PIMS sites at SFU, UW and UBC and at BIRS.

A large number of graduate students (over 50) and postdoctoral fellows (at least 10) directly benefited from the concentration period in scientific computing.

Scientific computing plays a critical role in applied and industrial mathematics at the PIMS universities and across North America. Within PIMS universities, the scientific computing community has been a very active collaborative group with a tradition of multi-university activities particularly among researchers at U. of Washington, SFU, and UBC. Recently new activities have emerged, due in large part to the leading role played by PIMS. A special feature of this period of concentration was the promotion of a multidisciplinary approach to the subject and the inclusion of important research topics such as fuel cells and medical imaging. The base of support for the group includes researchers from Mathematics, Applied Mathematics, and Computer Science.

Events

Two postdoctoral fellows were funded as part of this period of concentration: Dr Jianying Zhang (at UBC), who is now a faculty member at Western Washington University, and Dr Jianjun Xu (SFU), who currently holds a position at the University of California at Irvine.

During the period of concentration the following events were hosted:

Feb 2003	PIMS-IAM-CSC Senior Undergraduate Modeling Workshop	SFU & UBC
Apr 2003	BIRS Workshop on Computational Fuel Cell Dynamics	BIRS
Aug 2003	Workshop on Numerical Linear Algebra and Applications	UBC
Aug 2003	Five-Day BIRS Workshop on Computational Techniques for Moving Interfaces	BIRS
Oct 2003	Pacific Northwest Numerical Analysis Seminar	UW
Mar 2004	Biological Molecular Algorithms - A Mathematician's Perspective on Molecular Biology (Barry Merriman)	SFU-UBC
May 2004	Five-Day BIRS Workshop on Mathematical Foundations of Scientific Visualization, Computer Graphics and Massive Data Exploration	BIRS
June 2004	Adaptive wavelet and multiscale methods for partial differential equations – 2-day BIRS workshop	BIRS
Jul/Aug 2004	PIMS Distinguished Chair - Chris Budd Analytical and numerical aspects of multi-scale problems	SFU
Aug 2004	PIMS Distinguished Chair - Otmar Scherzer Scale Space Methods and Regularization for Denoising and Inverse Problems	UBC
Oct 2004	Pacific Northwest Numerical Analysis Seminar – 2-day BIRS workshop	BIRS
Oct 2004	Multiscale Modeling and Computation of Flow in Heterogeneous Media (Tom Hou)	UBC-SFU
Nov 2004	Joint SFU CSC and UBC IAM Seminar Data Assimilation in Nonlinear Dynamics Models (Juan Restrepo) Simple and complex impact oscillators and their bifurcations (Chris Budd)	SFU-UBC
Fall 2004	PIMS Distinguished Chair – Juan Restrepo	SFU
March 2005	Computational Fuel Cell Dynamics	BIRS
Aug 2005	Intl. Conference: Adaptivity and Beyond	SFU
2003-2005	PIMS-IAM Distinguished Speaker Series	UBC
2003-2005	PIMS-MITACS-CSC Seminar Series	SFU
2004-2006	University of Alberta Distinguished Lectures Series in Scientific Computing and Information Technology	UA

Impact of the period of concentration

The period of concentration established new collaborations and strengthened existing ones. Its strongest impact was probably felt at UBC and SFU, but there is also a much increased awareness of activities and expertise at all PIMS Universities. The groups at SFU and UBC worked together in organizing and coordinating the events, establishing a tradition of sharing opportunities. The spirit of this cooperation continues, and researchers regularly attend seminars and talks at the other site.

1. **Seminars and Talks.** Throughout the period there were regular weekly seminars co-hosted by the Centre for Scientific Computing at SFU, largely by visiting researchers. These weekly seminars provided a focal point for faculty and students. At UBC, the PIMS-IAM Distinguished seminar series attracted excellent speakers and large audiences. We consider these seminar series (in addition to on-going informal seminars) an important anchor for the activities of the Collaborative Research Group. Indeed, these series of talks continued both at SFU and UBC with Distinguished Lecture Series beyond the period of concentration.
2. **Workshops and Conferences.** The period of concentration allowed the group to organize a number of scientific meetings. In addition to our annual Pacific Northwest Numerical Seminar (in 2004 we organized a two-day meeting at Banff instead of the customary one-day format) we had an excellent international workshop on numerical linear algebra as well as a 2-day BIRS workshop on wavelets. In 2005 we organized an international conference on adaptive methods for solving differential equations. All these events attracted world leaders in the field, and provided an invaluable experience for the many postdocs and graduate students in our programmes. Without PIMS support (both financial and administrative) these meetings simply would not have happened.
3. **Faculty Recruitment.** Over the last three to four years many new faculty members in the field of Scientific Computing joined various departments at PIMS universities. Clearly, the decision whether to accept or reject a job offer is a complex one, and cannot be easily attributed to just one single factor. Yet, the increased scientific activity in the region, the strong collaborative spirit and clear evidence of funding opportunities for scientific initiatives appear to be very attractive to bright young researchers. Recent hires come from the top institutions, and many chose a PIMS university offer over offers from other prestigious universities.

4. **Student Recruitment.** With the strong emphasis of PIMS programmes on supporting training of highly qualified personnel it is no surprise to find a strong impact of the period of concentration on PIMS researchers' ability to attract excellent graduate students and postdoctoral fellows. As an example, the community spirit in our CRG proved to be contagious to graduate students, who have now organized two regional one-day meetings of students related to the CRG in Scientific Computing, in particular, inviting also colleagues from other areas of applied mathematics.
5. **Interdisciplinary Collaboration.** The special period gave rise to a close interdisciplinary collaboration in medical imaging, involving the medical imaging group at VGH/Radiology (UBC), and researchers from Computer Science and Mathematics. The period was also a boost to the interdisciplinary fuel cells project with Ballard Power Systems and researchers from UBC and SFU.
6. **International Collaboration.** PIMS activities during our period of concentration provided many opportunities for international collaboration. All our conferences and workshops attracted a strong international audience; most speakers in our various Lecture Series were international experts, and many of them spent bigger chunks of time with their hosts and graduate students. The PIMS Distinguished Chairs spent a month or more at the host institutions. They gave a series of lectures, and were engaged in many informal discussions as well as concrete collaborations. These ties have continued beyond the concentration period. For example, this summer two students of PIMS Distinguished Chair Otmar Scherzer participated in the PIMS Graduate Modeling workshop and Industrial Problem Solving Workshop, and one student worked for a month with the PIMS Medical Imaging Group.

Scientific Computing continues to be a very active PIMS Collaborative Research Group, and owes much of its strength to the support provided by PIMS.

Appendix:

MEMBERS OF THE COLLABORATIVE RESEARCH GROUP

Name	Department	Institution	Status
R. Choksi	Department of Mathematics	SFU	Faculty
M.C. Kropinski	Department of Mathematics	SFU	Faculty
T. Möller	School of Computing Science	SFU	Faculty
D. Muraki	Department of Mathematics	SFU	Faculty
K. Promislow	Department of Mathematics	SFU	Faculty
B. Russell	Department of Mathematics	SFU	Faculty
S. Ruuth	Department of Mathematics	SFU	Faculty
L. Trajkovic	Department of Engineering Science	SFU	Faculty
M. Trummer	Department of Mathematics	SFU	Faculty
J. Verner	Department of Mathematics	SFU	Faculty
R. Zahar	Department of Mathematics	SFU	Faculty
Jian-Jun Xu	PIMS	SFU	Postdoc
U. Ascher	Department of Computer Science	UBC	Faculty
O. Dorn	Department of Computer Science	UBC	Faculty
S. Dunbar	Electrical and Computer Engineering	UBC	Faculty
I. Frigaard	Department of Mathematics	UBC	Faculty
A. Peirce	Department of Mathematics	UBC	Faculty
B. Seymour	Department of Mathematics	UBC	Faculty
B. Shizgal	Department of Mathematics	UBC	Faculty
J. Varah	Department of Computer Science	UBC	Faculty
M. Ward	Department of Mathematics	UBC	Faculty
B. Wetton	Department of Mathematics	UBC	Faculty
M. Yedlin	Electrical and Computer Engineering	UBC	Faculty
Jian Ying Zhang,	PIMS/MITACS	UBC	Posdoc
Y. Lin	Department of Mathematics	U. Alberta	Faculty
J. Macki,	Department of Mathematics	U. Alberta	Faculty
P. Minev	Department of Mathematics	U. Alberta	Faculty
Y.S. Wong	Department of Mathematics	U. Alberta	Faculty
T. Ware	Department of Math and Stat	U. Calgary	Faculty
R. Westbrook	Department of Math and Stat	U. Calgary	Faculty
P. van den Driessche	Department of Computer Science	U. Victoria	Faculty
D. Olesky	Department of Computer Science	U. Victoria	Faculty

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L. Adams	Department of Applied Mathematics	U. Washington	Faculty
C. Bretherton	Department of Atmospheric Sciences	U. Washington	Faculty
J. Burke	Department of Applied Mathematics	U. Washington	Faculty
D. Durran	Department of Applied Mathematics	U. Washington	Faculty
A. Greenbaum	Department of Mathematics	U. Washington	Faculty
G. Hakim	Department of Atmospheric Sciences	U. Washington	Faculty
N. Kutz	Department of Applied Mathematics	U. Washington	Faculty
R. LeVeque	Department of Applied Mathematics	U. Washington	Faculty
R. O'Malley	Department of Applied Mathematics	U. Washington	Faculty
P. Schmid	Department of Applied Mathematics	U. Washington	Faculty
R. Bradean,	Ballard Corporation		Faculty
J. Kenna	Ballard Corporation		Faculty
M. Epton	Boeing Corporation		Faculty
S. Filipowski	Boeing Corporation		Faculty
J. Lewis	Boeing Corporation		Faculty
S. Reddy	Quadrus Financial Technologies		Faculty