Pacific Institute for the Mathematical Sciences

Year in Review 2019

Simon Fraser University • University of Alberta • University of British Columbia • University of Calgary
University of Lethbridge • University of Manitoba • University of Regina • University of Saskatchewan
University of Victoria • University of Washington

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About PIMS

The Pacific Institute for the Mathematical Sciences was founded in 1996; it is a consortium of universities in the Pacific Northwest and Western Canada.

Member universities: Simon Fraser University, University of Alberta, University of British Columbia, University of Calgary, University of Lethbridge, University of Manitoba, University of Regina, University of Saskatchewan, University of Victoria and University of Washington.

Affiliates: Portland State University, and the University of Northern British Columbia

The Pacific Institute for the Mathematical Sciences (PIMS) is a collaborative network dedicated to the promotion of discovery, understanding and awareness in the mathematical sciences. PIMS brings together leading researchers from major Universities across western Canada, as well as the University of Washington, and is a Unité Mixte Internationale of the National Center for Scientific Research (Le Centre national de la recherche scientifique, CNRS).

PIMS sponsors and organizes educational and community outreach, aboriginal math camps, and summer schools for both teachers and students, as well as initiatives to promote diversity in mathematics, partnerships that bring mathematical research to industry, cutting edge mathematical and scientific research, and events across the PIMS network that promote advancement in computer science, pure and applied mathematics, and statistics.

The central office is at the University of British Columbia, with a PIMS site office and a Site Director local to each of the ten member universities. The Site Director facilitates local opportunities and synergies, while the PIMS site offices provide administrative assistance for organizing local events. This distributed structure renders it quite unique, involving strong local site offices and activities, and allowing a broad impact across Western Canada and beyond.

The Board of Directors oversees the administration of PIMS, with membership consisting of the VP of Research from each of the member universities, as well as distinguished scientists and representatives from industry. An independent Scientific Review Panel composed of internationally renowned mathematical scientists assesses proposals for scientific events and programs.

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From the Director

2019 was another excellent year for PIMS and the advancement of the mathematical sciences. Our community worked together to develop answers and to implement programs addressing the Institute's mission-driven questions. How can PIMS, in concert with our member universities and our international partners, bring researchers and trainees together to advance discovery in the mathematical sciences? What actions can our community take to broaden participation in the mathematical sciences and higher learning more generally? How can PIMS improve linkages between the university community, industry, nonprofits, and governments to unleash the power of the mathematical sciences and our talented trainees in our programs to improve society? This document showcases some of the work we've done over the past year.

A diverse collection of research activities took place across the PIMS network in 2019, with a spotlight on an event in Arithmetic Topology. A few highlights are shared in a quick panoramic tour below. Fourteen postdoctoral scholars joined the PIMS community in 2019 bringing new energy and vibrancy. We shine the spotlight on Dr. Chandra Rajapulati who is working on mathematial problems in hydrology at Global Water Futures at the University of Saskatchewan. The Postdoctoral Training Centre in Stochastics and ongoing Collaborative Research Groups (Geometric Analysis, Geometric and Cohomological Methods in Algegra, High Dimensional Data Analysis) ran research and training programs at the knowledge frontier.

The Institute's international connections were strengthened in 2019. A Vancouver tour by Professor Etienne Ghys, co-sponsored by the French Consulate and the Peter Wall Institute for Advanced Studies, included public lectures at Science World and Alliance Française. The PIMS-CNRS International Research Lab was renewed in 2019 at a celebration event in Vancouver with CEO and Chairman of the CNRS, Antoine Petit. New mobility programs with Mitacs were expanded to include other countries. Planning for the next Congress of the Pacific Rim Mathematical Association (PRIMA) in Vancouver in 2021 is underway.

PIMS, with many collaborating organizations, ran a variety of programs to broaden participation in the mathematical sciences during 2019. The Diversity in Mathematics program guided a cohort of 23 female students toward research and industrial career pathways. The Elementary Math Contest (ELMACON), the Emerging Indigeneous Scholars Summer Camp, and a Math Summer School for Elementary School Teachers are highlighted below. An additional tranche of funding from the Governement of Canada extended the Callysto project PIMS operates with Cybera. In partnership with members of the Tla'amin Nation, a PIMS team at SFU developed remarkable education resources using Callysto to interactively demonstrate mathematical ideas in the intricate patterns of traditional Coast Salish woven baskets.

PIMS has more than twenty years of experience working with industry partners. Programs like the Lunch and Learn Seminar in Calgary and industrial problem solving workshops informed many of the Institute's initiatives in 2019. The bcdata colloquium, operated in partnership with Motorola Corporation, contributes to the development of a community that intertwines students, postdocs, faculty and industry partners. A workshop on mathematical sciences and clean energy applications explored ways that the PIMS community can contribute solutions to the climate crisis.

PIMS amplifies research, training, education and public outreach activities in the mathematical sciences across a vibrant network of member universities. We look forward to continuing our work together in 2020.

James Colliander
Director

2019 Around the Sites

The individual universities that make up the **PIMS** community organize a wide range of seminars, conferences and workshops that pack the annual calendar. Here is a small selection of some activity highlights from 2019.

Simon Fraser University

Over 100 attendees came together for the biannual 14th International Conference on Finite Fields and their Applications (Fq14). Researchers discussed theory, computation, and applications of finite fields, and the relation to other areas of mathematics. A diverse group of invited speakers came from France, Australia, China, Germany and the United States from different areas of research that are linked together through the common theme of finite fields.

University of Regina

PIMS was proud to support the 47th annual Canadian Operator Symposium. This event brought together over 60 researchers from across Canada and around the world. Researchers in the field of theory of operator algebras were able to disseminate their research findings and forge collaborations with other researchers. It also provided graduate students and postdoctoral researchers the opportunity to present their work in a supportive environment.

University of Calgary

For seven days the 2019 CMS Regional Math Camp brought together over 30 mathematically talented students in grades 7 – 10. The students were provided with training in mathematics, mathematical problem solving and opportunities for networking. Excitedly, the female participants outweighed the male participants in attendance.

University of Manitoba

Over the course of two days, researchers from central to western Canada convened to attend the 63rd Cascade Topology Seminar. The theme of the conference was low-dimensional topology and connections with mapping class groups, and related topics in geometric group theory. The objective of the conference was to highlight connections and commonalities between the fields and foster new collaborations between mathematicians based in different provinces.

University of British Columbia

Jupyter Day 2019 brought together a mix of over 60 instructors, researchers and students to share their experiences and learn about new Jupyter tools. Participants were also shown how Jupyter Notebooks can facilitate the instruction of Indigenous knowledges through Python's ability to perform geometric operations, while creating Tla'amin Nation patterns used in traditional basket weaving. The Tla'amin Nation and Callysto worked together on this collaboration.

University of Lethbridge

PIMS' Distinguished Speaker Series featured Veselin Jungic, SFU, who provided an overview of the Math Catcher Outreach Program: Hands-on and No-Fear Math. With a strong First Nations component, the aim of the program is to show elementary and high school students how math is used in everyday life decisions. Through storytelling, puzzles, pictures, models, and hands-on activities, young people were encouraged to enjoy math and dispel myths that math is boring and abstract.

University of Victoria

Attendees from Western Canada attended the first Levin Fest symposium. To celebrate the receipt of an honorary degree, Dr. Levin gave the keynote address as the CAIMS Distinguished Lecture in Mathematical Biology, "Public goods, from biofilms to societies". Attendees with research interests from economics to math biology were treated to plenary talks by both Mark Lewis (U. Alberta) and Carla Staver (Yale U.).

University of Saskatchewan

From June 10 – 21 the University of Saskatchewan hosted the Data Science Bootcamp. Participants were able to engage with courses in Machine Learning, Analysis of High-Dimensional Data, and Data Visualization. Students had the opportunity to utilize Jupyter Notebooks to create interactive visualization of the networks, dynamic charts and cartographic visualization. Participants also gained networking experience through poster presentations, honing a valuable skill they will need in their future careers.

University of Alberta

The Canadian Conference on Computational Geometry (CCCG) is a forum to disseminate and discuss new theoretical and applied results in discrete and computational geometry. Over 50 researchers attended the conference; with 38 papers presented and 3 plenary talks disseminating breakthroughs in discrete and computational geometry. Six papers were selected to appear in a special edition of the journal Computational Geometry: Theory and Applications that is dedicated to the CCCG. Additionally, several research collaborations were forged through in-person connections made at the conference.

University of Washington

Northwest Theory Day 2019: Proofs, Algorithms, Satisfiability and Logic, hosted faculty, postdocs, graduate and senior undergraduate students from PIMS universities, as well as top researchers from North America and Europe. Researchers discussed state-of-the-art and future directions of theoretical computer science research. Proof Complexity and its connections to SAT solvers, learning algorithms, and computational complexity were the themes of this workshop.
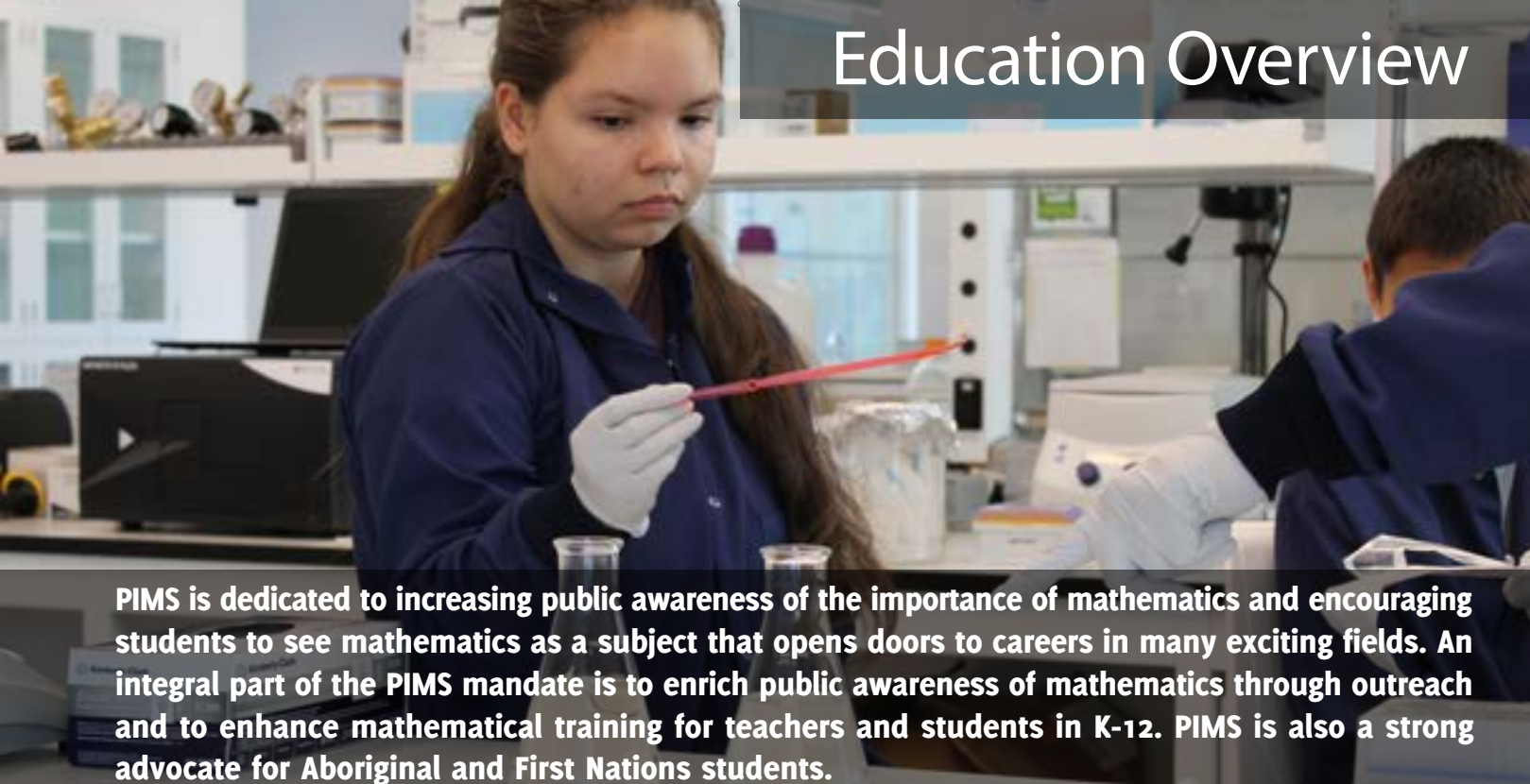
PIMS is dedicated to increasing public awareness of the importance of mathematics and encouraging students to see mathematics as a subject that opens doors to careers in many exciting fields. An integral part of the PIMS mandate is to enrich public awareness of mathematics through outreach and to enhance mathematical training for teachers and students in K-12. PIMS is also a strong advocate for Aboriginal and First Nations students.

Math education and outreach are fundamentally important components of PIMS' activities. With a robust calendar of events, we engage and connect with the different groups within the PIMS community, and deliver relevant content that promotes K-12 education in math through high quality education programs.

ELMACON

2019 marked the 20th anniversary of ELMACON, which was attended by over 300 participants! The aim was to provide an exciting experience for students in grades 5 - 7, as they competed in a creative setting through a supportive, and sport-like atmosphere.

Emerging Indigenous Scholars Summer Camp

PIMS partnered with Langara College to support Indigenous high school students in their pursuit of mathematics. 30 students gathered to receive Math and English instruction in the morning, and get a taste of the post-secondary experience in the afternoon. Students chose among disciplines such as: chemistry, engineering, computing science, and physics and gained experience within these fields. The aim was to provide a sound foundation in Mathematics, Science and English, while increasing confidence and success when continuing their education.

Math Summer School for Elementary School Teachers

Together with UBC and SFU, PIMS ran a 4-week summer school for 23 elementary school teachers. This camp provides teachers with an opportunity to improve their mathematical knowledge and skills. They also developed strategies for teaching to create an enthusiastic culture around math within their school.

Changing the Culture

Over 100 educators came together for PIMS' annual Changing the Culture to narrow the gap between those who enjoy mathematics, and those who claim they don't. Jo-ann Archibald's (Q'um Q'um Xiiem) plenary talk focused on how Indigenous knowledges and stories support culturally responsive and culturally-based pedagogical approaches, and the need for educators to work ethically while supporting Indigenous knowledges.

Postdoctoral Fellows

Every year PIMS sponsors numerous postdoctoral fellows (PDFs), attracting outstanding young scientists who contribute to PIMS research programs, many of whom later become faculty members at Canadian universities. PDFs are distributed throughout PIMS sites on a competitive basis. In addition, each one of PIMS' Collaborative Research Groups is allocated a number of PDFs, the selection of which is determined by an assessment panel.

2019 Postdocs:

Shuxing Li (SFU)	Fei Qi (UM)	Shirou Wang (UA)
Marco Carmosino (SFU)	Edward Timko (UM)	Hugo Lavenant (UBC)
Sergii Myroshnychenko (UA)	Zafer Selcuk Aygin (UL & UC)	Jason Bramburger (UVic)
Brian Freidin (UBC)	Hui Huang (US)	Tseleung So (UR)
Thomas Budzinski (UBC CNRS)	Chandra Rajulapati (US)	

Featured Postdoctoral Fellow: Chandra Rajulapati

Postdoctoral Researcher at the University of Saskatchewan.

"Hydrology deals with understanding of how water moves below and above Earth's surface. I developed interest in hydrology during my undergrad, as it deals with one of the most important, as well as valuable resources, on earth. With growing interest in fresh water sources, I have studied ground water aquifers in my masters and changes in precipitation for urban areas in my doctoral degree. After completion of a doctoral degree at the Indian Institute of Science, Bangalore, India, I joined the University of Saskatchewan in the fall of 2018 as a PIMS-GWF Postdoctoral fellow.

My research deals with understanding changes in hydroclimatic variables like precipitation and temperature at different scales, estimating risk due to extreme events like floods, droughts and heatwaves, and developing sustainable water management systems. Under a changing climate, it is important to understand how frequently we are experiencing extreme events, and their intensity for risk assessment and disaster management. Therefore, currently, I am analyzing the global climate models output and downscaling them to estimate changes in hydroclimatic variables for the future, at regional and global scale.

The best part of my experience as a PIMS-GWF PDF is attending the BIRS workshop at Banff from September 27-29 2019, where I got a chance to meet eminent mathematicians from all over Canada. My discussions with the workshop participants lead to a different perspective on Bayesian methods and Markov process, which are frequently used in modelling spatiotemporal and probabilistic structure of hydroclimatic processes and uncertainty quantification."

2019 PIMS fifth Postdoctoral Training Centre in Stochastics (PTCS)

This was the fifth annual meeting of the PIMS Postdoctoral Training Centre in Stochastics (PTCS). The retreat offers an opportunity for young researchers in pure or applied probability from Western Canada and Washington state to interact, communicate their recent results and ongoing research programs, and initiate new collaborations. The level of talks at the retreat was extremely high in terms of content and presentation. The open problems session led to at least one on-going collaboration between Y. Spinka and T. Budzinski on the enumeration of domino tilings. The range of topics from applied statistical hydrology to mathematical finance to the latest developments in random growth models, was a prominent feature of the workshop.

Chandra Rajulapati (US) spoke on modelling precipitation, both locally and globally, and how global trends provide inputs for urban precipitation estimates.

Shirou Wang (UC) presented her work on random dynamics from an applied modelling perspective in which the random cocycle structure arises due to extrinsic ergodic noise in the system and is further perturbed by a Markov chain arising from smaller intrinsic noise..

Thomas Budzinski (UBC) spoke on random gluing models to construct random manifolds from sequences of polygons.

2019 Results: During the meeting plans were made for an annual conference rotating between sites at UBC, U. Washington, U. Victoria and U. Alberta. A large meeting at UW was planned for 2020 using the final cycle of NSF funding for the PTCS, and a smaller weekend meeting at U. Victoria will be held in April of 2020. This will be followed by a one-week meeting in Victoria in 2021 and a large event at U. Alberta in 2022, with another Summer School in Probability in 2022 at either U. Alberta or UBC.

2019 Attending Postdocs:

Shuxing Li (SFU)	Fei Qi (UM)	Shirou Wang (UA)
Marco Carmosino (SFU)	Edward Timko (UM)	Hugo Lavenant (UBC)
Sergii Myroshnychenko (UA)	Zafer Selcuk Aygin (UL & UC)	Jason Bramburger (UVic)
Brian Freidin (UBC)	Hui Huang (US)	Tseleung So (UR)
Thomas Budzinski (UBC CNRS)	Chandra Rajulapati (US)	

2019 Prizes & Awards

CRM - Fields - PIMS Prize

Nassif Ghoussoub, University of British Columbia
Nassif Ghoussoub obtained his Ph.D. from Université Pierre et Marie Curie in 1975. Shortly thereafter he joined the Mathematics Department at UBC, where he is currently a Distinguished University Professor. Professor Ghoussoub's contributions have been recognized by the Coxeter-James, Jeffery-Williams and David Borwein Awards of the Canadian Mathematical Society, honorary doctorates from Université Paris-Dauphine and the University of Victoria, and Fellowship in the American Mathematical Society. He was elected Fellow of the Royal Society of Canada in 1993, and was appointed Officer of the Order of Canada in 2015. His present research interests are in non-linear analysis and partial differential equations.

PIMS Education Prize

Jamie Mulholland, Simon Fraser University
Jamie Mulholland is a senior lecturer in the Department of Mathematics at Simon Fraser University. Jamie's background is in pure mathematics; in particular abstract algebra, algebraic topology, combinatorial group theory, and number theory. He is also very interested in mathematics education and promoting mathematics to students at all age levels: elementary school through college/university. For Jamie, mathematics is a very beautiful subject which highlights some of the greatest achievements in human thought. Unfortunately, not everyone hangs on long enough to reach the stage where they encounter this beauty. This is not to say that a high level of sophistication is required to understand or appreciate the ideas, in fact, quite the opposite is true. Some of the ideas can be presented to students as early as elementary school.

UBC/PIMS Mathematical Sciences Young Faculty Award

Liam Watson, University of British Columbia
Dr. Liam Watson is an Associate Professor of Mathematics at UBC, with a research focus on Low Dimensional Topology. Dr. Watson received his PhD in 2009, from the University of Quebec. Dr. Watson has won teaching awards from UBC, the University of Glasgow and UCLA. He has also won a tier 2 Canada Research Chair award and a CRM- Simons professorship.

He studies problems in low-dimensional topology using invariants like Khovanov homology and Heegaard Floer homology. His research is supported by a grant from the Natural Sciences and Engineering Research Council of Canada (NSERC).

Diverstity in Mathematics

Over 30 high-school and undergraduate students participated in the second annual Diversity in Mathematics program. This multi-year, multi-level program promotes diversity and inclusivity in STEM. It is hosted by the Pacific Institute for Mathematical Sciences for female-identified undergraduate students studying mathematics.

Participants are exposed to a variety of mini-courses, lectures, group projects, panel discussions and field trips, with a variety of mathematical themes that are not currently explored in the regular curricula. Students in the high-school stream had the opportunity to be mentored by the undergraduate participants who instilled a sense of belonging amongst the university community.

Numerous academic and industrial career options were showcased to illuminate the many pathways that begin with mathematics.

Through the program's undergraduate stream, students were exposed to a new course each week. The first week was an: Introduction to Computational Fluid Dynamics for Medical Applications, and Fighting Infectious Diseases with Math and Genomics was showcased in the final week.

Callysto is a free, curriculum-based and skills development platform, available on any web browser, without any software installation. Launched in 2018 by the Pacific Institute for the Mathematical Sciences and Cybera, it was developed to help students strengthen their digital capabilities. It is funded through the federal government's CanCode program, and received new funding in 2019.

It gives students in grades 5-12 access to an interactive learning program, capable of big data processing, digital math equations, remote collaboration, and a multitude of other innovative functions to enhance computational and design thinking skills.

Learning modules are housed in Jupyter Notebooks, and allow users to seamlessly intertwine lines of code with formatted text, images, and visualizations. This provided an opportunity to pass down traditional Indigenous teachings. The Callysto Salish Basket project at Simon Fraser University combined the teachings of basic geometric math concepts with basket weaving patterns from the Tla'amin Nation on the Sunshine Coast.

From an education perspective, the platform is ideal for remote learning. Teachers can deliver assignments that are self-contained within a single Jupyter Notebook, and students can work directly inside the assignment. Teachers are able to follow a student's thought process in its raw form, helping them assess the level of understanding, as well as potential problem areas.

55,000	2,000	4,000
Students Trained	Teachers Trained	Callysto Hub Users

bcdata

Since its inception in 2017, bcdata has run a series of workshops and colloquiums to support the data science community. With the support of Avigilon (a Motorola Solutions Company) and the Pacific Institute for the Mathematical Sciences (PIMS), bcdata ran a series of Colloquiums in 2019. This provided an opportunity to identify synergies, facilitate the exchange of expertise, and support research collaborations.

Through the bcdata initiative, we have created a robust data science community, which supports expertise in young mathematicians and provides training and career pathways in data science. The collaboration facilitates relationships between government, industry, universities and not-for-profits. A goal is to forge long-term research and development partnerships to improve society and advance industry in British Columbia.

PIMS Workshop on Mathematical Sciences and Clean Energy Applications

Nearly 100 attendees participated in 33 talks over the course of the workshop. The theme was to minimize climate impacts and prevent runaway climate change. To achieve this, the energy chain of the global economy must be drastically decarbonized. Attendees were presented with first-hand accounts of mathematical scientists working in clean energy projects, gentle introductions to clean energy systems and mathematical tools, graduate student presentations, and panel discussions on topics such as challenges in clean energy. The role of mathematics in clean energy was highlighted in session topics such as: Wind Energy Market Modelling, Water, Optimization, Solar, Storage and Distribution, Electrochemical, and Energy Policy.

The workshop facilitated a greater dialogue between those in the mathematical sciences and the clean energy sector. A panel discussion on "How I got into Clean Energy Research" provided a window for the mathematical sciences community to see first-hand examples of how one can make the transition into clean energy research.

2019 COLLOQUIUMS:

Data Challenges and Solutions for Autonomous Vehicles
Yaser Khalighi, Caliber Data Labs

Data-driven Control and Optimization in the Wind Industry
Sampoorna Biswas, Data Engineer, Clir

Mapping the Internet
Stefan Hannie, Researcher and Developer, Corvum

Blog Post: Saving Lives With Data and Math

PIMS-CNRS International Research Lab Renewal

With the original PIMS-CNRS agreement signed in 2007, we are extremely pleased with the renewal of the PIMS-CNRS IRL #3069, in 2019. The agreement facilitates research collaborations between mathematical scientists at PIMS member universities in North America, and researchers across France. In its 80th year, the CNRS celebrates over 1,000 labs in France and about 100 labs outside of France. Through partnerships, researchers have the opportunity to visit labs which align with their research interests, facilitating a robust community and the exchange of information amongst researchers.

Additionally, the partnership provides access to PIMS-CNRS Fellowships, the PIMS-CNRS Student Mobility Program and PIMS-CNRS Poses Rouges 2020 which offers 3-month research positions in France to academics from PIMS member institutes. In 2019, PIMS was pleased to host 4 CNRS visitors: Dr. Raphael Chetrite and Dr. Joris van der Hoeven at PIMS SFU, and Dr. Charles Favre and Dr. Filippo A.E. Nuccio Mortarino Majno di Capriglio at PIMS UBC.

Above: CNRS CEO, Antoine Petit and PIMS Director, James Colliander at the CNRS IRL signing ceremeny in Vancouver. Below, PIMS CNRS visitors Raphael Chetrite (left) and Filipo Nucci (right)

Étienne Ghys - Vancouver Tour

PIMS has a longstanding relationship with the French mathematics community through its partnership with the CNRS (Centre National de la Recherche Scientifique). This relationship has been integral to facilitate and encourage research collaborations between mathematical scientists at PIMS member universities in North America and researchers across France, as well as hosting events such as Étienne's Vancouver Tour.

Étienne Ghys is a French mathematician whose scientific contributions deal with the geometry and topology of dynamical systems. The Consulate General of France in Vancouver and PIMS hosted the Etienne Ghys: Vancouver Tour from May 2 - 3, 2019, with a series of events in Downtown Vancouver, UBC Vancouver campus and a French session on Cambie Street at the Alliance Française.

The Geometry of Snowflakes | May 2, 2019 | A Mirror Maze: Numbers in Nature
Snowflakes are natural jewels. Scientists have been trying to understand them for more than four hundred years. Étienne told the story of snowflakes and used it as an opportunity to show beautiful images.

PIMS Colloquium - Singularities of Planar Analytic Curves | May 3, 2019
In the neighborhood of a singular point, a real analytic curve in the plane consists of a finite number of branches. Each of these branches intersects a small circle around the singular point in two points. The main purpose of this talk is to give a complete description of those analytic chord diagrams.
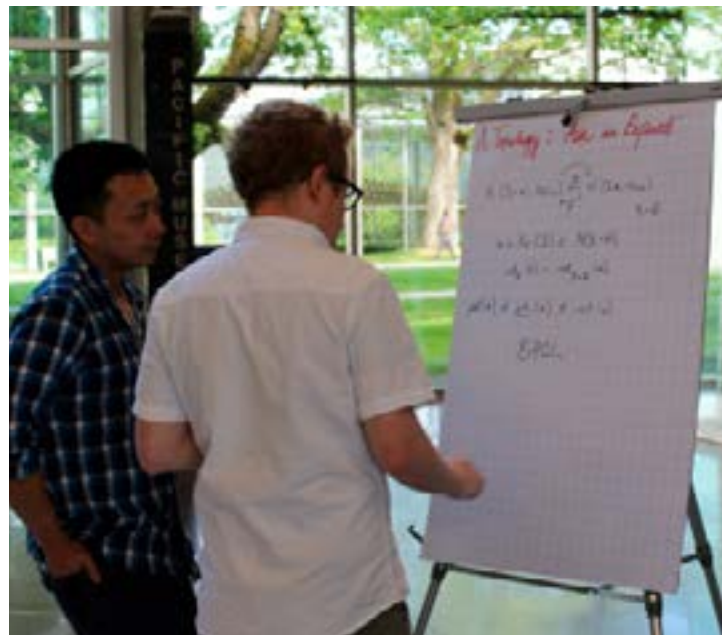
Café des Sciences - The Geometry of Networks | May 3, 2019
We live in a world organized by gigantic networks. Mathematicians have long been interested in these structures and understanding their geometry, which has little to do with the Pythagorean theorem!

PIMS Workshop on Arithmetic Topology

Over the last 10 years there has been a surge of activity at the intersection of algebraic topology, number theory and algebraic geometry. The development of new theorems, from Ellenberg–Venkatesh–Westerland's breakthrough results on the Cohen–Lenstra heuristics for function fields, to new sources of heuristics in topology, such as Vakil–Wood's predictions from the Grothendieck ring, facilitated the emergence of arithmetic topology as a new program of research.

New research activity in this emerging field provided the opportunity for a 5-day workshop, bringing together both junior and senior researchers from across disciplines. Attendees enjoyed 6 expository mini-courses by experts, 7 research talks, two sessions of junior participant lightning talks and 3 moderated problem sessions.

The objectives of the workshop were to provide researchers with a global view of this developing multidisciplinary area, instill a detailed awareness of the range of methods available, and develop a robust problem list to help guide scholarship in this area for the next 5 – 10 years.

2020 Event Highlights

SEMINARS, CONFERENCES AND WORKSHOPS

January 1 - Ongoing	**Calgary Lunchbox Lecture Series** University of Calgary
January 1 - Ongoing	**PIMS-UVIC Colloquium Series** University of Victoria
January 1 - Ongoing	**Calgary Algebra and Number Theory Seminar Series** Calgary
January 1 - Ongoing	**CORE Seminar** University of Washington
January 1 - Ongoing	**PIMS Nonlinear Dynamics Seminar Series** University of Victoria
January 1 - Ongoing	**Probability Seminar Series** University of Alberta
January 30 - Ongoing	**bcdata Colloquium Series** Vancouver
March 7 - 8	**Canadian Western Algebraic Geometry Symposium** University of Saskatchewan
April 1 - Ongoing	**PIMS Edmonton-Cambridge-Seoul Geometry and Physics Seminar** University of Alberta
April 30 - May 2	**BC Undergraduate Math and Statistics Conference** Simon Fraser University
May 1 - 3	**Alberta Number Theory Days XII** Banff International Research Station
May 9	**ELMACON** University of British Columbia
May 20 - 21	**Prairie Discrete Math Workshop** University of Lethbridge
May 25 - 29	**GAP XVII - Deformations and Higher Structures** University of British Columbia
June 15 - 24	**Foundations of Computational Mathematics Conference** Simon Fraser University
July 13 - 17	**Recent Advances and New Directions in the Interplay of Noncommutative Algebra and Geometry** University of Washington
August 5 - 7	**Canadian Conference on Computational Geometry** University of Saskatchewan
August 10 - 14	**Derivative Free Optimization Workshop** University of British Columbia
August 10 - 14	**New Trends in Localized Patterns in PDEs: Mathematical Theory & Applications to Physics, Biology & Social Sciences** University of British Columbia
September 30 - Ongoing	**Washington Experimental Mathematics Lab Collaborations (WXML)** University of Washington
October 24	**Mathematical and computational challenges in Cryo-Electron Microscopy** University of British Columbia

SUMMER SCHOOLS

May 9 - 20	**Two-week graduate course in processbased hydrological modeling** University of Saskatchewan
June 1 - 26	**PIMS- CRM Summer School in Probability** University of British Columbia
June 19 - July 10	**Path2Math Summer Academy** University of Manitoba
June 29 - July 10	**Summer School on discrete probability, physics and algorithms** University of Montreal
July 27 - August 8	**PIMS - Germany Summer School on Eigenvarieties** University of British Columbia
August 4 - 14	**PIMS Diversity in Mathematics Summer School** University of British Columbia & Simon Fraser University

COLLABORATIVE RESEARCH GROUPS

2018 - 2021	High Dimensional Data Analysis
2020 - 2023	Quantum Topology and Its Applications
2020 - 2023	Novel techniques in low dimension: Interactions between Floer homology, representation theory and algebraic topology

For more information and updates, visit www.pims.math.ca

Pacific Institute for the Mathematical Sciences