Addressing the concerns raised by the committee about the previous annual report.

(1) Although the purpose of the Centre was better defined than in previous years, the Committee found the Center' Mission Statement to be too broad and encourages its members to revisit the terms, with a more rigorous definition of scientific focus.

Answer: We thank the committee for making this suggestion. We have made the mission statement more precise and reflective of what CAMBAM objectives and long terms goals are.

(2) The original role of CAMBAM with respect to the Centre de Recherches Mathématiques (CRM) and the Ludmer Centre for Neuroinformatics and Mental Health was questioned and needs to be emphasized in next year's report.

Answer: As we have stated in the previous report and reemphasized again here, CAMBAM is one of the CRM labs that plays a central role in running activities and training programs that are relevant to CAMBAM mission. Also, CAMBAM is playing an integral role in CRM's FRQNT-renewal. As for the Ludmer Center, we are only collaborating in the running the seminar series. We never claimed otherwise.

(3) Further, the Center's role and position with respect to QLS and MCIM (McGill's Initiative in Computational Medicine) need to be clarified.

Answer: CAMBAM has strong partnership with the QLS program by running a join seminar series (in additional to the MiCM and Ludmer Center). Also several members of CAMBAM teach in the QLS foundation course QLSC 600 (including Anmar Khadra, Frédéric Guichard, Paul Francois, Judith Mandl, Erik Cook) and supervise many of the QLS PhD students. As for MiCM, CAMBAM collaborates MiCM in running some workshops that are of interest to both Centers and many CAMBAM PIs (e.g., Anmar Khadra and Pouya Bashivan) get seed funding from MiCM. All these ideas are highlighted in the new report.

(4) It was noted that the funds were used entirely for fellowships to CAMBAM students supervised by Center PIs. Although this was deemed to be fine operations, the Committee felt this was too narrow and not necessarily responding to the diversity of needs stemming from CAMBAM's mission.

Answer: We thank the committee for bringing up this very important point. CAMBAM makes significant effort in getting funding from different sources to run its training program. Even though the funding that it receives from CRM, Faculty of Science and FMHS can financially cover many of these programs, CAMBAM co-directors still try to find other funding sources to free up some funding for such fellowships. We also do not spend any funds on administrative support. That generates some surplus that CAMBAM intentionally uses to provide competitive fellowships to CAMBAM trainees of high calibre. Nonetheless, we plan to expand the scope of CAMBAM programs next year to organize scientific meetings. Once again, we plan to apply for funding to organize such meetings (e.g., SMB), but we may rely on our next year's budget to do so if our applications are unsuccessful. These ideas are highlighted in the report.

(5) The Committee could not identify any publication authored jointly between Center members from those listed in the report.

Answer: The research program of CAMBAM members is quite wide in spectrum and covers different topics in physiology, biology and ecology. Some collaborations do exist between members, but the main focus

of CAMBAM is to foster collaborations between researchers in the quantitative and experimental life sciences, the latter of which are not necessarily members of CAMBAM. These are quite evident in the publication records of CAMBAM PIs. The CAMBAM website provides links to the homepages of these PIs for further rinformation.

(6) CAMBAM's website needs to be updated, with new leadership information, etc.

Answer: The website was updated about 2 years ago and embedded in the CRM website: <u>http://www.crm.umontreal.ca/labo/cambam/en/</u>. The leadership information was always available under the "Contact" tab: <u>http://www.crm.umontreal.ca/labo/cambam/en/contact/</u>.



Faculty of

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Annual Reporting for Faculty Supported Research Centres and Networks

All Centres (provisional Centres; McGill Centres), Research groups and Networks that receive funding from the Faculty of Medicine and Health Sciences (FMHS) are required to provide two components of reporting:

- 1. an Annual Report of Activities and Outcomes (see below),
- 2. a Financial Statement (see attached Excel document).

The reporting period is May 1, 2020 – April 30, 2021.

Deadline: Monday, May 3rd, 2021

Please send both documents to the Research Office, Faculty of Medicine and Health Sciences (riac.med@mcgill.ca)

Continued support from the Faculty is contingent on:

- 1. the receipt of the reporting documents on time,
- 2. the evaluation of reported activities by the Faculty's Committee for Oversight of Research Units (CORU),
- 3. the availability of Faculty funds.

Your strong engagement in the Faculty's mission for continued research excellence and financial stewardship is truly appreciated.



Annual Report of Activities and Outcomes

Please respect the page limits, where indicated, or the report will be returned.

(The accepted font is Times New Roman or Calibri regular 11 pts)

- 1. Name of the Unit: Centre for Applied Mathematics in Bioscience and Medicine (CAMBAM)
- 2. Director's contact information: Anmar Khadra and Frédéric Guichard
- 3. If the Unit is a Senate-approved McGill Research Centre, indicate date of approval: November 16, 2011
- 4. Mission Statement of the Unit:

The mission of CAMBAM is to take a leadership role within North America (in general) and Canada (in particular) in promoting the applications of mathematical and computational sciences to study different aspects physiological, biological and ecological systems, as well as foster collaborations between the quantitative and experimental life scientists. CAMBAM meets its objectives by promoting and fostering research, teaching and training in applications of quantitative life sciences at all levels ranging from the molecular/genetic through single cell and whole organ physiology and biology to population dynamics and broader ecological questions, at different time and special scales. CAMBAM accomplishes these goals through (i) establishing various training programs that are developed independently or in collaborations with other international and national centers, including workshops and summer schools that involve hands-on training and continuously evolving material that copes with recent advances made in the field; and (ii) building partnerships with industry that can provide internships for CAMBAM trainees. Such training opportunities assist CAMBAM PIs to develop the expertise of their trainees by bringing them up to speed with their research project and connect them with industry. CAMBAM also provides them with funding opportunities to reward exceptional trainees.

5. Number of Unit members:

CAMBAM has 165 full members and 13 associate members (see Appendix 1 for a list of members obtained from the listserv). The core members of CAMBAM include 23 faculty members.

6. Number of members affiliated with McGill's FMHS:

Close to 50% of CAMBAM members belong to FMHS.

7. Unit's website:

URL: http://www.crm.umontreal.ca/labo/cambam/en/

Note: The website needs to feature the following:

- all sources of funding support (including the FMHS logo),
- the List of Members and their institutional affiliation with appropriate links,

- the activities supported by the Unit
- all previous Annual Reports.

The website has all that information.

- 8. Summary of past year's **goals and objectives** of the Unit. (limit: ½ page)
 - Maintain international leadership in the emerging field of quantitative biosciences. To accomplish this, CAMBAM has become a partner in an FQRNT-funded multi-center grant headed by the Centre de recherches mathématiques (CRM).
 - Connect researchers and students across faculties and institutions by creating interdisciplinary
 research teams and a framework for scientific and social interactions. That includes bridging
 complementary research programs together to establish multidisciplinary teams in the
 quantitative and life sciences. To accomplish this, we organize workshops and retreats and invite
 known speakers to the seminar series organized by CAMBAM in collaborations with other
 centers at McGill.
 - Support and prepare students and postdoctoral trainees for the expanding career opportunities in quantitative biosciences in both industry and academia. Trainee members of CAMBAM regularly get email announcements about different academic and industry-based job opportunities.
 - Establish stronger connections with industry. This is done through the industry partners of MITACS as well as NSERC-CREATE in Complex Dynamics, a partner of CAMBAM since 2018. Several trainees in CAMBAM currently participate in internships with these industry partners of both of these institutions.
 - Due to COVID-19, all CAMBAM activities (including workshops and seminar series) were conducted virtually. This will continue in the summer of 2021.
- 9. Major achievements enabled by the support obtained from the Faculty. (limit: 1 page)

(see Appendix for suggested metrics)

- Seminar Series (Appendix 2): CAMBAM continues to benefit from its partnership with the Quantitative Life Sciences program in running a weekly seminar series during the Fall and Winter terms in collaboration with the McGill Initiative in Computational Medicine (MiCM) and the Ludmer Centre. This seminar series, which was originally a CAMBAM event prior to this partnership, is still ongoing with 11 talks out of 20 allocated for CAMBAM invited speakers during 2019/2020. Due to COVID-19, talks were held virtually with attendees ranging between 50-60. Speakers were also invited to meet the trainees after the talks to interact more closely with them. CAMBAM member Suresh Krishna is taking the lead in organizing this seminar series in collaboration with members of the other partners. No cost was associated with this activity due to COVID-19.
- **Zoominar Series (Appendix 3):** Due to COVID-19, the seminar series was interrupted in the the Winter term 2020. As a result, CAMBAM took the initiative to revive its own seminar series over the summer of 2020 via zoom. The online series consisted of 17 talks. This "zoominar series" was quite successful and it was done in collaboration with the Fields institute in Toronto and the University of Waterloo. It attracted around 50-60 attendees on a weekly basis. CAMBAM co-director Anmar Khadra organized this zoominar series. No cost was associated with this activity due to COVID-19.
- **CAMBAM Zoomposium (Appendix 4)**: During the summer of 2020, CAMBAM organized a minisymposium titled "Multiple Timescales in Neuronal and Other Systems". The event was comprised of six talks and was attended by 100 people. CAMBAM co-director Anmar Khadra organized it. No cost was associated with this activity due to COVID-19.

- Online workshops: CAMBAM organized 3 one-day online workshops during the summer of 2020 led by students and postdoctoral fellows who are members of the CAMBAM. Co-director, Frédéric Guichard assisted these trainees in organizing these events and in promoting them internationally. These workshops benefited from the financial support of the CRM in the form of rewards to the organizers and were held via zoom. Attendees came from different academic institutions across North America. Here is the list:
 - 1. The first workshop was given by Thomas Bury (postdoc, McGill), July 27, 2020. The topic, 'Interactive data visualizations in Python' is inspired by the complexity and increasing availability of biological data which has forced the development of visualization methods that allow interaction with the in silico representation of living things. See Appendix 5 for more details.
 - 2. Shaza Alsibaai (PhD student, McGill), August 6, 2020, organized a workshop entitled 'Problems and solutions in lifting individual behavior to population level dynamics'. **See Appendix 6 for more details.**
 - **3.** Finally, Adrianne Jenner presented a workshop entitled 'Computational modeling to study cancer biology and treatments' on August 13, 2020. See Appendix 7 for more details.

These workshops have had a popularity that far exceeded expectations. 264 participants have registered to participate in the August 13 workshop on Optimizing Treatments for Cancer. Over 80 were registered for the July 27 workshop and over 50 for the August 6 workshop. They offered direct financial support and high visibility to the organizers. They also achieved their primary objective of stimulating the maintenance of scientific interactions during the first months of the pandemic. No cost was associated with these activities due to COVID-19.

- CAMBAM/NSERC-CREATE in Complex Dynamics Summer School (Appendix 8): CAMBAM and McGill's NSERC-CREATE program in Complex Dynamics of Brain and Behavior teamed up to organize this year's upcoming summer school (May 31 – June 11, 2021). Unlike previous summer schools, this year's event will be held virtually via zoom. The school is funded by the William K. and Katherine W. Estes Fund and the Psychonomic Society (\$20,000) as well as CRM (\$5,000). The summer school received 80 applications and 50 students are currently short listed for the event (both Canadian and international). The two-week event will cover different topics on the applications of nonlinear dynamics and computations to life sciences (ranging from the sub-cellular world to population dynamics) with a special emphasis on neuroscience and psychology. The program will include theory-based and application-based lectures taught by 25 internationally recognized researchers in the field including 15 CAMBAM members, as well as tutorial and computer labs that will complement the material covered in these lectures. There will be also projects assigned to the participants to work on and supervised by the instructors. CAMBAM codirector Anmar Khadra and CAMBAM associate member Caroline Palmer (who is also the director of NSERC-CREATE in Complex Dynamics) were successful in obtaining the funding (see Appendix 9). Speakers will be paid \$1,000 honorarium for participating. The IT team and TA will be also paid.
- Fellowships (Appendix 10): Due to the fact that CAMBAM managed to get external funding from other sources, including CRM and William K. and Katherine W. Estes Fund and the Psychonomic Society, CAMBAM has enough surplus to award 7 fellowships to research trainees (a total of ~\$60K). Students and PDFs in CAMBAM affiliated labs are expected to submit their research descriptions, CV, interest in qualitative bioscience and discuss past participation in CAMBAM events by June 1 to be considered for CAMBAM fellowships. An independent committee will evaluate the applications and a short list will be determined by June 8. In the coming year, the funding allocated to fellowships may be less due to other planned events (including scientific meetings).
- Workshop on Computational Modelling of Cancer Biology and Treatments (Appendix 11): CAMBAM members Adrianne Jenner and Morgan Craig teamed up with the CRM to organize this online workshop. The focus of this event will be an extension of the previous workshop held on August 13, 2020 with an emphasis on computational methods in oncology. No cost was associated with this activity due to COVID-19.
- CMS 2020 Winter Meeting (Appendix 12): CAMBAM co-director Anmar Khadra and CAMBAM associate member Claire Guerrier organized an entire session at the Canadian Mathematical Society (CMS) Winter Meeting that was held virtually online between December 4-7, 2020. Session title was "Mathematical

Modeling of Biological Systems". Many members of CAMBAM gave talks in this session to showcase their research work. International researchers also participated in this session. CAMBAM partners, McGill and CRM, were co-sponsors of this event. Registration fees were paid for some speakers.

Membership in the CRM: CAMBAM continues to be part of the <u>CRM</u>, a network of 12 research centers across Quebec and Ontario. This collaboration brings quantitative bioscience to the CRM and connects CAMBAM to the larger community of mathematical and computational researchers. CRM now provides additional funding to CAMBAM (~\$12,000 per year). CAMBAM is also playing a central part in CRM's effort in their grant renewal provided by FRQNT.

Name Last, First	Title PI, Staff or Trainee [Graduate student (GS) or post- doctoral fellow (PDF)]	Type of Membership Full, Associate	Affiliation(s)
Kehinde Ajibade	Grad student	Full	Concordia University
Yury Sokolov	Postdoctoral scholar	Associate	UCSD
Louis Richez	Grad student	Full	McGill
Nasri Balit	Grad student	Full	McGill
Thomas Bury	Postdoctoral fellow	Full	McGill
Nicolas Brodeur	Grad student	Full	University of Ottawa
Orsolya Lapohos	Grad student	Full	McGill
Jalal Al Rahbani	Grad student	Full	McGill
Rodrigo Migueles Ramirez	Grad student	Full	McGill
Max Oliveira De Souza	Associate professor	Associate	Universidade Federal Fluminense
Yangyang Wang	Assistant professor	Associate	University of Iowa

10. New Members who joined the Unit in the past year and their institutional affiliation(s).

11. Members who have **left the Unit** over the reported year.

Name Last, First	Title PI, Staff or Trainee [Graduate student (GS) or post- doctoral fellow (PDF)]	Type of Membership Full, Associate	Affiliation(s)
Saeed Farjami	Postdoctoral fellow	Full	University of Surrey

12. State how the current and forecasted activities of your Unit align with the Education or Research mission (Strategic Research Plan) of the FMHS and/or other Faculties at McGill (limit: ½ page):

CAMBAM contributes to the Faculty's research mission by developing mathematical and computational tools for understanding how complex biological systems function - from molecular to organismal levels. CAMBAM's contribution was specifically mentioned in the 2017 McGill Faculties of Medicine and Dentistry Strategic Research Plan. In addition, CAMBAM has close ties with the Initiative in Computational Medicine (MiCM). In partnership with the MiCM, CAMBAM has co-organized online workshops focused on mathematical and statistical methodologies. MiCM also provides seed funding to CAMBAM members with research focused on complex systems and machine learning (e.g., Anmar Khadra and Pouya Bashivan). CAMBAM also collaborates with the Quantitative Biosciences Program, the Ludmer Center and MiCM in organizing a very successful seminar series in computational medicine. These activities will continue in the near future. Finally, CAMBAM is heavily involved in the QLS program with many CAMBAM members teaching in the QLS foundation course QLSC 600 and (co-)supervising many QLS PhD students.

Bioscience and health research is quickly expanding from being an exclusively data collection endeavor to one that embraces the development of new technologies and quantitative methods. For example, much of the field of genetics is now driven by statistical and computational algorithms. To meet these changing needs, our researchers actively prepare students for life in both academic research and industry with the goal of bridging the "training gap" that exists between students in bioscience and those from mathematics, physics and engineering. Importantly, CAMBAM's interdisciplinary mission directly supports McGill's Strategic Research Plan to create a "convergence of life sciences, natural sciences, and engineering".

During the next few years, CAMBAM will continue its leadership role in Quantitative Biology at McGill, within Quebec and internationally. **CAMBAM has regularly organized summer schools on the applications of mathematical sciences to physiology and medicine and helped sponsor several workshops, one of which focused on infectious disease transmission, an urgent topic in this international health crisis of COVID-19 pandemic.** We will continue to sponsor and promote interdisciplinary seminars, workshops, events and summer schools to bring together researchers from across faculties and institutions to solve critical problems in bioscience and medicine.

13. Explain why support from the FMHS continues to be crucial to the operations of the Unit (**limit: ½ page**): FMHS support has allowed CAMBAM to pursue and achieve many of its current programs. Recognizing the fundamental importance of interdisciplinary research, CAMBAM has taken leadership role in promoting collaborations between members from across faculties and disciplines, and established track record of successful Canadian (Fields, NSERC-CREATE in Complex Dynamics) and international partnerships (MBI, NIMBios and MIT). With FMHS funding, CAMBAM has accomplished all of its important objectives and maintains a level of activity (both local and international) that compares favorably with other McGill research centers. Continuing support from FMHS will promote our interdisciplinary support of quantitative bioscience at McGill as well as allow us to maintain our international presence and collaborations with other centers. It is important to emphasize that many CAMBAM members are also members in the Society for Mathematical Biology and took leadership roles in that activities of this society (for example, the annual meeting that took place in Montreal in 2019).

- 14. List action items that the Unit has taken or will consider taking in the next year towards growth and sustainability of its operations (limit: ½ page)
- In collaboration with MITACS, CRM and NSERC-CREATE in Complex Dynamics, CAMBAM will expand its effort in establishing connections with industry partners that can provide internships to CAMBAM trainees. Such opportunities have been already pursued by several CAMBAM trainees.
- As co-directors of CAMBAM, Anmar Khadra and Frédéric Guichard, will make an effort to submit an NSERC-CREATE application in the next competition round to support CAMBAM trainees and other training programs of CAMBAM.

- CAMBAM will revive its in-person activities after the relaxation of covid-19 related restrictions, including its retreats and seminar series. The latter will be done in collaboration with the QLS, MiCM and Ludmer Centre. CAMBAM will invite international speakers who are leaders in their field of research to visit CAMBAM and interact directly and closely with CAMBAM PIs and trainees.
- CAMBAM has successfully managed to always find funding for all of its activities provided by various sources. That allowed CAMBAM directors to save the annual funding allocated for CAMBAM and use it to support outstanding and active students in the form of fellowships. In the coming years, such funding will be also used to organize scientific meeting with various themes in mathematical biology (e.g., electrophysiology). Such a meeting is in preparation and will be co-organized by CAMBAM co-director Anmar Khadra and Professor Derek Bowie (Pharmacology).
- CAMBAM will continue to establish new collaborations with international organization that support research programs in mathematical biosciences. That includes the Society for Mathematical Biology (SMB), Canadian Mathematical Society (CMS) and the Canadian Applied and Industrial Mathematics Society (CAIMS).
- Several new recruits and previous faculty members in FMHS with expertise in AI (e.g., Pouya Bashivan and Claire Brown) are members of CAMBAM. They will take leadership roles in developing the CAMBAM training program in machine/deep learning in neuroscience and microscopy. This will put CAMBAM at the forefront of research in computational sciences.
- 15. Provide suggestions about how the Faculty could do better to support the Unit and research efforts in general (e.g., centralized data repositories, institutional data management plans, support for software developments, guidance for adopting open-science practices, simplification of administrative procedures, etc.) (no page limit but please be specific and unleash your creativity!)

At this point, CAMBAM has been running its operations without any administrative support. The CRM occasionally provide some help in that front when needed, but support is quite limited to certain activities. CAMBAM intentionally never spends any funding on administrative support and solely relies on the efforts of its co-directors to run all CAMBAM operations in order to save the very limited funding of \$15,000 received from FMHS to support the core activities of CAMBAM. Additional funding will come a long way in allowing CAMBAM to have the freedom to expand such programs and rely occasionally in administrative support if necessary.

In the attached (Excel) Year-End Financial Report please detail:

- 1. Expenditures of funding provided by the FMHS and other sources, towards meeting the objectives of the Unit,
- 2. Any in-kind contributions provided to the Unit by other partners and sponsors,
- 3. Projected budget for the coming year (including request to the FMHS).

Suggested Performance Indicators (non-exhaustive list)

Quantitative:

- Governance: provide details of management meetings. For example, membership, frequency, attendance, the nature of the meetings and the outcomes.
- Number of workshops, conferences or seminars conducted, number of attendees and target audience;
- Number of visiting scientists hosted by the Unit;
- Number of outreach activities (e.g., public lectures, including in schools, the industry and government agencies, press releases);
- Number of publications co-authored by at least 2 Unit PIs, and journal impact factors;
- Number of targeted activities:
 - o involving research interactions for graduate and postgraduate students,
 - Industry stakeholder interactions;
- Number of web hits and articles downloaded;
- Outcomes of surveys of Unit members;
- Number of grants funded, with at least 2 Unit PIs as co-applicants;
- Prizes, special awards to member(s) as a result of Unit activities.

Qualitative:

- Activities/outcomes which may not have occurred without the Unit;
- Use of shared resources and facilities;
- Effectiveness of governance processes in place;
- Research building capacity, or removing impediments to research;
- Multi-disciplinary collaborations;
- Increased or new collaboration and partnerships as a result of Unit activities, and with different types of end users (e.g. industry, government and community groups);
- Workshops & meetings the Unit provided financial support for;
- Communication within/outside the Unit (e.g. email, newsletters, website, etc.);
- Level of engagement at seminars and workshops organized by the Unit;
- What exceptional successes, if any, have occurred during the reporting period;
- What disappointments, if any, occurred during the reporting period;
- How new skills have been acquired as a result of research technology;
- Emphasize collaborations between other Units at McGill and internationally;
- Development of tools, software, databases;
- Emphasize all kinds of open-science efforts.







Select List:		
CAMBAM_SEMINARS CAMBAM_Seminars - Department of Physiology	~	Update

<pre>lamees.mahmoud@MCGILL.CA alireza.aghighi@UMONTREAL.CA martin.aguilar@MAIL.MCGILL.CA sameed.ahmed@UWATERLOO.CA kehinde.ajibade@MAIL.MCGILL.CA sofia.alfonso@MAIL.MCGILL.CA derry.alison@UQAM.CA shaza.alsibaai@MAIL.MCGILL.CA juliatherton@GMAIL.COM hortecgg@CIENCIAS.UNAM.MX li@CRM.UMONTREAL.CA doedel@CSE.CONCORDIA.CA lfarley@CVLF.CA andyliu1987@GMAIL.COM eedavid2000@GMAIL.COM feng.xiongca@GMAIL.COM fglacoste@GMAIL.COM jinzhi.lei@GMAIL.COM krouchen@GMAIL.COM patrick.mineault@GMAIL.COM</pre>	<pre>(No Name Available) Alireza Aghighi Martin Aguilar Sameed Ahmed Kehinde Ajibade Sofia Alfonso Derry ALISON Shaza Alsibaai Juli Atherton No Name Available No Name Available</pre>
krouchen@GMAIL.COM	No Name Available
patrick.mineault@GMAIL.COM	No Name Available
shahedrz@GMAIL.COM	No Name Available
steven.sanche@GMAIL.COM	No Name Available
ysokolov@HEALTH.UCSD.EDU	No Name Available
alexis.dale@MAIL.MCGILL.CA	No Name Available
amandine.bemmo@MAIL.MCGILL.CA	No Name Available
aliars.racoul stel e-i ousset@MATE.MCOILE.CA	

ashkan.golzar@MAIL.MCGILL.CA costas.karatzas@MAIL.MCGILL.CA diana.mitchell@MAIL.MCGILL.CA ghoncheh.rasoulitezangi@MAIL.MCGILL.CA jessica.brooks@MAIL.MCGILL.CA louis.richez@MAIL.MCGILL.CA megha.kodancha@MAIL.MCGILL.CA moeed.shahamat@MAIL.MCGILL.CA mojdeh.golmohammadi@MAIL.MCGILL.CA nasri.balit@MAIL.MCGILL.CA Volker.hofmann@MAIL.MCGILL.CA yogesh.murugesan@MAIL.MCGILL.CA zibo.wang@MAIL.MCGILL.CA calleja@MATH.MCGILL.CA lafitte@MATH.UNIV-PARIS13.FR thomas.bury@MCGILL.CA steven xanthoudakis@MERCK.COM jvh@MITACS.CA patrice.roy@PFIZER.COM adams@PHYSICS.MCGILL.CA quenelgt@PLATTSBURGH.EDU andrea.green@UMONTREAL.CA paul.cisek@UMONTREAL.CA abrav103@UOTTAWA.CA nbrod033@UOTTAWA.CA romain.yvinec@WANADOO.FR belair@CRM.UMONTREAL.CA mathieu.blanchette@MCGILL.CA fx.brajot@MAIL.MCGILL.CA niklas.brake@MAIL.MCGILL.CA grace.brooks@MAIL.MCGILL.CA claire.brown@MCGILL.CA gil.bub@MCGILL.CA david.buckeridge@MCGILL.CA lucas.santos@MAIL.MCGILL.CA tyler.cassidy@MAIL.MCGILL.CA maurice.chacron@MCGILL.CA philippe.comtois@UMONTREAL.CA erik.cook@MCGILL.CA coordinator.gls@MCGILL.CA morgan.craig@UMONTREAL.CA danielcamaradesouza@YAHOO.COM.BR felipe.dargent@MAIL.MCGILL.CA nikolaos.dimitriou@MAIL.MCGILL.CA sean.duffy@MAIL.MCGILL.CA alan@BIC.MNI.MCGILL.CA Frederique.Fenneteau@CERTARA.COM frederique.fenneteau@HIBE.COM paulf@PHYSICS.MCGILL.CA francois.bourassa4@MAIL.MCGILL.CA

No Name Available Jacques Belair Mathieu Blanchette Francois-Xavier Brajot Niklas Brake Kyla Brooks Claire Brown, Dr. Gil Bub David Buckeridge Lucas Campanari Tyler Cassidy Maurice Chacron Philippe Comtois Erik Cook OLS Coordinator Morgan Craig Daniel Câmara Felipe Dargent Nikolaos Dimitriou Sean Duffy Alan Evans Frederique Fenneteau Frederique Fenneteau Paul Francois Francois Bourassa

fred.guichard@MCGILL.CA gregor.fussmann@MCGILL.CA elias.gedamu@MAIL.MCGILL.CA lefebvre.gen@UOAM.CA navid.sadeghighandehari@MAIL.MCGILL.CA glass@CND.MCGILL.CA mladen.glavinovic@MCGILL.CA celia.greenwood@MCGILL.CA tamara.gregg@MAIL.MCGILL.CA claire.guerrier@UNIV-COTEDAZUR.FR michael.guevara@MCGILL.CA ben.haller@MAIL.MCGILL.CA ian.hatton@MAIL.MCGILL.CA bing@INAME.COM tony.humphries@MCGILL.CA vincent.jacquemet@UMONTREAL.CA hassan.jamaleddine@MAIL.MCGILL.CA mohsen.jamali@MAIL.MCGILL.CA anmar.khadra@MCGILL.CA bo-ra.kim@MAIL.MCGILL.CA claudia.kleinman@MCGILL.CA svetlana.komarova@MCGILL.CA caolan.kovach-orr@MAIL.MCGILL.CA suresh.krishna@MCGILL.CA darya.kryzskaya@MAIL.MCGILL.CA grigoris.kylafis@MAIL.MCGILL.CA lajoie@DMS.UMONTREAL.CA orsolya.lapohos@MAIL.MCGILL.CA allen.larocque@GMAIL.COM jonas.lehnert@MAIL.MCGILL.CA jzlei@MAIL.TSINGHUA.EDU.CN vincent514@GMAIL.COM joshua.leon@DAL.CA dr.claudialerma@GMAIL.COM brian.leung2@MCGILL.CA juan.y.li@MAIL.MCGILL.CA nicole.li@MCGILL.CA alongtin@UOTTAWA.CA etienne.low-decarie@MAIL.MCGILL.CA flutsche@UOTTAWA.CA jessica.lvda@MAIL.MCGILL.CA metapfhor@GMAIL.COM michael.mackey@MCGILL.CA jacek.majewski@MCGILL.CA judith.mandl@MCGILL.CA justin.marleau@MAIL.MCGILL.CA geoffrey.mcgregor@MAIL.MCGILL.CA mahtab.nazari@MAIL.MCGILL.CA fahima.nekka@UMONTREAL.CA laurentiu.oprea@MAIL.MCGILL.CA

Frédéric Guichard Prof. Gregor Fussmann Elias Gedamu GeneviÃ["]ve Lefebvre Navid Sadeghi Ghandehari Leon Glass MladenI Glavinovic Celia Greenwood Tamara Gregg Claire Guerrier Michael Guevara Ben Haller Ian Hatton Bing Huang AntonyRaymond Humphries Vincent Jacquemet Hassan Jamaleddine Mohsen Jamali Anmar Khadra Chelsea Kim Claudia Kleinman Svetlana Komarova Caolan Kovach-Orr Suresh Krishna Darya Kryzskaya Grigoris Kylafis Guillaume Lajoie Orsolva Lapohos Allen Larocque Jonas Lehnert Jinzhi Lei Vincent Lemaire Joshua Leon Claudia Lerma Brian Leung juan Yao Li Nicole Li Andre Longtin Etienne Low-Decarie Frithjof Lutscher Jessica Lyda Laurent Mackay MichaelC Mackey Jacek Majewski Judith Mandl Justin Marleau Geoffrey McGregor Mahtab Nazari Fahima Nekka Laurentiu Oprea

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McGill Seminar Series in Quantitative Life Sciences and Medicine

Please note the McGill Seminar Series in Quantitative Life Sciences and Medicine will be held via Zoom in Winter 2021. The seminars will be held on Tuesdays between 12 and 1pm.

Zoom Link: https://mcgill.zoom.us/j/91589192037 (https://mcgill.zoom.us/j/91589192037)

QLS is joining efforts with the Centre for Applied Mathematics in Bioscience and Medicine (CAMBAM), the McGill initiative in Computational Medicine (MiCM) and the Ludmer Center to offer weekly interdisciplinary seminars.

For video recordings of previous seminars please visit here: <u>http://ludmercentre.ca/qls-seminar-videos/ (http://ludmercentre.ca/qls-seminar-videos/)</u>

Winter 2021	Speaker	Торіс
Jan. 12	Vladimir Reinharz (UQAM) Sponsored by QLS	<u>Conservation of structural long-range modules in RNAs</u> (//www.mcgill.ca/qls/channels/event/qls-seminar-series-vladimir-reinharz-327398)
Jan. 19	Paul Francois (McGill University) Sponsored by QLS	Information in cytokine dynamics : robotic mapping (//www.mcgill.ca/qls/channels/event/qls-seminar-series-paul-francois-327699)
Jan. 26 (QLS Research Day)	Corina Tarnita (Princeton University) Sponsored by QLS	<u>Self-organization and robustness in biological systems</u> <u>(//www.mcgill.ca/qls/channels/event/qls-seminar-series-corina-tarnita-327794)</u>
Feb. 2	Benjamin Haibe- Kains (University of Toronto) Sponsored by MiCM	Platforms to improve computational reproducibility in biomedical research (//www.mcgill.ca/qls/channels/event/qls-seminar-series-benjamin-haibe-kains-327824)
Feb. 9	David Albers (University of Colorado) Sponsored by QLS	Inference and dynamics using clinical data for mathematical physiology and biomedicine (//www.mcgill.ca/qls/channels/event/qls-seminar-series-david-albers- 328154)
Feb. 16	Gordon Berman (Emory University) Sponsored by QLS	Measuring behavior across scales (//www.mcgill.ca/qls/channels/event/qls-seminar- series-gordon-berman-328105)
Feb. 23	Sahir Bhatnagar (McGill University) Sponsored by QLS	Variable selection methods in high-dimensional genetic data (//www.mcgill.ca/qls/channels/event/qls-seminar-series-sahir-bhatnagar-328586)
Mar. 2	Reading Week	No Seminar

Winter 2021	Speaker	Торіс
Mar. 9	Albert Goldbeter (Université Libre de Bruxelles) Sponsored by CAMBAM	From circadian clock mechanism to sleep disorders and jet lag: Insights from a computational approach (//www.mcgill.ca/qls/channels/event/qls-seminar-series-albert-goldbeter-328517)
Mar. 16	Victoria Booth (University of Michigan) Sponsored by CAMBAM	Dynamics and bifurcations of sleep-wake behavior (//www.mcgill.ca/qls/channels/event/qls-seminar-series-victoria-booth-328585)
Mar. 23	Daniel Alexander (UCL) Sponsored by QLS	Model-based imaging and image-based modelling (//www.mcgill.ca/qls/channels/event/qls-seminar-series-daniel-alexander-329243)
Mar. 30	Cristina Savin (NYU) Sponsored by CAMBAM	<u>Structured neural variability and its roles in neural computation</u> (//www.mcgill.ca/qls/channels/event/qls-seminar-series-cristina-savin-329344)
Apr. 6	Jonathan Michaels (UWO) Sponsored by CAMBAM	Combining deep learning and primate electrophysiology to understand reach and grasp control (//www.mcgill.ca/qls/channels/event/qls-seminar-series-jonathan- michaels-329650)
Apr. 13	Anne-Louise Leutenegger (Inserm NeuroDiderot) Sponsored by QLS	Genomic inbreeding and its contribution to the study of human diseases (//www.mcgill.ca/qls/channels/event/qls-seminar-series-anne-louise-leutenegger- 330309)
Apr. 20	Arjun Krishnaswamy (McGill University) Sponsored by CAMBAM	Molecular cues for the assembly and function of retinal circuits (//www.mcgill.ca/qls/channels/event/qls-seminar-series-arjun-krishnaswamy-330062)

Winter 2021	Speaker	Торіс
Apr. 27	Stephen Coombes (University of Nottingham) Sponsored by CAMBAM	Next generation neural field modelling (//www.mcgill.ca/qls/channels/event/qls- seminar-series-stephen-coombes-329958)
May 4	Lluis Quintana-Murci (Institut Pasteur) Sponsored by QLS	Human Immunology through the Lens of Evolutionary Genetics (//www.mcgill.ca/qls/channels/event/qls-seminar-series-Iluis-quintana-murci-330523)
May 11	Maryam Shanechi (USC) Sponsored by CAMBAM	Dynamical modeling, decoding, and control of multiscale brain networks: from motor to mood (//www.mcgill.ca/qls/channels/event/qls-seminar-maryam-m-shanechi- 330750)

QLS would like to thank Dr. Mathieu Blanchette, Dr. Suresh Krishna, Dr. Anmar Khadra, Dr. Celia Greenwood, Lindsay Dayton, and Joanne Clark for their help with organizing the seminars.

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Appendix 3

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CRM-CAMBAM Seminar Series

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Organizers:	Centre de recherches mathématiques, CRM*, Khadra, Anmar, Flore Lubin*
	*contact for this listing

Description: Weekly seminar - math biological

En ligne/Web - Veuillez communiquer avec l'organisateur / Please contact the organizer for details: anmar.khadra@mcgill.ca

Info

Upcoming talks Past talks

Your time	Speaker	Title
Tue May 11 12:00	Maryam M. Shanechi	Dynamical modeling, decoding, and control of multiscale brain networks: from motor to mood
Tue Apr 27 12:00	Stephen Coombes	Next generation neural field modelling
Tue Apr 20 12:00	Arjun Krishnaswamy	Molecular cues for the assembly and function of retinal circuits
Tue Apr 06 12:00	Jonathan Michaels	Combining deep learning and primate electrophysiology to understand react
Fri Aug 28 12:30	Angela Reynolds	Modeling the Inn improve your experience. Got it!

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Your time	Speaker	Title
Fri Aug 14 12:30	Mark Chaplain	A Mathematical Framework for Modelling the Metastatic Spread of Cancer
Thu Aug 13 12:30	Morgan Craig, Adrianne Jenner, Paul Macklin, Randy Heiland, and Pantea Poolavand	Computational modelling to study cancer biology and treatments
Fri Aug 07 12:15	Jonathan Rubin	Multiple roles of synaptic "inhibition" & how they arise in decision-making pathways in the basal ganglia
Thu Aug 06 10:00	Tyler Cassidy, Francesca Scarabel, Shaza Alsibaai	CRM-CAMBAM Mini-workshop in Mathematical Biology
Fri Jul 31 12:30	Philip Maini	Modelling collective cell movement in biology and medicine
Mon Jul 27 09:00	Thomas Bury	Interactive data visualisations in Python
Fri Jul 24 12:15	Frithjof Lutscher	A seasonal hybrid model for the evolution of flowering onset in plants
Fri Jul 17 12:15	Sue Ann Campbell	Modulation of synchronization by a slowly varying M-current
Fri Jul 10 12:15	José Antonio Carrillo	Attractive-repulsive models in collective behavior and applications
Fri Jul 03 12:15	Carson Chow	Global predictions of unreported SARS-CoV2 infection from observed COVID-19 cases
Fri Jun 26 12:15	Thomas Hillen	Mathematical Modeling of the Immune-Mediated Theory of Metastasis
Fri Jun 19 16:00	James Sneyd	Modeling Calcium Signaling in Live Animals
Fri Jun 12 12:15	André Longtin	Gamma and Beta Burst Rhythms and E-I network inference
Fri Jun 05 10:00	Cambam Zoomposium	Cambam Zoomposium: Multiple Timescales in Neuronal and Other Systems
Fri May 29 12:15	Yoichiro Mori	Cell volume control and osmosis-driven cell movement
Fri May 22 12:30	Mathieu Desroches	Slow-fast analysis of neural bursters: old and new
Fri May 15 12:30	Pouya Bashivan	Analyze, Predict & Control: A Pragmatic Approach to Understanding the Visual Brain
Fri May 08 12:30	Roeland Merks	Collective cell nehavior and cell migration
Fri May 01 12:15	Claire Guerrier	Modeling axon-myelin relationships: insights on signal propagation and modulation

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CAMBAM Zoomposium: Multiple Timescales in Neuronal and Other Systems

5 juin 2020

Cohosted by the University of Waterloo and the Fields Institute

Abstract

The generation of neuronal activity - from spikes, to bursts, to multi-phase rhythms - fundamentally involves the interaction of processes that evolve on widely disparate timescales. As a result, advances in theoretical neuroscience and in methods for the analysis of multiple timescale dynamics have emerged synergistically, with experimental observations driving theoretical developments and with theoretical advances yielding new explanations for data. In this session, speakers will present work featuring advances on both sides of this partnership, which highlights new findings about neuronal and other biological systems together with the modern approaches to multiple timescale analysis that underlie these results.

Pour voir les vidéos de la conférence

First Session (10:00 - 11:30 AM - EDT)

10:00 - 10:30 --- Krasimira Tsaneva-Atanasova (Professor of Mathematics for Healthcare, University of Exeter)

Zoomposium CAMBAM : Échelles de temps multiples dans Neuronal et autres systèmes

Title: Pseudo-Plateau Bursting and Mixed-Mode Oscillations in a Model of Developing Inner Hair Cells

Abstract

Inner hair cells (IHCs) are excitable sensory cells in the inner ear that encode acoustic information. Before the onset of hearing IHCs fire calcium-based action potentials that trigger transmitter release onto developing spiral ganglion neurones. There is accumulating experimental evidence that these spontaneous firing patterns are associated with maturation of the IHC synapses and hence involved in the development of hearing. Building on our previous modelling work we propose a three-dimensional, reduced IHC model and carry out non-dimensionalisation. We show that there is a significant range of parameter values for which the dynamics of the reduced (three-dimensional) model map well onto the dynamics observed in the original biophysical (four-dimensional) IHC model. By estimating the typical time scales in the reduced IHC model we demonstrate that this model could be characterised by two fast and one slow or one fast and two slow variables. We investigate how changes in the conductance of the voltage-gated calcium channels as well as the fraction of free cytosolic calcium concentration in the model affect the oscillatory model bahaviour leading to transition from pseudo-plateau bursting to mixed-mode oscillations. Hence, using fast-slow analysis we are able to further our understanding of this model and reveal a path in the parameter space connecting pseudo-plateau bursting and mixed-mode oscillations by varying a single parameter in the model.

10:30 - 11:00 --- Elif Koksal Ersoz (Postdoc Researcher, Inserm)

Title: Neural Mass Modeling of Slow-Fast Dynamics of Seizure Initiation and Abortion

Abstract

Epilepsies refer to a neurological disorder affecting about 1% of the worldwide population. They are characterized by recurrent seizures that consist of episodes of paroxysmal neural discharges. During seizures, specific brain activity (rhythmic spikes, fast onset) is observed in electrophysiological data, typically in local field potentials (LFPs) recorded by SEEG electrodes. Neurophysiologically-plausible lumped-parameter models at the mesoscopic scale, namely neural mass models (NMMs), describe the average activity of neural subpopulations of main cells and interneurons. They are widely accepted as computational models of epilepsy. Notably, the Wendling-Chauvel NMM (Wendling et al., 2002) has been shown to not only mimic the epileptic LFP signals but also give insights on the physiological mechanisms related to different stages of a seizure due to presence of a two types of inhibitory interneurons with different synaptic time constants. In the former studies on the bifurcation analysis of the model have provided a dictionary of cortical patterns of activity and linked the seizure initiation and termination to a slow-fast process. Here, we consider the Wendling-Chauvel NMM. We investigate how the multiple timescale dynamics and the inhibition/excitation ratio shape together the epileptic discharges. We show that electrical pulses perturbing the SOM+ interneurons can induce a switch form epileptic to background activity.

11:00 - 11:30 --- Jonathan Touboul (Associate Professor of Mathematics, Brandeis University)

Title: Slow Chaos, Fast Chaos and Homeostasis in Neuronal Activity

Abstract

A number of natural phenomena and models qualify as chaotic mathematically, yet their dynamics are show a certain degree of regularity which may be sufficient to maintain appropriate function. For instance, the stomatogastric ganglion of crabs generates relatively slow periodic activity with 3 populations activating sequentially, but where neurons activate in chaotic bursts during their activation phase. These networks ensure appropriate function until excessive perturbations of the environment (e.g., temperature) leads populations start activating in a disorderly manner preventing the system from maintaining its function (see Marder Alonso, eLife 2019).

We will investigate, define and study these two types of chaos in the context of slow-fast dynamical systems with chaos in the fast variable. I will show a transition between 'fast chaos' trajectories (where the slow dynamics remains approximately regular), and `slow chaos' whereby slow dynamics is strongly affected by chaos on the fast variable. We will provide general conditions for a system to be in one type of chaos or the other, and study the transition between slow- and fast-chaos. I will illustrate these concepts on the Rulkov neuron model (possibly the simplest model supporting slow-fast chaos) and a simplified model of the crab stomatogastric ganglion.

Second Session (12:30 - 2:00 PM - EDT)

12:30 - 1:00 --- Saeed Farjami (Postdoctoral Research Associate, University of Surrey)

Title: Bursting in Cerebellar Stellate Cells Induced by Pharmacological Agents: Non-Sequential Spike Adding

Abstract

Cerebellar stellate cells (CSC) are inhibitory interneurons that synapse onto Purkinje cells. Our group has extensively studied their electrophysiological properties, including switching in responsiveness, the non-monotonic first-spike latency and run-up. Recent experimental evidence has shown that these neurons also possess the machinery to burst when treated with certain pharmacological agents separately or jointly. Indeed, treatment with 4AP, a partial blocker of delayed rectifier and A-type K+ channels, induced a bursting profile in CSCs significantly different than that produced when 4AP is applied in combination with Cd2+, a blocker of high voltage activated (HVA) Ca2+ channels. By extending an HH-model we previously revised to include HVA and Ca2+-activated K+ (KCa) channels, we showed that the model preserves its previous properties while simultaneously explaining how 4AP and Cd2+ induce the two burst profiles. We demonstrated that 4AP is likely potentiating HVA while Cd2+ is potentiating KCa. Our slow fast analysis revealed how these bursts are generated and showed that spike-adding in 4AP-generated bursts is non-sequential when changing HVA and KCa conductances, a feature never observed in other HH-type models. It also explained the role of delayed Hopf in generating non-spiking plateau in the active phase of 4AP+Cd2+-generated bursts. In this talk, we will provide an overview of the results listed above.

1:00 - 1:30 --- Yangyang Wang (Assistant Professor of Mathematics, University of Iowa)

Title: Complex Bursting Patterns in an Embryonic Respiratory Neuron Model

Abstract

Pre-Bötzinger complex (pre-BötC) network activity within the mammalian brainstem controls the inspiratory phase of the respiratory rhythm. While bursting in pre-BötC neurons during the postnatal period has been extensively studied, less is known regarding inspiratory pacemaker neuron behavior at embryonic stages. Recent data in mouse embryo brainstem slices have revealed the existence of a variety of bursting activity patterns depending on distinct combinations of burst-generating INaP and ICAN conductances. In this work, we consider a model of an isolated embryonic pre-BötC neuron featuring two distinct bursting mechanisms. We use methods of dynamical systems theory, such as phase plane analysis, fast-slow decomposition, and bifurcation analysis, to uncover mechanisms underlying several different types of intrinsic bursting dynamics observed experimentally including several forms of plateau bursts, bursts involving depolarization block, and various combinations of these patterns. Our analysis also yields predictions about how changes in the balance of the two bursting mechanisms contribute to alterations in inspiratory pacemaker neuron activity during prenatal development.

1:30 - 2:00 --- Marcello Codianni (PhD Student, University of Pittsburgh)

Title: Limb Segment Control in Stickbug Locomotion

Abstract

We investigate a neuromechanical mechanism for coordinating control of the protrator-retractor limb segment in the stick insect in a tetrapodal gait pattern. In this system, sensory feedback from the distal limb segent is modeled as periodic bottom-up forcing onto a system of excitable interneurons. These interneurons then feed this signal forward onto a set of half-center oscillators, which are also modulated by top-down signaling. In this work we construct parameter regions where this protractor-retractor network can entrain to bottom-up signals to effectively maintain gait and speed. When entrainment is lost, it can be recovered through modulation of top-down signals. We also characterize the possibility and maintenance of entrainment in the case of damaged or destroyed connections between the interneurons and the half-center oscillator. Finally, we investigate the ability of top-down signaling to modify movement timing, allowing for gait shifts and altered phase relationships.

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Appendix 5

CAMBAM workshop Interactive data visualisations in Python

Scheduled

Monday 27th July 9.00am-1.30pm

Summary

Modern scientific methods give rise to vast quantities of data. Creating effective visualisations is essential for both presentation and more importantly exploration of the data. This is no easy task when the data contains dozens of variables and millions of entries. Traditional visualisations are static, that is, what the user sees is what the user gets. Using interactive data visualisations allows the user to vary parameters, honing in on subsections of the data, or switching between different plot types - all without touching the code. This allows for rapid exploration of the data and seamless sharing amongst collaborators, who only require a web browser to open the visualisation.

This workshop will equip participants with the skills required to begin creating interactive visualisations in Python. The format will be highly interactive, with alternation between demonstrations by the instructor and participants working through their own Jupyter notebook (provided in advance). Participants will come away having made several of their own visualisations of either a large public dataset, or their own dataset if they would like to bring one. An example of what can be achieved using these tools can be found at the following link, where data output from a model of a cardiac arrhythmia is interactively viewed and analysed. https://modulated-parasystole.herokuapp.com/

Description of methodology

Basic knowledge of the Pandas library (handling of dataframes) will be assumed prior to the workshop. For those not familiar with Pandas, a (brief) tutorial will be provided in the form of a Jupyter notebook to work through, which will provide sufficient background. We will use the Plotly library for creating interactive plots, and the Dash library to combine these into a dashboard. Participants of the workshop will learn and implement the following techniques:

- 1. Organisation of Pandas DataFrames to facilitate rapid plotting.
- 2. Use of basic Plotly functionality including the creation of different plot representations (Bar, Line, Scatter, Histogram) and exportation to html files for interactive viewing.
- Visualisation of higher-dimensional data with the use of multiple traces, grid plots and 3-dimensional plotting.
- 4. Integration of sliders and drop-down boxes to interactively switch between different visualisations of the data.
- 5. (If time allows.) Combining interactive plots into a dashboard with components connected by callback functions.

Software requirements

The following should be installed on the participant's computer prior to the workshop:

- Python 3 (Anaconda distribution <u>https://www.anaconda.com/products/individual</u> recommended)
- Jupyter (comes installed with the Anaconda dist. above)
- Python libraries: Numpy, Pandas, Plotly, Dash

A Jupyter notebook will be sent around prior to the workshop to ensure that software is working in advance. If problems arise, please contact the instructor for help.

Instructor

Dr. Thomas Bury Postdoctoral researcher Department of Physiology, McGil University Contact: <u>thomas.bury@mcgill.ca</u>

Problems and solutions in lifting individual behaviour to population level dynamics

A CRM-CAMBAM Mini-workshop in Mathematical Biology Thursday 6th August (10:00 am - 2:30 pm)

SUMMARY

Individual level behaviour and processes, such as reproduction, movement, growth, and death, drive population level dynamics. Typically, mathematical modellers homogenize these individual level behaviours by considering the "average" behaviour and making arguments that lead to into ordinary differential equation models for population level dynamics. In this workshop, we introduce a modelling methodology that begins with the biological considerations underlying the individual level behaviour. Throughout careful book-keeping, we show how to use these individual level behaviours to derive population level dynamics. By using the classic SIR model from epidemiology, we show how considering more realistic infection dynamics naturally lead to functional equations, and illustrate the analytical and numerical techniques that allow modellers to derive biological information from the population level dynamics.

This workshop will provide a "users guide" overview to the use of structured population models and is intended as a gentle introduction to the use of delay equations in mathematical biology. Participants will learn to build population level models from individual level behaviours, will be introduced to the analytical and numerical skills used to derive biological information from population level dynamics, and will be able to identify the similarities and differences between structured population models and ordinary differential equation models. The workshop will be a mix of worked analytical and numerical examples and will include a refresher of the necessary mathematical techniques.

EXPECTED BACKGROUND

We expect that the workshop will be accessible to students with a background in undergraduate differential equations and numerical methods, and will refresh the relevant mathematical theory as necessary throughout the workshop.

Speakers

Tyler Cassidy Postdoctoral Researcher, Theoretical Biology and Biophysics, Los Alamos National Laboratory.

Francesca Scarabel Postdoctoral Researcher, Laboratory for Industrial and Applied Mathematics, York University.

Shaza Alsibaai

PhD Student, Department of Mathematics and Statistics, McGill University.

WORKSHOP OUTLINES

The workshop will be structured as follows:

- 1. Mathematical modelling beginning from individual level behaviour We begin by motivating the epidemiological examples that will be considered throughout the remainder of the workshop from individual level biological considerations to give a brief sketch of the modelling methodology. This portion of the workshop will be biologically based and will motivate the mathematical treatment in later sections.
- 2. Book-keeping techniques to translate individual level behaviour to population dynamics Through the examples introduced in 1, we demonstrate how to lift individual level behaviour to population level dynamics through careful book-keeping. Accordingly, we relate individual level behaviour to population dynamics and identify the necessary modelling ingredients for structured populations. This section will include a reminder of the method of characteristics for linear first order partial differential equations.
- 3. Numerical methods for structured population models In this section, we discuss existing numerical methods for the simulation of delay equations. We illustrate how to simulate the epidemiological example from Section 1 for different biological considerations. By providing skeleton code to the participants, this section will include hands-on implementation of numerical techniques for simulating structured population models. This section will include a refresher of the necessary numerical techniques for the simulation of differential equations.
- 4. Reducing a structured population model to a system of ordinary differential equations We conclude by discussing the relationship between the individual level modelling ingredients- birth, growth, maturity, etc., and the ability to reduce the resulting structured population model to a system of ODEs. We use the linear chain technique as an example of the sufficient condition to reduce an infinite delay equation to a system of ODEs.

REGISTRATION

The workshop is free but the participants need to register by clicking here.

Note: The zoom link of the workshop will be send to registrants emails few days before the workshop.

Computational modelling to study cancer biology and treatments

BACKGROUND

Cancer biology and treatment involves complex, dynamic interactions between cancer cells, the tumour microenvironment, and therapeutic molecules. Quantitative approaches combining mechanistic disease modelling and computational strategies are increasingly leveraged to rationalize pre-clinical and clinical studies, and to establish effective treatment strategies. In this way, mathematical approaches lay the foundation for computational "virtual laboratories" that offer fully controlled, and non-invasive conditions in which we can investigate emergent clinical behaviours and interrogate new therapeutic strategies. As an introduction to such virtual laboratories, this workshop will provide an overview of techniques used in computational oncology, with a focus on in silico clinical trials and agent-based models (ABMs). Virtual (or in silico) clinical trials are useful computational platforms that help distinguish mechanisms of therapeutic successes and failures, stratify patient risk classes based on an individual's physiology, and optimize drug-specific parameters. In these platforms, in silico patients are generated by drawing from distributions of possible patient characteristics and used to form virtual clinical trials, in which new treatment strategies can be evaluated prior to human trials. Data fitting and optimisation techniques are cornerstones of this computational platform and are used to generate realistic virtual patients and evaluate individualised therapies. ABMs are a computational formalism that describes the way individual agents (e.g. cancer cells) interact through probability distributions based on defined characteristics that have contributed significant insights into cancer biology at the intra-patient tissue level. In oncology, this technique has been applied to model spatial tumour formation, tumour cell heterogeneity, and the dynamics of treatment in the tumour microenvironment⁸. Modelling individual cells as agents allows for direct translation of biological observation into simulation rules and, like virtual clinical trials, the investigation of new hypotheses and treatment strategies.

In particular, this workshop will address:

- the optimization of parameter ranges to generate virtual patients or treatment schedules using a variety of techniques, including simulated annealing, least-squares nonlinear optimisation, gradient-based descent, and genetic algorithms.
- the translation between ABMs and PDEs
- how to code heterogenous tumour environments into an ABM using an open-source software known as PhysiCell

Workshop participants will have the opportunity to see how each of these techniques are applied in computational oncology and learn how to employ them on experimental or generated data in Matlab and in C++. By the end of this workshop, participants will have a comprehensive understanding of computational modelling in oncology, the explicit knowledge for how to design, code, and simulate an agent-based model, and an understanding of how to account for within- and betweenpatient heterogeneity by deploying *in silico* clinical trials.

PROGRAM – THURSDAY 13TH OF AUGUST 2020

12:30-13:00	Morgan Craig
	Introduction lecture on mathematical oncology, including tumour growth models, cancer resistance
	modelling, phenotypic switching, and stochastic models
<u>13:00-13:30</u>	Adrianne Jenner
	Lecture on computational modelling methods in cancer, with emphasis on in silico clinical trials,
	optimisation techniques and agent-based models
<u>13:30-13:40</u>	10 minute break
13:40-14:10	Adrianne Jenner
	Tutorial on using Matlab to leverage experimental data to generate virtual patients and optimize
	therapeutic protocols
<u>14:10-15:00</u>	Paul Macklin, Randy Heiland (part 1)
	Introduction lecture on the open-source agent-based modelling software PhysiCell and its applications in
	oncology, followed by the first session tutorial on applications of PhysiCell: exploring PhysiCell-powered
	nanoHUB apps
<u>15:00-15:15</u>	15 minute break
<u>15:15-16:00</u>	Paul Macklin, Randy Heiland (part 2)
	Second session tutorial on PhysiCell: building C++-based codes, reading data into Jupyter, then making a
	basic XML-based model (e.g. cell swarming, cancer cell proliferation).
16:00-16:10	10 minute break
16:10-16:30	Pantea Poolavand
	Lecture on the translation of ABMs to PDEs, case study in oncology

TICKETS

Free registration for the event can be found at:

https://www.eventbrite.com/e/computational-modelling-to-study-cancer-biology-and-treatments-tickets-113637272140 Make sure to go through the **"pre-flight checklist"** available on the Eventbrite page and download the appropriate programs and software to run PhysiCell. For the Matlab tutorial, you will need to have Matlab on your computer.

WORKSHOP ORGANISERS AND SPEAKERS

Morgan Craig, Assistant Professor, Université de Montréal/Centre de recherche CHUSJ, Montréal, Canada Adrianne Jenner, Postdoctoral Fellow, Université de Montréal/Centre de recherche CHUSJ, Montréal, Canada Paul Macklin, Associate Professor, Indiana University, Bloomington, USA Randy Heiland, Indiana University, Bloomington, USA Pantea Poolavand, University of Sydney, Sydney, Australia

INVITED SPEAKERS

HOME SUBSCRIBE PROGRAM READINGS CONTACT ENGLISH

Overview

ORGANIZERS

Anmar Khadra (McGill University)

Caroline Palmer (McGill University)

[English] See the list Summer School in Nonlinear Dynamics for Life Sciences with Applications to

Summer School in Nonlinear Dynamics for Life Sciences with Applications to Neuroscience and Psychology May 31-June 11, 2021

Hosted by CAMBAM and NSERC-CREATE in Complex Dynamics

Living systems are typical examples of dynamic systems with many interrelated parts or subsystems, ranging from small-scale cellular relationships to large-scale population relationships. Nonlinear dynamics arise when the behavior of one subsystem, with its own dynamics, becomes the input of another subsystem, imposing certain constraints on its dynamics. Mathematics, physics and computer science have provided important theoretical developments in understanding how nonlinear dynamics explain behavior in a wide range of disciplines in the natural sciences, social sciences and life sciences, based on common principles resulting from differential equations. Nonlinear dynamics underpin the developmental trajectory of living organisms, the dissemination of information in neural networks and disease in populations, as well as the prediction of ecosystem evolution in changing environments. Although the challenges are different in each area of research, the quantitative models required are shared between the different areas. These models, accompanied by statistical and computational tools, offer young scientists a platform to understand the dynamics of their systems and to guide new experiments. evolution of ecosystems in changing environments. Although the challenges are different in each area of research, the quantitative models required areas. These models, accompanied by statistical and computational tools, offer young scientists a platform to understand the dynamics of their systems and to guide new experiments. evolution of ecosystems in changing environments. Although the challenges are different in each area of research, the quantitative models required are shared between the different in each area of research, the quantitative models required are shared between the different in each area of research, the quantitative models required are shared between the different in each area of research, the quantitative models required are shared between the different areas. These models, accompanied by statistical and com

École d'été en dynamique non linéaire pour les sciences de la vie avec applications aux neurosciences et à la psychologie

As part of this two-week online summer school, organized by the Center for Applied Mathematics in Biosciences and Medicine as well as the CRSNG-CREATE program in complex dynamics at McGill University (Montreal), we aim to to provide a new generation of internationally recruited interns with fundamental tools in this field as well as to lecture on recent advances in the field of nonlinear dynamics, including: machine learning applications; developments in computational neuroscience; implications in cellular physiology; and infectious diseases (COVID-19) and the transmission of communications.

Financial partners:

William K. and Katherine W. Estes Fund



Appendix 9





The William K. and Katherine W. Estes Fund is jointly overseen by the Association for Psychological Science and the Psychonomic Society

February 8, 2021

Anmar Khadra Department of Physiology McGill University 3655 Promenade Sir William Osler Montreal QC H3G 1Y6 Canada

Dear Dr. Khadra:

On behalf of the Association for Psychological Science and the Psychonomic Society, I am writing regarding your full submission for the William K. and Katherine W. Estes Fund advanced training program, entitled "Nonlinear Dynamics in Life Sciences: Applications in Psychology and Neuroscience." I am happy to inform you that your proposal has been approved for funding in the amount of \$15,204.

A brief word about the logistics: The Estes Fund account is being managed by the Association for Psychological Science (APS). Sarah Schroeder (sschroeder@psychologicalscience.org) will serve as your liaison. Please contact her to arrange for disbursement of the funds. Our preference is that the grant be disbursed as a wire transfer to you or to your institution. After completion of the event, we request that you submit a final accounting of how the funds were spent and a brief narrative report (not to exceed one page). Please don't hesitate to get in touch as any questions arise.

The Estes Fund Committee asks that in all materials advertising the summer school you acknowledge the support of the William K. and Katherine W. Estes Fund.

We on the committee are truly excited about this summer school. Thanks so much for putting together a stellar proposal, and for the commitment of yourself and your colleagues to the development of mathematical and computational approaches to the mind.

Yours sincerely, on behalf of the Estes Fund committee,

Vie 7 Haly

Alice F. Healy, Chair Estes Fund Committee





CAMBAM Spring 2021 Fellowship Application Due June 1, 2021

<u>Please include this form plus trainee's CV in a single PDF</u> <u>document to Frederic.guichard@mcgill.ca</u>

Fellowships/amounts are awarded/determined based on the quality of the applicant, past participation in CAMBAM, past CAMBAM support received by applicant, funds available, number of applications received by CAMBAM, and number of applicants from the same lab.

Name and level of trainee (MSc, PhD or PDF):

Name of supervisor(s) and department:

List previous CAMBAM fellowships received by applicant (if any):

Brief statement (short paragraph) about the interdisciplinary nature of the trainee's research across biology, mathematics and computation:

Brief description of the trainee's and/or supervisor's participation in CAMBAM sponsored events during the last year:

HOME REGISTER SCHEDULE CONTACT FRANÇAIS

Overview

[Français]

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· · ·			

Morgan Craig (Centre de recherche du CHU Sainte-Justine & Université de Montréal)

Adrianne Lena Jenner (Queensland University of Technology)

Workshop on Computational Modelling of Cancer Biology and July 19-21, 2021

Cancer biology and treatment involves complex, dynamic interactions between cancer therapeutic molecules. Quantitative approaches combining mechanistic disease modell leveraged to rationalize preclinical and clinical studies, and to establish effective treat approaches lay the foundation for computational "virtual laboratories" that offer fully c we can investigate emergent clinical behaviours and interrogate new therapeutic strate As an introduction to such virtual laboratories, this workshop will provide an overview c with a focus on model development, data fitting, in silico clinical trials and agent-base examples of these techniques applied in research will be provided from experts in the r will be break-out group projects and tutorials to practice the relevant techniques. By t comprehensive understanding of computational modelling in oncology, the explicit know agent-based model, and an understanding of how to account for within- and between-p clinical trials. In summary, the learning outcomes are:

- develop a computational model of a problem in oncology
- understand the distinction between the different paradigms of ABMs
- understand the relationship between PDEs and ABMs
- develop an agent-based model using PhysiCell
- estimating parameter values from real-world data
- generating virtual patients and running in silico trials

	INVITED SPEAKERS	
	Richard Allen (Pfizer Inc)	
- t	Tyler Cassidy (Los Alamos National Laboratory)	
er ell	Morgan Craig (Centre de recherche du CHU Sainte-Justine & Université de Montréal)	nt, and re increasingly
y c ate	David Dai (Pfizer Inc)	ions in which
w (ase	Lisette de Pillis (Harvey Mudd College)	al oncology, practical
ו ne y t noי	Heiko Enderling (H. Lee Moffitt Cancer Center & Research Institute)	addition, there nts will have a nd simulate an
n-բ	Stacey Finley (University of Southern California)	in silico
	Jill Gallaher (H. Lee Moffitt Cancer Research Institute)	

Thomas Hillen (University of Alberta)

Workshop on Computational Modelling of Cancer Biology and Treatments

Adrianne Lena Jenner (Queensland University of Technology)

Paul Macklin (Indiana University)

Cicely Macnamara (University of St Andrews)

Blerta Shtylla (Pomona College)

Anudeep Surendran (Université de Montréal)

Kathleen Wilkie (Ryerson University)

2020 CMS Winter Meeting

Montreal, December 4 - 7, 2020

Scientific Sessions

All scientific sessions will take place online.

- <u>Additive Combinatorics and Discrete Geometry</u>
- Algebraic Combinatorixx (Women in Algebraic Combinatorics)
- Algebraic Geometry of Integrable Systems
- Applications and Recent Developments in Discontinuous Dynamical Systems
- <u>Arithmetic Statistics</u>
- Combinatorial Designs
- <u>Computations with Arithmetic Groups</u>
- Creative Assessments in the COVID-19 times
- Derived Categories and (Non)commutative Algebraic Geometry
- Discrete Analysis
- Enumerative Combinatorics
- Equidistribution on Arithmetic Manifolds
- Fibrations and Degenerations in Algebraic Geometry
- Graph Theory
- Hacking COVID-19: Share your innovative ways to deal with teaching online
- <u>History and Philosophy of Mathematics</u>
- Homotopy Theory
- Logic and Applications
- Mathematical biology
- Nonlinear PDEs and kinetic problems
- Operator algebras, (semi)groups, and dynamics
- **Optimal Transport and Applications**
- Optimization and Data Science
- <u>Probability in Number Theory</u>
- Recent Advances in Harmonic and Complex Analysis
- Spectral Methods and Singular Integral Equations
- <u>Student Research Talks Session</u>
- <u>Symplectic Topology</u>
- <u>The legacy of Mindstorms</u>
- Variational Analysis: Theory and Applications

Additive Combinatorics and Discrete Geometry

Org: Malabika Pramanik and Josh Zahl (UBC)

Tuesday December 8

11:00 - 11:30	Orit Raz (The Hebrew University of Jerusalem), Dimension-expanding polynomials and the discretized Elekes-R\'onyai
	theorem
11:30 - 12:00	Alexia Yavicoli (University of St Andrews), Patterns in thick compact sets
12:00 - 12:30	Sophie Stevens (Johann Radon Institute for Computational and Applied Mathematics), The Elekes-Szabó Problem and the Uniformity Conjecture
13:00 - 13:30	Brandon Hanson (University of Georgia), A better-than-Plunnecke bound for $A+2A$
13:30 - 14:00	Daniel Di Benedetto (University of British Columbia), Discretised point-line incidences and the dimension of Besicovitch sets
14:00 - 14:30	Jongchon Kim (University of British Columbia), Estimates for some geometric maximal functions associated with a set of directions
14:30 - 15:00	Jonathan Tidor (Massachusetts Institute of Technology), Joints of Varieties
16:00 - 16:30	Tongou Yang (University of British Columbia), Uniform decoupling in 12 for polynomials
16:30 - 17:00	Caroline Terry (Ohio State University), A stable arithmetic regularity lemma in finite abelian groups
17:00 - 17:30	Weikun He (Korea Institute of Advanced Study), Sum-product in representations of Lie groups

Algebraic Combinatorixx (Women in Algebraic Combinatorics)

Org: Angele Foley (Laurier) and Steph van Willigenburg (UBC)

Friday December 4

14:00 - 14:30	Rosa Orellana (Dartmouth College), Restricting Howe Duality
14:30 - 15:00	Sophie Spirkl (University of Waterloo), A complete multipartite basis for the chromatic symmetric function
15:30 - 16:00	Samantha Dahlberg (Arizona State University), Diameters of Graphs of Reduced Words of Permutations
16:00 - 16:30	Megumi Harada (McMaster University), Permutation bases for the cohomology rings of regular semisimple Hessenberg varieties.
17:00 - 18:00	Women in Algebraic Combinatorics Social

Saturday December 5

14:00 - 14:30Pamela Harris (Williams College), Kostant's partition function and magic multiplex juggling sequences14:30 - 15:00Lucy Martinez (Stockton University), Minimum Rank of Regular Bipartite Graphs15:00 - 15:30Sunita Chepuri (University of Michigan), Kazhdan-Lusztig Immanants for k-Positive Matrices15:30 - 16:00Nancy Wallace (UQAM), Toward a Schurification of Schröder path formulas.

2020 CMS Winter Meeting

16:00 - 16:30Anna Pun (University of Virginia), Distribution properties for t-hooks in partitions16:30 - 17:00Olya Mandelshtam (Brown University), The multispecies TAZRP and modified Macdonald polynomials

Algebraic Geometry of Integrable Systems

Org: Michael Groechenig (Toronto) and Steven Rayan (Saskatchewan)

Friday December 4

13:30 - 14:00	Ruxandra Moraru (University of Waterloo), Moduli spaces of stable bundles on complex nilmanifolds
14:00 - 14:30	Jack Ding (University of Toronto), Equivariant multiplicities of Schubert Varieties in the Based Loop Group
14:30 - 15:00	Davesh Maulik (MIT), Cohomology of the moduli of Higgs bundles and the Hausel-Thaddeus conjecture
15:30 - 16:00	<u>Junliang Shen</u> (MIT), Cohomological χ -independence for moduli of 1-dimensional sheaves and moduli of Higgs bundles
16:00 - 16:30	Iva Halacheva (Northeastern University), Lagrangian correspondences in Schubert calculus

Saturday December 5

- 10:00 10:30 Eloise Hamilton (IMJ-PRG, University of Paris), Moduli spaces for unstable Higgs bundles of rank 2 and their geometry
- 10:30 11:00 Peter Crooks (Northeastern University), Hessenberg varieties and Poisson slices
- 13:30 14:00 Alexei Oblomkov (UMass Amherst), 3D sigma models with defects and knot homology
- 14:00 14:30 <u>Olivia Dumitrescu</u> (UNC Chapel Hill), Mirror curve of orbifold Hurwitz numbers
- 14:30 15:00 Ana Balibanu (Harvard University), Steinberg slices in quasi-Poisson varieties
- 15:00 15:30 Lisa Jeffrey (University of Toronto), The triple reduced product and Higgs bundles
- 15:30 16:00 Brent Pym (McGill University), Beauville-Bogomolov-Weinstein splitting for Poisson varieties
- 16:00 16:30 Shiyu Shen (University of Toronto), Topological mirror symmetry for parabolic Higgs bundles
- 16:30 17:00 Jacques Hurtubise (McGill University), Moduli of bundles and degenerations of curves.

Applications and Recent Developments in Discontinuous Dynamical Systems

Org: Kevin Church (McGill) and Stacey Smith? (Ottawa)

Saturday December 5

- 14:00 14:30 <u>Stacey Smith?</u> (Ottawa), Using non-smooth models to determine thresholds for microbial pest management
- 14:30 15:00 Everaldo de Mello Bonotto (Universidade de Sau Paulo), Impulsive semidynamical systems
- 15:30 16:00 <u>Gabriel Duchesne</u> (McGill), Rigorous computations of periodic solutions for the pulse-harvested Hutchinson equation
- 16:00 16:30 Aili Wang (Baoji University of Arts and Sciences)



2020 CMS Winter Meeting

14:00 - 14:30 Kexue Zhang (Calgary), A unified asymptotic stability result for time-delay systems with delayed impulses
 14:30 - 15:00 Kevin Church (McGill), Spectral theory for impulsive delay differential equations
 15:00 - 15:30 Elena Braverman (Calgary), Stabilization of cycles with impulse stochastic control
 15:30 - 16:00 Marcia Federson (Universidade de Sau Paulo), An overview on stability results for impulsive and measure functional differential equations
 16:00 - 16:30 Xinzhi Liu (Waterloo), Impulsive Formation Control of Multi-Agent Systems

Monday December 7

14:00 - 14:30 Gail Wolkowicz (McMaster), Bifurcation analysis of an impulsive system describing Partial Nitritation and Anammox in a hybrid reactor
 14:30 - 15:00 Frithjof Lutscher (Ottawa), Population dynamics of discrete breeders
 15:00 - 15:30 Iain Moyles (York), A model of phosphorus recycling at the plant scale
 15:30 - 16:00 Marco Tosato (York), Multi-cycle Periodic Solutions of a Differential Equation with Delay that Switches Periodically
 16:00 - 16:30 Tyler Meadows (University of Idaho), Self-cycling fermentation with a produced compound

Arithmetic Statistics

Org: Chantal David (Concordia), Matilde Lalin (UdeM) and Jerry Wang (Waterloo)

Friday December 4

13:00 - 13:30	Neha Prabhu (Chennai Mathematical Instittue), A joint distribution theorem with applications to extremal primes for elliptic
	curves
13:30 - 14:00	Anup Dixit (Chennai Mathematical Institute), On the classification problem for general Dirichlet series
14:00 - 14:30	Lucile Devin (Chalmers University of Technology and University of Gothenburg), Chebyshev's bias and sums of two squares
14:30 - 15:00	Alexandra Florea (Columbia University), Non-vanishing for cubic L-functions
15:30 - 16:00	<u>Quanli Shen</u> (University of Lethbridge), The fourth moment of quadratic Dirichlet L-functions
16:00 - 16:30	Alia Hamieh (University of Northern British Columbia), Mean squares of long Dirichlet polynomials with the divisor function
	$ au_2(n)$

Saturday December 5

14:00 - 14:30
 14:30 - 15:00
 15:00 - 15:30
 15:30 - 16:00
 Ahmet Guloglu (Bilkent University), Non-vanishing of Cubic Twists of L-functions
 Asif Zaman (Toronto), An approximate form of Artin's holomorphy conjecture and nonvanishing of Artin L-functions
 Amita Malik (AIM), Bias statistics for the zeros of L-functions
 Allysa Lumley (CRM), Primes in short intervals: Heuristics and calculations

https://www2.cms.math.ca/Events/winter20/sessions_scientific#mb

2020 CMS Winter Meeting

- 16:00 16:30 <u>Will Sawin</u> (Columbia), Measures from moments for random groups
- 16:30 17:00 <u>Seoyoung Kim</u> (Queen's University), From the Birch and Swinnerton-Dyer conjecture to Nagao's conjecture
- 17:00 17:30 <u>Stanley Xiao</u> (University of Toronto), *The number of quartic*- D_4 *fields having monogenic cubic resolvent ordered by conductor*

Sunday December 6

14:00 - 14:30	Arul Shankar (University of Toronto), The 2-torsion subgroups of the class groups in families of cubic fields
14:30 - 15:00	Emilia Alvarez (University of Bristol), Moments of the logarithmic derivative of characteristic polynomials from $SO(N)$ and $USp(2N)$
15:00 - 15:30	Emma Bailey (University of Bristol), Moments of Moments of L-functions
15:30 - 16:00	Antoine Comeau-Lapointe (Concordia University), One-level density of the family of twists of an elliptic curve over function fields
16:00 - 16:30	Martin Cech (Concordia University), Mean values of real Dirichlet characters and double Dirichlet series
16:30 - 17:00	Brad Rodgers (Queen's University), Primes in short intervals in number fields
17:00 - 17:30	Wanlin Li (CRM), The Central Value of Dirichlet L-functions over Rational Function Fields

Combinatorial Designs

Org: Peter Dukes (UVic), Karen Meagher (Regina) and Brett Stevens (Carleton)

Friday December 4

13:00 - 13:30	Stefan Glock (ETH Zurich), Approximate Steiner triple systems of large girth
13:30 - 14:00	Curtis Bright (Waterloo), A Resolution of Lam's Problem via Satisfiability Solvers
14:00 - 14:30	Iren Darijani (Memorial), Colourings of star systems
15:30 - 16:00	Daniel Horsley (Monash), An Evans-style result for block designs
16:00 - 16:30	Tao Feng (BJTU), Nov\'{a}k's conjecture on cyclic Steiner triple systems and its generalization

Saturday December 5

- 14:00 14:30 Joanna Niezen (Victoria), Sarvate-Beam Group Divisible Designs
- 14:30 15:00 Kevin Halasz (SFU), Near transversals in group-based latin squares
- 15:00 15:30 <u>Coen del Valle</u> (Victoria), *Block designs of dimension three*
- 15:30 16:00 <u>Trent Marbach</u> (Ryerson University), *The localization number of designs*
- 16:00 16:30 Kirsten Nelson (Carleton), Interleaved Sequences
- 16:30 17:00 Mahsa Nasrollahi (Regina), The Erdős-Ko-Rado theorem for 2-intersecting families of perfect matchings

Sunday December 6

14:00 - 14:30	Esther Lamken, Applications of incomplete pairwise balanced designs
14:30 - 15:00	David Pike (Memorial), Colourings of Group Divisible Designs
15:00 - 15:30	Mateja Sajna (Ottawa), Bipartite 2-factorizations of complete multigraphs via layering
15:30 - 16:00	Peter Danziger (Ryerson), Directed cycle decompositions of complete digraphs
16:00 - 16:30	Andrea Burgess (UNB), On the Oberwolfach Problem for single-flip 2-factors via graceful labellings
16:30 - 17:00	Hadi Kharaghani (Lethbridge), On Equiangular Tight Frames

Computations with Arithmetic Groups

Org: Haluk Sengun (The University of Sheffield) and John Voight (Dartmouth)

Thursday December 3

9:30 - 10:00	Marc Masdeu (Universitat Autònoma de Barcelona), Quaternionic rigid meromorphic cocycles
10:00 - 10:30	Graham Ellis (National University of Ireland, Galway), An algorithm for computing Hecke operators
10:45 - 11:15	Angelica Babei (Centre de recherches mathématiques), Zeros of period polynomials for Hilbert modular forms
11:15 - 11:45	Ben Breen (Clemson University), A trace formula for Hilbert modular forms
12:00 - 12:30	Avner Ash (Boston College), Cohomology of congruence subgroups of $SL_3(Z)$ and real quadratic fields

Tuesday December 8

9:30 - 10:00	Cecile Armana (Université de Franche-Comté), Sturm bounds for Drinfeld-type automorphic forms over function fields
10:00 - 10:30	Neil Dummigan (University of Sheffield), Congruences involving non-parallel weight Hilbert modular forms
10:45 - 11:15	<u>Fang-Ting Tu</u> (Louisiana State University), A Geometric Interpretation of a Whipple's $_7F_6$ Formula
11:15 - 11:45	Mark McConnell (Princeton University)
12:00 - 12:30	Mathilde Gerbelli-Gauthier (McGill University), Limit multiplicity of non-tempered representations and endoscopy.

Creative Assessments in the COVID-19 times

Org: Andie Burazin (Toronto), Lauren DeDieu (Calgary) and Miroslav Lovric (McMaster)

Monday December 7

- 14:00 14:25
 Amenda Chow and Iain Moyles (York), Choose your own adventure in a multi-variable calculus course for engineering students
- 14:25 14:50 <u>Sean Fitzpatrick</u> (Lethbridge), *Deconstructing Exams for Remote Learning*

5/11/2021	2020 CMS Winter Meeting
14:50 - 15:15	Dan Wolczuk and Paul McGrath (Waterloo), Using Virtual Escape Rooms to Promote Student-Student Interactions
15:25 - 15:50	Samantha-Jo Caetano (Toronto), Trump vs. Biden - who will win?
15:50 - 16:15	Jerrod Smith (Calgary), Peer and Open-ended Assessment in Linear Algebra and Intro Proof Courses
16:15 - 16:40	Anton Mosunov (Waterloo), Let's Think Together: Using Oral Assessments to Develop Students' Thought Process
16:40 - 17:00	General Discussion

Derived Categories and (Non)commutative Algebraic Geometry

Org: Matthew Ballard (USC), Nitin Chidambaram (Alberta) and David Favero (Alberta)

Monday December 7

14:00 - 15:00	Tony Pantev (Penn), Mirror symmetry, intersection of quadrics, and Hodge theory
15:00 - 16:00	Katrina Honigs (Oregon), An obstruction to weak approximation on some Calabi-Yau threefolds
16:00 - 17:00	Max Lieblich (Washington), Filtered derived equivalence and birational Torelli theorems

Tuesday December 8

11:00 - 12:00	Ellen Kirkman (Wake Forest), Degree bounds for Hopf actions on Artin-Schelter regular algebras
13:00 - 14:00	Colin Ingalls (Carleton), Explicit coverings of families of elliptic surfaces by squares of curves
14:00 - 15:00	Alicia Lamarche (Utah), Derived Categories, Arithmetic, and Rationality
15:30 - 16:30	Dylan Allegretti (UBC), Stability conditions and cluster varieties
16:30 - 17:30	<u>Sabin Cautis</u> (UBC), Categorical structure of Coulomb branches of $4D N=2$ gauge theories

Discrete Analysis

Org: Tess Anderson (Purdue), Leo Goldmakher (Williams) and Brandon Hanson (Georgia)

Friday December 4

- 13:00 13:30 Sam Chow (Warwick), Bohr sets in diophantine approximation Marina Iliopoulou (Kent), A discrete Kakeya-type inequality 13:36 - 14:06 14:12 - 14:42 Aled Walker (CRM Montreal), Effective results on the structure of sumsets 14:48 - 15:18 Sarah Peluse (IAS), Modular zeros in the character table of the symmetric group
- 15:24 15:54 Fernando Shao (University of Kentucky), Gowers uniformity of primes in arithmetic progressions

Saturday December 5

13:30 - 14:00 Oleksiy Klurman (Bristol), Zeros of Fekete polynomials

2020 CMS Winter Meeting

- 14:06 14:36 Zane Li (Indiana University), Connections between decoupling and efficient congruencing
- 14:42 15:12 Larry Guth (MIT), Incidence estimates for well spaced rectangles
- 15:18 15:48 Hong Wang (IAS), Small cap decouplings
- 15:54 16:24 <u>Ruxiang Zhang</u> (IAS), Local smoothing for the wave equation in 2+1 dimensions
- 16:30 17:00 Dominique Kemp (Indiana University)

Sunday December 6

13:30 - 14:00	Michael Curran (Oxford), Khovanskii's Theorem and Effective Results on Sumset Structure
14:06 - 14:36	Amita Malik (AIM), Partitions into primes in arithmetic progression
14:42 - 15:12	Jose Madrid (UCLA), Improving estimates for discrete polynomial averages and related problems
15:18 - 15:48	Felipe Ramirez (Wesleyan University), Remarks about inhomogeneous pair correlations
15:54 - 16:24	Ayla Gafni (University of Mississippi), Asymptotics of Restricted Partition Functions
16:30 - 17:00	Freddie Manners (UC San Diego), Some facts about very dense Sidon sets

Enumerative Combinatorics

Org: Sergi Elizalde (Dartmouth), Steven Karp (LaCIM, UQAM), Nadia Lafreniere (Dartmouth) and Alejandro Morales (UMass Amherst)

Saturday December 5

- 14:00 14:30 Matjaž Konvalinka (University of Ljubljana), Some natural extensions of the parking space
- 14:30 15:00 <u>Vasu Tewari</u> (University of Pennsylvania), *Refined mixed Eulerian numbers*
- 15:00 15:30 <u>Svetlana Poznanovikj</u> (Clemson University), *Hecke insertion and maximal increasing and decreasing sequences in fillings of polyominoes*
- 16:00 16:30 <u>Colleen Robichaux</u> (University of Illinois Urbana-Champaign), An Efficient Algorithm for Deciding the Vanishing of Schubert Polynomial Coefficients
- 16:30 17:00 David Keating (University of California, Berkeley), A Vertex Model for LLT Polynomials

Sunday December 6

14:00 - 14:30Justine Falque (Université Paris-Sud), 3-dimensional Catalan objets: a (partial) overview and a new bijection14:30 - 15:00Sam Hopkins (University of Minnesota), Promotion of Kreweras words15:00 - 15:30Maria Gillespie (Colorado State University), Parking functions and a projective embedding of $\overline{M}_{0,n}$ 16:00 - 16:30Ali Assem Mahmoud (University of Ottawa), On the Enumerative Structures in QFT16:30 - 17:00Nathan Williams (University of Texas, Dallas), Strange Expectations in Affine Weyl Groups

2020 CMS Winter Meeting

Tuesday December 8	
11:00 - 11:30	Arvind Ayyer (Indian Institute of Science), Toppleable permutations and excedances
11:30 - 12:00	Ilse Fischer (University of Vienna), Bijective proofs of (skew) Schur polynomial factorizations
12:00 - 12:30	Helen Jenne (Université de Tours), Double-dimer condensation and the dP3 Quiver
13:00 - 13:30	Marni Mishna (Simon Fraser University), Enumerating excursions on Cayley graphs
13:30 - 14:00	Joel Lewis (George Washington University), Hurwitz numbers for reflection groups

Equidistribution on Arithmetic Manifolds

Org: Ilya Khayutin (Northwestern) and Simon Marshall (Wisconsin)

Monday December 7

Treader December 9

14:00 - 14:30	Amir Mohammadi (University of California, San Diego), Effective results in homogeneous dynamics
14:30 - 15:00	Asaf Katz (University of Michigan), An application of Margulis' inequality to effective equidistribution
15:00 - 15:30	Shai Evra (Princeton University), Ramanujan Conjecture and the Density Hypothesis
15:30 - 16:00	Mikolaj Fraczyk (The University of Chicago), Density hypothesis in horizontal families
16:00 - 16:30	Nicholas Miller (University of California, Berkeley), Geodesic submanifolds of hyperbolic manifolds
16:30 - 17:00	Alex Kontorovich (Rutgers University), Applications of Thin Orbits

Tuesday December 8

- 11:00 11:30 Lam Pham (Hebrew University), Arithmetic Groups and the Lehmer conjecture
- 11:30 12:00 <u>Arie Levit</u> (Yale University), *Quantitative weak uniform discreteness*
- 12:00 12:30 <u>Mathilde Gerbelli-Gauthier</u> (McGill University), *Limit multiplicity of non-tempered representations and endoscopy*.
- 13:00 13:30 <u>Will Sawin</u> (Columbia University), *The mixing conjecture over function fields*
- 13:30 14:00 Junehyuk Jung (Brown University), Intersections of geodesics on the modular surface
- 14:00 14:30 Lindsay Dever (Bryn Mawr College), Ambient prime geodesic theorems on compact hyperbolic 3-manifolds
- 14:30 15:00 Matthew Young (Texas A&M University), Moments and hybrid subconvexity for symmetric-square L-functions
- 15:30 16:00 <u>Wenyu Pan</u> (The University of Chicago), *Exponential mixing of geodesic flows for geometrically finite hyperbolic manifolds* with cusps
- 16:00 16:30 <u>Thomas Hille</u> (Northwestern University), Bounds for the Least Solution of Homogeneous Quadratic Diophantine Inequalities.
- 16:30 17:00 <u>Alireza Salehi Golsefidy</u> (University of California, San Diego), *Two new concepts for compact groups: Spectral independence and local randomness*

Fibrations and Degenerations in Algebraic Geometry

Org: Chuck Doran (Alberta) and Andrew Harder (Lehigh)

Friday December 4

13:00 - 14:00 Jordon Kostiuk (Brown University), Geometric Variations of Local Systems
 14:00 - 15:00 Elana Kalashnikov (Harvard University)
 15:30 - 16:30 Daniel Lopez (IMPA), Homology supported in Lagrangian submanifolds in mirror quintic threefolds
 16:30 - 17:30 Tokio Sasaki (University of Miami), Limits of geometric higher normal functions and Apéry constants

Saturday December 5

14:00 - 15:00	Matt Kerr (Washington University at St. Louis), Frobenius constants and limiting mixed Hodge structures
15:00 - 16:00	Sukjoo Lee (University of Pennsylvania), The mirror P=W conjecture from Homological Mirror Symmetry
16:00 - 17:00	Ursula Whitcher (Mathematical Reviews)

Sunday December 6

14:00 - 15:00	Alan Thompson (Loughborough University), Mirror Symmetry for Fibrations and Degenerations
15:00 - 16:00	Adrian Clingher (University of Missouri - St. Louis), On K3 surfaces of Picard rank 14

Graph Theory

Org: Danielle Cox (Mount Saint Vincent University), Kyle Mackeigan (Dalhousie University) and Todd Mullen (University of Saskatchewan)

Friday December 4

13:00 - 13:30	Lucas Mol (University of Winnipeg), The Threshold Dimension of a Graph
13:30 - 14:00	Ben Cameron (Guelph), The mean subtree order of a graph under edge addition
14:00 - 14:30	Iain Beaton (Dalhousie University), The Average Order of Dominating Sets of a Graph
14:30 - 15:00	Jeannette Janssen (Dalhousie University), Simultaneous embeddings of nested interval graphs
15:30 - 16:00	Margaret-Ellen Messinger (Mount Allison), Reconfiguration for Dominating Sets
16:00 - 16:30	Robert Bailey (Grenfell Campus, MUN), On the 486-vertex distance-regular graphs of KoolenRiebeek and Soicher

Saturday December 5

14:00 - 14:30	Melissa Huggan (Ryerson), The Orthogonal Colouring Game
14:30 - 15:00	Nancy Clarke (Acadia University), Surrounding Cops and Robber
15:00 - 15:30	Todd Mullen (University of Saskatchewan), Recent Results in Diffusion
15:30 - 16:00	Danny Dyer (MUN), Gracefully labelling triangular cacti using Skolem sequences
16:00 - 16:30	Ahmad Alkasasbeh (MUN), Graceful Labellings of Variable Windmills Using Skolem

Sequences

2020 CMS Winter Meeting

16:30 - 17:00 <u>Kyle MacKeigan</u> (Dalhousie University), Orthogonal Colourings of Graphs

17:00 - 17:30 Chris Duffy (University of Saskatchewan), Homomorphisms to Reflexive Oriented and Edge-Coloured Graphs

Hacking COVID-19: Share your innovative ways to deal with teaching online

Org: Judy Larsen (University of the Fraser Valley) and Miroslav Lovric (McMaster University) CMESG Working Group

Saturday December 5

15:00 - 17:00 <u>CMESG/CMS Working Group</u>, Hacking COVID-19: Sharing experiences with online teaching

Sunday December 6

15:00 - 17:00 <u>CMESG/CMS Working Group</u>, Hacking COVID-19: Sharing experiences with online teaching

History and Philosophy of Mathematics

Org: Maritza Branker (Niagara)

Friday December 4

- 13:00 13:30 Craig Fraser (IHSPT-Toronto), Henri Poincaré's Development of Hamilton-Jacobi Theory
- 13:30 14:00 <u>Yelda Nasifoglu</u> (Oxford), *The changing nature of mathematical diagrams in the seventeenth century*
- 14:00 14:30 Juan Fernández González and Dirk Schlimm (McGill), From a doodle to a theorem: a case study in mathematical discovery
- 14:30 15:00 <u>Margaret E. Schotte</u> (York), 'Demonstrate all this with diagrams': Recovering mathematical practice from early modern navigation exams
- 15:30 16:00 David Waszek (McGill), From notational change to substantial discovery: Leibniz, Bernoulli, and the exponential notation for differentials
- 16:00 16:30 <u>William Dou</u> (University of Hawaii-Manoa), *What Does "Aligning" Mean? Practices of Justification across Chinese Logic and Mathematics*

Saturday December 5

- 14:00 14:30 Mariya Boyko (Independent scholar), Socialist competition and its role in Soviet mathematics education
- 14:30 15:00 Maryam Vulis (St Johns University), The Life and Work of Zygmunt Janiszewski (1888 1920)
- 15:00 15:30 <u>Tom Drucker</u> (University of Wisconsin-Whitewater), From Plato to the Jabberwocky
- 15:30 16:00 Maritza Branker (Niagara University), Euphemia Lofton Haynes: her forgotten legacy

Homotopy Theory

2020 CMS Winter Meeting

Org: Agnès Beaudry (University of Colorado Boulder), Martin Frankland (University of Regina) and Donald Stanley (University of Regina)

Friday December 4

13:00 - 13:30	Kristine Bauer (University of Calgary), Operads of functors with derivatives
13:30 - 14:00	<u>Apurva Nakade</u> (University of Western Ontario), Discrete Chern-Simons via 2-group bundles on elliptic curves
14:00 - 14:30	Sacha Ikonicoff (University of Calgary), Unstable algebras over an operad
14:30 - 15:00	Katharine Adamyk (University of Western Ontario), Lifting A(1)-Modules

Saturday December 5

14:00 - 14:30 <u>Brandon Doherty</u> (University of Western Ontario), <i>Cubical models of (infinity,1)-categor</i>	ies
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- 14:30 15:00 Dorette Pronk (Dalhousie University), *Three approaches toward orbifold mapping objects*
- 15:00 15:30 <u>Nicholas Meadows</u> (Carleton University), Spectral Sequences in $(\infty, 1)$ -categories
- 15:30 16:00 Niny Arcila Maya (University of British Columbia), Decomposition of topological Azumaya algebras with involution
- 16:00 16:30 Rachel Hardeman (University of Calgary), A Search for Model Structure for A-Homotopy Theory
- 16:30 17:00 Luis Scoccola (Michigan State University), Homotopy coherence in applied topology

Sunday December 6

14:00 - 14:30	Sander Kupers (University o	f Toronto), <i>The rational</i>	homotopy type of certa	in diffeomorphism groups
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- 14:30 15:00 Marzieh Bayeh (University of Ottawa), Higher Equivariant and Invariant Topological Complexities
- 15:00 15:30 Ivan Limonchenko (University of Toronto), On homotopy theory of polyhedral products with Golod face rings
- 15:30 16:00 <u>Steven Amelotte</u> (University of Rochester), *The homotopy type of the fibre of the* p^{th} *power map on loop spaces of spheres*
- 16:00 16:30 Kate Poirier (New York City College of Technology), Polyhedra for V-infinity algebras, string topology, and moduli spaces

Logic and Applications

Org: Marcin Sabok (McGill) and Anush Tserunyan (Mcgill/UIUC)

Friday December 4

13:00 - 13:30	Jan Hubicka (Charles	University), Big Ramse	y degrees of the home	ogeneous universal partial order
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- 13:30 14:00 <u>Colin Jahel</u> (Lyon), Actions of automorphism groups of Fraissé limits on the space of linear orderings.
- 14:00 14:30 Dakota Ihli (UIUC), What generic automorphisms of the random poset look like
- 14:30 15:00 <u>Andy Zucker</u> (UCSD), Big Ramsey degrees via coding trees
- 15:30 16:00 Matt Bowen (McGill), Monochromatic products and sums in N
- 16:00 16:30 Jamal Kawach (Toronto), Fraïssé and Ramsey properties of Fréchet spaces

Saturday December 5

- 14:00 14:30Deirdre Haskell (McMaster)14:30 15:00Taboka Chalebgwa (McMaster), A remark on certain Schanuel n-tuples for the j-function.15:00 15:30Claude Laflamme (Calgary), How many siblings do you have?15:30 16:00William Chan (CMU), Definable Combinatorics of the First Uncountable Cardinal16:00 16:30Saeed Ghasemi (Czech Academy of Sciences), Strongly self-absorbing C*-algebras and Fra\"\i ss\'e limits
- 16:30 17:00 Pavlos Motakis (York), Coarse Universality

Sunday December 6

14:00 - 14:30	Antonina Kolokolova (Memorial)
14:30 - 15:00	Dino Rossegger (Waterloo), Degree spectra of analytic complete equivalence relations
15:00 - 15:30	Bradd Hart (McMaster), Undecidability and embedding problems in continuous logic
15:30 - 16:00	Ronnie Chen (UIUC), A universal characterization of standard Borel spaces
16:00 - 16:30	Michael Wolman (Caltech), Probabilistic Programming Semantics for Name Generation
16:30 - 17:00	Chris Kapulkin (Western Ontario), Canonicity for Homotopy Type Theory

Monday December 7

- 14:00 14:30Tomasz Ciesla (Lancaster), On lifting invariant probability measures14:30 15:00Forte Shinko (Caltech), Lifts of Borel actions on quotient spaces15:00 15:30Jenna Zomback (UIUC), A backward ergodic theorem and its forward implications15:30 16:00Spencer Unger (Toronto), Embeddings and factor maps between \mathbb{Z}^d actions
- 16:00 16:30 <u>Riley Thornton</u> (UCLA), *Factor of i.i.d. processes and Cayley diagrams*
- $\frac{1}{1000} = 10.00 \qquad \text{Meg momon} (000 \text{M}), 1 \text{ units} = 1000 \text{ m} \text{ meg mms}$
- 16:30 17:00 Konrad Wrobel (Texas A&M), Cost of inner amenable equivalence relations

Tuesday December 8

- 11:00 11:30 <u>Noe de Rancourt</u> (Vienna), *Intersection-smooth equivalence relations*
- 11:30 12:00 Zoltán Vidnyánszky (Caltech), Bases for Borel graphs of large chromatic number: injective case
- 12:00 12:30 <u>Aristotelis Panagiotopoulos</u> (Munster), Dynamical obstructions to classification by (co)homology and other TSI-group invariants.
- 13:00 13:30 Felix Weilacher (CMU), Descriptive Chromatic Numbers of Locally Finite and Everywhere Two Ended Graphs
- 13:30 14:00 Shaun Allison (CMU), Polish groups with the pinned property
- 14:00 14:30 <u>Assaf Shani</u> (Harvard), Classification by sequences of countable sets of reals

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14:30 - 15:00 Filippo Calderoni (UIC), Descriptive set theory: order and classification

Mathematical biology

Org: Claire Guerrier (Université Côte d'Azur) and Anmar Khadra (McGill)

Friday December 4

13:00 - 13:20	<u>Fernando Peruani</u> (CY Cergy Paris Université), A mathematical approach to bacterial infections: models for bacterial exploration and infection
13:20 - 13:40	Grant Lythe (University of Leeds), How many TCR clonotypes does a body maintain?
13:40 - 14:00	Bard Ermentrout (University of Pittsburgh), A model for the the inflammatory response to SARS-CoV-2 in the upper- and lower-respiratory tracts.
14:00 - 14:20	Sam Jamaleddine (McGill University), Investigating the effects of T cell avidity distributions on acute vs. chronic viral infection dynamics
14:20 - 14:40	Jürgen Reingruber (Institut de Biologie École Normale Supérieure), Monitoring and predicting the Covid-19 epidemic and its implications for hospitals

Saturday December 5

- 14:00 14:20 <u>Simon Girel</u> (Université Côte d'Azur), *Mathematical modeling of the CD8 T-cells immune response*
- 14:20 14:40 Jacques Bélair (Université de Montréal), Waning immunity in a two-strain disease model
- 14:40 15:00 Eric Foxall (University of British Columbia), Bifurcation theory of well-mixed stochastic population models
- 15:00 15:20 Paul Francois (McGill University), Information in cytokine dynamics : robotic mapping and machine learning
- 15:20 15:40 <u>Nathanael Hozé</u> (Institut Pasteur), Assessing virus circulation levels in the context of high serological cross-reactivity: the case of Mayaro and Chikungunya virus
- 15:40 16:00 Johannes Textor (Radboud University Medical Center), *A tipping point in cancer-immune dynamics leads to divergent immunotherapy responses and hampers biomarker discovery*

Sunday December 6

- 14:00 14:20 <u>Arthur Sherman</u> (National Institutes of Health), *Clinical Insights from a Diabetes Progression Model*
- 14:20 14:40 Anmar Khadra (McGill University), Excitable media in fish keratocytes model: Canard explosion, traveling waves and beyond
- 14:40 15:00 Thomas Hillen (University of Alberta), Non-local Models for Cellular Adhesion
- 15:00 15:20 <u>Khoren Ponsin</u> (McGill University), Mathematical Modeling of Cellular Phagocytosis During Embryogenesis of the Urogenital System
- 15:20 15:40 Lisanne Rens (TU Delft), Computational models for feedback between cell shape, cell signaling and extracellular matrix
- 15:40 16:00 <u>Stephanie Portet</u> (University of Manitoba), Intracellular transport driven by antagonistic motor proteins

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Monday December 7

14:00 - 14:20	Laurent Mackay (McGill University), Feedback onto cellular polarization from paxillin, implications for migrating cells.
14:20 - 14:40	Marc Roussel (University of Lethbridge), Dynamics-preserving model reduction using bipartite-graph representations of biochemical systems
14:40 - 15:00	Khanh Dao Duc (University of British Columbia), A study of stochastic dynamics of mRNA translation and their impact across biological scales

- 15:00 15:20 Brian Merchant (University of British Columbia), Using a Rho GTPase based model of cell polarization to explain group advantage in chemotaxis
- 15:20 15:40 Justin Tzou (Macquarie University), Localized patterns and narrow escape problems in more general geometries

Tuesday December 8

13:00 - 13:20	John Rinzel (New York University), A neuronal model for learning to keep a rhythmic beat.
13:20 - 13:40	David Holcman (Institut de Biologie École Normale Supérieure)
13:40 - 14:00	Lawrence Oprea (McGill University), Simulation and analysis of white matter in a variably hypomyelinated transgenic mouse model
14:00 - 14:20	Charles S. Peskin (New York University – Courant), Interaction of Facilitation and Depression in Synaptic Transmission
14:20 - 14:40	Saeed Farjami (Univeristy of Surrey), Non-sequential Spike Adding in Cerebellar Stellate Cells
14:40 - 15:00	Igor Belykh (Georgia State University), When repulsive coupling promotes synchronization of bursting neurons
15:00 - 15:20	Romain Veltz (INRIA-Sophia Antipolis), Mean field study of stochastic spiking neural networks

Nonlinear PDEs and kinetic problems

Org: Slim Ibrahim (Victoria) and Weiran Sun (SFU)

Friday December 4

13:30 - 14:00	<u>Ricardo Alonso</u> (Texas A&M University at Qatar, Qatar), Brief Intro to Dissipative Particle Systems and the role of self- similarity
14:00 - 14:30	Gong Chen (Fields Institute and University of Toronto, Canada), Long-time dynamics of the sine-Gordon equation
14:30 - 15:00	Zheng Chen (University of Massachusetts Dartmouth, US), Multiscale Convergence Properties for Spectral Approximation of a Model Kinetic Equation
15:30 - 16:00	Dayton Preissl (University of Victoria, Canada), The Hot, Magnetized Relativistic Maxwell Vlasov System
19:00 - 19:30	Hiroaki Kikuchi (Tsuda University, Japan), Existence of a ground state and blowup problem for a class of nonlinear Schr\" {o}dinger equations
19:30 - 20:00	Takafumi Akahori (Shizuoka University, Japan), Uniqueness of ground states for combined power-type nonlinear scalar field equations
20:00 - 20:30	Kai Koike (Kyoto University, Japan), Refined pointwise estimates for the solutions to a system of a 1D viscous compressible

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- 20:30 21:00 Tong Yang (City University of Hong Kong, Hong Kong), Some recent progress on the Boltzmann equation without angular cutoff
- 21:00 21:30 <u>I-Kun Chen</u> (National Taiwan University, Taiwan), A Revisit of the Velocity Averaging Lemma: On the Regularity of Stationary Boltzmann Equation in a bounded Convex Domain

Saturday December 5

19:00 - 19:30 Quyuan Lin (Texas A&M, US), *The Inviscid Primitive Equations and the Effect of Rotation*19:30 - 20:00 Ikkei Shimizu (Kyoto University, Japan), *Local well-posedness for the Landau-Lifshitz equation with helicity term*20:00 - 20:30 Yanxia Deng (Sun Yat-sen University), *Global existence and singularity of the Hill's type lunar problem*20:30 - 21:00 Yakine Bahri (University of Victoria, Canada), *Self-similar blow-up profiles for slightly supercritical nonlinear Schrödinger equations*21:00 - 21:30 Razvan Fetecau (Simon Fraser University, Canada), *Aggregation with intrinsic interactions on Riemannian manifolds*21:30 - 22:00 Shugo Yasuda (University of Hyogo, Japan), *Numerical analysis of the instability and aggregation in a kinetic transport equation with internal state*

Operator algebras, (semi)groups, and dynamics

Org: Chris Bruce (Queen Mary University of London) and Marcelo Laca (Victoria)

fluid and a moving point mass

Saturday December 5

9:00 - 9:30 Karen Strung (Czech Academy of Sciences), Constructions in minimal amenable dynamics and applications to classification of C*-algerbas.
 9:30 - 10:00 Kristin Courtney (University of Münster), C*-structure on images of completely positive order zero maps
 10:00 - 10:30 Jamie Gabe (University of Southern Denmark), Classification of embeddings
 10:30 - 11:00 Aaron Tikuisis (University of Ottawa), Classification of embeddings II

Monday December 7

- 9:00 9:30 <u>Takuya Takeishi</u> (Kyoto Institute of Technology), Partition functions as C*-dynamical invariants and actions of congruence monoids
- 9:30 10:00 Xin Li (University of Glasgow), K-theory for semigroup C*-algebras and partial crossed products
- 10:00 10:30 Nadia Larsen (University of Oslo), Equilibrium states on C*-algebras of right lcm monoids
- 10:30 11:00 Camila Fabre Sehnem (Victoria University of Wellington), Nuclearity for partial crossed products by exact discrete groups
- 14:00 14:30 <u>Matthew Kennedy</u> (University of Waterloo), Amenability, proximality and higher order syndeticity
- 14:30 15:00 Dilian Yang (University of Windsor), Zappa-Sz\'ep Actions of Groups on Product Systems

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- 15:00 15:30 Elizabeth Gillaspy (University of Montana), Homotopy of product systems, and K-theory for higher-rank graphs
- 15:30 16:00 <u>Anna Duwenig</u> (University of Wollongong), Cartan subalgebras for non-principal twisted groupoid C*-algebras
- 16:00 16:30 Ben Hayes (University of Virginia), A random matrix approach to the Peterson-Thom conjecture
- 16:30 17:00 <u>Tyrone Crisp</u> (University of Maine), An imprimitivity theorem for Hilbert modules

Tuesday December 8

9:00 - 9:30 Dan Ursu (University of Waterloo), Characterizing traces on crossed products of noncommutative C*-algebras
9:30 - 10:00 Hung-Chang Liao (University of Ottawa), Almost finiteness, comparison, and tracial Z-stability
10:00 - 10:30 Maria Grazia Viola (Lakehead University), Regularities properties of Cuntz-Pimsner algebras associated to C*-correspondences over commutative C*-algebras
10:30 - 11:00 Johannes Christensen (KU Leuven), A new approach to describing KMS states on C* -algebras.
11:00 - 11:30 Kari Eifler (Texas A&M University), Non-local games and quantum metric spaces
11:30 - 12:00 Boyu Li (University of Victoria), The Zappa-Szép product of a Fell bundle by a groupoid

Optimal Transport and Applications

Org: Jun Kitagawa (Michigan State) and Abbas Momeni (Carleton)

Saturday December 5

14:00 - 14:30 Robert McCann (University of Toronto), Inscribed radius bounds for lower Ricci bounded metric measure spaces with mean convex boundary
 14:30 - 15:00 Luigi De Pascale (Università di Pisa), The relaxation of the Coulomb multi-marginal optimal transport cost and applications
 15:00 - 15:30 Tongseok Lim (Purdue University), Geometry of interaction energy minimizers
 15:30 - 16:00 Yash Jhaveri (Columbia University), On the (in)stability of the identity map in optimal transportation
 16:00 - 16:30 Young-heon Kim (University of British Columbia), Optimal transport for dendritic structures
 16:30 - 17:00 Seonghyeon Jeong (Michigan State University), Equivalence of the synthetic MTW conditions

Sunday December 6

- 14:00 14:30 <u>Alfred Galichon</u> (New York University), Equilibrium transport with entropic regularization
- 14:30 15:00 Shuangjian Zhang (École normale supérieure, Paris), Wasserstein Control of Mirror Langevin Monte Carlo
- 15:00 15:30 Adrian Tudorascu (West Virginia University), ON THE CONVEXITY CONDITION FOR THE SEMI-GEOSTROPHIC SYSTEM
- 15:30 16:00 Farhan Abedin (Michigan State University), Exponential Convergence of Parabolic Optimal Transport on Bounded Domains
- 16:00 16:30 <u>Katy Craig</u> (University of California, Santa Barbara), *A blob method for spatially inhomogeneous degenerate diffusion and applications to sampling and two layer neural networks.*

2020 CMS Winter Meeting

16:30 - 17:00 René Cabrera (University of Massachusetts Amherst), *The Monge-Kantorovich Optimal Transportation of Mass Problem on Rectifiable Continuous Paths*

Optimization and Data Science

Org: Michael Friedlander (University of British Columbia), Abraham P Punnen (Simon Fraser University) and Mohamed Tawhid (Thompson Rivers University)

Saturday December 5

14:00 - 14:30 Montaz Ali (University of the Witwatersrand), Convex Formulation for Planted Quasi-Clique Recovery
14:30 - 15:00 Courtney Paquette (McGill University), Halting Time is Predictable for Large Models: A Universality Property and Average-case Analysis
15:00 - 15:30 Zhaosong Lu (University of Minnesota), First-Order Augmented Lagrangian Methods for Convex Conic Programming
15:30 - 16:00 Yankai Cao (UBC), A Global Optimization Algorithm for Clustering Problems
16:00 - 16:30 Ibrahim Numanagić (University of Victoria), Optimization in Pharmacogenomics
16:30 - 17:00 Jabed Tomal and Jan Ciborowski (Thompson River University, University of Calgary), Detection of environmental thresholds by assessing discontinuities in slopes and variances via a Bayesian regression model

Sunday December 6

- 14:00 14:30 Paula Fermín Cueto (University of Edinburgh), Machine learning and statistical methods for characterising and predicting capacity degradation of Li-ion cells
- 14:30 15:00 <u>Gonçalo dos Reis</u> (University of Edinburgh), *State of Health for the capacity and internal resistance of Li-ion cells: A machine learning approach with knees and elbows*
- 15:00 15:30 Lukasz Golab (University of Waterloo), Explanation Tables
- 15:30 16:00 <u>Mark Schmidt</u> (UBC), Faster Algorithms for Deep Learning?
- 16:00 16:30 <u>Tamon Stephen</u> (SFU), Minimal Cuts Set and Computing with Monotone Boolean Functions
- 16:30 17:00 Xuekui Zhang (University of Victoria), The Optimal Design of Clinical Trials with Potential Biomarker Effects, A Novel Computational Approach

Monday December 7

- 14:00 14:30 <u>Abdelmonem Ibrhaim</u> (Alzahr University), Binary whale optimization algorithm for feature selection
- 14:30 15:00 Aleksandr Aravkin (University of Washington), A Robust Risk Score for Evaluating Evidence in Global Health
- 15:00 15:30 Warren Hare (UBC), Imaginary Derivative Free Optimization
- 15:30 16:00 Xiaoping Shi (Thompson River University), Graph-based change-point test
- 16:00 16:30 <u>Thomas Humphries</u> (University of Washington Bothell), Unrolled iterative algorithm for CT image reconstruction with learned penalty term

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16:30 - 17:00 Monica Gabriela Cojocaru (University of Guelph), On Minty-variational inequalities and evolutionary stable states of generalized stable games

Probability in Number Theory

Org: Louis-Pierre Arguin and Andrew Granville (Université de Montréal)

Friday December 4

13:00 - 13:30	Dimitris Koukoulopoulos (Montréal), How concentrated can the divisors of a typical integer be?
13:30 - 14:00	Emma Bailey (CUNY), Random matrices and L -functions: moments of moments, branching, and log-correlation
14:00 - 14:30	Suresh Eswarathasan (Dalhousie), Counting tangencies of nodal domains
14:30 - 15:00	Sacha Mangerel (CRM), Arrangements of Consecutive Values of Real Multiplicative Functions
15:30 - 16:00	Francesco Cellarosi (Queens), Rational Horocycle lifts and the tails of Quadratic Weyl sums
16:00 - 16:30	Aled Walker (CRM & Cambridge), Triple correlations of dilates squares modulo 1

Saturday December 5

- 14:00 14:30 <u>Adam Harper</u> (Warwick), Large fluctuations of random multiplicative functions
- 14:30 15:00 <u>Claire Burrin</u> (CRM), Higher moment formulas for discrete lattice orbits in the plane
- 15:00 15:30 Youness Lamzouri (Lorraine), Zeros of linear combinations of L-functions near the critical line
- 15:30 16:00 <u>Vesselin Dimitrov</u> (Toronto), Small algebraic points and random polynomials: a distributional parallel and some recent results
- 16:00 16:30 <u>Asif Zaman</u> (Toronto), Low moments of random power series
- 16:30 17:00 Brad Rodgers (Queens), The distribution of sums of two squares in short intervals

Sunday December 6

- 14:30 15:00 Michel Pain (NYU), Extrema of branching random walks and log-correlated fields
- 15:00 15:30 Paul Bourgade (NYU), The Fyodorov-Hiary-Keating Conjecture
- 15:30 16:00 Maksym Radziwill (Caltech), Moments of the Riemann zeta function in tiny intervals
- 16:00 16:30 <u>Yu-Ru Liu</u> (Waterloo), Number of Prime Factors with a Given Multiplicity
- 16:30 17:00 Jean-Marie de Koninck (Laval), Consecutive integers divisible by a power of their largest prime factor

Monday December 7

- 14:00 14:30 <u>Winston Heap</u> (Max Planck), Random multiplicative functions and a model for the Riemann zeta function
- 14:30 15:00 Ram Murty (Queens), An "all-purpose" Erdos-Kac theorem
- 15:00 15:30 <u>Cameron Stewart</u> (Waterloo), Counting solvable S-unit equations

https://www2.cms.math.ca/Events/winter20/sessions_scientific#mb

Recent Advances in Harmonic and Complex Analysis

Org: Ilia Binder (Toronto), Damir Kinzebulatov (Université Laval) and Javad Mashreghi (Université Laval)

Sunday December 6

14:00 - 14:30 Paul Gauthier (Université de Montréal), Asymptotic first boundary value problem for holomorphic functions of several complex variables 14:30 - 15:00 Galia Dafni (Concordia University), Extension domains for bmo 15:00 - 15:30 Ryan Gibara (Université Laval), Boundedness and continuity of rearrangements on spaces defined by mean oscillation 15:30 - 16:00 Adi Glucksam (University of Toronto), Computability of harmonic measures 16:00 - 16:30 Malik Younsi (University of Hawaii), Holomorphic motions, capacity and conformal welding 16:30 - 17:00 Alexander Brudnyi (University of Calgary), On nonlinear Runge approximation problems 17:00 - 17:30 Ludovick Bouthat (Université Laval), The norm of an infinite L-matrix Wenbo Li (University of Toronto), Conformal dimension and minimality of stochastic objects 17:30 - 18:00 Frédéric Morneau-Guérin (Université TÉLUQ), La *-stabilité de l'espace pondéré des suites de carré sommable sur la 18:00 - 18:30 somme directe de groupes abéliens finis

Monday December 7

- 14:00 14:30 Thomas Ransford (Université Laval), A Gleason-Kahane-Żelazko theorem for reproducing kernel Hilbert spaces.
- 14:30 15:00 <u>Almaz Butaev</u> (University of Calgary), On geometric preduals of jet spaces on subsets of \mathbb{R}^n
- 15:00 15:30 <u>Pierre-Olivier Parisé</u> (Université Laval), Cesàro summability of Taylor series in weighted Dirichlet spaces
- 15:30 16:00 Larissa Richards (University of Toronto), On the rate of convergence of discrete interfaces to SLE.
- 16:00 16:30 Ignacio Uriarte-Tuero (Michigan State University), Two weight norm inequalities for singular integrals in \mathbb{R}^n
- 16:30 17:00 William Verreault (Université Laval), Nonlinear Oscillatory Expansions of holomorphic functions
- 17:00 17:30 James Wilson (University of Vermont), Discretization of adapted functions
- 17:30 18:00 Scott Rodney (Cape Breton University), Bounded Weak Solutions of Second Order Linear PDEs with Data in Orlicz Spaces
- 18:00 18:30 <u>Jie Xiao</u> (Memorial University), An optimal regularity for the planar $\bar{\partial}$ -equation
- 18:30 19:00 Javad Mashreghi (Université Laval), Outer Functions and the Schur Class

Spectral Methods and Singular Integral Equations

Org: Sheehan Olver (Imperial College London) and Richard Slevinsky (Manitoba)

Saturday December 5

2020 CMS Winter Meeting

- 14:00 14:30 <u>Timon Gutleb</u> (Imperial College London), Computing Equilibrium Measures with Power Law Kernels
- 14:30 15:00 <u>Travis Askham</u> (NJIT), Fast multipole methods for continuous charge distributions
- 15:00 15:30 Dan Fortunato (Harvard University), *The ultraspherical spectral element method*
- 15:30 16:00 Andrew Horning (Cornell University), *Twice is enough for dangerous eigenvalues*
- 16:00 16:30 Jim Bremer (UC Davis), A fast algorithm for simulating scattering from a radially symmetric potential
- 16:30 17:00 Nilima Nigam (Simon Fraser University), Steklov eigenfunctions: how and why to compute them

Sunday December 6

- 14:00 14:30 <u>Matthew Colbrook</u> (Cambridge University), A Mathieu function boundary spectral method for acoustic scattering
- 14:30 15:00 Sheehan Olver (Imperial College London), Sparse spectral methods for singular integral and fractional differential equations
- 15:00 15:30 <u>Manas Rachh</u> (Flatiron Institute), *Towards automatically adaptive solvers for Maxwell's equations in three dimensions*
- 15:30 16:00 Richard Mikael Slevinsky (University of Manitoba), Fast associated classical orthogonal polynomial transforms
- 16:00 16:30 <u>Alex Townsend</u> (Cornell University), Computing the spectra of differential operators
- 16:30 17:00
 Tom Trogdon (University of Washington), On arbitrary-precision enabled inverse scattering for the 1-dimensional Schr\"odinger operator

Student Research Talks Session

Sunday December 6

14:00 - 14:20 Sourabhashis Das (University of Lethbridge) 14:22 - 14:42 William Verreault (Université Laval) 14:44 - 15:04 Alexis Langlois-Rémillard (Ghent University) 15:06 - 15:26 Benoît Corsini (McGill University) Farzaneh Nikbakhtsarvestani (University of Manitoba) 15:28 - 15:48 David Stapleton (University of Amsterdam) 16:05 - 16:25 16:27 - 16:47 Maiko Serizawa (University of Ottawa) 16:49 - 17:09 Tingzhou Yu (University of Victoria) Damanvir Binner (Simon Fraser University) 17:11 - 17:31 17:33 - 17:53 Antoine Poulin (McGill University)

Symplectic Topology

Org: Octav Cornea and Egor Shelukhin (Université de Montréal)

Friday December 4

13:00 - 13:40	Zhang Jun (Montreal), Quantitative Lagrangian embeddings
14:10 - 14:50	Marcelo Atallah (Montreal), Hamiltonian no-torsion

Saturday December 5

14:00 - 14:40Ilia Kirillov (Toronto), Classification of coadjoint orbits for symplectomorphism groups of surfaces with boundary15:00 - 15:40Lara Suarez Lopez (Bochum), On the rigidity of Legendrian cobordisms16:00 - 16:40Jordan Payette (Montreal), Mean value inequalities for the Poisson bracket invariant

Sunday December 6

14:00 - 14:40	Francisco Torres de Lizaur (Toronto), Knots and links in Beltrami fields
15:00 - 15:40	Dominique Rathel-Fournier (Montreal), Unobstructed Lagrangian cobordism groups of surfaces
16:00 - 16:40	Jean-Philippe Chassé (Montreal), The impact of metric constraints on the behavior of shadow metrics

Tuesday December 8

- 11:00 11:40 Shira Tanny (Tel Aviv), *The Poisson bracket invariant: elementary and hard approaches.*
- 11:50 12:30 Cheng Yang (Toronto), Symplectic reduction and perturbation theory
- 13:10 13:50 <u>Qun Wang</u> (Toronto), Choreographies in the N-Vortex Problem
- 14:00 14:40 <u>Xiudi Tang</u> (Toronto), Symplectic ray removal
- 15:30 16:10 <u>Pranav Chakravarthy</u> (Western Ontario), Homotopy type of equivariant symplectomorphisms of rational ruled surfaces.

The legacy of Mindstorms

Org: Andrijana Burazin (Toronto) and Peter Taylor (Queen's University)

Tuesday December 8

- 13:00 13:20 <u>Peter Taylor</u> (peter.taylor@queensu.ca), Let's invite Seymour into our calculus classroom.
- 13:20 13:40 <u>Alfonso Gracia-Saz</u> (alfonso@math.toronto.edu), *Playing with Desmos in the classroom*
- 13:40 14:00 Andrew McEachern (andrewm6@yorku.ca), Tournaments in a Proofs Class
- 14:00 14:20 Bernardo Galvao-Sousa (beni@math.toronto.edu), Open ended modelling problems
- 14:20 14:40 Sarah Mayes-Tang (smt@math.toronto.edu), Using Stories to Learn Math in A First-Year Seminar
- 14:40 15:00 General Discussion

Variational Analysis: Theory and Applications

2020 CMS Winter Meeting

Org: Heinz Bauschke (UBC), Walaa Moursi (Waterloo), Shawn Wang (UBC) and Henry Wolkowicz (Waterloo)

Friday December 4

15:30 - 16:00Boris Mordukhovich (Wayne State), A Generalized Newton Method for Subgradient Systems16:00 - 16:30Walaa Moursi (Waterloo)

Saturday December 5

14:00 - 14:30	Patrick Combettes (NCSU), Proximal Analysis of Deep Neural Networks
14:30 - 15:00	Minh Bui (NCSU), Multivariate Monotone Inclusions in Saddle Form
15:00 - 15:30	Hao Hu (Waterloo), Computing the Nearest Doubly Stochastic Matrix by a Newton-type Method
16:00 - 16:30	Mohamed Tawhid (TRU), Improved Salp Swarm Optimization Algorithm for Data Clustering
16:30 - 17:00	Salihah Alwadani (UBCO), Resolvents and Yosida approximations of displacement mappings of isometries

Sunday December 6

14:00 - 14:30	Levent Tuncel (Waterloo), A journey from the theory of self-concordant functions and variable metrics to applications in convex optimization
14:30 - 15:00	Steve Vavasis (Waterloo), Nonlinear Conjugate Gradient for Convex Functions
15:00 - 15:30	Hristo Sendov (Western), A unified approach to operator monotone functions
15:30 - 16:00	Sedi Bartz (UM Lowell), Open questions in multi-marginal monotonicity and convex analysis
16:00 - 16:30	Tim Hoheisel (McGill), From perspective maps to epigraphical projections
16:30 - 17:00	Jane Ye (Victoria), Second-order optimality conditions for non-convex set-constrained optimization problems
17:00 - 17:30	Kimon Fountoulakis (Waterloo), p-Norm Flow Diffusion for Local Graph Clustering

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Year-End Financial Statement for May 1st 2020 to April 30th 2021

Research Centre, Core Facility, Network Name:

CAMBAM

Director and Administrator (Names and Contact information):

Anmar Khadra (anmar.khadra@mcgill.ca) and Fred Guichard (red.guichard@mcgill.ca)

Sources of Income / Revenue:

	Cash	In-kind
From Faculty of Medicine and Health Sciences (FMHS)	15,000	
Other sources List all sources (add rows as needed): RQNT/CRM (\$8,873), VPR research (\$35,000), FacSci/CRM (\$2,273) and UdeM/CRM (\$1,637).	47,783	CRM provides administrative support.
User Fees		
TOTAL INCOME / REVENUE:	62,783	

Expenditures:

Where applicable, provide details of items of expenditure as indicated below, e.g. salary components should be listed by individual, the cost of each workshop, individual working group, or other meetings should be given, as well as any research project funds expended

Description	FMHS funds	Contributing Organization contributions	
		Cash	In-kind
Personnel Salaries and related costs, for example:			
The Centre coordinator			
Research Associates, professional officers, technicians, laboratory attendants, administrators, organizers			
Specialist professional staff located within major facilities and other appropriate settings			

Student and trainee salaries			
Shared Research Resources, for example:			
Specialized equipment purchase or upgrade / repair			
Software tools			
Databases			
Bringing People Together, for example:			
Workshops (3 online workshops)		\$1,500	
Meetings			
Seminars (virtual - no expenses)	0	0	
Conferences (CMS Winter Meeting)		\$1,000	
Planning, co-ordination activities			
Travel			
Accommodation			
Purchase of specific Assets or Intellectual Property			
Other expenditure:			
Any other expenditure not falling under the specified expenditure headings above			
(give details): 7 fellowships of \$8,500 each.	\$15,000	44500	
TOTAL EXPENDITURES	15,000	47,000	
Carryover amount: Please note that a carryover balance is not permitted for some accounts (to clarify accounts affected, please consult Financial Affairs)			
Provide the reason for carryover* if permitted: It is essential that reasons be provided by carryover requests	There will be a total of \$783 carryover. This is a small amount that will be used in the next budget year.		

*It is the responsibility of the Centre, Core Facility, Network to ensure that the carryover amount requested in this document has been discussed with the Financial Affairs Office, Faculty of Medicine and Health Sciences

Director of Research Centre, Core Facility or Network or his/her Delegate:





Budget plan for May 1st 2021 to April 30th 2022

Total request from Faculty of Medicine and Health Sciences for 2021-22:

Sources of Income / Revenue:

	Cash	In-kind
From Faculty of Medicine and Health Sciences (FMHS)	15,000	
Other sources List all sources (add rows as needed): RQNT/CRM (\$14,000), VPR research (\$35,000), FacSci/CRM (\$2,500), UdeM/CRM (\$2,000) and ESTES Fund/Psychometric Society (\$20,000).	\$73,500	
User Fees		
TOTAL INCOME / REVENUE:	\$88,500	

Expenditures:

Where applicable, provide details of items of expenditure as indicated below, e.g. salary components should be listed by individual, the cost of each workshop, individual working group, or other meetings should be given, as well as any research project funds expended

Description	FMHS funds	Contributing Organization contributions	
		Cash	In-kind
Personnel Salaries and related costs, for example:			
The Centre coordinator			

Research Associates, professional officers, technicians,			
laboratory attendants, administrators, organizers			
Specialist professional staff located within major			
facilities and other appropriate settings			
Student and trainee salaries			
Shared Research Resources, for example:			
Specialized equipment purchase or upgrade / repair			
Software tools			
Databases			
Bringing People Together, for example:			
Workshops (Several online workshops)	\$2,000		
Workshops (CAMBAM/NSERC-CRATE Summer School)		25,000	
Meetings (One CAMBAM meeting)	10,000		
Seminars (CAMBAM/QLS)	\$3,000	\$5,000	
Conferences			
Planning, co-ordination activities			
Travel			
Accommodation			
Purchase of specific Assets or Intellectual Property			
Other expenditure:			
Any other expenditure not falling under the specified			
expenditure headings above			
(give details): 7 fellowships of \$6,326 each.		44,282	
TOTAL EXPENDITURES	15,000	\$74,282	