

# Retreat for Young Researchers in Stochastics

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## 1 Overview

This was the fifth annual meeting of the PIMS Postdoctoral Training Centre in Stochastics (PTCS). The Retreat offers an opportunity for young researchers in pure or applied probability from Western Canada and Washington state to interact, communicate their recent results and ongoing research programs, and initiate new collaborations. Nine postdoctoral fellows affiliated with PTCS, and one Ph.D. student spoke at the meeting. The 27 participants included postdoctoral fellows from U. Washington, U. of Alberta, U. of Calgary, U. Saskatchewan and UBC, Ph.D. students from U. Calgary, U. Alberta, U. Victoria, U. Washington and UBC, and faculty from U. Alberta, U. Calgary, U. Victoria, U. Regina, U. Washington and UBC.

The response from the participants after the retreat was quite positive.

## 2 Presentation Highlights

The range of topics from applied statistical hydrology to mathematical finance to the latest developments in random growth models was a striking feature of the workshop.

Chandra Rajulapati (U. Saskatchewan) spoke on modelling precipitation both locally and globally and how global trends provide inputs for urban precipitation estimates. She discussed the considerable challenge of adapting current static models to take account of global trends, notably climate change. She also presented the challenges faced in incorporating the disparate types of data (from ground measurement, satellite input and input from Global Climate Models) into the rainfall predictions. A particular challenge for Canada is the sparseness of on-ground data collection stations as compared to Europe and India, for example. She pointed to some unexpected phenomena which leads to data analysis challenges such as the increased variability of data in urban areas due to the presence of micro climates resulting from buildings and pollution issues.

Two talks on random dynamics from different perspectives were given by Joseph Horan (U. Vic) and Shirou Wang (U. Calgary). Joseph gave an extension of the Peron-Frobenius Theorem for matrices with non-negative entries to a sequence of random operators driven by an ergodic process. In particular he gave a contraction condition under which one has a lower bound on the “spectral gap” in this random setting and hence exponential rates of convergence of the resulting cocycles in Oseledets spaces. His perspective was from that of classical ergodic theory. Shirou Wang’s results were from an applied modelling perspective in which the random cocycle structure arises due to extrinsic ergodic noise in the system and is further perturbed by a Markov chain arising from smaller intrinsic noise. She was concerned with convergence of the random invariant laws as the size of the perturbation becomes small to a moving equilibrium under a synchronization assumption on the underlying ergodic sequence of operators. In this setting she did not address the issue of exponentially fast convergence, but found different limiting results on synchronization or desynchronization

depending on the strength of the synchronization of the non-perturbed ergodic system or on the regularity of the perturbation. Shirou and Joseph were not aware of each others work prior to the workshop.

There were three interesting presentations on random geometry given by the three postdocs at UBC, Thomas Budzinski, Delphin Senizergues and Yinon Spinka. Senizergues spoke on random growth models for trees based on (possibly random) weights giving the probabilities of attachment. One striking result showed the preferential attachment model (related to a common model for the internet) can be constructed through a particularly simple assignment of the random weights. Several precise results on the asymptotic growth properties of the resulting random trees were obtained. Thomas Budzinski spoke on random gluing models to construct random manifolds from sequences of polygons. This work is closely related to the random maps of Le Gall and Miermont constructed as random metric measure spaces by taking a scaling limit of a random planar map with  $n$  vertices as  $n$  gets large (one of the most important recent developments in the field [1]), but now the resulting surfaces are no longer conditioned to be spherical and so could be of large genus. A number of detailed properties of the growth dynamics were discussed including the fact that the rescaled vertex degrees in decreasing order converges to a Poisson-Dirichlet process. Spinka spoke on work done recently at UBC with Omer Angel. Their results again considered random geometry, this time given by random metrics on the circle of circumference  $L$  obtained by doing  $1/2$ -percolation between points in countable dense sets which are within distance one. For each  $L$  rational the graphs are all isomorphic a.s. and so determine an interesting class of graphs (up to isomorphism) indexed by  $L$ . But if  $L$  is irrational the resulting random graphs are not isomorphic to each other a.s. Earlier work in this field had focussed on normed linear spaces but this kind of disparate behaviour in the metric space setting was unexpected.

### 3 Outcome of the Meeting

The level of talks at this Retreat was extremely high in terms of content and presentation. Four of the ten lectures were given by outstanding young female postdoctoral fellows from U. Alberta, U. Calgary, and U. Saskatchewan. A number of the participants wrote after the meeting, all expressing thanks for a stimulating meeting. Yaozhong Hu (CRCI at U. Alberta) pointed to new connections made with faculty and young researchers at U. Calgary.

During the meeting plans were made for an annual conference rotating between sites at UBC, U. Washington, U. Victoria and U. Alberta. A large meeting at UW was planned for 2020 using the final cycle of NSF funding for the PTCS, and a smaller weekend meeting at U. Victoria will be held in April of 2020. This will be followed by a one-week meeting in Victoria in 2021 and a large event at U. Alberta in 2022, with another Summer School in Probability in 2022 at either UA or UBC. It was also agreed that these annual meetings featuring young researchers in Probability from PIMS sites should continue after the end of the funding for the PIMS Postdoctoral Training Centre for Stochastics, It was felt that a 3-day meeting might be better to offer more time for informal discussion. The extra day could be at U. Calgary prior to the weekend meeting at BIRS.

### References

- [1] J.F. Le Gall, , Plenary Lecture, ICM 2018. To appear in *Discrete Mathematics*, Volume 342, Issue 1, January 2019, Pages 152-167.