Trends in Persistent Homology

When:	Friday, 16 November 2018, 1-7pm
Where:	Emeleus Lecture Hall,
	School of Mathematics & Physics,
	Queen's University Belfast

Program

13:00 - 14:00	Get together with coffee and sandwiches
14:00 - 14:50	Talk by *Florian Pausinger* (Queen's University)
14:50 - 15:40	Talk by *Claudia Landi* (Universit di Modena e Reggio Emilia)
15:40 - 16:00	Coffee break
16:00 - 16:50	Talk by *Vitaliy Kurlin* (University of Liverpool)
16:50 - 17:40	Talk by *Pawel Dlotko* (Swansea University)
17:40 - 19:00	Reception for all participants with the chance to discuss with all speakers
19:30	Dinner for invited speakers open to all interested participants

Abstracts

Florian Pausinger, **Persistent Betti numbers of random Čech complexes**

We study the persistent homology of random Čech complexes. Generalizing a method of Penrose for studying random geometric graphs, we first describe an appropriate theoretical framework in which we can state and address our main questions. Then we define the kth *persistent* Betti number of a random Čech complex and determine its asymptotic order in the subcritical regime. This extends a result of Kahle on the asymptotic order of the ordinary kth Betti number of such complexes to the persistent setting.
Joint work with Ulrich Bauer (TU Munich).

Claudia Landi, **A discrete Morse-based approach to multidimensional persistence**

Multivariate data are becoming more and more popular in several applied sciences, including physics, chemistry, medicine, geography. A multivariate dataset is represented by a cell complex and a vector-valued function defined on its vertices. After setting the preliminaries, this talk will treat discrete gradient fields consistent with multi-filtrations. A discussion on what information regarding multidimensional persistent modules and their Betti numbers can be extracted from critical cells of such gradient fields will be the focus of this talk.

Vitaliy Kurlin, **A comparison of skeletonization algorithms with theoretical guarantees for unorganized point clouds.**

We study the problem of approximating an unorganized cloud of points (in any Euclidean or metric space) by a 1-dimensional graph or a skeleton. The following three algorithms run a near linear time and provide theoretical guarantees for an output skeleton: the 1-dimensional Mapper, alpha-Reeb graphs and a Homologically Persistent Skeleton. The algorithms will be introduced on simple examples and then experimentally compared on the same synthetic and real data. The synthetic data are random point samples around planar graphs and sets of edge pixels obtained by a Canny edge detector on images from the Berkeley Segmentation Database BSD500. The criteria for comparison are the running time, homotopy and homeomorphism types and geometric errors of reconstructed graphs.
*T*his is joint work with PhD student Phil Smith.

Pawel Dlotko, **Topology in action.**

Until twenty years ago topology was considered an abstract and hard to understand area of mathematics with virtually no links to applied sciences and industry. However recently we are witnessing a topological revolution: take physics, engineering, material science, biology and all the way to neuroscience, and data science. Topology is starting to play a very important role over there. In this talk I will talk about a few projects I am involved. I will start by remaining what persistent homology and mapper is, and I will present my recent construction in which I combine both for the sake of data analysis. Later I will explain how topology can be used for high-throughput screening of materials and to quantify spinodal decomposition in alloys.

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