Submittee: Pat Morin
Date Submitted: 2017-10-11 11:56
Title: Canadian Conference on Computational Geometry
Event Type: Conference-Workshop

Location:
Carleton University

Dates:
July 26-28, 2017

Topic:
Computational Geometry

Methodology:
This was a three day conference, with approxiately 50 contributed talks and three plenary speakers. All talks were recorded and are available on the conference website: http://2017.cccg.ca/ . On the second day, Shopify hosted an industry lunch for students.

Objectives Achieved:
The conference was attended by approximately 80 international visitors, with an approximately even mix of early career researchers (students and postdocs) and established researchers (professors).

Scientific Highlights:
The 29th Canadian Conference on Computational Geometry took place July 26-28th at Carleton University. The conference was attended by an international group of 75 researchers approximately half of which were students and postdocs. For the first time ever this year, the talks were recorded on video camera and are available for viewing on the conference website (2017.cccg.ca).

The conference had three plenary talks:

David Eppstein delivered the Paul Erdos Memorial Lecture and talked about Forbidden Configurations in Discrete Geometry in which he outlined a new theory in which one described classic (and modern) discrete and combinatorial geometry questions in terms of forbidden configurations. In doing so, a theory develops that is similar in spirit to the theory of forbidden minors in graph theory and this provides a number of general tools for solving these types of problems. At the end of the talk, David informed the audience that this project, which he started when he was invited to give the talk, has developed in into a 250+ page book that will be published next year!

Erin Chambers gave the second plenary talk entitled Burning the Medial Axis, in which she describe how the medial- axis (a commonly used shape descriptor) can be assigned signficance measures in order to prune away parts that are susceptible to noise. She discussed how a new measure, the burn time, provides significantly more robust skeletons that are also guaranteed to preserve certain topological features. This talk was full of beautiful images and videos arising from applying this work in computer graphics and machine learning.

Stefan Langerman delivered the Ferran Hurtado Memorial Lecture, in which he gave a delightful and entertaining talk entitled Tilers, Tilemakers, Transformers! In this talk he presented some remarkable recent results about 3d-surfaces that, no matter how they are cut into a net and unfolded produce a 2-dimensional object that tiles the plane. The talk was as much a magic show as a mathematics talk! During this talk, the audience was provided with paper, tape, and scissors so that they could make physical models of the 3d-surfaces and tiles discussed in the talk.

This year, CCCG also had a Best Student Presentation Award, that was awarded to Patrick Schnider (from ETH Zurich) for his presentation of the paper Sharing a Pizza: Bisecting Masses with Two Cuts. This paper was about how a (very general) pizza with four toppings can be cut with two straight-line cuts so that the resulting pieces can be shared fairly between two people, with each person getting exactly one half of each topping. This ham-sandwhich-type theorem was obtained using the Borsuk-Ulam Theorem along with the fact that two straight lines can be viewed as a degenerate conic section.

The conference had an opening reception at Play Food and Wine, a banquet at Carleton University, and a conference dinner at Cornerstone Bar and Grill. Attendees at the Conference Dinner were treated to the opening of La Machine in which the giant spider Kumo was lowered from the tower of Notre Dame Cathedral.

Organizers:

Biniaz, Ahmad, School of Computer Science, Carleton University
Bose, Prosenjit, School of Computer Science, Carleton University
De Carufel, Jean-Lou, Department of Computer Science and Electrical Engineering, University of Ottawa
Dujmovi?, Vida, Department of Computer Science and Electrical Engineering, University of Ottawa
Maheshwari, Anil, School of Computer Science, Carleton University
Morin, Pat, School of Computer Science, Carleton University
Smid, Michiel, School of Computer Science, Carleton University
Verdonschot, Sander, School of Computer Science, Carleton University

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Speakers:

David Eppstein, Computer Science Department, University of California, Irvine
Forbidden Configurations in Discrete Geometry
We review and classify problems in discrete geometry that depend only on the order-type or configuration of a set of points, and that can be characterized by a family of forbidden configurations. These include the happy ending problem, no-three-in-line problem, and orchard-planting problem from classical discrete geometry, as well as Harborthâ€™s conjecture on integer edge lengths and the construction of universal point sets in graph drawing. We investigate which of these properties have characterizations involving a finite number of forbidden subconfigurations, and the implications of these characterizations for the computational complexity of these problems.

Erin Chambers, Department of Computer Science, Saint Louis University

Burning the Medial Axis

Initially proposed by Blum in 1967, the medial axis of a shape consists of the union of all centers of maximally inscribed balls. The medial axis is one of the most commonly used tools for understanding shape, as it is homotopy equivalent to the original object, has codimension one, and is centrally located. In addition, it is used as a component in building skeletons that are of smaller dimension than the original object, but which capture the shape in a more compact but still useful representation. However, the medial axis is unstable to perturbations; even small changes in the boundary of the shape result in large changes in the medial axis.

Methods for pruning the medial axis are usually guided by some measure of significance, with considerable work done for both 2 and 3 dimensional shapes. However, the majority of significance measures over the medial axis are locally defined and hence unable to capture more global features, or are difficult to compute and sensitive to perturbations on the boundary. In general, there are no skeletons which provably capture the correct topology, are central to the object, are always result in a curve skeleton for a 3-dimensional input.

In this talk, I will present recent work done in 2d and 3d to compute new significance measures on the medial axis. In 2d, the extended distance function (EDF), also called the burn time, was recently developed by Liu et al., as well as related measures such as erosion thickness and weighted EDF. The EDF function was later generalized to the burn time function for 3 dimensional shapes, yielding both a mathematical framework for quantifying shape as well as an algorithm for approximating this function for a union of balls, which are commonly used for surface reconstruction and approximation. In 3d, this also allows us to develop a definition of topologically accurate 1-dimensional skeletons. These measures give practical methods for differentiating boundary noise from primary features, and can be used for shape alignment and recognition. In addition, there is both practical and theoretical evidence that these measures are robust under certain types of noise in the boundary, unlike the medial axis itself.

Stefan Langerman, DÃ©partement d'Informatique, UniversitÃ© Libre de Bruxelles

Tilers, Tilemakers, Transformers!

A tiling is a covering of the plane with copies of a geometric shape (tiles) without gaps or overlaps. A tiler is a shape that tiles the plane. An unfolding is obtained by cutting along the surface of a polyhedron through all its vertices, and opening all the dihedral angles between adjacent faces to obtain a single flat nonoverlapping geometric shape. A dissection is a decomposition of a shape into pieces that, can be rearranged to form another shape. In this hands-on talk, I will explore connections between these fascinating concepts, in an attempt to shed some light on several still unsolved algorithmic problems, among them: How easy (or hard) is it to determine if a given geometric shape can tile the plane?

Links:
https://www.youtube.com/playlist?list=PL7Q1MpbNe0pnan3gYPHK_-GEdpnvpRUfi

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