

Advances in Combinatorial and Geometric Rigidity

July 12-17, 2015

MEALS

*Breakfast (Buffet): 7:00–9:30 am, Sally Borden Building, Monday–Friday

*Lunch (Buffet): 11:30 am–1:30 pm, Sally Borden Building, Monday–Friday

*Dinner (Buffet): 5:30–7:30 pm, Sally Borden Building, Sunday–Thursday

Coffee Breaks: As per daily schedule, in the foyer of the TransCanada Pipeline Pavilion (TCPL)

***Please remember to scan your meal card at the host/hostess station in the dining room for each meal.**

MEETING ROOMS

All lectures will be held in the lecture theater in the TransCanada Pipelines Pavilion (TCPL). An LCD projector, a laptop, a document camera, and blackboards are available for presentations.

TECHNICAL, FILE SHARING and other FACILITIES

There is an LCD projector in the meeting room that you can use to connect your own computer to, or you can use the Macbook that BIRS provides.

This way, you can browse a website while the audience watches.

More information about our facilities is available here:

<http://www.birs.ca/facilities/description-of-facilities>

<http://www.birs.ca/organizers/publishing-slides>

The only other mechanism for sharing content that provided by BIRS is the workshop mail list, at 15w5114@lists.birs.ca. Participants could share links by sending email to that address.

SCHEDULE

Note: This is a TENTATIVE schedule. Expect schedule changes. Talks may be added/removed/ requested to be shorter to give more space between talks

Sunday

16:00 Check-in begins (Front Desk - Professional Development Centre - open 24 hours)

17:30–19:30 Buffet Dinner, Sally Borden Building

20:00 Informal gathering in 2nd floor lounge, Corbett Hall (if desired)

Beverages and a small assortment of snacks are available on a cash honor system.

Monday

7:00–8:40 Breakfast

8:45–9:00 Introduction and Welcome by BIRS Station Manager, TCPL

9:00 9:00 - 10: 15: 5 minute talks by participants

10:15 - 10:45 COFFEE BREAK

10:45 - 11:30 5 minute talks continue

11:30–13:00 Lunch

13:00 13:00-14:30: 5 minute talks continue

14:30-15:00: COFFEE BREAK

15:00-16:00: 5 minute talks continue

16:00-16:15: SHORT BREAK

16:15-17:30: Handbooks Discussion

17:30–19:30 Dinner

Open Problem Session (if desired)

Tuesday

7:00–9:00

Breakfast

9:00

9:00-9:40: W. Lam: Isothermic Triangulated Surfaces OR Discrete Minimal Surfaces
9:40-10:00: O. Karpenkov: Finite and infinitesimal flexibility of semidiscrete surfaces
10:00-10:45: COFFEE BREAK
10:45-11:30: B. Schulze: Rigidity of frameworks on spheres with variable radii

11:30–13:00

Lunch

13:00

13:00-13:40: S. Power: The generic rigidity of a partial triangulated Torus
13:40-14:05: J. Cruickshank: Inductive arguments for certain classes of three dimensional bar-joint frameworks
14:05-14:30: M. Sitharam: Recent developments in 3D bar-joint rigidity characterization
14:30-15:00: COFFEE BREAK
15:00-15:40: D. Kitson: Non-euclidean Rigidity and grid-like Reflection frameworks
15:40-16:00: J. Willoughby: Flattenability in non-Euclidean norms
16:00-17:30: OPEN PROBLEM BREAKOUT organization and SESSIONS

17:30–19:30

Dinner

Continue Breakout Sessions (if desired)

Wednesday

7:00–9:00

Breakfast

9:00

9:00 - 9:40: B. Chen: "Topologically 'polarized' periodic frameworks and applications to toys and origami"
9:40 - 10:00: P. Fowler: Symmetry Analysis of Some Perforated Polyhedra
10:00-10:45: COFFEE BREAK
10:45-11:10: S. Tanigawa: Sparsity count on group-labeled graphs for characterizing the infinitesimal rigidity of symmetric frameworks.
11:10-11:30: GROUP PHOTO: Meet in Foyer of TCPL

11:30–13:30

Lunch

Guided Tour of The Banff Centre; meet in the 2nd floor lounge, Corbett Hall

Free Afternoon

17:30–19:30

Dinner

Breakout sessions (if desired)

Thursday

7:00–9:00

Breakfast

9:00

9:00-9:40: A. McRobie & T. Mitchell: "Reciprocal Diagrams, Graphic Statics, Airy Stress Functions and Polyhedra"

9:40-10:20: B. Jackson: Rigidity and Fixed Slope Rigidity of point-line frameworks and relation to Scene analysis

10:20 - 11:00 COFFEE BREAK

11 - 11:30: W. Whiteley: Rigidity under Other metrics

11:30–13:00

Lunch

13:00

13:00-13:20: L. Theran: Low rank completion of matrices from a rigidity perspective.

iii

13:20-13:40: T. Jordán: Unique Low Rank Completability of partial matrices

13:40 - 14:10: S. Gortler: A simple characterization of when a complete Bipartite Framework is Universally Rigid OR Second order rigidity, Pre-stress stability and when do polygonal holes not destroy rigidity of a polytope?

14:10-14:30: S. Guest: Design and Construction of a new tensegrity sculpture

14:30-15:00: COFFEE BREAK

15:00 - 17:00: OPEN PROBLEM BREAKOUT sessions

17:00 -17:30: Report progress if any on open problems.

17:30–19:30

Dinner

Break out sessions (if desired)

Friday

7:00–9:00

Breakfast

9:00

9:00-9:45: M. Hempel: "Another Attack on Flexibility"

9:45 - 10:15: REPORT on Open Problems Progress

10:15-10:45: COFFEE BREAK

10:45-11:30: Continue Report on Open Problems Progress

11:30–13:00

Lunch

Checkout by

12 noon.

** 5-day workshop participants are welcome to use BIRS facilities (BIRS Coffee Lounge, TCPL and Reading Room) until 3 pm on Friday, although participants are still required to checkout of the guest rooms by 12 noon. **

Advances in Geometric and Combinatorial Rigidity

July 12-17, 2015

Banff 5-day Rigidity workshop 2015: talk titles (In alphabetical order of speaker surname)

=====

NOTE 1: there will be 5 min talks by ALL participants on the first day. They are not listed here. The authors of the talks listed here could choose to give 5 min talks on other topics.

NOTE 2: We started with the list of talks that were submitted by participants in response to a call by the organizers. First, some of the talks on global/universal rigidity were set aside for the subsequent 2-day workshop. Those are not listed here. All other submissions appear below.

NOTE 3:
Not all talks in the list below
could be accomodated into the schedule as 20-45 min talks.

T. BAKER (University of Florida, USA)

Title:
Canonical Decomposition for independent graphs in abstract rigidity sparsity matroids and application to materials modeling

Appears on the arXiv.

Joint work with Sitharam, Wang,
Willoughby.

B. CHEN (Leiden, Germany)

"Topologically 'polarized' periodic frameworks and applications to toys and origami"

The goal of the talk will be to introduce a topological invariant (due to Kane and Lubensky) inspired by recent ideas in condensed matter physics that is associated to the rigid unit mode spectrum of periodic frameworks.

I will bring some toys like the ones depicted in these youtube clips and explain how the properties of their mechanism follow from the

above:

https://www.youtube.com/watch?v=_CmB2akd1i0

https://www.youtube.com/watch?v=m7_Ig9MOVpQ

J. CRUICKSHANK (Galway, Ireland)

Title: "Inductive arguments for certain classes of three dimensional bar joint frameworks"

Abstract: "I will discuss some recent work with Steve Power and Derek Kitson on so-called block and hole graphs. This class of graphs (introduced by Finbow-Singh, Whiteley and Ross) are derived from triangulations of a sphere by introducing some isostatic blocks and some holes. We have applied vertex splitting arguments to generalise some of their results to the case of one block and many holes. For two or more blocks, it seems that vertex splitting will not suffice, so I will discuss a possible application of some recent work on Henneberg moves to this problem."

P. FOWLER (Sheffield, UK)

I would like to give a talk with the title

Symmetry Analysis of Some Perforated Polyhedra

which describes joint work with Simon Guest and Bernd Schulze

Key words/topics would be symmetry and rigidity.

S. GORTLER (and B. CONNELLY) (Harvard, Cornell, USA)

A simple characterization of when a complete bipartite framework is universally rigid.

OR

The equivalence of second order rigidity and prestress stability when the dimension is not constrained. This leads to a proof that triangulated convex polytopes are not just second order rigid in R^3 but also prestress stable in R^3 . It also leads to an understanding of when a set of polygonal holes can be removed from the faces of the polytope without destroying rigidity.

S. GUEST (Cambridge, UK)

'Design and construction of a new tensegrity sculpture'

M. HEMPEL (ETH Zurich, Switzerland)

I would like to talk about "Another Attack on Flexibility&Co.", this would be a one hour talk, and key words are Flexible Polyhedra, Moduli-Space, Parametrization by Angles, Realization Problems.

B. JACKSON (and K. CLINCH) (Queen Mary's, UK)

Here are some suggestions

Rigidity of point line frameworks - 50 mins survey type talk

Fixed slope rigidity of point line frameworks with parallel lines - 20 mins open problem with relation to scene analysis

T. JORDAN (Eotvos, Hungary)

Unique Low Rank Completability of Partially Filled Matrices.

Roughly speaking, we look at what happens if we replace fixed distances between pairs of points in a framework by fixed scalar products. We consider the concepts corresponding to local and global rigidity and the rigidity matroid in this scalar product version. The motivation comes from the PSD matrix completion problem.

Joint work with B. Jackson and S. Tanigawa. The length of the talk could be between 30 and 60 mins.

O. KARPENKOV (Liverpool, UK)

"Finite and infinitesimal flexibility of semidiscrete surfaces"

Abstract: In this talk we will discuss infinitesimal and finite flexibility for generic semidiscrete surfaces. These surfaces are combined of smooth ribbons, they are in some sense limit shapes of quadrilateral graphs. It turns out that a generic 2-ribbon semidiscrete surface has one degree of infinitesimal and finite flexibility, which leads to construction of funny flexible mechanisms. For general n-ribbon surfaces this is not the case. In particular we show a necessary condition

for infinitesimal flexibility of a 3-ribbon surface.

D. KITSON (Lancaster, UK)

Title: Rigidity for grid-like reflection frameworks.

Abstract: The allowable motions of a framework in a normed linear space are those continuous motions of the vertices which preserve distances between all pairs of adjacent vertices. In this talk we will begin with a survey of rigidity theory for frameworks in general normed spaces. We will then consider the special case of two-dimensional frameworks and norms for which the unit ball is a quadrilateral. The motions of such frameworks are grid-like in the sense that vertices which are adjacent to any pinned vertex are constrained to move along the boundary of a quadrilateral. We will present some new characterisations of rigidity, obtained with Bernd Schulze, for grid-like frameworks with reflectional symmetry.

Keywords: Non-Euclidean rigidity, symmetric frameworks

W. LAM (TU Berlin, Germany)

Isothermic triangulated surfaces ~40 min
-triangulated surfaces In Euclidean space with some special self-stress, a notion of conformal deformations which includes rigid deformations.

2. Discrete minimal surfaces ~40 min
-reciprocal parallel meshes, discrete complex analysis

A. McROBIE (Cambridge, UK) and T. Mitchell (Skidmore Owings and Merrill LLP, North America)

"Reciprocal Diagrams, Graphic Statics, Airy Stress Functions and Polyhedra"

E. ROSS (MESH Consultants, Inc, North America)

Title: Exact face-offsetting for polygonal meshes

Discrete Geometry talk. I make a connection to rigidity theory via some work of Alexandrov.

Keywords: triangle mesh, offsetting, face-offsetting, architecture, dual graph

S. POWER (Lancaster, UK)

"The generic rigidity of a partially triangulated torus."

I am hoping to put a preprint (with Kitson and Cruickshank) on the archive, shortly before the workshop, which has the same title.

The main theorem concerns the class of simple graphs which are obtained from a triangulated torus by the removal of edges to create a "single hole" (porthole) on the surface. We show that minimal rigidity in 3D is equivalent to (3,6)-tightness. The Maxwell count holds if the hole boundary has length 9ℓ and it is easily seen that this condition alone is insufficient.

The proof is quite a long reduction argument using edge contraction where permissible and various "fission moves" within the class.

The theorem is part of a wider project on the rigidity of "surface graphs", where facial structure and the global topology may play a role in reduction schemes.

B. SCHULZE (Lancaster, UK)

"Rigidity of frameworks on spheres with variable radii"

which is joint work with Tony, Shin-ichi and Walter.

M. SITHARAM (University of Florida, USA)

here is a possible 20 or 30 minute talk title.

Graded Exchange Algorithm yields closure of an abstract rigidity matroid: properties and a rank bound.

Abstract: Some recent developments in inductive constructions and combinatorial characterization towards 3D bar-joint rigidity, and significance of the number 9.

Joint work with Cheng and Vince

S. TANIGAWA (Kyoto, Japan)

title: Sparsity count on the group-labeled graphs for characterizing the infinitesimal rigidity of symmetric frameworks.

topic: extension of count matroids and combinatorial characterizations
of symmetric frameworks

key words: sparsity count, count matroids, group-labeled graphs,
bar-joint frameworks with symmetry, Laman's theorem

L. Theran (Aalto, Finland)

Title: Low rank completion of matrices from a rigidity perspective.

M. WANG (University of Florida, USA)

The title of my talk is:

Combinatorial characterization of rigidity of generalized pinned
subspace
incidence frameworks and application to machine learning

The content of the talk is joint work with Meera Sitharam and Mohamad
Tarifi.

Posted on ArXiv

W. WHITELEY (York University, Canada)

Rigidity and changes of metric.

Pairs of 'rigidity equivalent' symmetries (using
invariance of rigidity under selective inversion of joints in spherical geometry,
and projection); (sphere/plane slide joints as images of
points on the equator); on Plane-Minkowski transfers for DL frameworks; .

There are some conjectures for work that I could put into such a talk.

J. WILLOUGHBY (University of Florida, USA)

Title: On flattenability of graphs in L_p
Topic: We give a few results regarding the ℓ_p -flattenability of graphs under
different ℓ_p norms in relation to a few other topics including Cayley Configuration
spaces and Independence
Link: <http://arxiv.org/pdf/1503.01489.pdf>