Josh Thompson's research

I am interested in geometry and topology and their applications to data analysis, computer vision, and machine learning. I also enjoy mentoring undergraduate research projects in these areas. Below are links to some of my work, software, and resources for students interested in pursuing research in these areas.

geometry, topology and their applications

- schottky groups
  - visualizations (python)
- computational differential geometry
  - hyperbolic geometry (desmos)
  - frenet frames on helix w/code here (python)
  - parallel transport on a torus w/code here (python)
  - more parallel transport along a (1,2)-curve on torus (python)
- moduli spaces of geometric structures on surfaces
  - visualizations (python, open3D)
- geometric and topological data analysis
- having fun w/geometry & data (python & plotly and empet
- the cat map on the torus
- math education
  - what if ax=b meant ax=me?(prezi)
- visualizing topology (matlab)
- algorithms on manifolds
- anomaly detection algorithms

reading list

- masters thesis ideas pdf html
- office hours w/a geometric group theorist (chapter 1) pdf
- introduction to geometric group theory pdf
- data & cartan's moving frames

undergraduate research

- fun with fourier (slides via quarto & r)

master's thesis i've advised

- visualizing geometric structures on topological surfaces
- quandles that are knot quandles
- plumbing the depths of the shallow end: exploring persistent homology using small data

software and algorithms

- r for matlab users
- tda in r
- matrix algebra in r
- mass - modern applied statistics in s

papers and preprints

- Pseudo Isometric Surgery with Matt Clay, in Topology Proceedings

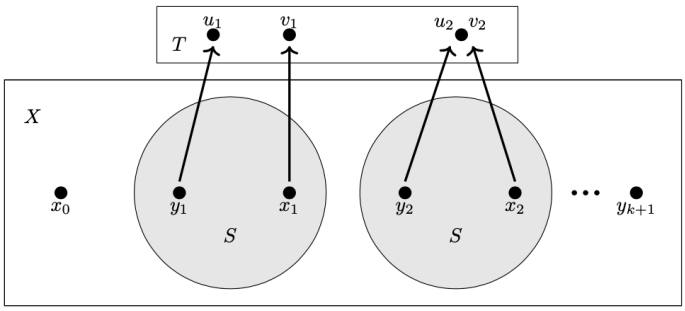
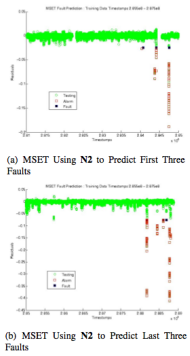


FIGURE 3. An admissible sequence

Figure 1: admissible sequence

- Collapsing Maps & Quasi-Isometries with undergraduate Davin Hemmila
- **Computing Geographic Distances** with undergraduate Chase Ashby. Mathematical Spectrum Vol. 48, No. 3, April 2016
- **iMath: Digital Images Modeled with Matrices** International Research in Education Vol. 3 No. 1, March 2015.
- **Evaluating Several Different Web Prediction Algorithms** Proc. of the ISCA 29th Int. Conf. on Computers and Their Applications, CATA 2014.
- **Identity Maps and their extensions on Parameter Spaces: Applications to anomaly detection in video**, with K. Wang, M. Kirby and C. Peterson. *Proceedings of the Science and Information Conference (SAI), pp 345-351, 2015 DOI: 10.1109/SAI.2015.7237167*
- **Accurate Fault Prediction of BlueGeneP RAS Logs Via Geometric Reduction** .pdf *Proc. of IEEE/IFIP International Conference on DSN, 2010*



(a) MSET Using **N2** to Predict First Three Faults

(b) MSET Using **N2** to Predict Last Three Faults

Figure 2. Fault detection using a mapping of the identity on non-fault data

Figure 2: MSET on BlueGeneP Figure

- **Graftings of Complex Projective Structures with Schottky Holonomy** .pdf Geometriae Dedicata: Volume 166, Issue 1 (2013), Page 203-232

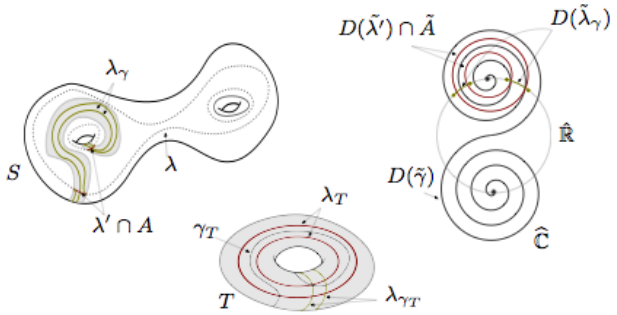


Fig. 7 Grafting S along a left-spiraling curve γ, the developed image and the Hopf torus.

Figure 3: Grafting Figure