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Curriculum Vitae
Eric Swenson

Department of Mathematics
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Education

Ph.D., Mathematics, Brigham Young University, April 1993, Advisor: J. Cannon.

B.S., Mathematics, Brigham Young University, December 1987.

Professional Experience

Associate professor, 2004-present, Brigham Young University

Research Scientist, Sept 2006–Feb 2007, Max Plank Institute Bonn

Assistant professor, 1997–2004, Brigham Young University

Visiting assistant professor, 1993–1994, Michigan Tech. University

Visiting professor, 1996, University of Wisconsin, Milwaukee

Visiting research fellow, 1995–1996, University of Southampton

Temporary faculty, 1994–1995, Brigham Young University

Grants

National Science Foundation, "Group boundaries and the torus theorem," Grant No. 9803461, 1998.

Simons Foundation Collaboration Grants for Mathematicians, "Group Boundary Dynamics," Grant No. 209403, 2011.

Department and University Service

Department Hiring Committee

Department Curriculum Committee

Department Linear algebra Committee.

Professional Service

Refereed for NSF Grant proposals

Refereed for Tenure and Promotions

Refereed for Crelles

Refereed for Illinois Journal of Mathematics (2)

Refereed for Transactions of the AMS(3)

Refereed for Geometriae Dedicata (2)

Refereed for Topology and its Applications

Refereed for Michigan Mathematical Journal

Refereed for Rocky Mountain Journal of Mathematics

Refereed for London Mathematical Society

Refereed for International Journal of Algebra and Computation

Refereed for Topology(2)

Refereed for Groups, Geometry and Dynamics(3)

Refereed for Differential Geometry and its Applications

Conference and Workshop Participation

Co-organized (with E. Freden) Special session in Geometric Group Theory at the 1999 and 2001 spring and 2011 fall western section meetings.

Organizer of Western Workshop in Geometric Topology 2010–Present.

Graduate Students Supervised

Rachel Wood, masters thesis, 2002

Russel Ricks masters thesis, 2011

Scholarly Presentations

1. "Splittings of groups: Inside and Out," Plenary address, 46th Spring Topology & Dynamics Conference, Mexico City, March 2012.

2. A "Transcersal" for minimal invariant sets in the boundary of a CAT(0) group 3-manifolds, Artin Groups and cubical Geometry, NYC, August 2011.

3. A "Transcersal" for minimal invariant sets in the boundary of a CAT(0) group, Geometric Group Theory, Hiafa, May 2011.

4. Ultrafilters and Group actions, Geometric Group Theory, Beḑlewo, "Boundaries and analysis" June 28–July 3, 2010.

5. The Cactus Tree for a Continuum, OU Topology Seminar, April 2010. Splitting Theorems and the JSJ: A survey, OU Colloquium, April 2010.

6. π-convergence and rank Rigidity in CAT(0) spaces, Invited address, Workshop on non-positive curvature and the elementary theory of free, Anogia Crete, June 2008.

   pdf file at http://myria.math.aegean.gr/conferences/groups08/schedule.htm

7. Splitting Theorems and the JSJ: A survey, Invited address, Workshop on non-positive curvature and the elementary theory of free Anogia Crete, June 2008.

   pdf file at http://myria.math.aegean.gr/conferences/groups08/schedule.htm

8. On Ballmann's conjecture, Max Dehn Seminar, University of Utah, October 2007.

9. On Ballmann's conjecture for CAT(0) groups, C.I.R.M. January 2007.

10. Comparing negative and non-positive curvature in group theory, Topology Seminar, Haifa November 2006.

11. Cut points in CAT(0) boundaries, Memorial Conference, Reznikov MPI, September 2006.

12. Boundary cut points and word hyperbolicity, Invited presentation, American Institute of Mathematics Workshop, April 2005. Beamer file available from website www.aimath.org.

13. A backward counterexample in convergence groups "Geometric and Analytic Methods in 3-D Topology" Oberwolfach. May 2003.

14. A backward counterexample in convergence groups, Topology Seminar, Orsay May 2003.

15. Convergence groups from subgroups, Max Dehn Seminar, University of Utah, November 2002.

16. A backward counterexample in convergence groups, Spring Topology Conference, Lubbock, TX, 2003.

17. Immersed surfaces and word hyperbolicity in 3-manifolds, Topology Seminar, UCSB, November 2001.

18. Immersed surfaces and word hyperbolicity in 3-manifolds, CRM Workshop on Geometric Group Theory, July 9–13, 2001.

19. Axial pairs and convergence groups, University of Oklahoma Topology Seminar, April 2001.

20. A word hyperbolic free-by-cyclic group containing a surface subgroup, Max Dehn Seminar, University of Utah, February 2001.

21. Torsion in CAT(0) Groups, Inter. Conf. on Geometric and Combinatorial Group Theory, Technion, June 2000.

22. Torsion subgroups of CAT(0) groups, ICGS2000 Lincoln Nebraska May 2000.

23. CAT(0) groups and boundary cut points, Cal. Tech. Topology Seminar, October 1999.

24. Hyperbolic elements and CAT(0) groups, Warwick Symposium on Computation in Group Theory and Geometry, 1999.

25. Axial pairs and convergence groups on S^1, 1999Spring Topology Conference, 1999.

26. CAT(0) boundary cut points, inter Wasatch Topology Conference, 1998.

27. Semistability and boundary cut points, CGAMA, 1998.

28. The algebraic torus theorem, Summer Wasatch Topology Conference, 1997.

29. The algebraic annulus theorem, Max Dehn Seminar, University of Utah, 1997.

30. The algebraic annulus theorem, Albany Group Theory Conference, 1996.

31. Geometric groups of isometries of negatively curved spaces, Topology Seminar, University of Warwick UK, December 1995.

32. Limit sets of negatively curved groups, Orlando AMS meeting, 1995.

33. Torsion elements in negatively curved groups, Principal speaker, Wasatch Topology Conference, 1994.

34. An infinite dimensional negatively curved boundary, Geometric Topology workshop, Park City, Utah, 1994.

35. Boundary dimension in negatively curved spaces, 1994 Lexington AMS meeting.

36. Hyperbolic elements of negatively curved groups, Albany Group Theory Conference, 1993.

Publications (all refereed)

1. Swenson, Eric *On cyclic CAT(0) domains of discontinuity.* Groups Geom. Dyn. **7** (2013), no. 3, 737-750, to appear.

   Abstract: Let X be a CAT(0) space, and G a discrete cyclic group of isometries of X. We investigate the domain of discontinuity for the action of G on the boundary ∂X.

2. Guralnik, Dan P.; Swenson, Eric L. *A 'transversal' for minimal invariant sets in the boundary of a CAT(0) group.* Trans. Amer. Math. Soc. **365** (2013), no. 6, 3069-3095.

   Abstract: We introduce new techniques for studying boundary dynamics of CAT(0) groups. For a group G acting geometrically on a CAT(0) space X we show there is a flat $F \subset X$ of maximal dimension (denote it by d), whose boundary sphere intersects every minimal G-invariant subset of ∂X. As applications we obtain an improved dimension-dependent bound on the Tits-diameter of ∂X for non-rank-one groups, a necessary and sufficient dynamical condition for G to be virtually-Abelian, and we formulate a new approach to Ballmann's rank rigidity conjectures.

3. Papasoglu, Panos; Swenson, Eric, *The cactus tree of a metric space.* Algebr. Geom. Topol. **11** (2011), no. 5, 2547-2578.

   Abstract: We extend the cactus theorem of Dinitz, Karzanov, Lomonosov to metric spaces. In particular we show that if X is a separable continuum which is not separated by $n-1$ points, then the set of all n-tuples of points separating X can be encoded by an R-tree.

4. Papasoglu, Panos; Swenson, Eric, *Boundaries and JSJ decompositions of CAT(0)-groups.* Geom. Funct. Anal. **19** (2009), no. 2, 559–590.

   Abstract: Let G be a one-ended group acting discretely and co-compactly on a CAT(0) space X. We show that ∂X has no cut points and that one can detect splittings of G over two-ended groups and recover its JSJ decomposition from ∂X. We show that any discrete action of a group G on a CAT(0) space X satisfies a convergence type property. This is used in the proof of the results above but it is also of independent interest. In particular, if G acts co-compactly on X, then one obtains as a Corollary that if the Tits diameter of ∂X is bigger than $\frac{3\pi}{2}$, then it is infinite and G contains a free subgroup of rank 2.

5. Papasoglu, Panos; Swenson, Eric, *From continua to R-trees.* Algebr. Geom. Topol. **6** (2006), 1759–1784 (electronic).

   Abstract: We show how to associate an R-tree to the set of cut points of a continuum. If X is a continuum without cut points we show how to associate an R-tree to the set of cut pairs of X.

6. Swenson, Eric L., *Bootstrapping in convergence groups.* Algebr. Geom. Topol. **5** (2005), 751–768 (electronic).

   We give an example of a Kleinian group G which is the amalgamation of two closed hyperbolic surface groups along a simple closed curve. The limit set G is the closure of a "tree of circles" (adjacent circles meeting in pairs of points). We alter the action of G on its limit set such that G no longer acts as a convergence group, but the stabilizers of the circles remain unchanged, as does the action of a circle stabilize on said circle. This is done by first separating the circles and then gluing them together backwards.

   We then show that in some sense, this is the only obstruction to bootstrapping: Let X be Peano continua without cut points which doesn't admit and essential map to the circle. If G acts on X by homeomorphism and A is a G-invariant collection of connected closed subsets of X, then G acts as a convergence group on X provided the following conditions are satisfied:

   (1) The collection $\mathcal{A}$ is null, that is for any $\epsilon > 0$, the set of elements of $\mathcal{A}$ with diameter at least ϵ, $\{A \in \mathcal{A} : \text{diam}(A) > \epsilon\}$, is finite.

   (2) $\mathcal{A}$ is fine, that is for any x, $y \in X$ there exists a finite $\mathcal{B} \subset \mathcal{A}$ such that $\cup\mathcal{B}$ separates x from y.

   (3) The stabilizer $\text{Stab}(A)$ acts as a convergence group on A for each $A \in \mathcal{A}$.

7. Swenson, Eric L., *Convergence groups from subgroups.* Geom. Topol. **6** (2002), 649-655 (electronic).

   Abstract: We give sufficient conditions for a groups of homeomorphisms of a Peano continuum X without cut-points to be a convergence group. The conditions are that there is a collection of convergence subgroups, whose limit sets "cut up" X in a sufficiently fine fashion.

8. Swenson, Eric L., *Quasi-convex groups of isometries of negatively curved spaces.* Geometric topology and geometric group theory (Milwaukee, WI, 1997). Topology Appl. **110** (2001), no. 1, 119–129.

   Abstract: We show that for any group G of isometries of a negatively curved (Gromov hyperbolic) metric space X, if every limit point of G is conical (or even horospherical) then for any $x \in X$, Gx is a quasi-convex set and G is a negatively curved (word hyperbolic) group.

9. Swenson, Eric L., *A cut point tree for a continuum.* Computational and geometric aspects of modern algebra (Edinburgh, 1998), 254–265, London Math. Soc. Lecture Note Ser., **275**, Cambridge Univ. Press, Cambridge, 2000.

   Abstract: Given a Hausdor continuum X, and a set of cut points $C \subset X$, we construct a "tree" $T \supset C$ and a function from X to T which preserves separation by elements of C. This result greatly simplifies the proof of the cut point conjecture for word hyperbolic groups, and is indispensable in the proof of the cut point theorem for CAT(0) groups.

10. Dunwoody, M. J.; Swenson, E. L., *The algebraic torus theorem.* Invent. Math. **140** (2000), no. 3, 605–637.

    Abstract: Let G be a finitely generated group and Γ a locally finite Cayley graph of G. We say $H < G$ has codimension 1 if the quotient of Γ by H has more than one end. We prove the following theorem which solves a number of outstanding conjectures.

    Let G be a finitely generated group and let $J < G$ be a polycyclic-by-finite subgroup of G. If J has codimension one in G, then one of the following is true:

    i G splits over a polycyclic-by-finite subgroup.

ii G is polycyclic-by-finite.

iii G is an extension of a virtually polycyclic-by-finite group by a cocompact Fuchsian group, a group which acts cocompactly and properly discontinuously by isometries on hyperbolic 2-space.

11. Swenson, E. L., *Axial pairs and convergence groups on S^1.* Topology **39** (2000), no. 2, 229–237.

    Abstract: We show that a group G of homeomorphisms of S^1 is a convergence group if it has a certain finiteness property of Fuchsian groups. This in turn implies that G acts properly discontinuously on hyperbolic 2-space by work of Casson, Jungreis, Gabai, and Tukia.

12. Swenson, Eric L. A cut point theorem for CAT(0) groups. J. Differential Geom. **53** (1999), no. 2, 327–358.

    Abstract: Let G be a group acting geometrically on a CAT(0) space X. We show that if ∂X has a cut point c, then the stabilizer of c contains an infinite torsion subgroup. In particular if X is 2-dimensional, X is a cube complex, or G is virtually torsion free then ∂X has no cut point. We also show that if a group H acts geometrically on a CAT(0) space, then H contains an element of infinite order.

13. Swenson, Eric L., *On Axiom H.* Michigan Math. J. **46** (1999), no. 1, 3–11.

    Abstract: We show that in fact not all points the Gromov boundary Z of a negatively curved (word hyperbolic) group G need satisfy Axiom H as was thought to be the case. We show however that almost all points of Z do satisfy Axiom H. Thus by work of Bestvina, for almost all $z \in Z$, either $H_q(Z, Z - \{z\})$ is uncountable or it is isomorphic to $H_q(Z)$, where the homology is Steenrod with coefficients in a countable field. We also show that if $H_q(Z, Z - \{z\})$ is countable for each $z \in Z$, then $H_q(Z, Z - \{z\}) \cong H_q(Z)$ for each $z \in Z$.

14. Cannon, J. W.; Swenson, E. L., *Recognizing constant curvature discrete groups in dimension 3.* Trans. Amer. Math. Soc. **350** (1998), no. 2, 809–849.

    Abstract: We characterize those groups which can act discretely, isometrically and cocompactly on hyperbolic 3-space in terms of the combinatorics of the action of G on its space at infinity. The major ingredients of the proof are the properties of Negatively Curved groups, the combinatorial Riemann mapping theorem, and the Sullivan Tukia theorem on groups which act uniformly quasi-conformally on the 2-sphere.

15. Swenson, Eric L., *Boundary dimension in negatively curved spaces.* Geom. Dedicata **57** (1995), no. 3, 297–303.

    Abstract: Let X be a negatively curved space. In the first section we give conditions under which the boundary of X will be finite dimensional and we find a bound on this dimension. In particular if the isometry group of G acts cocompactly, then the boundary of X has infinite dimension.

16. Swenson, Eric L., *Hyperbolic elements in negatively curved groups.* Geom. Dedicata **55** (1995), no. 2, 199–210.

    Abstract: We show that for any Negatively Curved (Gromov hyperbolic) group G, and any locally finite Cayley Graph, Γ, of G there is a number N such that for any nontorsion $g \in G$, g^n acts by translation on a geodesic line in Γ for some $n \leq N$.