Timothy M. Hsu

Curriculum Vitae

Educational History

6/90	S.B., Mathematics, Mass. Inst. of Technology
9/90	S.B., Music, M.I.T.
11/94	Ph.D., Mathematics, Princeton Univ.

Professional Experience

9/94–6/95	Princeton Univ., Lecturer; organizer, Rutgers-Princeton group theory seminar
9/95–6/98	U. Mich. Ann Arbor, Hildebrandt Res. Asst. Prof.
7/96	MSRI Summer graduate workshop, Mentor
9/97–12/97	U. Mich., Co-coordinator, Math 115 (Calculus I)
9/98–6/01	Pomona College, Visiting Asst. Prof.
8/01–8/06	San José State Univ., Asst. Prof.
8/01–6/12	Director, Center for Applied Mathematics, Computation and Statistics (CAMCOS), SJSU
8/06–8/12	San José State Univ., Assoc. Prof.
8/07–12/07	Member, Mathematical Sciences Research Institute (MSRI) program in Geometric Group Theory
8/12–present	San José State Univ., Prof.
8/13–present	San José State Univ., Coordinator, Math/Stats TA program
8/15–present	San José State Univ., Assoc. Chair, Math/Stats

Awards

5/90	Phi Beta Kappa, M.I.T.
9/90–8/94	NSF Graduate Fellowship
6/96–8/96	Rackham Summer Faculty Fellowship, U. Mich.
9/97	Krasny Prize for outstanding work in motivating undergraduate students, Math Dept., U. Mich.
6/04	Master's student J. Kittock awarded 2004 University Outstanding Thesis Award (two awarded SJSU-wide)
6/08	Master's student K. Shelley Nolan awarded 2008 University Outstanding Thesis Award (two awarded SJSU-wide)
1/12	Intel Science Talent Search advisee C. Day named 2012 semifinalist

Grants Awarded at SJSU

Fall 2001	SJSU Professional Development award, $1,500 for travel
Spring 2002	CAMCOS awarded $43,500 from Woodward Fund, for two semester projects with NASA Ames Research Center

2002–2003	CAMCOS awarded approx. $62,000 from Woodward Fund, for two year-long projects with NASA Ames Research Center
Summer 2002	SJSU summer faculty fellowship, one month summer salary
Fall 2002	SJSU Professional Development award, $1,175 for travel
Spring 2003	LPP planning grant: $2,285 for .1 release time
2003–2004	CAMCOS awarded $61,510 from Woodward Fund, for two year-long projects with NASA Ames Research Center
Fall 2003	SJSU Professional Development award, $1,000 for travel
Fall 2003	LPP implementation grant: $5,000 for .2 release time
Fall 2003	CAMCOS awarded $18,000 from NASA (Macready) for semester project with NASA Ames Research Center
Summer 2004	CAMCOS awarded $4,000 from Woodward Fund, for development of potential CAMCOS project with Numerical Algorithms Group (UK)
2004–2005	CAMCOS awarded $61,510 from Woodward Fund, for two year-long projects with NASA Ames Research Center
Fall 2004	SJSU Professional Development award, $1,000 for travel
Fall 2004	Junior Faculty Career Devlopment Grant: .2 release time
Spring 2005	$2,000 donation from Google to support Bay Area Discrete Math Day conference held at SJSU, 4/9/05
2005–2006	CAMCOS awarded $63,190 from Woodward Fund, for two year-long projects
2005–2006	Sally Casanova Pre-Doctoral $3,000 Scholarship awarded to student Jing-Wei Huang; up to $1,000 goes to faculty sponsor (Hsu) travel expenses
Fall 2005	CAMCOS awarded $15,796 from NASA Ames Research Center for “Intelligent Instruments on Robotic Helicopters”
Spring 2006	CAMCOS awarded $19,330 from Intel Corporation for “Analysis of Heat Pipe Performance Tailored for MEROM/Santa Rosa in Mobile Computers”
2006–2007	CAMCOS awarded $62,600 from Woodward Fund, for two year-long projects with NASA Ames Research Center
2007–2008	CAMCOS awarded $62,600 from Woodward Fund, for two year-long projects with NASA Ames Research Center
2008–2009	CAMCOS awarded $62,000 from Woodward Fund, for two year-long projects with NASA Ames Research Center
2009–2010	CAMCOS awarded $36,500 from Woodward Fund, for one semester-long project with NASA Ames Research

	Center
Spring 2010	University Planning Council Student Success Grant: .2 release time
Spring 2010	(w/ Dr. Maria Cayco) $2,750 awarded from Mathematical Association of America to support Northern California Undergraduate Mathematics Conference
Fall 2010	CAMCOS awarded $13,000 from Woodward Fund, for one semester-long project with NASA Ames Research Center
Spring 2010	CAMCOS awarded $20,400 from Woodward Fund, for one semester-long project with NASA Ames Research Center
Fall 2011	CAMCOS awarded $20,400 from Woodward Fund, for one semester-long project with NASA Ames Research Center
Spring 2013	$2,000 donation from D.E. Shaw to support Bay Area Discrete Math Day conference held at SJSU, 4/6/13
Summer 2013	Undergraduate Research Grant awarded for work with Charles Petersen
Fall 2013	SJSU Research, Scholarship, & Creative Activity Award: .2 release time
Spring 2016–present	Senior personnel, "First in the World" grant for teaching flipped calculus I: .2 release time in multiple semesters

Conferences and Sessions Co-organized

Fall 2004–	Bay Area Discrete Math Day (bi-annual local conference)
Spring 2005	BAD Math Day at SJSU, local organizer
Summer 2005	MAXENT 2005 (25th International Workshop on Bayesian Inference and Maximum Entropy Methods in Science and Engineering)
Summer 2007	MAA Mathfest: Panel discussion on "Starting and maintaining a student industrial research progam in the mathematical sciences"
Summer 2007	MAA Mathfest: Contributed paper session on "Student Research in Industrial Mathematics"
Spring 2008	AMS Western Section Meeting: Special session on "Combinatorics of partially ordered sets"
Spring 2010	Northern California Undergraduate Mathematics Conference
Spring 2013	BAD Math Day at SJSU, local organizer

Recent Talks

03/07/12	SJSU Math Colloquium, "Square-gluing puzzles and the Gauss-Bonnet Theorem"
05/04/12	U. Michigan RTG Workshop on Recent Progress on Hyperbolic 3-Manifolds, Ann Arbor, MI: Mini-course

	lectures "Special Cube Complexes", "Finiteness conditions of the dual cube complex", "Cubulating Malnormal Amalgams"
05/29/13	Cube complexes and 3-manifolds conference, Univ. of Ill. at Chicago, Chicago, IL: "Computing the ℓ^2-homology of clean complexes"
04/29/14	Claremont Colleges Math Colloquium, Harvey Mudd Coll., Claremont, CA: "Cube Complexes, 3-manifolds, and the Virtual Haken Theorem"
Fall 2014	Combinatorics Seminar, SJSU, San José, CA: "Introduction to combinatorial game theory" (3-talk series)
10/28/14	Santa Clara Univ. Math Colloquium, Santa Clara Univ., Santa Clara, CA: "Cube complexes, 3-manifolds, and the virtually fibered theorem"
04/15/15	SJSU Math Colloquium, SJSU, San José, CA: "Cube complexes, 3-manifolds, and the Virtually Fibered Conjecture"
04/12/17	Cal Poly Pomona Math/Stats Colloquium, Cal Poly Pomona, Pomona, CA: "How I flip calculus"
04/13/17	CSULA Math Seminar, CSULA, Los Angeles, CA: "How I flip calculus"

Research Interests

Geometric group theory; combinatorics of partially ordered sets; ℓ^2 invariants; combinatorial game theory; finite groups and related topics; cell complexes and low-dimensional topology; loops and quasigroups; computational group theory; undergraduate mathematics education.

Professional Societies

Member of the AMS, MAA, and SIAM.

Computer Skills

Fluent in LaTeX and HTML. Prior experience with C, FORTRAN, GAP, Java, LISP, Maple, Mathematica, MATLAB, Perl, and UNIX. Some professional programming and technical support experience.

Contact Information

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Publications (by subject, in reverse chronological order, with selected abstracts)

Combinatorics of partially ordered sets

[1] (with C. Petersen) *Upset-downset*, In preparation, 2017.

[2] (with C. Day) *Blue-red CHOMP*, In preparation, 2017.

[3] (with M. J. Logan and S. Shahriari) *Methods for nesting rank 3 normalized matching rank-unimodal posets*, Disc. Math. **309** (2009), no. 3, 521–531.

Anderson and Griggs proved independently that a rank-symmetric-unimodal normalized matching (NM) poset possesses a nested chain decomposition (or *nesting*), and Griggs later conjectured that this result still holds if we remove the condition of rank-symmetry. We give several methods for constructing nestings of rank-unimodal NM posets of rank 3, which together produce substantial progress towards the rank 3 case of the Griggs nesting conjecture. In particular, we show that certain nearly symmetric posets are nested; we show that certain highly asymmetric rank 3 NM posets are nested; and we use results on minimal rank 1 NM posets to show that certain other rank 3 NM posets are nested.

[4] (with M. J. Logan and S. Shahriari) *The generalized Füredi conjecture holds for finite linear lattices*, Disc. Math. **306** (2006), 3140–3144.

We define an *Anderson-Griggs* poset to be a finite rank-unimodal, rank-symmetric, normalized matching poset P, and we say that P has *rapidly decreasing rank numbers* if below the largest ranks in the middle of P, the size of each level is at most half of the previous one. Generalizing a question of Füredi about the Boolean lattice, we conjecture that every Anderson-Griggs poset of width w has a partition into w chains such that the size of each chain is one of two consecutive integers. We prove the conjecture for all Anderson-Griggs posets with rank ≤ 3, and consequently obtain the conjecture for Anderson-Griggs posets with rapidly decreasing rank numbers. In particular, there exists a partition of the linear lattice $L_n(q)$ (subspaces of an n-dimensional vector space over a field of order q, ordered by inclusion) into chains such that the number of chains is the number of subspaces of dimension $\lfloor n/2 \rfloor$, and the size of each chain is one of two consecutive integers.

[5] (with M. J. Logan, S. Shahriari, and C. Towse) *Partitioning the Boolean lattice into a minimal number of chains of relatively uniform size*, Eur. J. Comb. **24** (2003), no. 2, 219–228.

Let $\mathbf{2}^{[n]}$ denote the *Boolean lattice* of order n, that is, the poset of subsets of $\{1, \ldots, n\}$ ordered by inclusion. Extending our previous work on a question of Füredi, we show that for any $c > 1$, there exist functions $e(n) \sim \sqrt{n}/2$ and $f(n) \sim c\sqrt{n \log n}$ and an integer N (depending only on c) such that for all $n > N$, there is a chain decomposition of the Boolean lattice $\mathbf{2}^{[n]}$ into $\binom{n}{\lfloor n/2 \rfloor}$ chains, all of which have size between $e(n)$ and $f(n)$. (A positive answer to Füredi's question would imply that the same result holds for some $e(n) \sim \sqrt{\pi/2}\sqrt{n}$ and $f(n) = e(n) + 1$.) The main tool used is a matching property of normalized matching posets that is not hard to prove, but does not seem to have been widely used before.

[6] (with M. J. Logan, S. Shahriari, and C. Towse) *Partitioning the Boolean lattice into chains of large minimum size*, J. Comb. Thy. (A) **97** (2002), no. 1, 62–84.

Let $\mathbf{2}^{[n]}$ denote the *Boolean lattice* of order n, that is, the poset of subsets of $\{1, \ldots, n\}$ ordered by inclusion. Recall that $\mathbf{2}^{[n]}$ may be partitioned into what we call the *canonical symmetric chain decomposition* (due to de Bruijn, Tengbergen, and Kruyswijk), or CSCD. Motivated by a question of Füredi, we show that there exists a function $d(n) \sim (1/2)\sqrt{n}$ such that for any $n \geq 0$, $\mathbf{2}^{[n]}$ may be partitioned into $\binom{n}{\lfloor n/2 \rfloor}$ chains of size at least $d(n)$. (For comparison, a positive answer to Füredi's question would imply that the same result holds for some $d(n) \sim \sqrt{\pi/2}\sqrt{n}$.) More precisely, we first show that for $0 \leq j \leq n$, the union of the lowest $j+1$ elements from each of the chains in the CSCD of $\mathbf{2}^{[n]}$ forms a poset $\mathbf{T}_j(n)$ with the normalized matching property and log-concave rank numbers. We then use our results on $\mathbf{T}_j(n)$ to show that the nodes in the CSCD chains of size less than $2d(n)$ may be repartitioned into chains of large minimum size, as desired.

Geometric group theory

[7] (with E. Berkove, S. Dharia, and R. McGuigan) *The ℓ^2-cohomology of clean complexes*, preprint, 2016.

[8] (with D. T. Wise) *Cubulating malnormal amalgams*, Invent. Math. **199** (2015), no. 2, 293–331.

[9] (with I. J. Leary) *Artin HNN-extensions virtually embed in Artin groups*, Bull. Lon. Math. Soc. **40** (2008), no. 4, 715–719.

[10] (with D. T. Wise) *Cubulating graphs of free groups with cyclic edge groups*, Amer. J. Math. **132** (2010), no. 5, 1153–1188.

[11] (with D. T. Wise) *Groups with infinitely many types of fixed subgroups*, Israel J. Math. **144** (2004), 93–107.

[12] (with D. T. Wise) *Ascending HNN extensions of polycyclic groups are residually finite*, J. Pure Appl. Alg. **182** (2003), no. 1, 65–78.

[13] (with D. T. Wise) *Separating quasiconvex subgroups of right-angled Artin groups*, Math. Z. **240** (2002), no. 3, 521–548.

[14] (with D. T. Wise) *On linear and residual properties of graph products*, Mich. Math. J. **46** (1999), 251–259.

[15] (with D. T. Wise) *A non-residually finite square of finite groups*, in C. M. Campbell et al. (eds.), *Groups St. Andrews 1997 in Bath, I*, volume 260 of *LMS Lect. Notes*, 368–378. Cambridge Univ. Press, 1999.

[16] (with D. T. Wise) *Embedding theorems for non-positively curved polygons of finite groups*, J. Pure Appl. Alg. **123** (1998), 201–221.

Expository articles

[17] *Rational nonaxis points on the unit circle have irrational angles*, Amer. Math. Monthly **123** (2016), no. 5, 490.

[18] (with J. H. Conway) *Some very interesting sequences*, in T. Shubin, D. F. Hayes, and G. Alexanderson (eds.), *Expeditions in Mathematics*, MAA Spectrum series, chapter 6, 75–86. MAA, Washington, DC, 2011.

Moufang loops

[19] *Explicit constructions of code loops as centrally twisted products*, Math. Proc. Camb. Phil. Soc. **128** (2000), 223–232.

[20] *Moufang loops of class 2 and cubic forms*, Math. Proc. Camb. Phil. Soc. **128** (2000), 197–222.

Coset representations of modular subgroups

[21] *Permutation techniques for coset representations of modular subgroups*, in L. Schneps (ed.), *Geometric Galois Actions II: Dessins d'Enfants, Mapping Class Groups and Moduli*, volume 243 of *LMS Lect. Notes*, 67–77. Cambridge Univ. Press, 1997.

[22] *Identifying congruence subgroups of the modular group*, Proc. AMS **124** (1996), no. 5, 1351–1359.

Quilts

[23] *Quilts: Central extensions, braid actions, and finite groups*, volume 1731 of *Lect. Notes Math.*, Springer-Verlag, 2000.

[24] *Quilts, the 3-string braid group, and braid actions on finite groups: an introduction*, in J. Ferrar and K. Harada (eds.), *The Monster and Lie Algebras*, volume 7 of *Ohio State Univ. Math. Res. Inst. Pubs.*, 85–97. de Gruyter, 1998.

[25] *Some quilts for the Mathieu groups*, in C. Dong and G. Mason (eds.), *Moonshine, the Monster, and Related Topics*, volume 193 of *Contemp. Math.*, 113–122. AMS, 1996.

[26] *Quilts, T-systems, and the combinatorics of Fuchsian groups*, PhD thesis, Princeton Univ., 1994.

[27] (with J. H. Conway) *Quilts and T-systems*, J. Alg. **174** (1995), 856–908.