

Curriculum Vita – Victor Samuel (Sam) Nelson

I. BIOGRAPHICAL DATA

Education

Ph.D.	Mathematics	Louisiana State University, August 2002 Advisor: R.A. Litherland Dissertation: <i>Racks, Quandles and Virtual Knots</i>
M.S.	Mathematics	Louisiana State University, June 1998
B.S.	Mathematics (with Honors) Philosophy minor	University of Wyoming, June 1996

Postdoctoral Experience

2012-Present	Associate Professor (with Tenure), Claremont McKenna College
2009-Present	Extended Graduate Faculty, Claremont Graduate University
2009-2012	Assistant Professor, Claremont McKenna College
2008-2009	Visiting Assistant Professor, Claremont McKenna College
2007-2008	Visiting Assistant Professor, Pomona College
2006-2007	Visiting Assistant Professor, Whittier College
2003-2006	Visiting Assistant Professor, University of California, Riverside
2002-2003	Visiting Assistant Professor, Whittier College

II. RESEARCH

Publications¹

1. Quantum enhancements of involutory birack counting invariants. (with Veronica Rivera[†] (HMC)) *J. Knot Theory Ramifications* **23** (2014) 1460006, 15 pp.
2. Augmented biracks and their homology (with Jose Cenicer[‡] (LSU), Mohamed Elhamdadi (USF) and Matthew Green[†] (USF)). *Internat. J. Math.* **25** (2014) 1450087, 19 pp.
3. Link invariants from finite biracks. *Knots in Poland. III. Part 1, 197212, Banach Center Publ.*, 100, Polish Acad. Sci. Inst. Math., Warsaw, 2014.
4. Hom quandles. (with Alissa Crans (LMU)) *J. Knot Theory Ramifications* **23** (2014) 1450010, 18 pp.
5. Polynomial birack modules. (with Evan Cody[†]) *Topology Appl.* **173** (2014), 285293.
6. Kei Module Invariants of Knots and Links (with Michael Grier[†]). *Homology Homotopy Appl.* **16** (2014) 167177.
7. Link invariants from finite racks. *Fund. Math.* **225** (2014) 243258.
8. Birack Dynamical Cocycles and Homomorphism Invariants (with Emily Watterberg[†]). *J. Algebra Appl.* **12** (2013) 1350049 14 pp.
9. Birack Shadow Modules and Their Link Invariants (with Katie Pelland[†]). *J. Knot Theory Ramifications* **22** (2013) 1350056 12 pp.
10. Birack modules and their link invariants (with Regina Bauernschmidt[†]). *Comm. Contemp. Math.* **15** (2013) 1350006, 13 pp.

^{1†} indicates undergraduate student coauthor; [‡] indicates graduate student coauthor.

11. Twisted virtual biracks (with Jessica Cenicerós[†]). *Topol. Appl.* **160** (2013) 421–429.
12. Link invariants from the Alexander virtual biquandle (with Alissa Crans (LMU) and Allison Henrich (Seattle U)), *J. Knot Theory Ramifications* **22** (2013) 134004, 15 pp.
13. Virtual shadow modules and their link invariants (with Jackson Blankstein[†], Catherine Lepel[†], Susan Kim[†] and Nicole Sanderson[†]). *Internat. J. Math.* **23** (2012) 1250096, 22 pp.
14. Enhancements of the rack counting invariant via N-reduced dynamical cocycles (with Alissa Crans (LMU) and Aparna Sarkar[†]), *New York J. Math* **18** (2012) 337-351.
15. BiKei and invariants of unoriented links (with Sinan Aksoy[†]). *J. Knot Theory Ramifications* **21** (2012) 120045 13 pp.
16. N-Degeneracy in rack homology and link invariants (with Mohamed Elhamdadi (USF)). *Hiroshima Math. J.* **42** (2012) 127–142.
17. (t, s) -racks and their link invariants (with Jessica Cenicerós[†]). *Internat. J. Math.* **23** (2012) 1250001 19 pp.
18. Rack module enhancements of counting invariants (with Garret Heckel[‡], Aaron Haas[†], Jonah Yuen[†], and Qingcheng Zhang[†]). *Osaka J. Math* **49** (2012) 471–488.
19. The column group and its link invariants (with Johanna Hennig[†]). *J. Knot Theory Ramifications* **21** (2012) 1250063 15 pp..
20. On rack polynomials. (with Tim Carrell[†]). *J. Alg. Appl.* **10** (2011) 1221–1232.
21. Rack shadows and their invariants (with Wesley Chang[†]) *J. Knot Theory Ramifications.* **20** (2011) 1259–1269.
22. Semiquandles and flat virtual knots. (with Allison Henrich (Seattle U.)). *Pacific J. Math.* **248** (2010) 155-170.
23. Link invariants from finite Coxeter racks. (with Ryan Wieghard[†]) *J. Knot Theory Ramifications* **20** (2011) 1247–1257.
24. The combinatorial revolution in knot theory. *Notices Am. Math. Soc.* **58** (2011) 1553–1561.
25. The 2-generalized knot group determines the knot (with Walter D. Neumann (Barnard College)). *Commun. Contemp. Math.* **10** (2008) 843–847.
26. Generalized quandle polynomials. *Can. Bull. Math.* **54** (2011) 147–158.
27. Virtual Yang-Baxter 2-cocycle invariants (with Jose Cenicerós[†]). *Trans. Amer. Math. Soc.* **361** (2009) 5263–5283.
28. On bilinear biquandles (with Jacquelyn Rische[†]). *Colloq. Math.* **112** (2008) 279–289.
29. On symplectic quandles (with Esteban Adam Navas[†]). *Osaka J. Math.* **45** (2008) 973–985.
30. A polynomial invariant of finite quandles. *J. Alg. Appl.* **7** (2008) 263–273.
31. Symbolic computation with finite biquandles (with Conrad Creel[†]). *J. Symbolic Comput.* **42** (2007) 992–1000.
32. An isomorphism theorem for Alexander biquandles (with Daisy Lam[†]). *Intl. J. Math.* **20** (2009) 97 – 107.
33. Quandles and Linking Number (with Natasha Harrell[†]). *J. Knot Theory Ramifications* **16** (2007) 1283–1293.

34. Matrices and finite biquandles (with John Vo[†]). *Homology Homotopy Appl.* **8** (2006) 51–73.
35. Non-classicality and quandle difference invariants (with Natasha Harrell[†]). *Topology Proc.* **30** (2006) 251–263.
36. Matrices and finite Alexander quandles (with Gabriel Murillo[†] and Anthony Thompson[†]). *J. Knot Theory Ramifications* **16** (2007) 769–778.
37. Symbolic computation with finite quandles (with Richard Henderson (Red Hat) and Todd Macedo[†]). *J. Symbolic Comput.* **41** (2006) 811–817.
38. On the orbit decomposition of finite quandles (with Chau-Yim Wong[‡]). *J. Knot Theory Ramifications* **15** (2006) 761–772.
39. Matrices and finite quandles (with Benita Ho[†]). *Homology Homotopy Appl.* **7** (2005) 197–208.
40. On Generalized Knot Groups (with Xiao-Song Lin (UCR)). *J. Knot Theory Ramifications* **17** (2008) 263–272.
41. Alexander quandles of order 16 (with Gabriel Murillo[†]). *J. Knot Theory Ramifications* **17** (2008) 273–278.
42. Signed ordered knotlike quandle presentations. *Algebr. Geom. Topol.* **5** (2005) 443–462.
43. Virtual crossing realization. *J. Knot Theory Ramifications* **14** (2005) 931–951.
44. Classification of finite Alexander quandles. *Topology Proc.* **27** (2003) 245–258.
45. The Betti numbers of some finite racks (with R. A. Litherland (LSU)). *J. Pure Appl. Alg.* **178** (2003) 187–202.
46. Unknotting virtual knots via Gauss diagram forbidden moves. *J. Knot Theory Ramifications* **10** (2001) 931–935.

Papers in Peer Review

1. Symmetric Enhancements of Virtual Birack Counting Invariants (With Melinda Ho[†] (Scripps)) arXiv:1410.4584
2. Ribbon Biquandles and Virtual Knotted Surfaces (with Patricia Rivera[†] (Claremont High)) arXiv:1409.7756
3. Quotient Quandles and the Fundamental Latin Alexander Quandle (with Sherilyn Tamagawa[†] (Scripps)) arXiv:1404.6008
4. Lie Ideal Enhancements of Counting Invariants (with Gillian Grindstaff[†] (Pomona)) arXiv:1404.5642

Conference Talks

1. *Ribbon Biquandles and Virtual Knotted Surfaces*, Conference on Knot Theory and Its Applications to Physics and Quantum Computing, University of Texas at Dallas, January 2015
2. *Finite type enhancements of biquandle counting invariants*, AMS Sectional meeting, University of North Carolina Greensboro, Fall 2014
3. *Augmented Birack Homology*, Lloyd Roeling UL Lafayette Mathematics Conference, Fall 2013.
4. *Augmented Birack Homology*, AMS sectional meeting, Washington University of St. Louis, Fall 2013.

5. *Biracks and their Knot Invariants*, 2013 TAPU Workshop on Knot Theory and Related Topics, NIMS, Daejeon, Korea, Summer 2013.
6. *Quandles and their Knot Invariants*, 2013 TAPU Workshop on Knot Theory and Related Topics, NIMS, Daejeon, Korea, Summer 2013.
7. *Quantum enhancements*, Knots in Washington XXXV conference, The George Washington University, Fall 2012.
8. *Counting invariants of knots and links*, UnKnot, the Undergraduate Knot Theory conference, Denison University, Summer 2012.
9. *Three new enhancements of counting invariants*, AMS sectional meeting, University of Kansas, Spring 2012.
10. *Polynomial birack module invariants*, AMS sectional meeting, University of South Florida, Spring 2012.
11. *Virtual Shadow Modules and their Link Invariants*, Knots in Washington XXXIII conference, George Washington University, Fall 2011.
12. *Twisted virtual biracks*, AMS sectional meeting, University of Nebraska at Lincoln, Fall 2011.
13. *Link Invariants from the Alexander virtual biquandle*, AMS sectional meeting, University of Nebraska at Lincoln, Fall 2011.
14. *Bikei and unoriented link invariants*, Knots in Washington conference, George Washington University, Spring 2011.
15. *Birack algebras, shadow algebras and link invariants*, Seventh East Asian School of Knots and Related Topics, Higashi-Hiroshima, Japan, January 2011.
16. *Rack modules and generalizations*, Knots in Washington conference, George Washington University, Fall 2010.
17. *Rack module enhancements of counting invariants and (t, s) -racks*, AMS Fall sectional meeting, University of California, Los Angeles, Fall 2010.
18. *Rack module enhancements of counting invariants*, Knots in Chicago conference, University of Illinois at Chicago, Fall 2010.
19. *Blackboard Biracks and their link invariants*, Knots in Washington conference, George Washington University, Spring 2010.
20. *Rack Shadows and their invariants*, Knots in Washington conference, George Washington University, Fall 2009.
21. *Column group enhancements*, AMS sectional meeting, Florida Atlantic University, Fall 2009.
22. *Counting invariants of knots/links*, invited address, UnKnot (undergraduate knot theory) conference, Denison University, Summer 2009.
23. *Knot invariants from finite racks*, Knots in Washington conference, George Washington University, Spring 2009.
24. *Enhancements of counting invariants*, Knots in Washington conference, George Washington University, Spring 2008.
25. *Virtual cocycle invariants*, AMS sectional meeting, Louisiana State University, Spring 2008.
26. *Generalized quandle polynomials*, AMS/MAA joint meetings, San Diego, Winter 2008.

27. *Quandles and linking number*, Knotting Mathematics and Art conference, University of South Florida, Fall 2007.
28. *Quandles and linking number*, AMS sectional meeting, University of New Mexico, Fall 2007.
29. *A polynomial invariant of finite quandles*, Knots in Washington conference, Spring 2007.
30. *Quandle difference invariants*, Spring Topology and Dynamics Conference, University of North Carolina, Greensboro, Spring 2006.
31. *Quandle difference invariants*, Knots in Washington conference, George Washington University, Spring 2006.
32. *Virtual Crossing Realization*, Spring Topology and Dynamics Conference, Texas Tech University, Spring 2003.
33. *Virtual Crossing Realization*, AMS sectional meeting, Louisiana State University, Spring 2003.
34. *Classification of Finite Alexander Quandles*, AMS sectional meeting, University of Central Florida, Fall 2002.
35. *Classification of Finite Alexander Quandles*, Spring Topology and Dynamics Conference, University of Texas at Austin, Spring 2002.

Selected Colloquia, Seminars and other Talks

1. *Ribbon Biquandles and Virtual Knotted Surfaces*, North Carolina State University Algebra and Combinatorics Seminar, Fall 2014
2. *Finite type enhancements of biquandle counting invariants*, Claremont ANTC Seminar, Fall 2014
3. *Finite type enhancements of biquandle counting invariants*, Claremont Topology Seminar, Fall 2014
4. *New enhancements of the Birack Counting Invariant*, Claremont ANTC seminar, Spring 2014
5. *Counting Invariants and Their Enhancements*, Vassar College Mathematics Colloquium, Spring 2014
6. *Augmented Birack Homology*, CSU Long Beach Colloquium, Fall 2013.
7. *Knot Theory*, CSU Fullerton Analysis Seminar, Fall 2013.
8. *Augmented Birack Homology*, Claremont Topology Seminar, Fall 2013.
9. *Enhancements of Counting Invariants*, Louisiana State University Mathematics Colloquium, Spring 2013.
10. *Rack and Birack Module Invariants*, Louisiana State University Topology Seminar, Spring 2013.
11. *Enhancements of Counting Invariants*, University of Louisiana Lafayette Mathematics Colloquium, Spring 2013.
12. *Enhancements of Counting Invariants*, University of South Florida Math Colloquium Spring 2013.
13. *Quantum enhancements of birack counting invariants*, Claremont Topology Seminar, Fall 2012.
14. *Toward the Kontsevich integral: integrals and link invariants*, Claremont Analysis Seminar, Spring 2012.
15. *Polynomial birack modules*. Claremont Topology Seminar, Spring 2012.
16. *Birack projection invariants*, Claremont Algebra/Number Theory/Combinatorics Seminar, Spring 2012.

17. *Enhancements of counting invariants*. UCR Topology Seminar, Spring 2012.
18. *Link invariants from the Alexander virtual biquandle*, Claremont Algebra Seminar, Fall 2011.
19. *BiKei and unoriented link invariants*, Claremont Topology Seminar, Spring 2011.
20. *The Rack Algebra* Claremont Algebra seminar, Pomona College, Spring 2011.
21. *Birack Modules, Kei modules and Shadow Modules* Claremont Algebra seminar, Pomona College, Spring 2011.
22. *Rack module enhancements of counting invariants*, Claremont Topology Seminar, Fall 2010.
23. *The Algebra of Knots*, Mathematics Colloquium, Fullerton College, Fall 2010.
24. *Blackboard Biracks and their link invariants*, Claremont Algebra seminar, Pomona College, Spring 2010.
25. *Quandles, Racks and the Fundamental Group*, Claremont Topology seminar, Pomona College, Spring 2010.
26. *Rack Shadows and their invariants*, Mathematics Colloquium, University of South Florida, Fall 2009.
27. *The Combinatorial Revolution in Knot Theory*, Mathematics Colloquium, California State University Fresno, Fall 2009.
28. *The Combinatorial Revolution in Knot Theory*, Claremont Mathematics (CCMS) Colloquium, Fall 2009.
29. *Algebraic structures in knot theory*, Mathematics Colloquium, California State University Dominguez Hills, Spring 2009.
30. *Applications of knot theory*, Atul Vyas Memorial lecture, Claremont McKenna College, Fall 2008.
31. *Algebraic structures in knot theory*, Claremont algebra seminar, Pomona College, Fall 2008.
32. *Semiquandles and flat virtual knots*, Claremont topology seminar, Pomona College, Fall 2008.
33. *Rack counting invariants*, Claremont topology seminar, Pomona College, Spring 2008.
34. *Algebraic structures from knots*, Claremont algebra seminar, Pomona College, Fall 2007.
35. *Virtual knots and finite biquandles*, USC topology seminar, University of Southern California, Spring 2006.
36. *Virtual knot theory*, featured talk at annual Math Week, University of Wyoming, Spring 2005
37. *Quandles and generalized knot groups*, Claremont topology seminar, Pomona College, Fall 2004.
38. *Quandle cocycle invariants*, UCR Topology seminar, University of California, Riverside, Winter 2004.

Grants

1. Simons Foundation Collaboration Grant – \$35,000 over five years (2014–2019).

III. TEACHING

Courses Taught

Claremont McKenna College (2008–Present)

1. *Algebraic Topology* (2 sections). Homology and cohomology theory with applications to category theory and knot theory.
2. *Calculus I* (2 sections). Limits, derivatives, optimization, antiderivatives.
3. *Calculus II* (7 sections). Integration, sequences and series.
4. *Calculus III, Honors Calculus III* (5 sections). Multivariable differential and integral calculus.
5. *Discrete Mathematics* (6 sections). Graph theory, binomial coefficients, recurrence relations, discrete probability, propositional logic.
6. *Intro to/Foundations of Pure Mathematics* (1 section). A liberal arts math course covering selected topics from abstract algebra, real and complex analysis, and topology.
7. *Linear Algebra* (4 sections). Vector spaces, linear transformations, matrix algebra, determinants, eigenvalues, canonical forms.
8. *Modern Geometry* (2 sections). Axiomatic systems, discrete geometry, hyperbolic, elliptic, affine and projective geometry, fractals.

Pitzer College (Summer 2009)

1. *Mathematics of Gambling* (1 section). A summer course on discrete probability with applications to popular games of chance.

Pomona College (2007-2008)

1. *Calculus I* (3 sections). Limits, continuity, derivatives and integration.
2. *Linear Algebra* (1 section). Vector spaces, linear transformations, matrix algebra, Gaussian elimination, determinants, eigenvalues, canonical forms.
3. *Topology* (1 section). Open and closed sets, continuous maps, compactness, separation axioms, product and quotient topologies, homotopy, fundamental group, covering spaces.

University of California, Riverside (2003-2006; Summer 2008)

1. *Calculus I* (3 sections). Limits, continuity, derivatives and integration.
2. *Calculus II* (4 sections). Techniques and applications of integration.
3. *Calculus III* (2 sections). Sequences and series.
4. *Discrete Structures II*. (1 section). Graph theory, binomial coefficients, recurrence relations, discrete probability, propositional logic.
5. *Linear Algebra*. Vector spaces, linear transformations, matrix algebra, Gaussian elimination, determinants, eigenvalues, canonical forms. 3 sections.
6. *Matrix Algebra for Business* (3 sections). Gaussian elimination, determinants, eigenvalues and eigenvectors, applications.
7. *Topology II* (2 sections). Product and quotient topologies, homotopy, fundamental group, covering spaces.

8. *Vector Calculus I* (1 section). Partial derivatives, gradients, vector fields, Jacobian matrices, Lagrange multipliers, Implicit function theorem.
9. *Vector Calculus II* (2 sections). Iterated integrals, line integrals, surface integrals, Green's Theorem, Stokes' Theorem.

Whittier College (2002-2003; 2006-2007)

1. *Business Mathematics*. (1 section). Techniques of optimization, linear programming, gaussian elimination.
2. *Calculus II* (2 sections). Integration, sequences and series.
3. *College Algebra* (1 section). Polynomial and rational equations, factoring, curve sketching.
4. *Differential Equations II* (1 section). First order linear ODEs, integrating factors, Laplace transforms.
5. *Discrete Mathematics* (1 section). Graph theory, binomial coefficients, recurrence relations, discrete probability, propositional logic.
6. *Modern Algebra II*. (1 section). Rings, ideals, fields, quotients, extensions, Galois groups, solvable groups.
7. *Quantitative Reasoning* (6 sections). Liberal arts math course focusing on basic computational skills.

Louisiana State University (2000-2002)

1. *Remedial Algebra* (1 section). Basic arithmetic and beginning algebra.
2. *College Algebra* (2 sections). Polynomial and rational equations, factoring, curve sketching.
3. *Business Calculus I* (5 sections). Differential and integral calculus without trig functions, with applications to business.
4. *Calculus I* (1 Section). Limits, continuity, derivatives and integration.

Other

1. *Knot Theory* (with Allison Henrich (Seattle U)), mini-course at Canada-USA MathCamp, Summer 2014

New Courses Developed

1. CMC Math 35, *Foundations of Pure Mathematics*. A liberal arts math course covering selected topics from abstract algebra, real and complex analysis, and topology.
2. CMC Math 140, *Modern Geometry*. A survey course on modern concepts in geometry including axiomatic systems, discrete geometry, hyperbolic, elliptic, affine and projective geometry, and fractals.
3. CMC Math 149a/144, *Algebraic Topology*. Chain complexes, homology and cohomology with applications to topology.

Senior Theses Supervised

1. *Symmetric Enhancements of Virtual Birack Counting Invariants*, Melinda Ho, Scripps College Fall 2014.
2. *Quotient Quandles and the Fundamental Latin Alexander Quandle*, Sherilyn Tamagawa, Scripps College 2014.
3. *Lie Ideal Enhancements*, Gillian Grindstaff, Pomona College 2014.
4. *The Mathematics of Invisibility*, Austin Gomez, Claremont McKenna College 2013.
5. *Birack dynamical cocycles and their link invariants*, Emily Watterberg, Scripps College 2012.
6. *Polynomial birack modules*, Evan Cody, Pomona College 2012.
7. *Shadow modules and their link invariants*, Katie Pelland, Pomona College, 2011.
8. *Birack modules and their link invariants*, Gina Bauernschmidt, Pomona College, 2011.
9. *Kei Module Invariants of Knots and Links*, Michael Grier, Pomona College, 2011.
10. *Twisted virtual biracks*, Jessica Cenicerros, Claremont McKenna College, 2011.
11. *Normalizing the symplectic quandle polynomial invariant*, Lisa Pearis, Scripps College, 2010.
12. *Enhancements of counting invariants: the column group*, Johanna Hennig, Scripps College, 2009.
13. *The Surface Biquandle*, Tim Carrell, Pomona College, 2009.
14. *Homogeneous quandle structures on S_3* , Charles Medford, Pomona College, 2008.
15. *Virtual Yang-Baxter cocycle invariants*, Jose Cenicerros, Whittier College, 2008.

IV. SERVICE

Committees

1. CMC PSR Committee on Diversity, Identity and Speech (co-Chair), 2014–Present
2. CMC APT Committee, 2013–Present
3. CMC Civil Rights Board, 2012–Present
4. AMS Library Committee, 2013–2016
5. CMC Committee on Academic Computing, 2011–2014
6. CMC Institutional Review Board, 2010–2011
7. Claremont Mathematics Colloquium Co-Chair, 2010–2011
8. CMC Math Dept. Hiring Committee for Stats position, 2010–2011
9. CMC Math Dept. Committee on data collection for WASC Assessment, 2010–2011

Conference Sessions Organized

1. *Algebraic structures in knot theory* (with Allison Henrich (Seattle U.)) AMS sectional meeting, University of California, Riverside, Fall 2013.
2. *Algebraic structures in knot theory* (with Carmen Caprau (CSUF)) AMS sectional meeting, University of California, Los Angeles, Fall 2010.
3. *Algebraic structures in knot theory* (with Alissa Crans (LMU)) AMS sectional meeting, University of California, Riverside, Fall 2009.
4. *Algebraic structures in knot theory* (with Alissa Crans (LMU)) AMS/MAA joint meetings, Washington DC, Winter 2009.
5. *Knot Theory and the Topology of 3-manifolds* (with Jim Hoste (Pitzer), Erica Flapan (Pomona), and David Bachman (Pitzer)), AMS sectional meeting, Claremont McKenna College, Spring 2008.
6. *Recent Advances in Knot Theory: Quandle Theory and Categorized Knot Invariants* (with Alissa Crans (LMU)), AMS sectional meeting, Louisiana State University, Spring 2008.

Service to Academic Community

1. Reviewer for Zentralblatt MATH
2. Referee for journals and conference proceedings
3. Recommendation letters for students, colleagues and TAs
4. Software code and algorithms for research made freely available online