

# Curriculum Vita

## J. Scott Carter

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### Education

B.S. March 1978, Summa Cum Laude, University of Georgia, Athens, Georgia, Mathematics Major.

Ph.D. in Mathematics, May 1982, Yale University, New Haven, Connecticut, Dissertation: "Surgery on Immersions: a Geometric Approach to Stable Homotopy," Advisor Prof. Ronnie Lee.

### Positions Held

Dec. 7, 2018 - Present: Professor Emeritus, University of South Alabama, Department of Mathematics and Statistics, Mobile, Alabama.

Oct. 5, 2010 - June 1, 2018: Professor, University of South Alabama, Department of Mathematics and Statistics, Mobile, Alabama.

Jan. 2003 - Oct. 5, 2010: Chair, University of South Alabama, Department of Mathematics and Statistics, Mobile, Alabama.

May 2002 - Dec. 2002: Interim Chair, University of South Alabama, Department of Mathematics and Statistics, Mobile, Alabama.

Sept. 1996 - May 2002: Professor, University of South Alabama, Department of Mathematics and Statistics, Mobile, Alabama.

Aug. 1989 - May 1996: Assistant Professor or Associate Professor, University of South Alabama, Department of Mathematics and Statistics, Mobile, Alabama.

Aug. 1988 - June 1989: Lecturer, Wayne State University, Department of Mathematics, Detroit, Michigan.

Aug. 1987 - June 1988: Lecturer, University of Texas, Austin, Texas.

Aug. 1985 - June 1987: Assistant Professor, Department of Mathematics and Computer Studies, Lake Forest College, Lake Forest, Illinois.

Aug. 1982 - June 1985: Instructor, Mathematics Department, University of Texas, Austin, Texas.

1978 -1982: Teaching Assistant, Mathematics Department, Yale University, New Haven, Connecticut.

## Publications

### Journal Articles

1. *Surgery Theory of Immersions*, Proc. Northwestern Homotopy Theory Conf. (Miller and Priddy, eds.), AMS Contemp. Math Series 19 (1983), 23-37.
2. *Surgery on Codimension One Immersions in  $(n+1)$ -space: Removing  $n$ -tuple Points*, Trans. of the AMS 289, No. 1, (1986), 83-102.
3. *On Generalizing Boy's Surface: Constructing a Generator of the Third Stable Stem*, Trans. of the AMS 289, No. 1 (1986), 103-121.
4. *A Further Generalization of Boy's Surface*, Houston Journal of Mathematics 12, No. 1 (1986), 11-31.
5. *Simplifying the Self Intersection Sets of Codimension One Immersions in  $(n+1)$ -space*, Houston Journal of Mathematics 13, No. 3, 353-366.
6. *Surgery on the Equatorial Immersion I*, Illinois Journal of Mathematics 32, No. 4, Winter 1988, 703-715.
7. *Surgery on the Equatorial Immersion in Low Dimensions*, Differential Topology Proceedings, Siegen 1987, Springer LMN 1350, U. Koschorke, ed.
8. *Triple Points of Immersed Surfaces in Three Dimensional Manifolds*, (with Ki Hyoung Ko), Topology and Its Applications 32, (1989), 149-159.
9. *Immersed Codimension One Projective Spaces in Spherical Space Forms*, Proc. of the AMS 105, No. 1, January 1989, 254-257.
10. *Immersed Projective Planes in Lens Spaces*, Proc. of the AMS 106, No. 1 (May 1989), 251-260.
11. *Classifying Immersed Curves*, Proc. of the AMS 111, No.1 (Jan. 1991), 281-287.
12. *Extending Immersed Curves to Proper Immersions of Surface*, Topology and its Applications 40 (1991), 287-306.
13. *Closed Curves that Never Extend to Proper Maps of Disks*, Proc. of the AMS 113, No. 3 (Nov 1991), 879-888.

14. *Canceling Branch Points on Projections of Surfaces in 4-Space*, (with Masahico Saito), Proc. of the AMS. 116, No 1. (Sept 1992), 229-237.
15. *Extending Immersed Circles in the Sphere to Immersed Disks in the Ball*, Comm. Math. Helv. 67 (1992), 337-348.
16. *Szygies among Elementary String Interactions in Dimension 2+1*, (with Masahico Saito), Letters in Mathematical Physics 23 (1991), 287-300.
17. *Planar Generalizations of the Yang Baxter Equation and Their Skeins*, (with Masahico Saito), Journal of Knot Theory and its Ramifications Vol 1, No. 2 (1992), 207-217.
18. *A Diagrammatic Theory of Knotted Surfaces*, (with Masahico Saito), in "Quantum Topology," ed. Randy Baadhio and Louis Kauffman, World Science Publishing (Singapore 1993), 91-115.
19. *Reidemeister Moves for Surface Isotopies and Their Interpretations As Moves to Movies*, (with Masahico Saito), Journal of Knot Theory and its Ramifications Vol 2, No 3 (1993), 251-284.
20. *Knotted Surfaces, Braid Movies, and Beyond*, (with Masahico Saito), in "Quantum Gravity," ed. John Baez, Oxford University Press (1994), 191-229.
21. *New Solutions to the Permutohedron Equation*, (with Masahico Saito), in "Quantum Topology Kansas 1993," ed. David Yetter, World Science Publishing Company, (1994), 51-65,
22. *Knot Diagrams and Braid Theories in Dimension 4*, (with Masahico Saito), in "Real and Complex Singularities," ed. W. L Marar, Pitman Research Notes in Mathematics, Longman Publishing (1995).
23. *A Seifert Algorithm for Knotted Surfaces*, (with Masahico Saito), Topology, Vol 36, No. 1 (1996), 179-201.
24. *Braid and Movies*, (with Masahico Saito), Journal of Knot Theory and Its Ramifications, Vol 5, No. 5 (1996), 589-608.
25. *On Formulations and Solutions of Simplex Equations*, (with Masahico Saito), International Journal of Modern Physics A, Vol 11, No 24, (1996), 4453-4463.
26. *Normal Euler Classes of Knotted Surfaces and Triple Points on Their Projections*, (with Masahico Saito), Proc. Amer. Math. Soc., 125 (1997), no. 2, 617-623.
27. *A Combinatorial Description of Knotted Surfaces and Their Isotopies*, (with Joachim Rieger and Masahico Saito), Advances in Mathematics, 127, No. 1, April 15 (1997), 1-51.

28. *Surfaces in 3-Space that Do Not Lift to Embeddings in 4-Space*, (with Masahico Saito), Knot theory (Warsaw, 1995), 29–47, Banach Center Publ., 42, Polish Acad. Sci., Warsaw, 1998.
29. *Diagrammatics, Singularities, and Their Algebraic Interpretations*, (with Louis H. Kauffman and Masahico Saito), 10th Brazilian Topology Meeting (São Carlos, 1996). Mat. Contemp. 13 (1997), 21–115.
30. *Singularities of the Projections of Surfaces in 4-Space*, (with Vera Carrara and Masahico Saito), Singularities of the projections of surfaces in 4-space. Pacific J. Math. 199 (2001), no. 1, 21–40.
31. *Thin-G theory and Local Moves for Gems*, (with Sótenes Lins), Adv. Math. 143 (1999), no. 2, 251–283.
32. *Alexander Numbering of Knotted Surface diagrams*, (with Seiichi Kamada and Masahico Saito), Proc. Amer. Math. Soc., 128 (2000), 3761-3771.
33. *Structures and Diagrammatics of 4-Dimensional Topological Lattice Field Theories*, (with Louis Kauffman and Masahico Saito), Advances in Math., 146, 39-100 (1999).
34. *State-sum Invariants of Knotted Curves and Surfaces from Quandle Cohomology*, (with Daniel Jelsovsky, Seiichi Kamada, Laurel Langford, and Masahico Saito), Electron. Res. Announc. Amer. Math. Soc. 5 (1999), 146-156.
35. *Quandle Homology Groups, Their Betti Numbers, and Virtual Knots*, (with Daniel Jelsovsky, Seiichi Kamada, and Masahico Saito), J. Pure Appl. Algebra 157 (2001), no. 2-3, 135–155.
36. *Computations of Quandle Cocycle Invariants of Knotted Curves and Surfaces*, (with Daniel Jelsovsky, Seiichi Kamada, and Masahico Saito), Adv. Math. 157 (2001), no. 1, 36–94.
37. *Geometric Interpretations of Quandle Homology*, (with Seiichi Kamada, and Masahico Saito) J. Knot Theory Ramifications 10 (2001), no. 3, 345–386.
38. *Shifting Homomorphisms in Quandle Cohomology and Skeins of Cocycle Knot Invariants*, (with Daniel Jelsovsky, Seiichi Kamada, and Masahico Saito), Journal of Knot Theory and its Ramifications, Vol 10 ( 2001), no 4, 579-596.
39. *A Theorem of Sanderson on Link Bordisms in Dimension 4*, (with Seiichi Kamada, Shin Satoh, and Masahico Saito) Algebraic and Geometric Topology 1 (2001), paper no. 14, 299-310.

40. *Diagrammatic Computations for Quandles and Cocycle Knot Invariants*, (with Seiichi Kamada and Masahico Saito), AMS Contemporary Math Series, ed. Lou Kauffman, David Radford, and Fernando Sousa.
41. *Stable Equivalence of Knots on Surfaces and Virtual Knot Cobordisms*, (with Seiichi Kamada and Masahico Saito), Journal of Knot Theory and its Ramifications, Vol 11, No 3 (May 2002), 311-322.
42. *Twisted Quandle Homology Theory and Cocycle Knot Invariants*,(with Mohammed Elhamdadi, and Masahico Saito), Algebr. Geom. Topol. 2 (2002) 95-135.
43. *Bordism of Unoriented Surfaces in 4-Space*, (with Seiichi Kamada, Shin Satoh, and Masahico Saito) Michigan Math. J. 50 (2002), no. 3, 575–591.
44. *Quandle Cohomology and State-sum Invariants of Knotted Curves and Curfaces*, (with Daniel Jelsovsky, Seiichi Kamada, Laurel Langford, and Masahico Saito), Trans. Amer. Math. Soc. 355 (2003), no. 10, 3947–3989.
45. *Quandle Homology Theory and Cocycle Knot Invariants*, (with Masahico Saito), Proceedings of Symposia in Pure Mathematics Vol 71 (2003), 249-268, ed. Mattic, et al.
46. *Cocycle Knot Invariants, Quandle Extensions, and Alexander Matrices*, (with Angela Harris, Marina Nikiforou, and Masahico Saito), in Low Dimensional Topology of the 21st Century, ed. Hitoshi Murakami, RIMS Kokyuroku 1272 (Kyoto 2002), also available at math.GT/0204113
47. *Extensions of Quandles and Cocycle Knot Invariants* (with Mohamed Elhamdadi, Marina Appiou Nikiforou, and Masahico Saito), J. Knot Theory Ramifications 12 (2003), no. 6, 725–738, also available at math.GT/0107021
48. *Generalizations of Quandle Cocycle Invariants and Alexander Modules from Quandle Modules* (with Masahico Saito) Intellegence of Low Dimensional Topology, Shodo-Shima, JAPAN (Decemeber 2003), 77-90.
49. *Homology Theory for the Set-theoretic Yang-Baxter Equation and Knot Invariants from Generalizations of Quandles*, (with Mohamed Elhamdadi and Masahico Saito), Fund. Math. 184 (2004), 31–54.
50. *Cocycle Knot Invariants from Quandle Modules and Generalized Quandle Homology*, (with Matias Graña, Mohamed Elhamdadi and Masahico Saito) Osaka J. Math. 42 (2005), no. 3, 499–541.
51. *Ribbon Concordance of Surface-knots via Quandle Cocycle invariants*, (with Masahico Saito and Shin Satoh) J. Aust. Math. Soc. 80 (2006), no. 1, 131–147.

52. *Ribbon-moves for 2-knots with 1-handles Attached and Khovanov-Jacobsson numbers*, Proc. Amer. Math. Soc. 134 (2006), no. 9, 2779–2783.
53. *A Lower Bound for the Number of Reidemeister Moves of Type III*, (with Mohamed Elhamdadi, Masahico Saito, and Shin Satoh) Topology and its Applications, 153 (15), 2788-2794.
54. *Categories for Knotted Curves and Surfaces and Quandles*, In Sica, Giandomenico, ed. “What is Category Theory? Advanced Studies in Mathematics and Logic.” Polimet-rica, Publisher, Italy, 17-44.
55. *Set Theoretic Yang-Baxter Solutions via Fox Calculus*, (with Masahico Saito), J. Knot Theory Ramifications 15 (2006), no. 8, 949–956, math.GT/0503166.
56. *Cohomology of the Adjoint of Hopf algebras*, Journal of Generalized Lie Theory and Applications, Vol 2, No. 1, March 2008, 19-34.
57. *Cohomology of Categorical Self-Distributivity*, (with Alissa Crans, Mohamed Elhamdadi, Masahico Saito), Journal of Homotopy and Related Structures, Vol 3, No. 1, 13-63, math.GT060717.
58. *Cohomology of Frobenius Algebras and the Yang-Baxter Equation*, (with Alissa Crans, Mohamed Elhamdadi, Enver Karadayi, and Masahico Saito), in Communications of Contemporary Mathematics (Lin Memorial Issue ed. Birman and Tian, eds.) 10 (2008), suppl. 1, 791814. arxiv.0705.3231.
59. *Virtual Knot Invariants from Group Biquandles and Their Cocycles*, (with Mohamed Elhamadadi, Masahico Saito, Daniel Silver, and Susan Williams), J. Knot Theory and Its Ramifications Vol 18(7) (July 2009) 957-972, arxiv.0206255.
60. *Symmetric Extensions of Dihedral Quandles and Triple Points of non-orientable sur-  
faces*, (with Kanako Oshiro and Masahico Saito), Topology Appl. 157(5) (2010), 857–869.
61. *Algebraic Structures Derived from Foams*, (with Masahico Saito), to appear Journal of Lie Algebras and Related Structures, vol. 5 (2011), arxiv.1001.0775
62. *Heron’s Formula from a 4-dimensional Perspective*, (with David Mullens), Visual Math-ematics, 13, No. 1, (2011), on line at <http://www.mi.sanu.ac.rs/vismath/>
63. *A Survey of Quandle Ideas*, in “Introductory lectures on knot theory,” 22-53, Series on Knots and Everything, 46, World Science Publ. (Hackensack, 2012).
64. *Classical Knot Theory*, Symmetry 4 (2012), No. 1, 225-250.

65. *A Knotted 2-dimensional Foam with Non-trivial Cocycle Invariant*, (with Atsushi Ishii), in “Intelligence of Low Dimensional Topology, (Oct. 2012), RIMS, Kyoto, 43-56.
66. *Braids and Branched Coverings of Dimension Three*, (with Seiichi Kamada), in “Intelligence of Low Dimensional Topology, (Oct. 2012), RIMS, Kyoto, 64–81.
67. *Reidemeister/Roseman-type Moves to Embedded Foams in 4-dimensional Space*, to appear in L. H. Kauffman and V. O. Manturov (Eds.) *New Ideas in Low-Dimensional Topology*. arxiv.1210.3608
68. *How to Fold a Manifold*, (with Seiichi Kamada), to appear in L. H. Kauffman and V. O. Manturov (Eds.) *New Ideas in Low-Dimensional Topology*. arxiv.1301.4259
69. *Three Dimensions of Knot Coloring*, (with Dan Silver and Susan Williams) *Amer. Math. Monthly* 121 (2014), no. 6, 506–514. arxiv.1301.5378
70. *Invariants of Links in Thickened Surfaces*, (with Dan Silver and Susan Williams), *Algebr. Geom. Topol.* 14 (2014), no. 3, 1377–1394, arxiv.1304.4655
71. *Non-orientable surfaces in 4-dimensional space*, *J. Knot Theory Ramifications* 23 (2014), no. 11, 1430002, 52 pp.
72. *Some elementary aspects of 4-dimensional geometry*, (with David Mullens), *Symmetry* 7 (2015), no. 2, 515–545.
73. *Reidemeister/Roseman-type moves to embedded foams in 4-dimensional space*, in “New ideas in low dimensional topology,” 1–30, Ser. *Knots Everything*, 56, World Sci. Publ., Hackensack, NJ, 2015.
74. *How to fold a manifold*, (with Seiichi Kamada) in “New ideas in low dimensional topology,” 31–77, Ser. *Knots Everything*, 56, World Sci. Publ., Hackensack, NJ, 2015.
75. *Three-dimensional braids and their descriptions* (with Seiichi Kamada) *Topology Appl.* 196 (2015), part B, 510–521.
76. *Geometric and homological considerations of local crossings of  $n$ -foams*, *J. Knot Theory Ramifications* 24 (2015), no. 13, 1541007, 50 pp.
77. *Twist spinning knotted trivalent graphs*, (with Seung Yeop Yang) *Proc. Amer. Math. Soc.* 144 (2016), no. 3, 1371–1382.
78. *Fractal simplices*, *J. Knot Theory Ramifications* 25 (2016), no. 9, 1641003, 15 pp.
79. *Homology for quandles with partial group operations*, (with Atsushi Ishii, Masahico Saito, and Kokoro Tanaka, *Pacific J. Math.* 287 (2017), no. 1, 19–48.

80. *A prismatic classifying space*, (with Victoria Lebed and Seung Yeop Yang) in “Non-Associative Mathematics and Its Applications,” ed. Vojtechovsky et. al. Contem. Math, AMS (Providence 2018), 43–68.
81. *Polytopes, Tensors, Graphs, Foams, and Homology*, J. Knot Theory Ramifications, 27 (2018), no. 11, 1843015, 37 pp.

## Books

- “How Surfaces Intersect in Space: an Introduction to Topology,” World Scientific Publishing (1st edition Feb. 1993), (2nd edition 1995).
- “The Classical and Quantum  $6j$ -symbols,” Princeton University Press (1995) (with Daniel E. Flath and Masahico Saito).
- “Knotted Surfaces and Their Diagrams,” American Mathematical Society Surveys and Monographs Series, Vol 55, (1997) (with Masahico Saito).
- “Knotted Surfaces in 4-dimensional Spaces,” (with Seiichi Kamada and Masahico Saito), Encyclopaedia of Mathematics, 142, series in Low Dimensional Topology 111, Springer (Berlin 2004).
- “Intelligence of Low Dimensional Topology, 2006,” Ed. Carter, Kamada, Kauffman, Kawachi, and Kohno, World Scientific publishing (Singapore, 2007).
- “An Excursion in Diagrammatic Algebra. Turning a Sphere from Red to Blue,” Series on Knots and Everything, 48. World Scientific Publishing (Hackensack, 2012).
- “Diagrammatic Algebra,” with Seiichi Kamada Mathematical Surveys and Monographs Volume: 264; American Mathematical Society (Providence 2021).

## Preprints

- Some Amusing Permutation Representations*, (with Yongju Bae and Byeorhi Kim), preprint available at [arxiv.org/pdf/math/](https://arxiv.org/pdf/math/)
- A Geometric Method to Compute Some Elementary Integrals*, (with Abhijit Champanerker) preprint available at [arxiv.org/pdf/math/0608722](https://arxiv.org/pdf/math/0608722)
- Cocycle Deformations of Algebraic Identities and R-matrices*, (with Alissa Crans, Masahico Saito, Mohamed Elhamdadi), preprint available at [arxiv.org/pdf/0802.2294](https://arxiv.org/pdf/0802.2294)
- Frobenius Modules and Essential Surface Cobordisms*, (with Masahico Saito), preprint available at [arxiv.org/pdf/1812.08475.pdf](https://arxiv.org/pdf/1812.08475.pdf)

## Professional Memberships

- Member American Mathematical Society  
 Managing Editor Journal of Knot Theory and Its Ramifications



## Honors

$\Phi K \Phi$  scholar of the year, 2006.

## Grants Awarded

**1996, National Security Agency**, “Generalizations of the Temperley-Lieb Algebra and Applications,” # MDA904-96-10071.

**2000, National Science Foundation**, ”Cohomology State-Sum Invariants in Dimensions 3 and 4.” # DMS-9988107.

**2003, National Science Foundation**, “Collaborative Research: Cocycle Invariants of Low-Dimensional Knots and Manifolds,” # DMS-0301095.

**2006, National Science Foundation**, “Collaborative Research: Algebraic Structures and Cohomology Theories Associated to Knottings,” # DMS-0603926.

**2012, Brain-Pool Trust**, Ministry of Education Science and Technology and the Korean Federation of Science and Technology Societies, grant support for visiting Kyungpook National University, Daegu, Korea, Dec. 2011-Aug. 2012.

**2018, Japanese Society for the Promotion of Science**, Ten month grant to study and collaborate on topics in higher dimensional algebra, # JSPS 18511.

**2019, ICERM**, Illustrating Mathematics, three months residence support.