Eric P. Klassen

Vita — June 2002

Personal:

Birthdate:	3 December 1958
Birthplace:	Topeka, Kansas
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Address:	Department of Mathematics
	Florida State University
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Education:

1982	B.A., Harvard University, summa cum laude
1983	M.S., Cornell University
1987	Ph.D., Cornell University, *Advisor:* Marshall M. Cohen

Research Grants:

1990–1993	National Science Foundation Postdoctoral Research Fellowship ($75,000)
Summer, 1992	COFRS Grant, Florida State University ($8,000)
1/95–12/97	National Science Foundation Research Grant ($41,500)
Summer, 1997	COFRS Grant, Florida State University ($8,000)
8/2001–8/2004	National Science Foundation FRG Grant ($522,000)
	(with A. Srivastava, D. Banks, and G. Erlebacher)

Positions Held:

1987–1990	Bantrell Postdoctoral Research Fellow, California Institute of Technology
1990–1995	Assistant Professor, Florida State University
1995-2002	Associate Professor, Florida State University
2002-present	Professor, Florida State Unversity

Visiting Positions:

1990–91	Visiting Scholar (NSF postdoc), University of California at San Diego
Summer '93	Visiting Research Associate, California Institute of Technology
July '94	Visiting Professor, Frankfurt University (Germany)
1994–95	Visiting Assistant Professor, Indiana University

Professional Society:

American Mathematical Society

Publications: *(each followed by a brief summary)*

- ⋆ *All papers listed below have been published, are in press, or have been submitted to refereed journals except the one listed under "Conference Proceedings."*
- ⋆ *With the exception of items 18, 20, and 22, all of the following papers have their authors listed in alphabetical order, as is the custom in pure mathematics.*

Published *(in refereed journals):*

(1) E. Klassen, *An open book decomposition for* $RP^2 \times S^1$, Proceedings of the AMS vol. 96 (1986), pp. 523–524.

In this paper I describe explicitly an open-book decomposition whose existence had been demonstrated by Berstein and Edmonds.

(2) P. Kirk and E. Klassen, *Chern-Simons invariants of* 3*-manifolds and representation spaces of knot groups*, Math. Annalen 287(1990), 343–367.

If K *is a knot in a* 3*-manifold* M*, we give a formula for the difference between the Chern-Simons invariants of two flat* $SU(2)$*-connections on* M *in terms of an integral along the space of representations of the complement of* K*; we then use this formula to make several explicit computations.*

(3) E. Klassen, *Representations of knot groups in* $SU(2)$, Transactions of the AMS (2)326(1991), 795–828.

In this paper, which is a published version of my PhD thesis, I calculate specifically the representation spaces of several classes of knot groups in $SU(2)$*. I also prove theorems relating the dimension of these spaces to the existence of incompressible surfaces in the knot complements, and prove that those reducible representations which are singular correspond to roots of the Alexander polynomial.*

(4) P. Kirk and E. Klassen, *Representation spaces of Seifert-fibered homology* 3*-spheres*, Topology (1) 30 (1991), 77–95.

In this paper, we prove a conjecture of Fintushel and Stern that the representation space of every Seifert-fibered homology 3*-sphere is a manifold which admits a Morse function with only even index critical points. Combining this theorem with work of Fintushel and Stern, we give a technique for computing the Floer homology of all Seifert-fibered homology* 3*-spheres.*

(5) C. Frohman and E. Klassen, *Deforming representations of knot groups in* $SU(2)$, Comment. Math. Helvetici 66(1991), 340–361.

We prove that those reducible representations of knot goups which correspond to simple roots of the Alexander polynomial can be deformed to arcs of irreducible representations in $SU(2)$ *and in* $SL(2, R)$.

(6) E. Klassen, *Representations in* $SU(2)$ *of the fundamental groups of the Whitehead link and of doubled knots*, Forum Math. 5(1993), 93–109.

Using the $SU(2)$*-representation space of the Whitehead link complement computed in my thesis, I give a method for computing the representation spaces of the twisted Whitehead doubles of certain knots.*

(7) P. Kirk and E. Klassen, *Chern-Simons invariants of* 3*-manifolds split along tori and the circle bundle over the representation space of* T^2, Comm. Math. Phys. 153 (1993) 521–557.

Using an explicitly constructed circle bundle over the representation space of the torus, we interpret the Chern-Simons invariant of a 3*-manifold whose boundary consists of tori as a section of a bundle, and then prove an addition formula for Chern-Simons invariants of* 3*-manifolds which are split along tori.*

(8) B. Fine, P. Kirk and E. Klassen, *A local analytic splitting of the holonomy map on flat connections*, Math. Annalen, 299 (1994) 171-189.

Given a representation ρ of the fundamental group of a manifold M into $U(n)$, we define an analytic map from a neighborhood of ρ in the space of all such representations to the space of flat connections on M which is a 1-sided inverse of the holonomy map.

(9) P. Kirk and E. Klassen, *Computing spectral flow via cup products*, J. Diff. Geom. 40 (1994), 505–562.

Given a path of flat connections on a 3-manifold M with boundary, we show that the first order behavior of those eigenvalues of the signature operator which are passing through zero can be calculated using a bilinear form constructed from the cohomology algebra of M. We use this to prove many cases of a conjecture of L. Jeffrey concerning spectral flow of torus bundles.

(10) P. Kirk, E. Klassen, and D. Ruberman, *Splitting the spectral flow and the Alexander matrix*, Comment. Math. Helv. 69 (1994), 375–416.

Let X be a 3-manifold and let Y be a manifold obtained from X by replacing a solid torus in X by a knot complement. We show that the spectral flow between two flat connections on Y which are reducible on the knot complement differs from the spectral flow between the corresponding two flat connections on X by a twisted signature of the Alexander matrix of the knot.

(11) P. Kirk and E. Klassen, *Analytic deformations of the spectrum of a family of Dirac operators on an odd-dimensional manifold with boundary*, Memoirs AMS (1995) Vol. 124, No. 592.

Given a Dirac operator on an odd-dimensional manifold with boundary, we study two types of spectrum: the extended L^2 spectrum and the Atiyah-Patodi-Singer spectrum, both of which depend on the choice of a Lagrangian subspace of the kernel of the tangential operator. Given an analytic path of such Dirac operators, we prove that the deformation theories of these two types of spectra are equivalent in an important sense.

(12) M. Heusener and E. Klassen, *Deformations of dihedral representations*, Proc. AMS (1997) Vol. 125 No. 10, 3039-3047.

Given a representation of a knot group into $SO(3, R)$ whose image lies in a dihedral subgroup, we give a sufficient condition for this representation to lie on a smooth arc of representations of the knot group into $SO(3, R)$.

(13) P. Kirk and E. Klassen, *The spectral flow of the odd signature operator and higher Massey products*, Math. Proc. Camb. Phil. Soc. (1997) **121**, 297-320.

Given a path of flat connections on a closed odd-dimensional manifold M, we give a technique for calculating the first non-vanishing derivatives of all those eigenvalues of the signature operator which pass through 0 at a given time. Our technique involves bilinear forms defined in terms of cup products and higher Massey products on the cohomology of M.

(14) P. Kirk and E. Klassen, *Continuity and analyticity of families of self-adjoint Dirac operators on a manifold with boundary*, Illinios J. Math. (1998) Vol. 42, Issue 1,123-138.

In this paper we prove basic results about the continuity and analyticity of a path of formally self-adjoint operators with Atiyah-Patodi-Singer boundary conditions on a manifold with boundary.

(15) M. Fried, E. Klassen and Y. Kopeliovich, *Realizing the alternating groups as monodromy groups of meromorphic functions on genus one Riemann surfaces*, Proc. AMS (2000), Vol. 129, No. 1, 111-119.

In this paper it is proven that for each $n \geq 4$, a generic Riemann surface of genus 1 admits a meromorphic function whose monodromy group is the alternating group A_n and all of whose critical points have multiplicity precisely 3.

(16) P. Kirk and E. Klassen, *The first-order spectral flow of the odd signature operator on a manifold with boundary*, Topology and its Applications (2001), vol. 116 (2), 199-226.

Given a path of Dirac operators associated to a path of flat connections on a manifold with boundary, we show how to compute the first order behavior of those eigenvalues which pass through 0 at each point on the path. We use Atiyah-Patodi-Singer boundary conditions to make the operators self-adjoint.

(17) H. Boden, C. Herald, P. Kirk and E. Klassen, *Gauge theoretic invariants of Dehn surgeries on knots*, Geometry and Topology, Vol. 5 (2001) Paper no. 6, 143-226.

We show how to compute several gauge theoretic invariants for manifolds obtained by Dehn surgery on knots. These invariants include spectral flow, Atiyah-Patodi-Singer rho invariants, and Boden and Herald's $SU(3)$*-version of the Casson invariants. We carry out these computations for surgeries on (2,q)-torus knots.*

(18) A. Srivastava and E. Klassen, *Monte Carlo extrinsic estimators for manifold valued parameters*, IEEE Transactions on Signal Processing (2002), vol. 50, no. 2, 299 - 308.

We focus on the use of Monte Carlo methods in signal/image processing scenarios where the underlying parameter spaces are certain Riemannian manifolds. We investigate the issue of estimating means and variances *of manifold-valued parameters, using ideas from independent and importance sampling. By involving the underlying geometry of these spaces, we specify the notion of* extrinsic means, *derive Monte Carlo methods to estimate them, and utilize large-sample asymptotics to approximate the estimator covariances, in appropriate vector spaces. The results are illustrated using applications in target pose estimation (orthogonal groups) and subspace estimation (Grassmann manifolds). The asymptotic covariances are utilized to construct confidence regions, to perform comparisons, and to determine the sample size for MC methods.*

In press *(at refereed journals):*

(19) E. Klassen and Y. Kopeliovich, *Hurwitz spaces and braid group representations*, 2002, 17 pages.

Associated to each branched cover of the Riemann sphere there is a Hurwitz space, and a corresponding representation of a finite index subgroup of the spherical braid group. In this paper we show how to compute this representation explicitly, and use this computation to show that the generic Riemann surface of genus one admits a meromorphic function with certain prescribed combinatorial branch structure.

Submitted *(to refereed journals):*

(20) A. Srivastava and E. Klassen, *Geometric Filtering for Subspace Tracking*, 2001, 18 pages.

We address the problem of tracking principal subspaces using ideas from nonlinear filtering. The subspaces are represented by their complex projection matrices and time-varying subspaces correspond to trajectories on the Grassmannian manifold. Under a Bayesian approach, we impose a smooth prior on the velocities associated with the subspace motion. This prior combined with any standard likelihood function forms a posterior density on the Grassmannian, for filtering and estimation. Using a sequential Monte Carlo method, a recursive nonlinear tracking algorithm is derived and some implementation results are presented.

(21) E. Klassen, C. Nolder, M. Seppälä, and T. Sutton, *Computation of Teichmüller distance between elliptic curves*, 2002, 9 pages.

We give an efficient numerical algorithm for the computation of the Teichmüller distance between any two elliptic curves over the complex numbers.

Conference Proceedings:

(22) Wang, Sinha, and Klassen, *Exploiting topological and geometric properties for selective subdivision*, Proceedings of the Symposium on Computational Geometry (1985: Baltimore) [New York, NY]: Association for Computing Machinery, SIGGRAPH, 39–45.

In this paper, a collaboration with two applied mathematicians, we prove a theorem involving the topology of surfaces in 3-space, and use it to describe a computer algorithm for calculating the intersection of two surfaces in 3-space.

Citations: *(other than by myself and coauthors)*

1990: 1

1991: 1

1992: 2

1993: 1

1994: 11

1995: 1

1996: 9

1997: 10

1998: 13

1999: 9

2000: 7

2001: 6

Invited Lectures:

Rice University, Feb. 1987

University of Pennsylvania, Feb. 1987

Columbia University, Feb. 1987

Michigan State Topology Conference, May 1987

Georgia Topology Conference, Aug. 1987

Berkeley/Stanford Topology Seminar, Oct. 1987

UCLA, Oct. 1987

AMS special session (org. by Bonahon), Clairemont, CA, Nov. 1988

Georgia Topology Conference, Aug. 1989

Harvard University, Nov. 1989

Tufts University, Nov. 1989

Brandeis Universtiy, Nov. 1989

UCLA Southern California Topology Seminar, Dec. 1989

Florida State University, February 1990

Kansas State University, February 1990

University of Iowa, March 1990

University of Wisconsin, March 1990

University of Quebec at Montreal, March 1990

University of Utah, March 1990
University of Hawaii Topology conference, Aug. 1990
Georgia Topology Conference, Aug. 1991
Yale University, April 1992
University of Texas, May 1992
University of Tennessee low-dimensional topology conference, May 1992
Indiana University, June 1992
Florida State University fall topology conference, Oct. 1992
AMS special session (org. by Mrowka), Los Angeles, Nov. 1992
AMS special session (org. by Rong), Washington DC, Apr. 1993
Caltech gauge theory seminar, June 1993
Colloquium, Siegen University, Germany, July 1994
Colloquium, Frankfurt University, Germany, July 1994
Topology Seminar, Frankfurt University, Germany, July 1994
Indiana University/Purdue University at Indianapolis topology seminar, Sept. 1994
Indiana University topology seminar, Sept. 1994
Colloquium, Florida State University, Sept. 1995
AMS special session (org. by P. Gilmer), Baton Rouge, April 1996
AMS special session (org. by P. Bowers), Atlanta, October 1997
AMS special session (org. by D. Auckly), Manhattan KS, March 1998
AMS special session (org. by H. Volklein), Gainesville FL, January 1999
Colloquium, University of Helsinki, Finland, May 1999
AMS special session (org. by M. Seppala), New Orleans, January 2001
Colloquium, Florida State University, Oct. 2001

Meeting Organized:

AMS special session, Charlotte, NC, October 1999

Refereeing:

Transactions of the AMS (1988,2000)
Proceedings of the Georgia International Topology Conference (1993)
NSF Proposals (1993-2002)
Proceedings of the AMS (1995)
Communications in Algebra (1996)
Comment. Math. Helvetici (1998)
Proc. of the London Math. Soc. (1998,2000)
Modern Physics Letters A (2000)
Topology and Its Applications (2001)

Teaching *(courses taught):*

Fall '91	MAD 3104 (Discrete Math I) MAC 3311 (Calculus I)
Fall '92	MAD 3105 (Discrete Math II) MTG 4302/5316 (Elementary Topology)
Spring '93	DIS in number theory
Fall '93	MAC 3311 (Calculus I) MTG 5326 (Topology I)
Spring '94	MAC 3312 (Calculus II, honors) MTG 5327 (Topology II)
Fall '94	On leave
Spring '95	On leave
Fall '95	MAC 3313 (Calculus III)
Spring '96	MAC 3311 (Calculus I) MTG 4212 (College Geometry)
Fall '96	MTG 4212 (College Geometry) MTG 6396 (Topics in Topology)
Spring '97	MAD 3104 (Discrete Math I) MTG 6396 (Topics in Topology)
Summer '97	MAD 3105 (Discrete Math II)
Fall '97	MTG 4212 (College Geometry) MTG 5376 (Topics in Topology) MTG 6939 (Topology Seminar)
Spring '98	MAC 2311 (Calculus I) MTG 6939 (Topology Seminar)
Fall '98	MAC 2311 (Calculus I) MTG 5316 (Elementary Topology) MTG 6939 (Topology Seminar) MTG 3930 (Putnam Preparation)
Spring '99	MTG 4212 (College Geometry) MTG 6939 (Topology Seminar)
Fall '99	MTG 4212 (College Geometry) MAC 2312 (Calculus II, honors)
Spring '00	MAC 2313 (Calculus III)
Summer '00	MAC 2312 (Calculus II)

Fall ‘00	On Sabbatical
Spring ‘01	MTG 2312 (Calculus II, honors) MGF 3301 (Introduction to Advanced Mathematics)
Summer ‘01	MAC 2313 (Calculus III)
Fall ‘01	MTG 4212 (College Geometry) MAT 5932 (Differential Geometry)
Spring ‘02	MAC 2312 (Calculus II, two sections)