

**CURRICULUM VITAE**  
**Anthony J. Tromba**  
Professor of Mathematics

Anthony Tromba  
Signature

03/04/2019  
Date

**EMPLOYMENT AND PROFESSIONAL ACTIVITY**

2006	Visiting Professor Max Planck Institute, Leipzig
2001 – 2005	Chair, Mathematics
2000	Visiting Professor, Scuola Normale, Pisa
1998-present	Co-Director, Monterey Bay Area Mathematics Project (\$727,000 in grants to support the professional development of teachers in Santa Cruz, Monterey and San Benito Counties)
1995-present	Professor of Mathematics, University of California, Santa Cruz
1992-1995	Ordentlicher Professor, Ludwigs Maximillians Universität, München (Professor auf Lebenszeit)
1989-1992	Member of the Executive Committee of the Board of Trustees and Director of Development, Mathematical Sciences Research Institute (MSRI), Berkeley, California
1986-1987	Max Planck Institut, Bonn, West Germany Research Director, Group on Non-Linear Partial Differential Equations and Calculus of Variations
1983	Visiting Professor, University of Paris
1982-1984	Max Planck Institut, Bonn, West Germany Research Director, Group on Non-Linear Partial Differential Equations
1978-1979	Visiting Professor of Mathematics, University of Bonn, Germany
1977-1992	Professor of Mathematics, University of California, Santa Cruz
1976-1977	Visiting Professor of Mathematics, University of Michigan, Ann Arbor
1975	Visiting Professor of Mathematics, Institute for Advanced Study, Princeton
1974	Visiting Professor of Mathematics, State University of New York, Stony Brook
1973-1977	Associate Professor of Mathematics, University of California, Santa Cruz

1970-1973	Assistant Professor of Mathematics, University of California, Santa Cruz
1970	Visiting Professor, Istituto Matematico, Pisa, Italy. Invited by the CNR (National Council of Research of Italy)
Fall 1969	Visiting Professor, Steklov Institute, Moscow (on the USSR Scientific Exchange Program representing the United States National Academy of Sciences)
1968-1969	Assistant Professor, Mathematics Stanford University
1967	Member of the Technical Staff, Bell Telephone Laboratories, Murray Hill, New Jersey
1963-1965	Lecturer in Mathematics, Cornell University

## EDUCATION

1968	Princeton University	Ph.D. in Mathematics
1965	Cornell University	B.A. (with distinction)

## MAJOR SCIENTIFIC RESULTS

1. Proved the first non-trivial index theorem in non-linear partial differential equations.
2. Solved the finiteness problem for the Classical Plateau Problem
3. Extended Degree Theory to Classical Minimal Surfaces
4. Solved the existence question for higher genus minimal surfaces

The above results were honored by an invitation to address The International Congress of Mathematicians in Berkeley in 1986, and in a mathematical calendar published by Springer Verlag.

5. Developed an entirely new approach to Teichmüller Theory and then calculated the curvature of Teichmüller Space with respect to its Weil Petersson Metric. This problem, proposed by Ahlfors, had been open for over 25 years.

This work was honored by the Taniguchi Foundation, Japan.

6. Resolved the problem of boundary branch points for energy or area minimizing surfaces in Plateau's Problem

## HONORS AND AWARDS Since 1986

2012-2018	\$450,000 grant from The University of California Innovative Learning Technology Initiative
2011	Invited Research Professor, Mathematics Institute , Bonn, Germany
2007	Mini Course ETH Zürich; A Global Theory of Branched Immersions
2007	Invited Research Professor, Hausdorff Institute, Bonn

- 2007 One of nine international professors invited by the Swiss Academy of Sciences to lecture in Basel on the occasion of the three-hundredth birthday of Leonhard Euler
- 2002 Excellence in Teaching Award, University of California, Santa Cruz
- 2001 Invited Plenary Lecturer, Conference on the Calculus of Variations, Max Planck Society, Leipzig
- 2000 Invited Plenary Lecturer (1 of 5 Americans), Portuguese Mathematical Millennium Celebration, Coimbra, Portugal, October 2000.
- 1995 Invited by the Max Plank Society to organize the second ever Mathematical Conference at Schloss Ringberg on the Tegernsee, (Munich)
- 1993 Invited to give the Inaugural Address to all new students, ETH Zürich
- 1992 Accepted one of ten permanent Chairs (Lehrstuhle) of Mathematics (Lehrstuhl für Analysis) at the University of München (Ludwig-Maximilians Universität)
- 1991 Invited to deliver the Nachdiplom Vorlesungen, ETH Zürich
- 1991 Invited Leader, Summer School for Gifted German University Students (Studien Stiftung des Deutschen Volkes) Schloss Salem.
- 1990 Invited Principal Lecturer, XIV Nevanlinna Symposium Helsinki, Finland
- 1989 One of eight foreigners and eight Japanese selected by the Taniguchi Foundation to participate in the special conference "Prospects in Complex Geometry" held on Lake Biwa, Kyoto, Japan, August.
- 1989 Appointed to The Executive Committee of The Board of Trustees of MSRI
- 1989 Named the first Director of Development of MSRI
- 1987 Asked by the American Mathematical Society to write the foreword for the special edition of reviews in Global Analysis, 1980-1986.
- 1987 Invited to give one of the CIME lectures (along with R. Schoen, L. Nirenberg, L. Cafferelli) on the Calculus of Variations, Montecatini, Italy. These lectures appear as part of a book published by Springer-Verlag.
- 1986 Mathematical work honored by an invited address, International Congress of Mathematicians (ICM), Berkeley, 1986, one of four U.C. professors selected by a succession of international committees.
- 1986 One of four foreigners (F. Almgren (Princeton), R. Beals (Yale), S. Agmon (Tel Aviv) invited by S.S. Chern to lecture in the DD7 summer school on Partial Differential Equations, Nankai University, Tianjin Province, China.

## **PUBLISHED WRITINGS**

### **Books since 1996**

14. **The Parsimonious Universe**, (with S. Hildebrandt) Springer Verlag, September 1996.

- Kugel, Kreis, und Seifenblasen** (with S. Hildebrandt), (German version of The Parsimonious Universe), Birkhauser (Basel), 1996.
15. **Vector Calculus**, 5<sup>th</sup> Edition, W.H. Freeman, New York, (Used at UCLA, Harvard, Princeton, Purdue, Rice, Brown, UC Santa Barbara, Cal Tech, Cornell, University of Wisconsin, Indiana University, Wellesley, Sarah Lawrence, etc.).
  16. **Calculo Vectorial**, Spanish Edition of the 5<sup>th</sup> and 6<sup>th</sup> Editions of Vector Calculus.
  17. **Regularity of Minimal Surfaces**, Grundlehren der Mathematischen Wissenschaften, Springer-Verlag (contract signed in 2002). ( 2010)
  18. **Global Analysis of Minimal Surfaces**, Grundlehren der Mathematischen Wissenschaften, Springer-Verlag.(2010)
  19. **Principi di Minimo Forme Ottimali in Natura**, Italian Edition of the Parsimonious Universe Scuola Normale di Pisa (2006)
  20. **Vector Calculus**, 6<sup>th</sup> Edition , W.H. Freeman and Co. , December 2011
  21. **Vector Calculus , Instructors Guide 6th Edition** , W/H. Freeman and Co. Spring 2012
  22. **A Theory of Branched Minimal Surfaces** , Springer Verlag, Fall 2011
23. Rogawski, Marsden, Tromba, Calculus I, II, III, IV an interactive E-Textbook for UC's Calculus Online, Macmillan (2019)
  24. Approximately 370 Lectures for UC's Online Calculus Courses (together with Frank Bäuerle) ( Completed Fall 2018)
  25. Video Lectures on History of Mathematics for UC's online Calculus:
  26. Morse Theory and The Calculus of Variations (In Preparation)

#### Articles in Professional Journals

1. *Degree Theory on Banach Manifolds* (with K.D. Elworthy), **Proceedings of Symposium on Non-Linear Functional Analysis**, Chicago, 1968.
2. *Differential Structures on Banach Manifolds* (with K.D. Elworthy), **Proceedings of Symposium on Global Analysis**, Berkeley, 1968.
3.  *$\Lambda$ -manifolds* (with R. Bonic and J. Frampton), **Journal of Functional Analysis**, 3, 310-320, 1969.
4. *Some Theorems on Fredholm maps* , **Proceedings of the American Math Society** , Vol. 34, No. 2, 1972.

5. *Morse lemma on Banach Manifolds*, **Proceedings of the American Math Society**, Vol. 34, No. 2, 1972.
6. *The Classification of Hölder Spaces of Continuous Functions*, **Journal of Functional Analysis**, Vol. 10, No. 3, July 1972.
7. *Degree Theory and Non-linear Partial Differential Equations*, **Proceedings of the Summer Conference on Global Analysis**, Trieste, Italy, 1972.
8. *The Morse lemma on Arbitrary Banach Spaces*, **American Math Society**, Vol. 79, No. 1, 1973.
9. *Stable Homotopy Groups of Spheres and Non-linear P.D.E.*, preprint.
10. *The Euler Poincare Index Theorem for Fredholm Vector Fields and the Theory of Geodesics on Closed Finite Dimensional Riemannian Manifolds*, **Annali della Scuola Normale Superiore di Pisa**, Vol. II, No. 1, 1975.
11. *On the Isometries of Hölder Spaces of Continuous Functions*, **Studia Mathematica**, LVII, 1976.
12. *Theorie de Morse sur les varietes de Banach*, **C.R. Acad. Sc. Paris**, 1975.
13. *Almost-Riemannian Structures on Banach Manifolds, The Morse lemma and the Darboux Theorem*, **Canadian Journal Math**, No. 3, 1976.
14. *Fredholm Vector Fields and a Transversality Theorem*, **Journal of Functional Analysis**, No. 4, December, 1976.
15. *A General Approach to Morse Theory*, **Journal of Differential Geometry**, January 1978.
16. *The Euler Characteristic of Vector Fields on Banach Manifolds and a Globalization of Leray-Schauder Degree*, **Advances in Mathematics**, vol. 28, no. 2, May 1978.
17. *The Morse-Sard-Brown Theorem for Functionals and the Problem of Plateau*, **American Journal of Mathematics**, vol. 99, no. 6, pp. 1251-1256 (1977).
18. *The Euler Characteristic of Vector Fields and the Problem of Plateau*, **Proc. Lyon Conference on Global Analysis** (1975).
19. *On the Number of Solutions to Plateau's Problem*, **Bull. Amer. Math. Soc.**, vol. 82, 1976.
20. *A General Approach to Lusternik-Schnirelman Theory*, preprint.
21. *On the Number of Simply Connected Minimal Surfaces Spanning a Curve in  $R^n$* , **Memoirs of the AMS**, November 1977.
22. *The Number of Minimal Surfaces Spanning a Curve is Generically Finite* (with R. Böhme), **Bull. AMS**, September 1977.
23. *The Set of Curves of Uniqueness for Plateau's Problem has a Dense Interior*; **Springer Verlag Lecture Notes in Math 597**.
24. *The Index Theorem for Classical Minimal Surfaces* (with R. Böhme); preprint **BSFB72 Lecture note series**, Bonn, 1977, **Annals of Math 112** (1980).
25. *The Beer Barrel Theorem*, **SFB72 Lecture note series** - Bonn, 1977, and **Proc. of the Conference on Functional Differential Equations**, Springer-Verlag.

26. *Non-degenerate Solutions of Boundary Value Problems*, (with Joel Smoller), **Journal of Non-Linear Analysis** (1977), and preprint no. 220 SFB Bonn.
27. *A Note on t'Hoofft's Hamiltonian in Two Dimensional Quantum Chromodynamics*; **Physical Review D**, vol. 18, no. 10, May 1977.
28. *The Cusp Catastrophe for Minimal Surfaces* (with M. Beeson), **Manuscripta Mathematica**, 46, 273-308 (1984).
29. *Extreme Curves Bound Embedded Minimal Surfaces of the Type of the Disc* (with F. Tomi), **Math. Zeitschrift** 158 , pp. 137-145 (1978).
30. *On the Structure of Curves of Prescribed Non-degeneracy Type*, (with F. Tomi), **Crelles Journal**, Band 316, pp. 31-43, 1980.
31. *A Sufficient Condition for a Critical Point of a Functional to be a Minimum and its Applications to Plateau's Problem*, **Mathematische Annalen** 263 (1983), pp. 303-312.
32. *A General Asymptotic Fixed Point Theorem*, **Crelles Journal**, Band 332 (118-125) 1982, SFB 72 preprint no. 411, Bonn, Germany.
33. *Degree Theory on Oriented Infinite Dimensional Varieties and the Morse Number of Minimal Surfaces Spanning a Wire in ; Part I:  $n > 4$*  , **Preprint no. 468**, Bonn, Germany. Trans. AMS Vol 290, No. 1, July 1985.
34. *On the Morse Number of Minimal Surfaces Spanning a Curve*, **Manuscripta Mathematica** 48 (1984) 139-161.
35. *On a Purely Riemannian Approach to Teichmüller Theory* (with Arthur Fischer), **Mathematische Annalen** 267 (1984) 311-345; **SFB 72 preprint no. 516** , Bonn, W. Germany.
36. *Almost Complex Principal Fibre Bundles and Teichmüller Theory* (with Arthur Fischer), **Crelles Journal Band 352** (1984) 151-160; **SFB preprint no. 515**, Bonn, Germany.
37. *On the Weil-Petersson Metric on Teichmüller space*, (with A. Fischer), **SFB 72 preprint series**, no. 538, Bonn, Germany. **Transactions of AMS** Vol 284, No. 1, July 1984.
38. *On the Morse Number of Embedded and Non-Embedded Minimal Immersions Spanning Wires on the Boundary of Special Bodies in  $R^3$* , **SFB 72 preprint no. 517**, Bonn, Germany. **Mathematische Zeitschrift** 188 (1984), 149-170.
39. *Unfolding Bifurcations of an Elliptic Boundary Value Problem*, **Mathematische Zeitschrift** 187, 145-150, 1984 (with H.O. Peitgen).
40. *On Plateau's Problem for Minimal Surfaces of Higher Genus*, **SFB 72 preprint no. 580**, Bonn, Germany.
41. *On Plateau's Problem for Minimal Surfaces of Higher Genus in  $R^3$* , (with F. Tomi), **Bull AMS** (Oct 1985).
42. *On A New Proof That Teichmüller Space is a Cell*, (with A. Fischer), **Transactions of the AMS**, Vol 303, No. 1, Sept. 1987.

43. *On a Natural Algebraic Affine Connection on the Space of Almost Complex Structures and the Curvature of Teichmüller's Space with Respect to its Weil-Peterssen Metric*, **Manuscripta Mathematica** 56, 475-497 (1986).
44. *Global Analysis and Teichmüller Theory*, **Proceedings of the Tromba Seminar on Non-Linear Analysis**, Max Planck Institut, April-July 1984, Bonn, Germany (Vieweg 1986).
45. *A Proof of Douglas' Theorem on the Existence of Disc like Minimal Surfaces Spanning Jordan Contours in  $R^n$* , **Proceedings of the Palaiseau Seminar on Minimal Surfaces**, Ecole Polytechnique, 1984, Asterik 1987.
46. *On an Energy Function for the Weil-Peterson Metric on Teichmüller Space*, **Manuscripta Mathematica** 59, 249-260 (1987).
47. *A Riemannian Proof of the Mumford Compactness Theorem*, (with F. Tomi), **Proceedings of the Nankai Conference on Partial Differential Equations** (DD7), Nankai, China (1986) Lecture notes no. 1306, Springer-Verlag.
48. *Teichmüller Theory in Riemannian Geometry*, CIME Lectures, Montecatini, Italy (1987), Springer-Verlag.
49. *Problems in Global Analysis and Minimal Surfaces*, **Proceedings of the 15th Anniversary of the Applied Mathematics Institute**, Bonn University.
50. *Existence Theorems for Minimal Surfaces on Non Zero Genus Spanning a Contour*, **Memoirs of the AMS**, No. 382, Vol 71, Jan. 1988 (with F. Tomi).
51. *New Results on the Classical Plateau Problem*, **Proceedings of the International Congress of Mathematicians**, Berkeley (1986).
52. *Global Analysis* (1980-1986), **AMS Reviews in Global Analysis**, S58, 1980-1986.
53. *The Index Theorem for Minimal Surfaces of Higher Genus*, **Memoirs of the AMS**, Number 560, September 1995.
54. *Intrinsic Third Derivatives for Dirichlet's Energy for Plateau's Problem and the Morse Inequalities for Disc Minimal Surfaces in  $R^3$* , preprint SFB 256, Bonn., **The Journal of the Calculus of Variations and Partial Differential Equations**, Vol.1, (1993) 335-353.
55. *On the Levi Form of Dirichlet's Energy on Teichmüller's Moduli Space*, S.F.B. 256 preprint #206, Bonn, Germany, Appendix E, **Teichmüller Theory in Riemannian Geometry**, Birkhauser 1992. [See B-12]
56. *On Harmonic Maps*; Appendix B, **Teichmüller Theory in Riemannian Geometry**, Birkhauser 1992. [See B-12]
57. *Dirichlet's Energy on Teichmüller's Moduli Space and the Nielsen Realization Problem*, **Math Zeitschrift**, 222,(1996) 451-464.
58. *Dirichlet's Energy on Teichmüller's Moduli Space in Strictly Pluri-Subharmonic*, preprint #207, SFB 256, Bonn, Germany, accepted for publication in Trans. AMS, withdrawn in order to resubmit for a volume honoring Stefan Hildebrandt now appears in **Geometric Analysis and Calculus of Variations** International Press (1996) 315-341.

59. *On the Global Evolution Problem in 2+1 Gravity* (with Lars Andersson & Vincent Moncrief) **Journal of Geometry & Physics**, November 1997.
60. Book Review: “Ethnomathematics, Challenging Eurocentrism in Mathematics Education”, **Heterodoxy** (October 1997) Vol 5, No. 8.
61. *The Morse Theory of Two-Dimensional Minimal Surfaces and their Generic Non- Degeneracy in Riemannian Manifolds*, **Calculus of Variations and Partial Differential Equations**, 10, 135-170 (2000).
62. *On Interior Branch Points for Minimal Surfaces*. To appear in the book “A Theory of Branch Minimal Surfaces,” Springer-Verlag. This paper was accepted by Annales Henri Poincare, but withdrawn after I realized that the theory could be greatly improved. This is now the appendix in *A Theory of Branched Minimal Surfaces* pgs. 193 – 205. [See B-22] (Non-Exceptional Branch points; The vanishing of the  $L^{\text{th}}$  derivative,  $L$  even)
63. *On the Negativity of Higher Order Derivatives of Dirichlet’s Energy for Plateau’s Problem*, *Manuscripta Mathematica*, 131, pp 179-197 (2010)
64. *Non-Planar Simply Branched Minimal Surfaces Cannot be Minima for Energy on Area unless they are Global Holomorphic Reparameterizations of an Immersed Minimal Surface*, submitted to *Math. Zeitschrift*. Accepted, but later withdrawn after I saw how to dramatically improve the result.. This is now a special case of the general theory in my book *A Theory of Branched Minimal Surfaces* pgs. 77 – 107. [See B-22] (The Second Main Theorem: Exceptional Branch Points; The Condition  $k > 1$ )
65. *On the non-existence of exceptional branch points for weak relative minima in Plateau’s Problem; J. Fixed Point Theory and Applications*, Vol. 7, Number 1, 189-199
66. On the branch point index of minimal surfaces (with S. Hildebrandt). *Archiv der Mathematik* 92, (2009) 493-500
67. *On the non-existence of boundary branch points for minimal surfaces spanning smooth contours II* solicited by *J. Fixed Point Theory and Applications*; *J. Fixed Point Theory Appl.* 10 (2011) 1 DOI 10.1007/s11784-011-0057-9  
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68. **A Theory of Branched Minimal Surfaces** , Springer Verlag, Fall 2011 (A Research Manuscript published in book format)
69. *Morse Theory and Hilbert’s 19<sup>th</sup> Problem* (with F. Tomi) ( Preprint) to be submitted)
70. *Morse Theory and a solution to Hilbert’s 19<sup>th</sup> Problem II* ( In preparation)
71. *Morse Theory and The Calculus of Variations* ( In preparation)

## Department Service

Acting Chair Mathematics, Summer 2015



Acting Chair Mathematics, Summer 2014

Acting Chair Mathematics, Summer 2012

Committee Chair Ph.D Oral Exam Spring 2014

Committee Chair Ph.D Oral Exam Spring 2014

### **University Service**

Ongoing Reviewer for the Governor's Innovative Technology Initiative