

# CURRICULUM VITAE

HIROSHI KOKUBU

April 1, 2012

## Personal Information :

**Family name:** Kokubu  
**Given name:** Hiroshi  
**Birthdate:** August 20, 1959  
**Birthplace:** Tsu city, Mie prefecture, Japan  
**Citizenship:** Japan

## Employment :

**Title:** Professor  
**Employer:** Kyoto University  
**Address:** Department of Mathematics  
Kyoto University  
Kyoto 606-8502, Japan  
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## Education :

Dr. Sc. 1988 Kyoto University (Mathematics)  
Adviser: Prof. M. Yamaguti  
Thesis: Homoclinic and heteroclinic bifurcations of vector fields  
MSc. 1984 Kyoto University (Mathematics)  
Adviser: Prof. M. Yamaguti  
Thesis: Normal forms for parametrized vector fields and its  
application to bifurcations of some reaction diffusion equations  
BSc. 1982 Kyoto University (Mathematics)

## Research Interests :

Dynamical Systems

**Professional Appointments :**

Academic year 2010:	Chair of Department of Mathematics
November 1st, 2006 - present:	Professor, Kyoto University
April, 1997 - March, 1998:	Visiting Senior Research Scientist, Georgia Institute of Technology
December 16th, 1995 - October 30th, 2006:	Associate Professor, Kyoto University
April 1st, 1990 - December 15th, 1995:	Lecturer, Kyoto University
April 1st, 1988 - March 31st, 1990:	Junior Science Research Fellow at Yoshida College, Kyoto University with the fellowships from JSPS (Japan Society for Promotion of Science)

Associate Editor of Scientific Journals:

Ouyou Suuri (Bulletin of Japan Society of Industrial and Applied Mathematics, 1996-1999)  
Sugaku, Mathematical Society of Japan (1998-2002)  
SIAM Journal of Applied Dynamical Systems (2007- )  
Kyoto Journal of Mathematics (2010- )  
Japan Journal of Industrial and Applied Mathematics (2010- )  
NOLTA (2010- )

**Membership of Academic Societies :**

Mathematical Society of Japan  
Japan Society of Industrial and Applied Mathematics  
Society of Industrial and Applied Mathematics (USA)

**Research Grants Received :**

Kaken-hi (Grant-in-Aid from Ministry of Education, Science, Technology, Culture, and Sport, Japan), 1988-89, 1991, 1994, 1995, 1996, 1997-98, 1998-1999, 2000-2002, 2002-2004, 2005-2008, 2009-2012  
CREST (Japan Science and Technology Agency), 2009-2015  
JSPS US-Japan Joint Research Grant, 1994-95, 2001-2003  
Kyoto University Foundation, 1992

## List of Publications :

1. (with S. Ushiki & H. Oka) Existence d'attracteurs étranges dans le déploiement d'une singularité dégénérée d'un champ de vecteurs invariant par translation, *C. R. Acad. Sci. Paris, Sér. I, Math.* **298** (1984), 39 – 42.
2. Normal forms for parametrized vector fields and its applications to bifurcations of some reaction diffusion equations, *Japan Journal of Applied Mathematics*, **1** (1984), 273 – 297.
3. (with H. Oka) Constrained Lorenz-like attractors, *Japan Journal of Applied Mathematics*, **2** (1985), 495 – 500.
4. (with H. Oka) An approach to constrained equations and strange attractors, in “Patterns and Waves – Qualitative Analysis of Nonlinear Differential Equations”, (Eds. H. Fujii, M. Mimura & T. Nishida), *Stud. Math. Appl.*, Vol. 18 (1986), Kinokuniya/ North-Holland, 607 – 630.
5. On a codimension 2 bifurcation of heteroclinic orbits, *Proceeding of Japan Academy* **63** (1987), 298 – 301.
6. Homoclinic and heteroclinic bifurcations of vector fields, *Japan Journal of Applied Mathematics*, **5** (1988), 455 – 501.
7. (with L. O. Chua) Normal forms for nonlinear vector fields, Part I: Theory and algorithm, *IEEE Transactions of Circuits and Systems*, **35** (1988), 863 – 880; Part II: *ibid* **36** (1989), 51 – 70.
8. (with Y. Nishiura & H. Oka) Heteroclinic and homoclinic bifurcations in bistable reaction diffusion systems, *Journal of Differential Equations*, **86** (1990), 260 – 341.
9. Heteroclinic bifurcations associated with different saddle indices, in *Proceedings of the International Conference “Dynamical Systems and Related Topics”*, (Ed. K. Shiraiwa), (1991), World Scientific, 236–260.
10. A construction of three-dimensional vector fields which have a codimension two heteroclinic loop at Glendinning-Sparrow T-point, *Zeitschrift für angewandte Mathematik und Physik*, **44** (1993), 510–536.
11. (with M. Kisaka & H. Oka) Supplement to homoclinic doubling bifurcation in vector fields, in “Dynamical Systems, Santiago 1990”, (Eds. R. Bamon, R. Labarca, J. Levowicz, and J. Palis, Jr.), *Pitman Research Notes in Mathematics*, Vol. **285**, (1993), Longman Scientific and Technical, 92–116.
12. (with M. Kisaka & H. Oka) Bifurcations of  $N$ -homoclinic and  $N$ -periodic orbits in vector fields, *Journal of Dynamics and Differential Equations*, **5** (1993), 305–357.
13. (with H. Oka) Rikigakukei no bunki riron, *Sugaku* **45** (1993), 12–26; English translation: Bifurcation theory for dynamical systems, *Sugaku Expositions*, **9** (1996), 1–19.

14. (with T. Matsumoto, M. Komuro & R. Tokunaga) "Bifurcations - Sights, Sounds and Mathematics", 1993, 468+XL pages, Springer-Verlag.
15. (with A. J. Homburg & M. Krupa) The cusp horseshoe and its bifurcations from inclination-flip homoclinic orbits, *Ergodic Theory and Dynamical Systems*, **14** (1994), 667–693.
16. (with F. Dumortier & H. Oka) A degenerate singularity generating geometric Lorenz attractors, *Ergodic Theory and Dynamical Systems*, **15** (1995), 833–856.
17. (with M. Komuro & H. Oka) Multiple homoclinic orbits from orbit-flip, I: Homoclinic doubling bifurcations, *International Journal of Bifurcation and Chaos*, **6** (1996), 833–850.
18. (with K. Mischaikow & H. Oka) Existence of infinitely many connecting orbits in a singularly perturbed ordinary differential equations, *Nonlinearity*, **9** (1996), 1263–1280.
19. (with H. Oka & D. Wang) Linear grading function and further reduction of normal forms, *Journal of Differential Equations*, **132** (1996), 293–318.
20. (with V. Naudot) Existence of infinitely many homoclinic doubling bifurcations from some codimension three homoclinic orbits, *Journal of Dynamics and Differential Equations*, **9** (1997), 445–462.
21. (with K. Mischaikow, Y. Nishiura, H. Oka, & T. Takaishi) Connecting orbit structure of monotone solutions in the shadow system, *Journal of Differential Equations*, **140** (1997), 309–364.
22. (with T. Gedeon, K. Mischaikow, H. Oka, & J. Reineck) Conley index for fast-slow systems, Part I: One-dimensional slow dynamics, *Journal of Dynamics and Differential Equations*, **11** (1999), 427–470.
23. (with K. Mischaikow & H. Oka) Directional transition matrix, in "Conley Index Theory" (Eds. K. Mischaikow, M. Mrozek, P. Zgliczyński), Banach Center Publication, Vol. 47, 1999, Warsaw, Poland, pp. 133–144.
24. (with F. Dumortier) Chaotic dynamics in  $\mathbf{Z}_2$ -equivariant unfoldings of codimension 3 singularities of vector fields in  $\mathbf{R}^3$ , *Ergodic Theory and Dynamical Systems*, **20** (2000), 85–107.
25. (with F. Dumortier and S. Ibanez) New aspects of the unfolding of the nilpotent singularity of codimension three, *Dynamical Systems: an International Journal*, **16** (2001), 63–95.
26. (with A. J. Homburg & V. Naudot) Homoclinic-doubling cascades, *Archeiv for Rational Mechanics and Analysis*, **160** (2001), 195–243.
27. (with T. Gedeon, K. Mischaikow, and H. Oka) Chaotic solutions in slowly varying perturbations of Hamiltonian systems with applications to shallow water sloshing, *Journal of Dynamics and Differential Equations*, **14** (2002), 63–84.

28. (with R. Roussarie) Existence of a singularly degenerate heteroclinic cycle in the Lorenz system and its dynamical consequences, Part I, *Journal of Dynamics and Differential Equations*, **16** (2004), 513-557.
29. (with F. Dumortier and S. Ibanez) Cocoon bifurcations in three dimensional reversible vector fields, *Nonlinearity*, **19** (2006), 305-328.
30. (with T. Gedeon, K. Mischaikow, and H. Oka) The Conley index for fast-slow systems II: Multi-dimensional slow variable, *Journal of Differential Equations*, **225** (2006), 242-307.
31. (with M. Gameiro, T. Gedeon, W. Kalies, K. Mischaikow, and H. Oka) Topological horseshoes of travelling waves for a fast-slow predator-prey system, *Journal of Dynamics and Differential Equations*, **19** (2007), 623-654.
32. (with D. Wilczak and P. Zgliczynski) Rigorous verification of the cocoon bifurcation in the Michelson system, *Nonlinearity* **20** (2007), 2147-2174.
33. (with S. Day, S. Luzzatto, K. Mischaikow, H. Oka, and P. Pilarczyk) Quantitative hyperbolicity estimates in one-dimensional dynamics, *Nonlinearity* **21** (2008), 1967-1987.
34. (with Z. Arai, W. Kalies, K. Mischaikow, H. Oka, and P. Pilarczyk) A database schema for the analysis of global dynamics of multiparameter systems, *SIAM Journal on Applied Dynamical Systems*, **8** (2009), 757-789.
35. (with Z. Arai and P. Pilarczyk) Recent development in rigorous computational methods in dynamical systems, *Japan Journal of Industrial and Applied Mathematics*, **26** (2009), 393-417.
36. (with Z. Arai, M. Gameiro, T. Gedeon, K. Mischaikow, H. Oka) Graph-based topological approximation of saddle-node bifurcation in maps to appear in *RIMS Kokyuroku BESSATSU*, 2011.

**Selected Invited Talks at International Scientific Meetings :**

1. Construction and bifurcation of vector fields with certain type of codimension two, International Conference “Dynamical Systems and Related Topics”, Nagoya International Center, Nagoya, Japan, September 3 - 7, 1990.
2. Supplement to homoclinic doubling bifurcation in vector fields, Tercera Escuela Internacional de Sistemas Dinamicos, Universidad de Santiago de Chile, Santiago, Chile, November 26 - December 1, 1990.
3. On a homoclinic doubling bifurcation in vector fields; Constructions of vector fields which has a heteroclinic loop at Glendinning-Sparrow T-point, 4th Czecho-Slovak Summer School on Dynamical Systems, Bratislava, Czecho-Slovakia, June 24 - 29, 1991.

4. A degenerate singularity generating geometric Lorenz attractors, International Conference “Bifurcations in Differentiable Dynamics”, Limburgs Universitair Centrum, Diepenbeek, Belgium, June 9 – 13, 1992.
5. A degenerate singularity generating geometric Lorenz attractors, Workshop “Homoclinic Chaos and Normal Forms”, Fields Institute, Waterloo, Canada, November 13 - 16, 1992.
6. Homoclinic twisting bifurcations and cusp horseshoes, International Conference / Workshop on Dynamical Systems, IMPA, Rio de Janeiro, Brazil, August 2 - 14, 1993.
7. Homoclinic bifurcations at orientation switch, International Conference on Dynamical Systems and Chaos, Tokyo Metropolitan University, Tokyo, Japan, May 23 - 27, 1994.
8. Multiple homoclinic bifurcations in vector fields, The 3rd International Congress on Industrial and Applied Mathematics, Congress Centrum Hamburg, Hamburg, Germany, July 3 - 7, 1995
9. Existence of infinitely many connecting orbits in a singularly perturbed ordinary differential equations, ”Problems and Methods in Singular Perturbations” Centre International de Rencontres Mathematiques, Luminy, Marseille, France, July 17 - 21, 1995
10. Existence of infinitely many connecting orbits in a singularly perturbed vector field and its application to detecting chaotic dynamics, Workshop on Dynamical Systems and Geometry, Pontificia Universidade Catorica do Rio de Janeiro, Rio de Janeiro, Brazil July 31 - August 9, 1996
11. Chaotic solutions in slowly varying perturbations of Hamiltonian systems with applications to shallow water sloshing, Workshop on Conley index theory, Stefan Banach Center, Warsaw, Poland, June 16 - 26, 1997.
12. Homoclinic doubling cascades in vector fields, 4th International Symposium on Dynamical Systems, IMPA, Rio de Janeiro, Brazil, July 29 - August 8, 1997.
13. Connecting orbit structure of monotone solutions in the shadow system, AMS 1997 Fall Southeastern Sectional Meeting, Special Session on ‘Nonlinear Dynamics and Applications’ (Organizer: Y. Yi and W. Shen), Georgia Institute of Technology, Atlanta, USA, October 17 - 19, 1997.
14. A topological approach to singularly perturbed ODEs of slow-fast type, International Conference on Local Differentiable Dynamics, Limburgs Universitair Centrum, Diepenbeek, Belgium, June 15 - 19, 1998.
15. On transition matrices Minisymposium ”Topological Methods and Conley Index” Equadiff 1999 August 1-7, 1999, Free University of Berlin, Germany

16. Conley index and its applications, I & II NCTS Seminar on Dynamical Systems, March 23 & 30, 2000, National Center for Theoretical Sciences, Tsing Hua University, Taiwan
17. Homoclinic doubling cascades in vector fields The Third Asian Mathematical Conference October 23-27, 2000
18. Lorenz-like dynamics in a Lorenz-like family Session on Ordinary Differential Equations and Dynamical Systems BMS-DMV Joint Mathematical Meeting, Liege, Belgium June 8-10, 2001
19. Lorenz-like dynamics in a Lorenz-like family Workshop Global Analysis of Dynamical Systems (in honour of Floris Takens' 60th birthday), Lorentz Center, Leiden University, The Netherlands June 23-27, 2001
20. Singularly degenerate heteroclinic cycles and Lorenz-like dynamics International Conference "New Directions in Dynamical Systems" Satellite Conference of ICM 2002, Beijing, P.R.China Ryukoku University and Kyoto University, Kyoto, Japan August 5-15, 2002.
21. Heteroclinic bifurcations in reversible three-dimensional vector fields, First Japan-Taiwan Conference on Dynamical Systems, National Center of Theoretical Sciences National Tsinghua University, Hsinchu, Taiwan March 21-25, 2005
22. Conley index theory for slow-fast systems and its application to travelling wave solutions in a predator-prey system MSJ-IRI2005 International Conference "Asymptotic Analysis and Singularities" July 18-27, 2005, Sendai International Center, Sendai, Japan
23. Conley-Morse chain complexes and chain maps based on spectral sequences Conference "Dynamics, Topology, and Computations" Mathematical Research and Conference Center, Bedlewo, Poland June 4-10, 2006
24. Rigorous verification of the cocoon bifurcation in the Michelson system International Conference on Bifurcation Theory of Dynamical Systems and Related Topics Peking University, Beijing, China December 15-19, 2006
25. Rigorous computational methods for global dynamics and bifurcations: two examples International Conference "Dynamics in Perturbations" On the occasion of Freddy Dumortier's 60th birthday Hasselt University, Hasselt, April 23-25, 2007 and Koninklijk Vlaamse Academie van België voor Wetenschappen en Kunsten, Brussels, April 26-27, 2007
26. A method for constructing databases for global dynamics of multi-parameter systems Japan-Taiwan Joint Workshop on "Numerical Analysis and Scientific Computations" Department of Mathematics, National Taiwan University, November 7-8, 2009
27. Rigorous Topological Computation of Dynamics and Applications Long-term workshop: Mathematical Sciences and Their Applications, Hotel Rako-Hananoi, Kamisuwa, Nagano, Japan, September 19-October 2, 2010

28. Topological bifurcation theorems for Morse decompositions International Conference "Far-From-Equilibrium Dynamics", RIMS, Kyoto University, Kyoto, Japan, January 4-8, 2011
29. Graph based topological computation for global analysis of dynamical systems Conference on Computational Methods in Dynamics ICTP, Trieste, Italy, July 4-8, 2011
30. Topological-computational methods for analyzing global dynamics and bifurcations IUTAM Symposium on 50 years of chaos, Kyoto University, Japan, November 28 - December 2, 2011

**Doctoral students supervised :**

- Shunsaku Nii (1995), now an associate professor in Kyushu University  
 "An extension of the stability index for travelling wave solutions and its application for bifurcations"
- Masashi Kisaka (1996), now an associate professor in Kyoto University  
 "On the connectivity of Julia sets of transcendental entire functions"
- Masayuki Asaoka (1999), now an associate professor in Kyoto University  
 "Markov covers and finiteness of periodic attractors for diffeomorphisms with a dominated splitting"
- Zin Arai (2003), now an associate professor in Hokkaido University  
 "Tangencies and the Conley index"
- Hiroki Takahashi (2006), now a Lecturer (permanent) in Kyoto University  
 "On the basin problem for Hénon-like attractors"
- Maria Vivien Visaya (2006), now an assistant professor in Ateneo de Manila University, The Philippines  
 "A Lower estimate of the topological entropy from a one-dimensional reconstruction of time series"
- Mitsuru Shibayama (2007), now a Lecturer (permanent) in Osaka University,  
 "Multiple symmetric periodic solutions to the  $2n$ -body problems with equal masses"
- Ippeï Obayashi (2009), now a post-doctoral researcher in Kyoto University,  
 "Exponential decay of correlations for surface semiflows with an expanding direction"
- Kaname Matsue (2010), now an assistant professor in Tohoku University,  
 "Rigorous verification of bifurcations of differential equations via the Conley index theory"