Dr. Arno Berger Curriculum vitae

Department of Mathematical and Statistical Sciences
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Current research interests

Theory and applications of Benford's Law, scale-invariance and -distortion, quantization. Nonautonomous dynamical systems, especially stability, finite-time hyperbolicity and spectral theory. Relations between dynamical systems and probability theory; stochastic aspects of dynamical systems, including qualitative and quantitative descriptions of transition phenomena, e.g. almost automorphy, bifurcations, orbit statistics. Bifurcations and ergodic properties of spatially extended discrete systems, including formation, stability and robustness of special solutions, e.g. waves, fronts, discrete breathers. Applications in classical mechanics and engineering.

Employment

7/07 – present	Associate Professor (tenured since 7/10) Department of Mathematical and Statistical Sciences, University of Alberta, Canada
9/08 – 8/11	Adjunct Fellow Department of Mathematics and Statistics, University of Canterbury, New Zealand
1/05 – 6/07	Humboldt Research Fellow *Nonautonomous Dynamical Systems* Institute of Mathematics, Johann Wolfgang Goethe–Universität, Frankfurt, Germany
2/04 – 6/08	Lecturer in Applied Mathematics; Senior Lecturer from 1/06 Department of Mathematics and Statistics, University of Canterbury, New Zealand
9/02 – 2/03	Research Fellow, European Commission Research and Training Network *Localisation by Nonlinearity and Spatial Discreteness* (Locnet), University of Warwick, Coventry, UK
9/01 – 9/02	Max Kade Research Fellow and Visiting Assistant Professor School of Mathematics, Georgia Institute of Technology, Atlanta GA, USA
10/97 – 1/04	Universitätsassistent (Assistant professor) Institute of Mechanics, Vienna University of Technology, Vienna, Austria
12/95 – 9/97	Doctoral Research Associate for *Nonlinear Stability Theory in Engineering* Grant FWF-P10705, Austrian Science Fund

Education

2/04	Habilitation in Applied Mathematics, Vienna University of Technology Thesis: *Stochastic behaviour of dynamical systems: Concepts and applications*
1/04	Dipl.-Ing. (equiv. MSc) in Applied Mathematics
10/97	Dr. techn. (equiv. PhD), Vienna University of Technology Thesis: *Applications of Conley index theory for proving chaotic behaviour* (in German) Advisor: Prof. H. Troger
12/95	Dipl.-Ing. (equiv. MSc) in Mechanical Engineering
2/95	First Diploma (equiv. BA) in Mathematics
6/94	First Diploma (equiv. BSc) in Mechanical Engineering

Publications

Monographs

[B1]   *An Introduction to Benford's Law* (with T.P. Hill), Princeton University Press, Princeton and Oxford, 2015.

[B2]   *Chaos and Chance*, An Introduction to Stochastic Aspects of Dynamics, deGruyter Textbook, deGruyter, Berlin–New York, 2001.

Articles

[B3]   Most linear flows on $\mathbb{R}^d$ are Benford, *J. Differential Equations* (to appear), 26 pp., 2015.

[B4]   A characterization of Benfords Law in discrete-time linear systems (with G. Eshun), *J. Dynam. Differential Equations* (to appear), 39 pp., 2015.

[B5]   Benford solutions of linear difference equations (with G. Eshun), in: Z. AlSharawi et al. (eds.), *Theory and Applications of Difference Equations and Discrete Dynamical Systems*, Springer Proceedings in Mathematics & Statistics **102** (2014), 23–60.

[B6]   Invariant measures for general induced maps and towers (with R. Zweimüller), *Discrete Contin. Dyn. Syst.* **33** (2013), 3885–3901.

[B7]   A limit theorem for occupation measures of Lévy processes in compact groups (with S.N. Evans), *Stoch. Dyn.* **13** (2013), 1250008, 16 pp.

[B8]   A basic theory of Benford's law (with T.P. Hill), *Probab. Surv.* **8** (2011), 1–126.

[B9]   Finite-state Markov chains obey Benford's law (with T.P. Hill, B. Kaynar and A. Ridder), *SIAM J. Matrix Anal. Appl.* **32** (2011), 665–684.

[B10]   Some dynamical properties of Benford sequences, *J. Difference Equ. Appl.* **17** (2011), 137–159.

[B11]   Benford's law strikes back: no simple explanation in sight for mathematical gem (with T.P. Hill), *Math. Intelligencer* **33** (2011), 85–91.

[B12]   On finite-time hyperbolicity, *Commun. Pure Appl. Anal.* **10** (2011), 963–981.

[B13]   More on finite-time hyperbolicity, *Bol. Soc. Esp. Mat. Apl. S⃗eMA* **51** (2010), 25–32.

[B14]   An improved maximum allowable transfer interval for L^p-stability of networked control systems (with A. Jentzen, F. Leber, D. Schneisgen and S. Siegmund), *IEEE Trans. Automat. Control* **55** (2010), 179–184.

[B15]   A definition of spectrum for differential equations on finite time (with T.S. Doan and S. Siegmund), *J. Differential Equations* **246** (2009), 1098–1118.

[B16]   Scale-distortion inequalities for mantissas of finite data sets (with T.P. Hill and K.E. Morrison), *J. Theoret. Probab.* **21** (2009), 97–117.

[B17]   Nonautonomous finite-time dynamics (with T.S. Doan and S. Siegmund), *Discrete Contin. Dyn. Syst. Ser. B* **9** (2008), 463–492.

[B18]   Counting uniformly attracting solutions of nonautonomous differential equations, *Discrete Contin. Dyn. Syst. Ser. S* **1** (2008), 15–25.

[B19]   Uniformly attracting solutions of nonautonomous differential equations (with S. Siegmund), *Nonlinear Analysis* **68** (2008), 3789–3811.

[B20]   On the distribution of mantissae in nonautonomous difference equations (with S. Siegmund), *J. Difference Equ. Appl.* **13** (2007), 829–845.

[B21]   Newton's Method obeys Benford's Law (with T.P. Hill), *Amer. Math. Monthly* **114** (2007), 588–601.

[B22]   A Characterisation of Newton maps (with T.P. Hill), *ANZIAM J.* **48** (2006), 211–223.

[B23]   Chaos in spatially extended systems via the Peak-Crossing Bifurcation (with L.A. Bunimovich), *Internat. J. Bifur. Chaos Appl. Sci. Engrg.* **15** (2005), 11, 3607–3621.

[B24]   Benford's Law in power-like nonautonomous dynamical systems, *Stoch. Dyn.* **5** (2005), 587–607.

[B25] One-dimensional dynamical systems and Benford's law (with L.A. Bunimovich and T.P. Hill), *Trans. Amer. Math. Soc.* **357** (2005), 197–219.

[B26] Multi-dimensional dynamical systems and Benford's law, *Discrete Contin. Dyn. Syst.* **13** (2005), 219–237.

[B27] Almost automorphic dynamics in symbolic lattices (with S. Siegmund and Y. Yi), *Ergodic Theory Dyn. Syst.* **24** (2004), 677–696.

[B28] A criterion for non-persistence of travelling breathers for perturbations of the Ablowitz–Ladik lattice (with R.S. MacKay and V.M. Rothos), *Discrete Contin. Dyn. Syst. Ser. B* **4** (2004), 911–920.

[B29] On the gap between random dynamical systems and continuous skew products, (with S. Siegmund), *J. Dynam. Differential Equations* **15** (2003), 237–279.

[B30] Propagation of small waves in inextensible strings (with M. Schagerl), *Wave Motion* **35** (2001), 339–353.

[B31] Rigorous error bounds for RK methods in the proof of chaotic behaviour, *J. Comput. Appl. Math.* **111** (1999), 13–24.

Other publications

[B32] A Short Introduction to the Mathematical Theory of Benfords Law (with T.P. Hill), pp. 22–66 in: S.J. Miller (ed.), *The Theory and Applications of Benfords Law*, Princeton University Press, Princeton and Oxford, 2015.

[B33] *R. Taschner: The Continuum*, Book review, *Z. Angew. Math. Mech.* **87** (2007), 257.

[B34] *M. Denker: Einführung in die Analysis dynamischer Systeme*, Book review, *Z. Angew. Math. Mech.* **86** (2006), 251–252.

[B35] *T. Kaczynski, M. Mischaikow, M. Mrozek: Computational Homology*, Book review, *Z. Angew. Math. Mech.* **86** (2006), 334-335.

[B36] *G. H. Choe: Computational Ergodic Theory*, Book review, *Z. Angew. Math. Mech.* **86** (2006), 743–744.

[B37] Dynamics and Digits: On the Ubiquity of Benford's Law, *Proceedings of Equadiff 2003*, World Scientific, Singapore, 2005, 693–695.

[B38] On the regular and chaotic motion of a kicked pendulum: a Markovian approach, *Z. Angew. Math. Mech.* **81** (2001), S611–612.

[B39] On the appropriate treatment of singularly perturbed wave equations (with M. Schagerl), *Z. Angew. Math. Mech.* **81** (2001), S623–624.

[B40] Zur Stabilität eines Doppelpendels mit geradlinig geführtem Endpunkt, *Z. Angew. Math. Mech.* **80** (2000), S335–336.

[B41] Zum praktischen Nachweis von Chaos mit Hilfe der Conley Index Theorie, *Z. Angew. Math. Mech.* **79** (1999), S791–792.

[B42] RK methods and the proof of chaotic behaviour, pp. 11–20 in: P. de Oliveira et al. (eds.), *Proc. of the Second Meeting on Numerical Methods for Differential Equations*, Coimbra, 1998.

Theses

[B43] *Stochastic behaviour of dynamical systems: Concepts and applications*, Habilitation thesis, Vienna University of Technology, 2003.

[B44] *Applications of Conley index theory for proving chaotic behaviour* (in German), PhD thesis, Vienna University of Technology, 1997.

[B45] *Conley index theory and dynamical systems* (in German), MSc thesis in Applied Mathematics, Vienna University of Technology, 1996.

[B46] *On the stability of the retrieval of tethered satellites* (in German), MSc thesis in Mechanical Engineering, Vienna University of Technology, 1995.

Teaching experience

Fall 14	*Introduction to Differential Equations* 3 hrs Undergraduate Course MATH 334 University of Alberta (105 students)
Winter 12	*Honors Advanced Calculus II* 4 hrs Undergraduate Honors Course MATH 317 University of Alberta (16 students)
Fall 11	*Honors Advanced Calculus I* 4 hrs Undergraduate Honors Course MATH 217 University of Alberta (23 students)
Fall 08 – 12, 14	*Calculus III* 3 hrs Undergraduate Course (plus labs) MATH 209 (up to 2 sections) University of Alberta (approx. 150 students per year and section)
Winter 08	*Differential Equations* 3 hrs Undergraduate Course (plus labs) MATH 201 University of Alberta (105 students)
Fall 07, 08, 10, 12	*Ordinary Differential Equations* 3 hrs Graduate Course (plus problem sessions) MATH 524 University of Alberta (approx. 12 students each year)
January 07	*Dynamical Systems* ICE-EM/AMSI Summer School for Honours students and Graduates University of Sydney (10 students)
Summer 06	*Calculus 1* 2 hrs Undergraduate course (plus tutorials and labs) MATH 108W (2 streams) University of Canterbury (117 students)
Winter 06, 07	*Analysis 2* 2 hrs Undergraduate course (plus tutorials) MATH 243 University of Canterbury (approx. 25 students)
Summer 05	*Linear Algebra 2* 4 hrs Undergraduate course (plus tutorials and labs) MATH 254/EMTH 204 University of Canterbury (73 students)
February 05	*Conley Index Theory* Short course for graduate students and faculty Johann Wolfgang Goethe–Universität Frankfurt (5 participants)
Summer 04 – 07	*Matrix Algebra II* 2 hrs Undergraduate course (plus tutorials) MATH 252/EMTH 203 University of Canterbury (approx. 120 students each year) *Hilbert Spaces* 2 hrs Honours course (plus weekly problem class) MATH 420 University of Canterbury (approx. 10 students each year)
Winter 04, Summer 06	*Partial Differential Equations* 2 hrs Undergraduate course (plus tutorials) MATH 361 University of Canterbury (approx. 45 students each year)
Summer 02	*Stochastic Aspects of Dynamics* 3 hrs Graduate course MATH 8803 Georgia Institute of Technology (14 students)
Spring 99 – 01, 03	*Chaos and Chance* 3 hrs Graduate course (plus tutorials) for mathematicians, physicists and engineers Vienna University of Technology (approx. 10 students each year)

Spring 98 – 01	*Mechanics of Solids 2B*
	Graduate course for engineers, mathematicians and physicists
	Vienna University of Technology (approx. 50 students each year)
Fall 97 – 00	*Mechanics of Solids 2A*
	Compulsory final year undergraduate course
	Vienna University of Technology (approx. 100 students each year)

Student supervision and mentoring

At the University of Alberta:

C. Shan	2/15 – present	PostDoc in Applied Mathematics (teaching mentor)
J. Mitra	5/14 – 8/14	NSERC USRA student (supervisor)
A. Duh	1/14 – 7/14	Honors project in Applied Mathematics, Research assistant (supervisor)
C. Prosko	5/14 – 8/14	NSERC USRA student (supervisor)
E. Ihekwoaba	3/14 – present	MSc studies in Applied Mathematics (supervisory committee member)
E. al Dabbas	4/13 – present	PhD studies in Pure Mathematics (supervisory committee member)
A. Wynne	1/13 – present	MSc studies in Pure Mathematics (supervisor)
C. Xu	1/13 – present	PhD studies in Applied Mathematics (supervisor)
M. Akinwumi	1/13 – present	PhD studies in Applied Mathematics (teaching mentor)
S. Ye	5/12 – 8/12	NSERC USRA student (supervisor)
G. Eshun	9/11 – 7/14	MSc studies in Applied Mathematics (supervisor)
J. Zielinski	1/11 – 4/11	Honors project in Applied Mathematics (co-supervisor)
F. Li	9/08 – 11/10	MSc studies in Applied Mathematics (supervisor)
Z. Shuai	9/07 – 8/10	PhD studies in Applied Mathematics (co-supervisor)
M. Niksirat	5/08 – 8/08	summer project on differential equations (supervisor)

MSc committee: P. Conner (University of Alberta, 7/14)

L. Jiang (University of Alberta, 6/14)

B. Okeke (University of Lethbridge, 11/13; external examiner)

I. Guzman Aybar (University of Alberta, 9/13)

Z. Ye (University of Alberta, 7/13)

A. Biglands (University of Alberta, 8/09)

L.-Y. Hsieh (University of Victoria, 9/08; external examiner)

PhD committee: K. Schlitt (University of Alberta, 9/14)

K. Tikhomirov (University of Alberta, 11/13)

P. Deghani (University of Alberta, 5/11)

G. Del Magno (Georgia Institute of Technology, 6/02)

Graduate committee: member 7/09 – 6/12 and 7/14 – present,

Teaching awards committee: member 7/14 – present,

AMI graduate lecture award committee: member 3/08 – present.

At the University of Canterbury:

P.-T. Dinh   7/05 – 3/06   Honours project and thesis in ergodic theory (supervisor)

Honours project committee: member 9/05 – 9/06.

Informal mentoring of students in Germany on dynamics and control theory, and students in Brazil, Cuba, The Netherlands, and USA on Benford's Law.

Professional service

Regular referee for *Discrete Contin. Dyn. Syst. Ser. A, B* and *S, J. Differential Equations, Ann. Probab, Found. Comput. Math., Proc.* and *Trans. Amer. Math. Soc., Nonlinear Analysis, J. Dynam. Differential Equations, Stoch. Dyn., Chaos, Nonlinearity.*

Incidental referee for *Amer. Statist., J. Math. Biology, Acta Mechanica, Appl. Math Lett., Aquat. Bot., Carpathian J. Math., Integers, Math. Social Sci., New Zealand J. Math., Physica A, J. Dyn. Syst. Differ. Equ., Nonlin. Sci. and Numer. Sim, Unif. Distrib. Theory.*

Regular reviewer for *Math. Reviews.*

Reviewer of three NSERC Discovery Grant Applications since 1/10.

Benford Online Bibliography: establishing and maintaining the world's most comprehensive online research resource and bibliography on Benford's Law (`www.benfordonline.net`, freely accessible since 7/09, approx. 15,000 page views/month on average).

Service to Department and Faculty:

at the University of Alberta: Library committee member 7/09 – 6/11, chair 7/11 – present, Member of 8 hiring committees in Applied Mathematics since 10/07, Faculty Evaluation Committee, Faculty of Science, elected member 7/12 – 6/14.

at the University of Canterbury: Departmental enrolment coordinator 1/06 – 12/06.

Organisation of meetings and programmes

Special session on *Dynamical Systems*, 2011 CMS Summer Meeting, Edmonton AB, Canada, 6/11: co-organiser (with H. Wang)

Minisymposium *Recent Advances in Nonautonomous Dynamics*, SIAM conference on Applications of Dynamical Systems, Snowbird UT, USA, 5/11: co-organiser (with C. Pötzsche)

NZIMA/NZMRI Summer program and workshop on *Dynamical Systems*, Raglan, New Zealand, 1/11: co-organiser (with V. Kirk and R. Murray)

Special session on *Nonautonomous Dynamical Systems*, 8th AIMS conference, Dresden, Germany, 5/10: co-organiser (with R. Johnson and S. Novo)

Special session on *Dynamical Systems*, 1st AMS-NZMS conference, Wellington, NZ, 12/07: co-organiser (with R. Murray and M. Nicol)

DFG programme SPP1305 *Regelungstheorie digital vernetzter dynamischer Systeme*, (initial phase 7/07–6/10): member

Grants

4/09 – 3/16	NSERC Discovery Grant Individual – *Quantitative aspects of dynamical systems* (CAD$ 18,000 p.a.)
4/08 – 3/09	NSERC Discovery Grant Individual – *The dynamics of digits* (CAD$ 16,000)
7/07 – 6/10	DFG travel grant under programme SPP 1305 (approx. CAD$ 16,000)
7/07 – 6/10	University of Alberta Fac. Sci. Start-up grant (CAD$ 40,000)
1/05 – 6/07	HUMBOLDT Research Fellowship – *Structures of Nonautonomy* (approx. CAD$ 44,000)
2/04 – 6/07	various University of Canterbury travel grants (total approx. CAD$ 9,000)
9/01 – 8/02	MAX KADE Research Fellowship – *Mechanisms of Chaos* (US$ 48,800)
12/95 – 9/97	Austrian Science Fund Doctoral Research Grant – *Nonlinear Stability Theory in Engineering* (approx. CAD$ 35,000)

Honors and awards

1/14	Department of Mathematical and Statistical Sciences Teaching Award
7/08	*Best JDEA paper in 2007* award for [B20], awarded by ISDE
4/04	HUMBOLDT fellowship awarded by the Alexander von Humboldt Foundation, Germany
12/00	MAX KADE fellowship awarded by the Austrian Academy of Sciences
12/97	Award of the Secretary of State for Science, Austria
10/97	*Promotio sub auspiciis praesidentis rei publicae* (doctoral degree awarded with highest national honors)

Lectures at Conferences and Universities (since 2006)

Invited lectures and seminar talks

11/13	Colloquium, Department of Mathematics and Computer Science, University of Lethbridge, Canada
6/13	Ergodic theory seminar, University of Vienna, Austria
5/13	Intl. Conference on Difference Equations and Applications, Sultan Qaboos University, Muscat, Oman
5/13	AG Differentialgleichungen, J.W. Goethe Universität, Frankfurt, Germany
3/13	Conference on Dynamics of Differential Equations, Georgia Tech, Atlanta, USA
6/12	Mathematics Seminar, Alpen-Adria-Universität, Klagenfurt, Austria
7/11	Butler Memorial Conference on Differential Equations and Population Biology, University of Alberta, Edmonton, Canada
6/10	Amsterdam Econometric Seminar, Tinbergen Institute, Amsterdam, The Netherlands
6/10	SIAM Conference on Emerging Topics in Dynamical Systems, Barcelona, Spain
5/10	Minisymposion *Nonautonomous Dynamical Systems* 8th AIMS Conference on Dynamical Systems and Differential Equations, Dresden, Germany
5/10	AG Differentialgleichungen, J.W. Goethe Universität, Frankfurt, Germany
12/09	Dynamical Systems Seminar, TU Munich, Germany

7/09	Oberseminar Analysis, Dresden University of Technology, Germany
6/09	Dynamical Systems Seminar, Vienna University of Technology, Austria
5/09	North-South meeting, Reed Deer College, AB, Canada
4/09	Mathematics Colloquium, CalPoly, San Luis Obispo, USA
1/09	Workshop on Dynamics and Statistics of Extended Systems, BIRS, Banff, Canada
9/08	Intl. Conference on Infinite Dimensional Dynamical Systems, York University, Toronto, Canada
8/08	Northwest Dynamics Symposium III, University of Victoria, Victoria, Canada
3/08	Dynamics Seminar, University of Victoria, Victoria, Canada
12/07	Workshop on Applications of Benford's Law, Santa Fe, USA
7/07	Workshop on Dynamical Systems and Number Theory, Strobl, Austria
5/07	Stochastics Colloquium, University of Utrecht, The Netherlands
11/06	Mathematics Seminar, University of New South Wales, Sydney, Australia
8/06	Workshop on Measurable Dynamics, BIRS, Banff, Canada
6/06	Minisymposion *Nonautonomous Dynamical Systems* 6th AIMS Conference on Dynamical Systems and Differential Equations, Poitiers, France
6/06	Colloquium, Vienna University of Technology, Austria
3/06	Dynamical Systems Seminar, University of Alberta, Edmonton, Canada

Conferences and other presentations

6/15	CMS Summer Meeting, University of Prince Edward Island, Charlottetown, Canada
6/11	CMS Summer Meeting, University of Alberta, Edmonton, Canada
1/11	NZIMA/NZMRI Summer Workshop on Dynamical Systems, Raglan, New Zealand
12/10	CMS Winter Meeting, University of British Columbia, Vancouver, Canada
6/09	Intl. conference on Non-autonomous and Stochastic Dynamical Systems, Sevilla, Spain
12/08	Joint AustMS-NZMS Meeting, University of Canterbury, Christchurch, New Zealand
12/07	Joint AMS-NZMS Meeting, Victoria University, Wellington, New Zealand
12/06	NZ Mathematics Colloquium 2006, University of Waikato, Hamilton, New Zealand