David J. Albers

CURRICULUM VITAE

May 2007

David J. Albers
Date of Birth: 20 February 1975
Place of Birth: Madison, WI, USA

University of California-Davis
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RESEARCH INTERESTS: dynamical systems (both abstract and computational); learning theory; game theory; ergodic theory; random matrix theory; random dynamical systems; computational fluid mechanics, rank-one theory, computational differential geometry; information geometry.

EDUCATION:

PhD in Physics with minor in Mathematics: University of Wisconsin, Madison - 8/04
M.A. in Physics: University of Wisconsin, Madison - 12/02
B.S. in Physics and Mathematics: University of Wisconsin, Madison - 5/98

AWARDS AND FELLOWSHIPS:

Max Planck Institute Postdoctoral Fellowship 2005

Santa Fe Institute NSF Physics Graduate Fellowship, Spring/Summer 2000

Van Vleck Graduate Fellowship, 1998

Hilldale Undergraduate Research Fellowship, 1996

RESEARCH EXPERIENCE:

Postdoctoral Scholar - under James P. Crutchfield, University of California-Davis - 3/07 - present

Postdoctoral Fellow - Max Planck Institute for Mathematics in the Sciences - 2/05 - 2/07

Postdoctoral Scholar - under James P. Crutchfield, University of California-Davis - 9/04-1/05

Santa Fe Institute Graduate Fellow under James P. Crutchfield, Santa Fe Institute - Santa Fe, NM - 6/02 - 9/02, 3/03, 5/03 - 9/03, 1/04 - 8/04

NSF Physics Graduate Fellow at the Santa Fe Institute - Santa Fe, NM - 3/00 - 8/00

Research Assistant under Professor J. C. Sprott, University of Wisconsin-Madison, Department of Physics - 7/99 - 2/00, 8/00 - 1/01

Lab Technician (physical chemistry) under Professor George Zografi, University of Wisconsin-Madison, School of Pharmacy - 5/96 to 5/98

Lab Technician (organic chemistry) under Professor Charles Sih, University of Wisconsin-Madison, School of Pharmacy - 5/93 to 9/97

TEACHING EXPERIENCE:

Teaching Assistant, Introductory Physics with and without calculus, undergraduate laboratory, University of Wisconsin-Madison. Department of Physics - 9/98 - 12/98, 1/01 - 1/03

Head Teaching Assistant, Introductory Physics, under Professors Ugo Camerini and Paul Quin, University of Wisconsin-Madison, Department of Physics - 1/99 - 5/99

Teaching Assistant Trainer with Steve Peterson, University of Wisconsin-Madison, Department of Physics - 8/02

Student Hourly updating undergraduate physics lab manuals under Professor U. Camerini, University of Wisconsin, Department of Physics - 7/97 to 6/99

COMMITTEES, SOCIETIES, AND PROFESSIONAL SERVICE:

Member of the American Mathematical Society, the American Physical Society
Member of the teaching assistant evaluation committee, University of Wisconsin Department of Physics, fall 1999, fall 2000
Referee for Nonlinearity, Physics Letters A, and Chaos

PUBLICATIONS:

1. Albers, D. J., Sprott, J. C., "Probability of local bifurcation type from a fixed point: A random matrix perspective" J. Stat. Phys. 125 (2006) 885-921

2. Albers, D. J., Sprott, J. C., Crutchfield, J. P., "Persistent Chaos in High Dimensions" Phys. Rev. E 74 (2006) 057201

3. Albers, D. J., Sprott, J. C., "Routes to chaos in high-dimensional dynamical systems: a qualitative numerical study" Physica D 223 (2006) 194-207

4. Albers, D. J., Sprott, J. C., "Structural Stability and Hyperbolicity Violation in Large Dynamical Systems," Nonlinearity 19 (2006) 1801-1847

5. Albers, D. J, 2004. "A qualitative numerical study of high-dimensional dynamical systems," PhD thesis, University of Wisconsin-Madison.

6. Dechert, W. D., Sprott, J. C., Albers, D. J., 1999. "On the Probability of Chaos in Large Dynamical Systems: A Monte Carlo Study," J. Econ. Dynamics and Control, 23 1197-1205

7. Albers, D. J., Sprott, J. C., Dechert, W. D., 1998. "Routes to Chaos in Artificial Neural Networks with Random Weights," Int. J. Bifurcation and Chaos 8, 1463-1478

8. Albers, D. J., Sprott, J. C., Dechert, W. D., 1996. "Dynamical Behavior of Artificial Neural Networks with Random Weights," in Intelligent Engineering Systems Through Artificial Neural Networks, ed. by C. H. Dagli, M. Akay C. L. P. Chen, B. R. Fernandez, and J. Grosh, vol. 6 of Artificial Neural Networks in Engineering, pp. 17-22. ASME Press, New York

Submitted or to be submitted:

Shalizi, Cosma R., Albers, D. J., "Symbolic Dynamics for Discrete Adaptive Games,"

Albers, D. J., J. P. Crutchfield, and Sprott, J. C., "Marco-geometric variation in high-dimensional, high-entropy dynamical systems"

Albers, D. J., Sato, Y., Crutchfield, J.P., Sprott, J. C., "On the number of attractors for an ensemble of universal mappings"

Albers, D. J., Sprott, J. C., Crutchfield, J.P., "Phenomenological Scaling in the Organization of High-dimensional Dynamics"

Albers, D. J., Atay, F. M, "Continuous space representations using time-delay systems: entropy, dimension, state mixing and time-rescaling"

PRESENTATIONS:

At international meetings:

Invited speaker, "Identification and variation of the number of attractors in an ensemble of high-dimensional dynamical systems," at the International Conference of the Dynamics of Complex Systems: mathematical modeling, method, and prediction, in honor of Y. Pesin and Y. Takahashi on their 60^{th} birthdays, University of Hokkaido (in Sapporo Japan), March 20, 2007

"Multiagent Dynamical Systems with Reinforcement Learning," at Dynamics Days - 23^{rd} Annual International Conference on Nonlinear Dynamics and Complex Systems, Chapel Hill, North Carolina, Jan. 2-5, 2004

"Dynamical Behavior of Neural Networks with Random Weights," at Artificial Neural Networks, Fuzzy Logic and Evolutionary Programming for Designing Smart Engineering Systems, St. Louis, Missouri, Nov. 10-13, 1996

At the Max Planck Society:

Invited speaker, "On the variation of the number of attractors in high-dimensional dynamical systems" at the Max Planck Institute for the Physics of Complex Systems, Dresden, Germany, 12/7/06

"Toward a solution to a problem of Poincaré: A Macro-analysis of geometric variation of high-dimensional dynamics," at the Max Planck Institute for Mathematics in the Sciences, Leipzig Germany, 7/20/06

"A Potpourri of Recent Results in High-Dimensional Dynamical Systems" at the Max Planck Institute for Mathematics in the Sciences, Leipzig, Germany, 9/22/05

Invited speaker, "Persistent Chaos in High-Dimensional Neural Networks: A Computational Perspective" at the Max Planck Institute for the Physics of Complex Systems, Dresden, Germany, 4/15/05

"Persistent Chaos in High-Dimensional Neural Networks" at the Max Planck Institute for Mathematics in the Sciences, Leipzig, Germany, 2/20/05

At the University of Wisconsin Madison:

"What the heck is a Pugh-Shub" at the Chaos and Complexity Series Group, University of Wisconsin-Madison, 11/4/03

"Modeling Phenomena with Mathematics" at the Chaos and Complexity Series Group, University of Wisconsin-Madison, 10/14/02

"Symbolic Dynamics of the Fixed-Position, Non-Equilbrium Farmer-Joshi Market Model" at the Chaos and Complexity Series Group, University of Wisconsin- Madison, 10/31/00

"Routes of Chaos in Neural Networks with Random Weights," at the Chaos and Complexity Series Group, University of Wisconsin- Madison, 10/28/97

"Dynamical Behavior of Neural Networks with Random Weights," at the Chaos and Complexity Seminar Series, University of Wisconsin-Madison, 10/29/96

At the Santa Fe Institute:

Invited speaker, "Persistence of dynamics in high-dimensional dynamical systems," 1/11/06

"Generic Dynamical Behaviors and Transitions along Curves in Parameter Space in Various Sets of Mappings: A Potpourri of Confusing Results," 2/24/04

"Structural Stability and Partial Hyperbolicity in Large Dynamical Systems," 7/22/03

"Robustness and Structural Stability in Dynamical Systems," 10/22/02

Other locations:

Invited speaker, "Recent results regarding geometric variation in high-dimensional dynamical systems," at the University of Hokkaido (in Sapporo Japan) Center for Research Institute for Electronic Science (RIES) and Department of Mathematics, 9/12/06.

Invited speaker, "Toward a solution to a problem of Poincaré: A Macro-analysis of geometric variation of high-dimensional dynamics," at the University of California Davis Center for Computational Science and Engineering, 6/21/06

Invited speaker, "A Dynamics Stability Conjecture," at University of Colorado Boulder Applied Math Group, 1/22/04

COMPUTING SKILLS:

PROGRAMMING LANGUAGES: C, C++, BASIC

OPERATING SYSTEMS: Unix (Linux, BSD, OSX, Solaris, Digital Unix), Mac OSX and OS 9, Microsoft Windows (all versions)

MISC: HTML programming, LaTeX, MatLab (Octave), Mathematica, System administration

RESEARCH FOCI:

My research has two particular areas of focus, dynamical systems and learning theory.

Dynamical systems:

My work with dynamical systems consists largely of statistical studies of the qualitative behavior of high-dimensional dynamical systems. In particular, I am interested in understanding the geometric mechanisms that yield persistent, chaotic dynamics and the existence of Lyapunov exponents. The set of mappings I use for many of the above investigations consist of scalar, feedforward neural networks. However, I also use both

standard time-delay systems, and many low-dimensional, prototypical examples when they can be shown meaningful to the problem I am attempting to solve. One current focus involves utilizing renormalization groups to forge a connection between PDE-like systems and standard time-delay systems. Another project I am currently engaged in involves applying rank-one theory to a fluid PDE-system representing the polar-night-jet in atmospheric dynamics.

Learning theory:

My original interest in learning theory stems from several applied problems in dynamical systems (e.g., attractor and dynamical reconstruction), as well as working towards a geometric and dynamical understanding of learning algorithms. To this end I am studying, in a game theoretic framework, the different dynamics, information capacities, and success of different learning schemes. Examples of learning schemes under consideration are reinforcement learning, simulated annealing, neural networks, and epsilon machine learning. There are many problems that I intend to address using the aforementioned framework, a partial list includes: ecology of different agents with different learning schemes in a multi-agent dynamical system; a geometric understanding of the dynamics of these multi-agent dynamical systems; and a more fundamental understanding of how information is held and processed within various learning schemes. This approach to learning theory is addressed within a multi-agent, complex systems construction.

REFERENCES:

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