

CURRICULUM VITAE

Edward Ott

Distinguished University Professor of Electrical Engineering and of Physics

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I. Education:

B.S. 1963 Electrical Engineering, The Cooper Union
 M.S. 1965 Electrophysics, Polytechnic University
 Ph.D. 1967 Electrophysics, Polytechnic University

II. Experience

1967-1968 NSF Postdoctoral Fellow
 Department of Applied Mathematics and Theoretical Physics
 Cambridge University, Cambridge, U.K.

1968-1979 Faculty of the Department of Electrical Engineering
 Cornell University, Ithaca, NY

1976 and
 1971-1972 Plasma Physics Division
 Naval Research Laboratory, Washington, D.C.

1985 Institute for Theoretical Physics
 University of California
 Santa Barbara, CA

1979-Present Department of Electrical and Computer Engineering, and
 Department of Physics
 University of Maryland, College Park, MD

III. Publications

Professor Ott is an author of over 450 papers in refereed scientific journals.

He is the author of the book *Chaos in Dynamical Systems* (Cambridge University Press), a graduate level textbook also widely used by researchers in the field (over 6000 Google Scholar citations) and an editor of the book *Coping with Chaos* (John Wiley).

According to Google Scholar, Prof. Ott has received over 58,600 citations and has an h-index of 109. According to the ISI Web of Science, Prof. Ott's journal articles have received over 33,800 citations with a corresponding h-index of 91. (Note: For these citation and h-index data, papers have been filtered out if they list E.Ott as an author, but the E. Ott listed is not Edward Ott of the University of Maryland).

IV. Honors and Awards

Fellow, American Physical Society

Fellow, IEEE

Fellow, SIAM

Original member, ISI/Thompson-Scientific Highly Cited Researchers Database

University of Maryland, Certificate of Teaching Excellence

University of Maryland, Engineering College Research Award

Naval Research Laboratory Research Publications Award

Distinguished University Professor, University of Maryland

Yuen Sang and Yuen Kit So Professor, University of Maryland

2014 Julius Edgar Lilienfeld Prize (from the American Physical Society) "For pioneering contributions in nonlinear dynamics and chaos theory that have been uniquely influential for physicists and scientists working in many fields."

2016 Citation Laureate in Physics (with C. Grebogi and J.A. Yorke; from Thompson-Reuter) "For their development of a control theory of chaos." [From Wikipedia: "Thompson Reuters Citation Laureates is a list of candidates considered likely to win the Nobel Prize in their respective field."]

2017 Lewis Fry Richardson Medal (from the European Geosciences Union) "...for pioneering contributions in the theory of chaos with applications to ...kinematic dynamos and ... weather forecasting." Also, referring to Ott's work on weather forecasting, "... this highly original approach is widely used in operational weather prediction."

2017 Jürgen Moser Lecture/Award (from the Society for Industrial and Applied Mathematics) "...for his extensive and influential contributions to nonlinear dynamics, including seminal work on chaos theory and on the dynamics of physical systems."

V. Publications in Refereed Journals Since 2015

1. "Estimating Forecast Model Bias in Coupled Global and Limited-Area Models,"

- Matthew Kretschmer, Brian R. Hunt, and Edward Ott, *Tellus A* **67**, 28040 (2015); doi: 10.3402/tellusa.v67.28040.
2. “Impact of Imperfect Information on Network Attack,” Andrew Melchionna, Jesus Caloca, Shane Squires, Thomas M. Antonsen, Edward Ott, and Michelle Girvan, *Phys. Rev. E* **91**, 082807 (2015); doi: 10.1103/PhysRevE.91.032807.
 3. “Apparent Topologically Forbidden Interchange of Energy Surfaces under Slow Variation of a Hamiltonian,” Zhixin Lu, Christopher Jarzynski, and Edward Ott, *Phys. Rev. E* **91**, 052913 (2015); doi: 10.1103/PhysRevE.91.052913.
 4. “Frequency Assortativity Can Induce Chaos in Oscillator Networks,” Per Sebastian Skardal, Juan G. Restrepo, and Edward Ott, *Phys. Rev. E* **91**, 060902 (2015); doi: 10.1103/PhysRevE.91.060902.
 5. “Random Coupling Model for the Radiation of Irregular Apertures,” Gabriele Gradoni, Thomas M. Antonsen, and Edward Ott, *Radio Sci.* **50**, 678 (2015); doi: 10.1002/2014RS005577.
 6. “Data Assimilation Using a Climatologically Augmented Local Ensemble Transform Kalman Filter,” Matthew Kretschmer, Brian R. Hunt, and Edward Ott, *Tellus A* **67**, 26617 (2015); doi: 10.3402/tellusa.v67.26617.
 7. “Defining Chaos,” Brian R. Hunt and Edward Ott, *Chaos* **25**, 097618 (2015); doi: 10.1063/1.4922973.
 8. “A Statistical Model for the Excitation of Cavities through Apertures,” Gabriele Gradoni, Thomas M. Antonsen, Steven M. Anlage, and Edward Ott, *IEEE Trans. EMC* **57**, 1029 (2015); doi: 10.1109/TEMC.2015.2421346.
 9. “Uncertainty as to Whether or Not a System Has a Chaotic Attractor,” Madhura Joglekar, Edward Ott, and James A. Yorke, *Nonlinearity* **28**, 3803 (2015); doi: 10.1088/0951-7715/28/11/3803.
 10. “A Composite State Method for Ensemble Data Assimilation with Multiple Limited-Area Models,” Matthew Kretschmer, Brian R. Hunt, Edward Ott, Craig H. Bishop, Sabrina Rainwater, and Istvan Xunyogh, *Tellus A* **67**, 26495 (2015); doi: 10.3402/tellusa.v67.26495.
 11. “Dynamical Transitions in Large Systems of Mean-Field-Coupled Landau-Stuart Oscillators: Extensive Chaos and Cluster States,” Wai Lim Ku, Michelle Girvan, and Edward Ott, *Chaos* **25**, 123122 (2015); doi: 10.1063/1.4938534.
 12. “Focusing Waves at Arbitrary Locations in a Ray-Chaotic Enclosure Using Time-Reversed Synthetic Sonas,” Bo Xiao, Thomas M. Antonsen, Edward Ott, and Steven M. Anlage, *Phys. Rev. E* **93**, 052205 (2016); doi: 10.1103/PhysRevE.93.052205.
 13. “Echo Behavior in Large Populations of Chemical Oscillators,” Tianran Chen, Mark R.

- Tinsley, Edward Ott, and Kenneth Showalter, *Phys. Res. X* **6**, 041054 (2016); doi: 10.1103/PhysRevX.6.041054.
14. “Inhibitory Neurons Promote Robust Critical Firing Dynamics in Networks of Integrate-and-Fire Neurons,” Zhixin Lu, Shane Squires, Edward Ott, and Michelle Girvan, *Phys. Rev. E* **94**, 062309 (2016); doi: 10.1103/PhysRevE.94.062309.
 15. “Intermodulation in Nonlinear SQUID Metamaterials: Experiment and Theory,” Daimeng Zhang, Melissa Trepanier, Thomas Antonsen, Edward Ott, and Steven M. Anlage, *Phys. Rev. B* **94**, 174507 (2016); doi: 10.1103/PhysRevB.94.174507.
 16. “Feedback Control Stabilization of Critical Dynamics via Resource Transport on Multilayer Networks: How Glia Enable Learning Dynamics in the Brain,” Yogesh S. Virkar, Woodrow L. Shew, Juan G. Restrepo, and Edward Ott, *Phys. Rev. E* **94**, 042310 (2016); doi: 10.1103/PhysRevE.94.042310.
 17. “Resynchronization of Circadian Oscillators and the East-West Asymmetry of Jet-Lag,” Zhixin Lu, Levin Klein-Cardena, Steven Lee, Thomas M. Antonsen, Michelle Girvan, and Edward Ott, *Chaos* **26**, 094811 (2016); doi: 10.1063/1.4954275.
 18. “Using Machine Learning to Replicate Chaotic Attractors and Calculate Lyapunov Exponents from Data,” Jaideep Pathak, Zhixin Lu, Brian R. Hunt, Michelle Girvan, and Edward Ott, *Chaos* **27**, 121102 (2017); doi: 10.1063/1.5010300.
 19. “Experimental Study of Quantum Graphs with Simple Microwave Networks: Non-Universal Features,” Z. Fu, T. Koch, T. M. Antonsen, E. Ott, and S. M. Anlage, *Acta Phys. Pol. A* **132**, 1655 (2017); doi: 10.12693/APhysPolA.132.1655.
 20. “Nonlinear Wave Chaos: Statistics of Second Harmonic Fields,” Min Zhou, Edward Ott, Thomas M. Antonsen Jr., and Steven M. Anlage, *Chaos* **27**, 103144 (2017); doi: 10.1063/1.4986499.
 21. “Uncovering Low Dimensional Macroscopic Chaotic Dynamics of Large Finite Size Complex Systems,” Per Sebastian Skardal, Juan G Restrepo, and Edward Ott, *Chaos* **27**, 083121 (2017); doi: 10.1063/1.4986957.
 22. “Coherent Oscillations of Driven rf SQUID Metamaterials,” Melissa Trepanier, Daimeng Zhang, Oleg Mukhanov, V. P. Koshelets, Philipp June, Susanne Butz, Edward Ott, Thomas M. Antonsen, Alexey V. Ustinov, and Steven M. Anlage, *Phys. Rev. E* **95**, 050201 (2017); doi: 10.1103/PhysRevE.95.050201.
 23. “Frequency and Phase Synchronization in Large Groups: Low Dimensional Description of Synchronized Clapping, Firefly Flashing, and Cricket Chirping,” Edward Ott and Thomas M. Antonsen, Jr., *Chaos* **27**, 051101 (2017); doi: 10.1063/1.4983470.
 24. “Modeling the Network Dynamics of Pulse-Coupled Neurons,” Sarthak Chandra, David Hathcock, Kimberly Crain, Thomas M. Antonsen, Michelle Girvan, and Edward Ott,

- Chaos **27**, 033102 (2017); doi: 10.1063/1.4977415.
25. “Reservoir Observers: Model-Free Inference of Unmeasured Variables in Chaotic Systems,” Zhixin Lu, Jaideep Pathak, Brian Hunt, Michelle Girvan, Roger Brockett, and Edward Ott, Chaos **27**, 041102 (2017); doi: 10.1063/1.4979665.
 26. “Using Machine Learning to Replicate Chaotic Attractors and Calculate Lyapunov Exponents,” Jaideep Pathak, Zhixin Lu, Brian R. Hunt, Michelle Girvan, and Edward Ott, Chaos **27**, 121102 (2017).
 27. “Model-Free Prediction of Large Spatiotemporally Chaotic Systems from Data: A Reservoir Computing Approach,” Jaideep Pathak, Brian Hunt, Michelle Girvan, Zhixin Lu, and Edward Ott, Phys. Rev. Lett. **120**, 024102 (2018); doi: 10.1103/PhysRevLett.120.024102
 28. “Hybrid Forecasting of Chaotic Processes: Using Machine Learning in Conjunction with a Knowledge-Based Model,” Jaideep Pathak, Alex Wikner, Rebeckah Fussell, Sarthak Chandra, Brian R. Hunt, Michelle Girvan, and Edward Ott, Chaos **28**, 041101 (2018).
 29. “Attractor Reconstruction by Machine Learning,” Zhixin Lu, Brian R. Hunt and E. Ott, Chaos **28**, 061104 (2018).
 30. “Continuous versus Discontinuous Transitions in the D-Dimensional Generalized Kuramoto Model: Odd D is Different,” S. Chandra, M. Girvan, and E. Ott, Phys. Rev. X **9**, 011002 (2019).
 31. “Revealing Underlying Universal Wave Fluctuations in a Scaled Ray Chaotic Cavity with Remote Injection,” B. Xiao, T. M. Antonsen, E. Ott, Z. B. Drikas, J. G. Gil, and S. M. Anlage, Phys. Rev. E **97**, 062220 (2018).

C. Books

1. Chaos in Dynamical Systems by E. Ott (Cambridge University Press, 1993). [over 6000 citations in Google Scholar].
2. Coping with Chaos, edited by E. Ott, T. Sauer, and J. A. Yorke (John Wiley & Sons, 1994).

D. Patents

1. Plasma Heating with Intense Pulsed Ion Beams, United States Patent 4, 115, 191 (Sept. 19, 1978) (with W. M. Manheimer).

2. Quasioptical Gyroklystron, United States Patent 4, 491, 765 (Jan. 1, 1985) (with W. M. Manheimer and A. Bondeson).

E. Other

1. The Beauty of Order and Chaos, exhibit at Fine Arts Museum of Long Island, NY, April 1 – June 24, 1990.
2. A chaos art show, “Radical Science Stuff,” assembled by The Museum of Discovery and Science, Ft. Lauderdale, FL, has circulated through about 18 art museums and science museums nationally. This show includes some Grebogi-Ott-Yorke computer generated pictures. Similar exhibits appeared with Grebogi-Ott-Yorke pictures at the Baltimore Science Museum and at the Science Museum in San Francisco, CA.
3. A chaos exhibition, “A Chaos of Delight: Artists and Scientists Seek an Understanding of Their World” at The Delaware Center for the Contemporary Arts, Feb. 2 – March 17, 1996.

VIII. Ph.D. Theses Advised:

1. Thomas M. Antonsen, Ph.D. (Cornell University) 1977, “Theoretical Problems in Plasma Heating.”
2. Alice L. Newman, Ph.D. (Cornell University) 1979, “Nonlinear Simulation of Type I Irregularities in the Equatorial Electrojet.”
3. Paul T. Bonoli, Ph.D. (Cornell University) 1980, “Toroidal and Scattering Effects on Lower Hybrid Wave Propagation in Tokamaks.”
4. John A. Swegle, Ph.D. (Cornell University) 1980, “An Investigation of $\mathbf{E} \times \mathbf{B}$ -Type Equilibria in Magnetically Insulated Structures.”
5. Thomas P. Hughes, Ph.D. (Cornell University) 1981, “Nonlinear Waves on Charged Particle Beams.”
6. David A. Russell, Ph.D. (Cornell University) 1981, “Problems in Deterministic Chaotic Behavior in Plasma Physics.”
7. James D. Hanson, Ph.D. (University of Maryland) 1982, “An Alpha Particle Driven Alfvén Wave Instability in a Tandem Mirror Reactor.”
8. Spilios Riyopoulos, Ph.D. (University of Maryland) 1983, “Waves and Turbulence in Plasmas.”

9. Reggie Brown, Ph.D. (University of Maryland) 1985, "Dynamics in the Chaotic Regime: Ergodic Adiabatic Invariants and Power Spectra of Period Doubling Cascades."
10. Peter M. Battelino, Ph.D. (University of Maryland) 1987, "Three Frequency Quasiperiodicity, Torus Break-up, and Multiple Coexisting Attractors in a High Dimensional Dissipative System."
11. Bai-Sig Park, Ph.D. (University of Maryland) 1988, "Dimension of Fractal Basin Boundaries."
12. Siegfried Bleher, Ph.D. (University of Maryland) 1989, "Chaotic Dynamics of Open Hamiltonian Systems: Fractal Boundaries and Chaotic Scattering."
13. Mingzhou Ding, Ph.D. (University of Maryland) 1990, "Strange Sets in Quasiperiodically Forced Systems and in Chaotic Scattering."
14. Luise S. Shuetz, Ph.D. (University of Maryland) 1991, "Quantum Chaos in Systems with Ray Splitting."
15. John C. Sommerer, Ph.D. (University of Maryland) 1991, "The Effect of Noise on Nonlinear Systems near Crisis."
16. Lei Yu, Ph.D. (University of Maryland) 1991, "Fractal Distribution of Convected Particles and the Transition to Chaos for Random Maps."
17. Troy Shinbrot, Ph.D. (University of Maryland) 1992, "Controlling Chaos: Using the Butterfly Effect to Direct Trajectories to Targets in Chaotic Systems."
18. Yunson Du, Ph.D. (University of Maryland) 1993, "Chaotic Flows and Magnetic Dynamos."
19. Paul So, Ph.D. (University of Maryland) 1995, "Observing and Controlling Chaotic Systems and Wave Chaos Statistics."
20. Shankar C. Venkataramani (University of Maryland) 1996, "Random Walks in Chaos."
21. Charles D. Reyl (University of Maryland) 1996, "Scaling and Fractal Properties of Magnetic Fields and Fluid Vorticity in Chaotic Fluid Flows."
22. Guo Hui Yuan (University of Maryland) 1997, "Shipboard Crane Control, Simulated Data Generation, and Border-Collision Bifurcations."
23. Michael Gabbay (University of Chicago) 1997, "Dynamics of Vortex Filaments in the Complex Ginzburg-Landau Equation."

24. Joeri Jacobs (University of Maryland) 1997, "Transient Chaos."
25. Keeyeol Nam (University of Maryland) 1999, "Vortex and Vorticity Dynamics in the Complex Ginzburg-Landau Equation and in the Two-Dimensional Navier Stokes Equation."
26. Matthew R. Hendrey (University of Maryland) 2000, "Effects of Inhomogeneities in the Complex Ginzburg-Landau Equation."
27. Mitrajit Dutta (University of Maryland) 2000, "Chaotic Systems: Predictable Unpredictabilities and Synchronization."
28. David Sweet (University of Maryland) 2000, "Higher Dimensional Nonlinear Systems: Bursting and Scattering."
29. Jong-Won Kim (University of Maryland) 2002, "Dynamics of Extended Systems."
30. Douglas N. Armstead (University of Maryland) 2002, "Power Law Decay and Self-Similar Distributions in Stadium Billiards."
31. Romulus Breban (University of Maryland) 2003, "Low Dimensional Chaos: Phase Synchronization and Indeterminate Bifurcations."
32. Michael Oczkowski (University of Maryland) 2003, "Scenarios for the Development of Locally Low Dimensional Atmospheric Dynamics."
33. Aleksey Zimin (University of Maryland) 2003, "Bubbling Transition and Data Assimilation."
34. Yue-Kin Tsang (University of Maryland) 2004, "Two-Dimensional Turbulence with Drag."
35. Vasily Dronov (University of Maryland) 2005, "Application of Chaotic Synchronism and Controlling Chaos to Communications."
36. Jonathan Ozik (University of Maryland) 2005, "Evolution of Discrete Dynamical Systems."
37. Xing Zheng (University of Maryland) 2005, "Statistics of Impedance and Scattering Matrices in Chaotic Microwave Cavities."
38. Juan G. Restrepo (University of Maryland) 2005, "Synchronization in Networks of Coupled Oscillators."

39. Matthew Cornick (University of Maryland) 2007, "Problems in Spatiotemporal Chaos."
40. Seung-Jong Baek (University of Maryland) 2007, "Synchronization in Chaotic Systems: Coupling of Chaotic maps, Data Assimilation, and Weather Forecasting."
41. Viktor Nagy (University of Maryland) 2009, "Control, Dynamics and Epidemic Spreading in Complex Systems."
42. James A. Hart (University of Maryland) 2009, "Scattering from Chaotic Cavities: Exploring the Random Coupling Model in the Time and Frequency Domains."
43. Nicholas A. Mecholsky (University of Maryland) 2010, "Continuum Model for Flocking: Obstacle Avoidance, Equilibrium and Stability."
44. Young-Noh Yoon (University of Maryland) 2011, "Information Flow in an Atmospheric Model and Data Assimilation."
45. Mark R. Herrera (University of Maryland) 2013, "Complex Flows in Granular and Quantum Systems,"
46. Gilad Barlev (University of Maryland) 2013, "Synchronization of Network Coupled Chaotic and Oscillatory Dynamical Systems."
47. Wai Shing Lee (University of Maryland) 2013, "The Effect of Coupling Delays and Amplitude/Phase Interaction on Large Coupled Oscillator Networks."
48. John Platig (University of Maryland) 2013, "Making Predictions and Handling Errors in Reconstructing Biological Networks."
49. Ming-Jer Lee (University of Maryland) 2013, "Statistical Modeling of Wave Chaotic Transport and Tunneling."
50. Wai Lim Ku (University of Maryland) 2014, "Large Systems of Many Interconnected Dynamical Units: Gene Network Inference, Epigenetic Heritability, and Emergent Behavior in Oscillator Systems."
51. Matthew Kretschmer (University of Maryland) 2015, "Information Synthesis across Scales in Atmospheric State Estimation: Theory and Numerical Experiments."
52. Zhixin Lu (University of Maryland) 2017, "Dynamics of Large Systems of Nonlinearly Evolving Units."