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ESTIMACIÓN ÓPTIMA DE SECUENCIAS
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Bibliografía

- [Abarba1993b] H. D. I. Abarbanel y M. B. Kennel, “Local False Neighbors and Dynamical Dimensions from Observed Chaotic Data.” *Physical Review E*, 47 (5), 3057–3068, May 1993.
- [Abarba1998] H. D. I. Abarbanel, T. W. Frison, y L. S. Tsimring, “Obtaining Order in a World of Chaos: Time-Domain Analysis of Nonlinear and Chaotic Signals.” *IEEE Signal Processing Mag.*, 15 (3), 49–65, May 1998.
- [Abel2002] A. Abel y W. Schwarz, “Chaos Communications - Principles, Schemes and System Analysis.” *Proceedings of the IEEE*, 90 (5), 691–710, May 2002.
- [Abramo1965] M. Abramowitz y I. A. Stegun (eds.) *Handbook of Mathematical Functions : With Formulas, Graphs, and Mathematical Tables*, Dover, New York, NY (USA), 1965.
- [Aches1997] D. Acheson, *From Calculus to Chaos: An Introduction to Dynamics*, Oxford University Press, Oxford, 1997.
- [Adler2001] C. Adler, R. Kneusel, y W. Younger, “Chaos, Number Theory, and Computers.” *Journal of Computational Physics*, 166, 165–172, 2001.
- [Aihara1990] K. Aihara, T. Takabe, y M. Toyoda, “Chaotic Neural Networks.” *Physics Letters A*, 144 (6–7), 333–340, 12 Mar. 1990.
- [Akaike1973] H. Akaike, “Information Theory and an Extension of the Maximum Likelihood Principle.”, en *Proc. 2nd Int. Symposium on Information Theory (ISIT)*, 267–281, Budapest (Hungary), 2–8 Sep. 1973, supplement *Problems of Control and Information Theory*.
- [Akaike1974] H. Akaike, “A New Look at the Statistical Model Identification.” *IEEE Trans. Automatic Control*, AC-19, 716–723, 1974.
- [Akay2001] M. Akay (ed.) *Nonlinear Biomedical Signal Processing, Vol. II: Dynamic Analysis and Modeling*, IEEE Press Series on Biomedical Engineering, IEEE Press, New York, 2001.

- [Alder1959] B. J. Alder y T. E. Wainwright, “Studies in Molecular Dynamics I: General Method.” *Journal of Chemical Physics*, 31, 459–466, 1959.
- [Alligo1996] K. T. Alligood, T. D. Sauer, y J. A. Yorke, *Chaos: An Introduction to Dynamical Systems*, Springer-Verlag, New York, 1996.
- [Anasta2001] G. Anastassiou, *Quantitative Approximations*, Chapman & Hall/CRC, 2001.
- [Ander1975] J. B. Anderson y J. B. Bodie, “Tree Encoding of Speech.” *IEEE Trans. on Information Theory*, IT-21 (4), 379–387, Jul. 1975.
- [Ander1980] H. C. Andersen, “Molecular Dynamics Simulations at Constant Pressure and/or Temperature.” *Journal of Chemical Physics*, 72, 2384–2393, 1980.
- [Ander1994] J. B. Anderson y E. Offer, “Reduced-State Sequence Detection with Convolutional Codes.” *IEEE Trans. on Information Theory*, 40 (3), 965–972, May 1994.
- [Andrie1999] C. Andrieu y A. Doucet, “Joint Bayesian Model Selection and Estimation of Noisy Sinusoids via Reversible Jump MCMC.” *IEEE Trans. on Signal Processing*, 47 (10), 2667–2676, Oct. 1999.
- [Andrie2001] C. Andrieu, E. Barat, y A. Doucet, “Bayesian Deconvolution of Noisy Filtered Point Processes.” *IEEE Trans. on Signal Processing*, 49 (1), 134–146, Jan. 2001.
- [Anosov1967] D. V. Anosov, “Geodesic Flows on Closed Riemannian Manifolds with Negative Curvature.” *Proc. Steklov Institute of Mathematics*, 90, 1967.
- [Apost1967] T. M. Apostol, *Calculus, Vol. 1: One-Variable Calculus, with an Introduction to Linear Algebra*, 2ª ed., John Wiley & Sons, New York, NY (USA), 1967.
- [Apple1986] J. H. Applegate, M. R. Douglas, Y. Gürsel, G. J. Sussman, y J. Wisdom, “The Outer Solar System for 200 Million Years.” *Astronomical Journal*, 92, 176–194, Jul. 1986.
- [Arecc1982] F. T. Arecchi, R. Meucci, G. Puccioni, y J. Tredicce, “Experimental Evidence of Subharmonic Bifurcations, Multistability, and Turbulence in a Q-Switched Gas Laser.” *Physical Review Letters*, 49, 1217–1220, 1982.
- [Argyri2005] A. Argyris, D. Syvridis, L. Lerger, V. Annovazzi-Lodi, P. Colet, I. Fischer, J. Garcia-Ojalvo, C. R. Mirasso, L. Pesquera, y K. A. Shore, “Chaos-Based Communications at High Bit Rates Using Commercial Fibre-Optic Links.” *Nature*, 438, 343–346, 17 Nov. 2005.

- [Bablo1986a] A. Babloyantz, “Evidence of Chaotic Dynamics of Brain Activity During the Sleep Cycle.”, en G. Mayer-Kress (ed.) *Dimension and Entropies in Chaotic Systems*, 252–259, Springer-Verlag, Berlin, 1986.
- [Bablo1986b] A. Babloyantz y A. Destexhe, “Low-Dimensional Chaos in an Instance of Epilepsy.” *Proc. National Academy of Science USA*, 83, 3513–3517, 1986.
- [Banbro1994] M. Banbrook y S. McLaughlin, “Is Speech Chaotic?: Invariant Geometrical Measures for Speech Data.”, en *IEE Colloquium on Exploiting Chaos in Signal Processing*, 8/1–10, London (UK), 6 Jun. 1994.
- [Beck1993] C. Beck y F. Schlögl, *Thermodynamics of Chaotic Systems*, Cambridge University Press, Cambridge, 1993.
- [Belair1995] J. Belair, L. Glass, U. D. Heiden, y J. Milton (eds.) *Dynamical Disease: Mathematical Analysis of Human Illness*, Springer-Verlag, Berlin (Germany), 1995.
- [Benedi1991] M. Benedicks y L. Carleson, “The Dynamics of the Hénon Map.” *The Annals of Mathematics*, 133 (1), 73–169, Jan. 1991.
- [Bowen1975] R. Bowen, “ ω -Limit Sets for Axiom A Diffeomorphisms.” *Journal of Differential Equations*, 18 (333–339), 1975.
- [Box1973] G. E. P. Box y G. C. Tiao, *Bayesian Inference in Statistical Analysis*, Addison-Wesley, Reading, MA (USA), 1973.
- [Cao2002] L. Cao y C. W. Chen, “Blind Channel Estimation and Equalization Using Viterbi Algorithms.”, en *Proc. IEEE Vehicular Tech. Conf. (VTC)*, tomo 3, 1532–1535, Birmingham, AL (USA), 6–9 May 2002.
- [Carrol1991] T. L. Carroll y L. M. Pecora, “Synchronizing Chaotic Circuits.” *IEEE Trans. on Circuits and Systems*, 38 (4), 453–456, Apr. 1991.
- [Carrol1993] T. L. Carroll y L. M. Pecora, “Synchronizing Nonautonomous Chaotic Circuits.” *IEEE Trans. on Circuits and Systems II: Analog and Digital Signal Processing*, 40 (10), 646–650, Oct. 1993.
- [Carrol1998a] T. L. Carroll, “Multiple Attractors and Periodic Transients in Synchronized Nonlinear Circuits.” *Physics Letters A*, 238, 365–368, 16 Feb. 1998.
- [Carrol1999] T. L. Carroll y L. M. Pecora, “Using Multiple Attractor Chaotic Systems for Communication.” *Chaos: An Interdisciplinary Journal of Nonlinear Science*, 9 (2), 445–451, Jun. 1999.

- [Casda1989] M. Casdagli, "Nonlinear Prediction of Chaotic Time Series." *Physica D*, 35, 335–356, 1989.
- [Casda1991] M. Casdagli, "State Space Reconstruction in the Presence of Noise." *Physica D*, 51, 52–98, 1991.
- [Celka1995b] P. Celka, "Chaotic Synchronization and Modulation of Nonlinear Time-Delayed Feedback Optical Systems." *IEEE Trans. on Circuits and Systems I: Fundamental Theory and Applications*, 42 (8), 455–463, Aug. 1995.
- [Chen1992] G. Chen y X. Dong, "On Feedback Control of Chaotic Dynamic Systems." *Int. Journal of Bifurcation and Chaos*, 2, 407–411, 1992.
- [Chen1993c] G. Chen y X. Dong, "On Feedback Control of Chaotic Continuous-Time Systems." *IEEE Trans. on Circuits and Systems I: Fundamental Theory and Applications*, 40 (9), 591–601, Sep. 1993.
- [Chen1995a] R. Chen y T.-H. Li, "Blind Restoration of Linearly Degraded Discrete Signals by Gibbs Sampling." *IEEE Trans. on Signal Processing*, 43 (10), 2410–2413, Oct. 1995.
- [Cheng1996] Q. Cheng, R. Chen, y T.-H. Li, "Simultaneous Wavelet Estimation and Deconvolution of Reflection Seismic Signals." *IEEE Trans. on Geoscience and Remote Sensing*, 34 (2), 377–384, Mar. 2001.
- [Chua1977] L. O. Chua y S. M. Kang, "Section-Wise Piecewise-Linear Functions: Canonical Representation, Properties and Applications." *Proceedings of the IEEE*, 65 (6), 915–929, Jun. 1977.
- [Chua1986] L. O. Chua, M. Komuro, y T. Matsumoto, "The Double Scroll Family, Parts I and II." *IEEE Trans. on Circuits and Systems*, CAS-33 (11), 1073–1118, Nov. 1986.
- [Chua1988b] L. O. Chua y T. Lin, "Chaos in Digital Filters." *IEEE Trans. on Circuits and Systems*, 35 (7), 648–658, Jul. 1988.
- [Chua1992] L. O. Chua, "The Genesis of Chua's Circuit." *Archiv für Elektronik und Übertragungstechnik*, 46 (4), 250–257, 1992.
- [Ciftci2001a] M. Ciftci y D. B. Williams, "Optimal Estimation for Chaotic Sequences Using the Viterbi Algorithm.", en *Proc. IEEE Int. Conf. on Acoustics, Speech and Signal Processing (ICASSP)*, 1094–1097, Salt Lake City, Utah (USA), 7–11 May 2001.
- [Ciftci2001b] M. Ciftci y D. B. Williams, "Optimal Estimation and Sequential Channel Equalization Algorithms for Chaotic Communications Systems." *EURASIP Journal on Applied Signal Processing*, 4, 249–256, 2001.

- [Colet1994] P. Colet y R. Roy, “Digital Communications with Synchronized Chaotic Lasers.” *Optics Letters*, 19, 2056–2058, 1994.
- [Collet1980] P. Collet y J. P. Eckmann, *Iterated Maps on the Interval as Dynamical Systems*, Birkhauser, 1980.
- [Cong1998] L. Cong y S. Songgeng, “Chaotic Frequency Hopping Sequences.” *IEEE Trans. on Communications*, 46 (11), 1433–1437, Nov. 1998.
- [Cong1999] L. Cong, W. Xiaofu, y S. Songgeng, “A General Efficient Method for Chaotic Signal Estimation.” *IEEE Trans. on Signal Processing*, 47 (5), 1424–1428, May 1999.
- [Cong2001] L. Cong y W. Xiaofu, “Design and Realization of an FPGA-Based Generator for Chaotic Frequency Hopping Sequences.” *IEEE Trans. on Circuits and Systems I: Fundamental Theory and Applications*, 48 (5), 521–532, May 2001.
- [Cornfe1982] I. P. Cornfeld, S. V. Fomin, y Y. G. Sinai, *Ergodic Theory*, Springer, New York, NY (USA), 1982.
- [Coven1988] E. M. Coven, I. Kan, y J. A. Yorke, “Pseudo-Orbit Shadowing in the Family of Tent Maps.” *Trans. of the American Mathematical Soc.*, 308 (1), 227–241, Jul. 1988.
- [Cover1991] T. M. Cover y J. A. Thomas, *Elements of Information Theory*, John Wiley & Sons, New York, NY (USA), 1991.
- [Cox1999] I. J. Cox, M. L. Miller, y A. L. McKellips, “Watermarking as Communications with Side Information.” *Proceedings of the IEEE*, 87 (7), 1127–1141, Jul. 1999.
- [Cuomo1993a] K. M. Cuomo y A. V. Oppenheim, “Chaotic Signals and Systems for Communications.”, en *Proc. IEEE Int. Conf. on Acoustics, Speech, and Signal Processing (ICASSP)*, tomo III, 137–140, Minneapolis (MN), USA, 27–30 Apr. 1993.
- [Cuomo1993b] K. M. Cuomo y A. V. Oppenheim, “Circuit Implementation of Synchronized Chaos with Applications to Communications.” *Physical Review Letters*, 71 (1), 65–68, 5 Jul. 1993.
- [Cvitan1989] P. Cvitanovic (ed.) *Universality in Chaos*, 2^a ed., IOP Publishing Ltd., London (UK), 1989.
- [Davy2004] M. Davy y J. Idier, “Fast MCMC Computations for the Estimation of Sparse Processes from Noisy Observations.”, en *Proc. IEEE Int. Conf. on Acoustics, Speech and Signal Proc. (ICASSP)*, tomo II, 1041–1044, Montreal, Canada, 17–21 May 2004.

- [DeMelo1993] W. de Melo y S. van Strien, *One-Dimensional Dynamics*, Springer-Verlag, 1993.
- [Deane1990] J. H. B. Deane y D. C. Hamill, "Instability, Subharmonics, and Chaos in Power Electronic Systems." *IEEE Trans. on Power Electronics*, 5 (3), 260–268, Jul. 1990.
- [Dedieu1993] H. Dedieu, M. P. Kennedy, y M. Hasler, "Chaos Shift Keying: Modulation and Demodulation of a Chaotic Carrier Using Self-Synchronizing Chua's Circuits." *IEEE Trans. on Circuits and Systems II: Analog and Digital Signal Processing*, 40 (10), 634–642, Oct. 1993.
- [Dedieu1998] H. Dedieu y M. Ogorzalek, "Using Nonlinear Dynamics to Improve the Noise Performance of Chaos Communication Systems.", en *Proc. IEEE Int. Conf. on Electronics, Circuits & Systems (ICECS)*, 111–114, Lisboa (Portugal), 7–10 Oct. 1998.
- [Dempster1977] A. P. Dempster, N. M. Laird, y D. B. Rubin, "Maximum Likelihood from Incomplete Data Via the EM Algorithm." *Journal of the Royal Statistical Soc., Series B*, 39 (1), 1–38, 1977.
- [Devan1989] R. L. Devaney, *An Introduction to Chaotic Dynamical Systems*, Perseus Books, Reading, MA (USA), 1989.
- [Devore1993] R. A. Devore y G. G. Lorentz, *Constructive Approximation*, Springer-Verlag, 1993.
- [Dmitri2003] A. S. Dmitriev, B. Y. Kyarginsky, A. I. Penas, y S. O. Starkov, "Experiments on Direct Chaotic Communications in Microwave Band." *Int. Journal of Bifurcation and Chaos*, 13 (6), 1495–1507, 2003.
- [Drake1992] D. F. Drake y D. B. Williams, "On Error Function Selection for the Analysis of Nonlinear Time Series.", en *Proc. IEEE Int. Conf. on Acoustics, Speech, and Signal Processing (ICASSP)*, tomo 5, 329–332, San Francisco, CA (USA), 23–26 Mar. 1992.
- [Duane1987] S. Duane, A. D. Kennedy, B. J. Pendleton, y D. Roweth, "Hybrid Monte Carlo." *Physics Letters B*, 195, 216–222, 1987.
- [Duel1989] A. Duel-Hallen y C. Heegard, "Delayed Decision-Feedback Sequence Estimation." *IEEE Trans. on Communications*, 37 (5), 428–436, May 1989.
- [Elmir1994a] J. M. H. Elmirghani y R. A. Cryan, "New Chaotic Based Communication Technique with Multiuser Provision." *IEE Electronics Letters*, 30 (15), 1206–1207, 21 Jul. 1994.

- [Endo1988] T. Endo y L. O. Chua, "Chaos from Phase-Locked Loops." *IEEE Trans. on Circuits and Systems*, 35 (8), 987–1003, Aug. 1988.
- [Eyubo1988] M. V. Eyuboglu y S. U. H. Qureshi, "Reduced-State Sequence Estimation with Set Partitioning and Decision Feedback." *IEEE Trans. on Communications*, 36 (1), 13–20, Jan. 1988.
- [Falcon1990] K. J. Falconer, *Fractal Geometry: Mathematical Foundations and Applications*, John Wiley & Sons, New York, NY (USA), 1990.
- [Farmer1987] J. D. Farmer y J. J. Sidorowich, "Predicting Chaotic Time Series." *Physical Review Letters*, 59 (8), 845–848, 24 Aug. 1987.
- [Farmer1988] J. D. Farmer y J. J. Sidorowich, "Exploiting Chaos to Predict the Future and Reduce Noise.", en Y. C. Lee (ed.) *Evolution, Learning and Cognition*, World Scientific, Singapore, 1988.
- [Farmer1991] J. D. Farmer y J. J. Sidorowich, "Optimal Shadowing and Noise Reduction." *Physica D*, 47, 373–392, 1991.
- [Feigen1980] M. Feigenbaum, "Universal Behavior in Nonlinear Systems." *Los Alamos Science*, 1, 4–27, 1980.
- [Fessle1993a] J. A. Fessler, N. H. Clinthorne, y W. L. Rogers, "On Complete Data Spaces for PET Reconstruction Algorithms." *IEEE Trans. on Nuclear Science*, 40 (4), 1055–1061, Aug. 1993.
- [Fessle1993b] J. A. Fessler y A. O. Hero, "Complete-Data Spaces and Generalized EM Algorithms.", en *Proc. IEEE Int. Conf. on Acoustics, Speech and Signal Processing (ICASSP)*, tomo 4, 1–4, Minneapolis, MN (USA), 27–30 Apr. 1993.
- [Fessle1994] J. A. Fessler y A. O. Hero, "Space-Alternating Generalized EM Algorithm." *IEEE Trans. on Signal Processing*, 42 (10), 2664–2667, Oct. 1994.
- [Fheng1998] D. Z. Fheng, Z. Bao, y L. C. Jiao, "Total Least Mean Squares Algorithm." *IEEE Trans. on Signal Proc.*, 46 (8), 2122–2130, Aug. 1998.
- [Fincke1985] U. Fincke y M. Pohst, "Improved Methods for Calculating Vectors of Short Length in a Lattice, Including a Complexity Analysis." *Mathematics of Computation*, 44 (170), 463–471, Apr. 1985.
- [Flepp1991] L. Flepp, R. Holzner, E. Brun, M. Finardi, y R. Badii, "Model Identification by Periodic-Orbit Analysis for NMR-Laser Chaos." *Physical Review Letters*, 67 (17), 2244–2247, 21 Oct. 1991.

- [Forney1972] G. D. Forney, Jr., "Maximum Likelihood Sequence Estimation of Digital Sequences in the Presence of Intersymbol Interference." *IEEE Trans. on Information Theory*, IT-18, 363–372, May 1972.
- [Forney1973] G. D. Forney, Jr., "The Viterbi Algorithm." *Proceedings of the IEEE*, 61, 268–278, Mar. 1973.
- [Foschi1977] G. J. Foschini, "A Reduced State Variant of Maximum Likelihood Sequence Detection Attaining Optimum Performance for High Signal-to-Noise Ratios." *IEEE Trans. on Information Theory*, IT-23 (5), 605–609, Sep. 1977.
- [Fraser1989b] A. M. Fraser, "Reconstructing Attractors from Scalar Time Series: A Comparison of Singular System and Redundancy Criteria." *Physica D*, 34, 391–404, 1989.
- [Fraser1992] A. M. Fraser, "Modeling Nonlinear Time Series.", en *Proc. IEEE Int. Conf. on Acoustics, Speech and Signal Processing (ICASSP)*, tomo V, 313–316, San Francisco, CA (USA), 23–26 Mar. 1992.
- [Fris2000a] E. Y. Frisman y E. V. Last, "Oscillations & Chaos in the Model of the Pacific Salmon's Number Dynamics.", en *Proc. IEEE Int. Conf. on Control of Oscillations and Chaos (COC)*, 573–575, St. Petersburg (Russia), 5–7 Jul. 2000.
- [Fris2000b] E. Y. Frisman y E. V. Sycheva, "Oscillations and Chaos in Population Dynamics Caused by the Hunting.", en *Proc. IEEE Int. Conf. on Control of Oscillations and Chaos (COC)*, 576–578, St. Petersburg, 5–7 Jul. 2000.
- [Galias2001a] Z. Galias y G. M. Maggio, "Quadrature Chaos Shift Keying.", en *Proc. IEEE Int. Symp. on Circuits and Systems (ISCAS)*, tomo III, 313–316, Sydney (Australia), 6–9 May 2001.
- [Galias2001b] Z. Galias y G. M. Maggio, "Quadrature Chaos Shift Keying: Theory and Performance Analysis." *IEEE Trans. on Circuits and Systems I: Fundamental Theory and Applications*, 48 (12), 1510–1519, Dec. 2001.
- [Galka2000] A. Galka, *Topics in Nonlinear Time Series Analysis with Implications for EEG Analysis*, World Scientific, Singapore, 2000.
- [Gelfan1990] A. E. Gelfand y A. F. M. Smith, "Sampling Based Approaches to Calculating Marginal Densities." *Journal of the American Statistical Association*, 85 (410), 398–409, Jun. 1990.

- [Geman1984] S. Geman y D. Geman, "Stochastic Relaxation, Gibbs Distributions, and the Bayesian Restoration of Images." *IEEE Trans. on Pattern Analysis and Machine Intelligence*, PAMI-6, 721–741, 1984.
- [Gilhou1991] K. S. Gilhousen, I. M. Jacobs, R. Padovani, A. J. Viterbi, L. A. W. Jr., y C. E. W. III, "On the Capacity of a Cellular CDMA System." *IEEE Trans. on Vehicular Technology*, 40 (2), 303–312, May 1991.
- [Gleick1988] J. Gleick, *Caos: La Creación de una Ciencia*, Seix Barral, Barcelona, 1988.
- [Glendi1994] P. Glendinning, *Stability, Instability and Chaos: An Introduction to the Theory of Nonlinear Differential Equations*, Cambridge University Press, Cambridge, MA (USA), 1994.
- [Gollub1975] J. P. Gollub y H. L. Swinney, "Onset of Turbulence in a Rotating Fluid." *Physical Review Letters*, 35, 927–930, 1975.
- [Golub1980] G. H. Golub y C. F. Van Loan, "An Analysis of the Total Least Squares Problem." *SIAM Journal of Numerical Analysis*, 17 (6), 883–893, Dec. 1980.
- [Golub1996] G. H. Golub y C. F. Van Loan, *Matrix Computations*, 3ª ed., The John Hopkins University Press, Baltimore, MD (USA), 1996.
- [Grassi1997] G. Grassi y S. Mascolo, "Nonlinear Observer Design to Synchronize Hyperchaotic Systems via a Scalar Signal." *IEEE Trans. on Circuits and Systems I: Fundamental Theory and Applications*, 44 (10), 1011–1014, Oct. 1997.
- [Grebo1983] C. Grebogi, E. Ott, y J. A. Yorke, "Crises, Sudden Changes in Chaotic Attractors, and Transient Chaos." *Physica D*, 7, 181–200, 1983.
- [Gross1977] S. Grossmann y S. Thomae, "Invariant Distributions and Stationary Correlation Functions of One- Dimensional Discrete Processes." *Zeitschrift für Naturforschung*, 32, 1353–1363, 1977.
- [Gucken1983] J. Guckenheimer y P. Holmes, *Nonlinear Oscillations, Dynamical Systems, and Bifurcation of Vector Fields*, Springer-Verlag, 1983.
- [Haken1975] H. Haken, "Analogy Between Higher Instabilities in Fluids and Lasers." *Physical Letters A*, 53 (1), 77–78, 19 May 1975.
- [Halle1993] K. S. Halle, C. W. Wu, M. Itoh, y L. O. Chua, "Spread Spectrum Communication Through Modulation of Chaos." *International Journal of Bifurcation and Chaos*, 3 (2), 469–477, 1993.

- [Hammel1988] S. M. Hammel, J. A. Yorke, y C. Grebogi, "Numerical Orbits of Chaotic Processes Represent True Orbits." *Bulletin of the American Mathematical Society*, 19 (2), 465–469, Oct. 1988.
- [Hammel1989] S. M. Hammel, *Noise Reduction for Chaotic Systems*, Technical report, Naval Surface Warfare Center, Silver Spring, MD (USA), 1989.
- [Hasler1995] M. Hasler, "Engineering Chaos for Encryption and Broadband Communication." *Phil. Trans. of the Royal Soc. of London A*, 353, 115–126, 1995.
- [Hasler1997b] M. Hasler y Y. L. Maistrenko, "An Introduction to the Synchronization of Chaotic Systems: Coupled Skew Tent Maps." *IEEE Trans. on Circuits and Systems I: Fundamental Theory and Applications*, 44 (10), 856–866, Oct. 1997.
- [Hasler1999] M. Hasler, "Separating Chaos and Noise.", en *Proc. Int. Workshop on Nonlinear Dynamics of Electronic Systems (NDES)*, Ronne (Denmark), 15–17 Jul. 1999.
- [Hasler2001] M. Hasler, "Ergodic Chaos Shift Keying.", en *Proc. IEEE Int. Symp. on Circuits and Systems (ISCAS)*, tomo III, 145–148, Sydney (Australia), 6–9 May 2001.
- [Hassar1994] B. Hassard, S. Hastings, W. Troy, y J. Zhang, "A Computer Proof that the Lorenz Equations Have "Chaotic" Solutions." *Applied Mathematical Letters*, 7, 79–83, 1994.
- [Hassi2005] B. Hassibi y H. Vikalo, "On the Sphere Decoding Algorithm I: Expected Complexity." *IEEE Trans. on Signal Processing*, 53 (8), 2806–2818, Aug. 2005, part 1/2.
- [Hastin1970] W. K. Hastings, "Monte Carlo Sampling Methods Using Markov Chains and their Applications." *Biometrika*, 57 (1), 97–109, Apr. 1970.
- [Hayes1975] J. F. Hayes, "The Viterbi Algorithm Applied to Digital Data Transmission." *IEEE Communications Mag.*, 13 (2), 15–20, Mar. 1975.
- [Hayes1993] S. Hayes, "Communicating with Chaos." *Physical Review Letters*, 70 (20), 3031–3034, 17 May 1993.
- [Hayes1994] S. Hayes, C. Grebogi, E. Ott, y A. Mark, "Experimental Control of Chaos for Communication." *Physical Review Letters*, 73 (13), 1781–1784, Sep. 26 1994.

- [Hayes1996] S. Hayes y C. Grebogi, “Using Controlled Chaos for Digital Signaling: A Physical Principle for 1-Stage Waveform Synthesis.”, en *Proc. IEEE MTT-S Int. Microwave Symp. (IMS)*, 1879–1882, San Francisco, CA (USA), 17–21 Jan. 1996.
- [Haykin1995] S. Haykin y X. B. Li, “Detection of Signals in Chaos.” *Proceedings of the IEEE*, 83 (1), 95–122, Jan. 1995.
- [Haykin1999] S. Haykin, *Neural Networks: A Comprehensive Foundation*, 2^a Ed., Prentice-Hall, Upper Saddle River, NJ (USA), 1999.
- [Haykin2002] S. Haykin y B. Van Veen, *Signals & Systems*, 2^a Ed., John Wiley & Sons, New York, 2002.
- [Heida1992a] G. Heidari-Bateni, C. D. McGillem, y M. F. Tenorio, “A Novel Multiple-Address Digital Communication System Using Chaotic Signals.”, en *Proc. IEEE Int. Communications Conf. (ICC)*, 1232–1236, Chicago, IL (USA), 14–18 Jun. 1992.
- [Heida1992b] G. Heidari-Bateni y C. D. McGillem, “Chaotic Sequences for Spread Spectrum: An Alternative to PN-Sequences.”, en *Proc. IEEE Int. Conf. on Selected Topics in Wireless Communications (ISWC)*, 437–440, Vancouver, BC (Canada), 25–26 Jun. 1992.
- [Heida1994] G. Heidari-Bateni y C. D. McGillem, “A Chaotic Direct-Sequence Spread-Spectrum Communication System.” *IEEE Trans. on Communications*, 42 (2/3/4), 1524–1527, Feb./Mar./Apr. 1994.
- [Henon1976] M. Hénon, “A Two-Dimensional Mapping with a Strange Attractor.” *Communications in Mathematical Physics*, 50, 69–77, 1976.
- [Hero1993] A. O. Hero y J. A. Fessler, *Asymptotic Convergence Properties of EM-Type Algorithms*, Technical report no. 282, Communications and Signal Proc. Lab., Dept. of EECS, Univ. of Michigan, Apr. 1993.
- [Hiper2] ETSI TS 101 475 V1.1.1, *Broadband Radio Access Networks (BRAN); HIPERLAN Type 2; Physical (PHY) Layer*, ETSI, Apr. 2000.
- [Ho2003] T. J. Ho, “The Application of the Viterbi Algorithm to Multiple Model Tracking.”, en *Proc. American Control Conf.*, 1254–1259, Denver, Colorado (USA), 4–6 Jun. 2003.
- [Holden1986] A. V. Holden (ed.) *Chaos*, Manchester Univ. Press, 1986.
- [Hollan1975] J. H. Holland, *Adaptation in Natural and Artificial Systems*, MIT Press, 1975.

- [Hudson1981] J. L. Hudson y J. C. Mankin, "Chaos in the Belousov-Zhabotinskii Reaction." *Journal of Chemical Physics*, 74, 6171–6177, 1981.
- [Hunt1993] B. R. Hunt y J. A. Yorke, "Maxwell on Chaos." *Nonlinear Science Today*, 3 (1), 1–4, 1993.
- [Hyvari2001] A. Hyvarinen, J. Karhunen, y E. Oja, *Independent Component Analysis*, John Wiley and Sons, New York (NY), USA, 2001.
- [Iansi1985] M. Iansiti, Q. Hu, R. M. Westervelt, y M. Tinkham, "Noise and Chaos in a Fractal Basin Boundary Regime of a Josephson Junction." *Physical Review Letters*, 55, 746–749, 1985.
- [Isabel1995] S. H. Isabelle, *A Signal Processing Framework for the Analysis and Application of Chaotic Systems*, Tesis Doctoral, Massachusetts Institute of Technology (MIT), 1995.
- [Isabel1997] S. H. Isabelle y G. W. Wornell, "Statistical Analysis and Spectral Estimation Techniques for One-Dimensional Chaotic Signals." *IEEE Trans. on Signal Processing*, 45 (6), 1495–1506, Jun. 1997.
- [Isabel1998] S. H. Isabelle y G. W. Wornell, "Nonlinear Maps.", en V. K. Madisetti y D. B. Williams (eds.) *The Digital Signal Processing Handbook*, CRC Press & IEEE Press, 1998.
- [Isola2002] S. Isola, "On the spectrum of Farey and Gauss Maps." *Nonlinearity*, 15 (5), 1521–1539, Sep. 2002.
- [Itoh1993] M. Itoh y H. Murakami, "Chaos Synchronization in Discrete-Time Dynamical Systems and Secure Communication.", en *Proc. 11th European Conf. on Circuit Theory and Design*, 611–614, Davos (Switzerland), 30 Aug. – 3 Sep. 1993.
- [Itoh1995] M. Itoh y H. Murakami, "New Communication Systems via Chaotic Synchronizations and Modulations." *IEICE Trans. on Fundamentals*, E78-A (3), 285–290, Mar. 1995.
- [Itoh1999] M. Itoh, "Spread Spectrum Communication via Chaos." *International Journal of Bifurcation and Chaos*, 9 (1), 155–213, 1999.
- [Jako2000] Z. Jákó y G. Kis, "On the Effectiveness of Noise Reduction Methods in DCSK Systems.", en *Proc. IEEE Int. Symp. on Circuits and Systems (ISCAS)*, tomo IV, 437–440, Geneva (Switzerland), 28–31 May 2000.
- [Jeline1971] F. Jelinek y J. B. Anderson, "Instrumentable Tree Encoding of Information Sources." *IEEE Trans. on Information Theory*, 17 (1), 118–119, Jan. 1971.

- [Jiang2006] G.-P. Jiang, W. X. Zheng, W. K.-S. Tang, y G. Chen, “Integral-Observer-Based Chaos Synchronization.” *IEEE Trans. on Circuits and Systems II: Express Briefs*, 53 (2), 110–114, Feb. 2006.
- [Kang1978] S. M. Kang y L. O. Chua, “A Global Representation of Multidimensional Piecewise-Linear Functions with Linear Partitions.” *IEEE Trans. on Circuits and Systems*, 25 (11), 938–949, Nov. 1978.
- [Kantz2003] H. Kantz y T. Schreiber, *Nonlinear Time Series Analysis*, 2^a ed., Cambridge University Press, Cambridge (UK), 2003.
- [Kaplan1995] D. Kaplan y L. Glass, *Understanding Nonlinear Dynamics*, Springer-Verlag, 1995.
- [Kay1993] S. M. Kay, *Fundamentals of Statistical Signal Processing: Estimation Theory*, Prentice Hall, 1993.
- [Kay1995a] S. M. Kay, “Asymptotic Maximum Likelihood Estimator Performance for Chaotic Signals in Noise.” *IEEE Trans. on Signal Processing*, 43 (4), 1009–1012, Apr. 1995.
- [Kay1995b] S. M. Kay y V. Nagesha, “Methods for Chaotic Signal Estimation.” *IEEE Trans. on Signal Processing*, 43 (8), 2013–2016, Aug. 1995.
- [Kay1998a] S. M. Kay, *Fundamentals of Statistical Signal Processing: Detection Theory*, Prentice Hall, 1998.
- [Kenne1986] M. P. Kennedy y L. O. Chua, “Van der Pol and Chaos.” *IEEE Trans. on Circuits and Systems*, 33 (10), 974–980, Oct. 1986.
- [Kenne1995] M. P. Kennedy, “Bifurcation and Chaos.”, en W. K. Chen (ed.) *The Circuits and Filters Handbook*, 1089–1163, CRC Press & IEEE Press, 1995.
- [Kenne1996] M. P. Kennedy, “Communicating with Chaos: State of the Art and Engineering Challenges.”, en *Proc. 4th Int. Workshop on Nonlinear Dynamics of Electronic Systems (NDES)*, 1–8, Seville (Spain), 25–28 Jun. 1996.
- [Kenne1997] M. P. Kennedy, “Applications of Chaos in Communications.”, en D. DoCampo, A. Figueiras-Vidal, y F. P. González (eds.) *Intelligent Methods in Signal Processing and Communications*, 243–261, Birkhäuser, 1997.
- [Kenne1998] M. P. Kennedy, G. Kolumbán, G. Kis, y Z. Jákó, “Recent Advances in Communicating with Chaos.”, en *Proc. IEEE Int. Symp. on Circuits and Systems (ISCAS)*, tomo IV, 461–464, Monterey (CA), USA, 31 May – 3 Jun. 1998.

- [Kenne2000] M. P. Kennedy, R. Rovatti, y G. Setti (eds.) *Chaotic Electronics in Telecommunications*, CRC Press, Boca Raton, FL (USA), 2000.
- [Kennel1992] M. B. Kennel, R. B. Brown, y H. D. I. Abarbanel, “Determining Minimum Embedding Dimension Using a Geometrical Construction.” *Physical Review A*, 45 (6), 3403–3411, 15 Mar. 1992.
- [Khan2005] Z. Khan, T. Balch, y F. Dellaert, “MCMC-Based Particle Filtering for Tracking a Variable Number of Interacting Targets.” *IEEE Trans. on Pattern Analysis and Machine Intelligence*, 27 (11), 1805–1819, Nov. 2005.
- [Khun2002] J. Khun-Jush, P. Schramm, G. Malmgren, y J. Torsner, “HiperLAN2: Broadband Wireless Communications at 5 GHz.” *IEEE Communications Mag.*, 40 (6), 130–136, Jun. 2002.
- [Kisel1999] A. Kisel, H. Dedieu, y M. Ogorzalek, “Noise Reduction Methods for Chaotic Communication Schemes.”, en *Proc. IEEE Int. Symp. on Circuits and Systems (ISCAS)*, tomo IV, 446–449, Orlando, FL (USA), 30 May – 2 Jun. 1999.
- [Kisel2001] A. Kisel, H. Dedieu, y T. Schimming, “Maximum Likelihood Approaches for Noncoherent Communications with Chaotic Carriers.” *IEEE Trans. on Circuits and Systems I: Fundamental Theory and Applications*, 48 (5), 533–542, May 2001.
- [Kocak1986] H. Kocak, *Differential and Difference Equations through Computer Experiments*, Springer-Verlag, 1986.
- [Kocar1992] L. Kocarev, K. S. Halle, K. Eckert, L. O. Chua, y U. Parlitz, “Experimental Demonstration of Secure Communications via Chaotic Synchronization.” *International Journal of Bifurcations and Chaos*, 2 (3), 709–713, 1992.
- [Kohon1991] T. Kohonen, “Self-Organizing Maps: Optimization Approaches.” *Artificial Neural Networks*, 981–990, 1991.
- [Kolum1996] G. Kolumbán, H. Dedieu, J. Schweizer, J. Ennitis, y B. Vizvari, “Performance Evaluation and Comparison of Chaos Communication Systems.”, en *Proc. 4th Int. Workshop on Nonlinear Dynamics of Electronic Systems (NDES)*, 105–110, Seville (Spain), 27–28 Jun. 1996.
- [Kolum1997a] G. Kolumbán, M. P. Kennedy, y G. Kis, “Performance Improvement of Chaotic Communications Systems.”, en *Proc. European Conf. on Circuit Theory and Design (ECCTD)*, 284–289, Budapest (Hungary), 30 Aug.– 3 Sep. 1997.

- [Kolum1997c] G. Kolumbán, G. Kis, y Z. Jákó, “FM-DCSK: A New and Robust Solution for Chaotic Communications.”, en *Proc. Int. Symp. on Nonlinear Theory and its Applications (NOLTA)*, 117–120, Honolulu (USA), 11–12 Feb. 1997.
- [Kolum1998a] G. Kolumbán, M. P. Kennedy, G. Kis, y Z. Jákó, “FM-DCSK: A Novel Method for Chaotic Communications.”, en *Proc. IEEE Int. Symp. on Circuits and Systems (ISCAS)*, tomo IV, 477–480, Monterey, CA (USA), 31 May – 3 Jun. 1998.
- [Kolum1998b] G. Kolumbán, M. P. Kennedy, y L. O. Chua, “The Role of Synchronization in Digital Communications Using Chaos - Part II: Chaotic Modulation and Chaotic Synchronization.” *IEEE Trans. on Circuits and Systems I: Fundamental Theory and Applications*, 45 (11), 1129–1140, Nov. 1998.
- [Kolum2000a] G. Kolumbán y M. P. Kennedy, “The Role of Synchronization in Digital Communications Using Chaos - Part III: Performance Bounds for Correlation Receivers.” *IEEE Trans. on Circuits and Systems I: Fundamental Theory and Applications*, 47 (12), 1673–1683, Dec. 2000.
- [Kolum2002] G. Kolumbán, M. P. Kennedy, Z. Jákó, y G. Kis, “Chaotic Communications with Correlator Receivers: Theory and Performance Limits.” *Proceedings of the IEEE*, 90 (5), 711–732, May 2002.
- [Kostel1990] E. J. Kostelich y J. A. Yorke, “Noise Reduction: Finding the Simplest Dynamical System Consistent with the Data.” *Physica D*, 41, 183–196, 1990.
- [Kostel1993] E. J. Kostelich y T. Schreiber, “Noise Reduction in Chaotic Time-Series Data: A Survey of Common Methods.” *Physical Review E*, 48 (3), 1752–1763, Sep. 1993.
- [Kushne1978] H. J. Kushner y D. S. Clark, *Stochastic Approximation Methods for Constrained and Unconstrained Systems*, Springer-Verlag, 1978.
- [Laney2002] D. C. Laney, G. M. Maggio, F. Lehman, y L. Larson, “Multiple Access for UWB Impulse Radio with Pseudochaotic Time Hopping.” *IEEE Journal on Selected Areas in Communication*, 20 (9), 1692–1700, Dec. 2002.
- [Lapede1987] A. Lapedes y R. Farber, *Nonlinear Signal Processing Using Neural Networks: Prediction and System Modeling*, Technical report LA-UR 87-2662, Los Alamos National Lab., Los Alamos, New Mexico (USA), 1987.

- [Lathi1998] B. P. Lathi, *Signal Processing and Linear Systems*, Berkeley-Cambridge Press, 1998.
- [Lau2003] F. C. M. Lau y C. K. Tse, *Chaos-Based Digital Communication Systems*, Springer-Verlag, Berlin, 2003.
- [Lee1977] W. U. Lee y F. S. Hill, Jr., "A Maximum-Likelihood Sequence Estimator with Decision-Feedback Equalization." *IEEE Trans. on Communications*, COM-25 (9), 971–979, Sep. 1977.
- [Leung1997] H. Leung y J. Lam, "Design of Demodulator for the Chaotic Modulation Communication System." *IEEE Trans. on Circuits and Systems I: Fundamental Theory and Applications*, 44 (3), 262–267, Mar. 1997.
- [Leung2006] H. Leung, S. Shanmugan, N. Xie, y S. Wang, "An Ergodic Approach for Chaotic Signal Estimation at Low SNR with Application to Ultra-Wide-Band Communication." *IEEE Trans. on Signal Processing*, 54 (3), 1091–1103, Mar. 2006.
- [Li1975] T. Y. Li y J. A. Yorke, "Period Three Implies Chaos." *American Mathematical Monthly*, 82, 985–992, 1975.
- [Libcha1982a] A. Libchaber y J. Maurer, "A Rayleigh Bénard Experiment: Helium in a Small Box.", en T. Riste (ed.) *Nonlinear Phenomena at Phase Transitions and Instabilities*, 259–286, Plenum Pub. Corp., 1982.
- [Libcha1982b] A. Libchaber, C. Laroche, y S. Fauve, "Period Doubling Cascade in Mercury, a Quantitative Measurement." *La Journal de Physique-Lettres*, 43, L211–L216, 1982.
- [Linsay1981] P. S. Linsay, "Period Doubling and Chaotic Behaviour in a Driven Anharmonic Oscillator." *Physical Review Letters*, 47, 1349–1352, 1981.
- [Lipton1996] J. M. Lipton y K. P. Dabke, "Spread Spectrum Communications Based on Chaotic Systems." *International Journal of Bifurcation and Chaos*, 6 (12A), 2361–2374, 1996.
- [Lorent1996] G. G. Lorentz y M. V. Golitschek, *Constructive Approximation: Advanced Problems*, Springer-Verlag, 1996.
- [Lorenz1963a] E. N. Lorenz, "Deterministic Nonperiodic Flow." *Journal of the Atmospheric Sciences*, 20, 130–141, 1963.
- [Lorenz1963b] E. N. Lorenz, "The Mechanics of Vacillation." *Journal of the Atmospheric Sciences*, 20, 448–464, Sep. 1963.
- [Lorenz1976] E. N. Lorenz, "Nondeterministic Theories of Climatic Change." *Quaternary Research*, 6, 495–506, 1976.

- [Lorenz1987] E. N. Lorenz, “Deterministic and Stochastic Aspects of Atmospheric Dynamics.”, en C. Nicolis y G. Nicolis (eds.) *Irreversible Phenomena and Dynamical Systems Analysis in Geosciences*, 159–179, Reidel, 1987.
- [Luengo2000b] D. Luengo, C. Pantaleón, I. Santamaría, y J. Ibáñez, “Modulación de Señales Digitales Usando Mapas Caóticos.”, en *Actas del XV Symposium Nacional de la Unión Científica Internacional de Radio (URSI)*, 131–132, Zaragoza, 13–15 Sep. 2001.
- [Luengo2001a] D. Luengo, C. Pantaleón, y I. Santamaría, “Competitive Chaotic AR(1) Model Estimation.”, en *Proc. XI IEEE Int. Neural Networks for Signal Processing (NNSP) Workshop*, 83–92, North Falmouth, MA (USA), 10–12 Sep. 2001.
- [Luengo2001b] D. Luengo, C. Pantaleón, y I. Santamaría, “Modelado AR(1) Usando Mapas Caóticos Lineales a Tramos.”, en *Actas del XVI Symposium Nacional de la Unión Científica Internacional de Radio (URSI)*, 173–174, Villaviciosa de Odón (Madrid), 19–21 Sep. 2001.
- [Luengo2002a] D. Luengo, C. Pantaleón, y I. Santamaría, “Bayesian Estimation of Discrete Chaotic Signals by MCMC.”, en *Proc. XI European Signal Processing Conf. (EUSIPCO)*, 333–336, Toulouse (France), 3–6 Sep. 2002.
- [Luengo2004a] D. Luengo, C. Pantaleón, I. Santamaría, L. Vielva, y J. Ibáñez, “Multiple Composite Hypothesis Testing: A Competitive Approach.” *Journal of VLSI Signal Processing Systems for Signal, Image and Video Technology*, 37 (2/3), 319–331, Jun. 2004.
- [Luengo2005a] D. Luengo y I. Santamaría, “Secure Communications Using OFDM with Chaotic Modulation in the Subcarriers.”, en *Proc. IEEE 61st Semiannual Vehicular Technology Conference (VTC2005-Spring)*, 1022–1026, Stockholm (Sweden), 30 May - 1 Jun. 2005.
- [Luengo2005b] D. Luengo, I. Santamaría, y L. Vielva, “Asymptotically Optimal Maximum-Likelihood Estimation of a Class of Chaotic Signals Using the Viterbi Algorithm.”, en *Proc. XIII European Signal Processing Conf. (EUSIPCO)*, Antalya (Turkey), 4–8 Sep. 2005.
- [Luengo2005c] D. Luengo y I. Santamaría, “Análisis de un Esquema Novedoso de Comunicaciones Caóticas con OFDM y su Aplicación en Comunicaciones Seguras.”, en *Actas del XX Symposium Nacional de la Unión Científica Internacional de Radio (URSI)*, Gandía (Valencia), 14–16 Sep. 2005.

- [Luengo2005d] D. Luengo, I. Santamaría, y L. Vielva, “A General Solution to Blind Inverse Problems for Sparse Input Signals.” *Neurocomputing*, 69 (1–3), 198–215, Dec. 2005.
- [Luengo2006] D. Luengo y I. Santamaría, “OFDM System with Inverse Chaotic Coding in the Subcarriers.” *IEEE Trans. on Circuits and Systems II: Express Briefs*, Sep. 2006, enviado para su publicación.
- [Mackey1977] M. C. Mackey y L. Glass, “Oscillations and Chaos in Physiological Control Systems.” *Science*, 197 (4300), 287–289, Jul. 1977.
- [Maggio2001a] G. M. Maggio y L. Reggiani, “Applications of Symbolic Dynamics to UWB Impulse Radio.”, en *Proc. IEEE Int. Symp. on Circuits and Systems (ISCAS)*, tomo III, 153–156, Sydney (Australia), May 6–9 2001.
- [Maggio2001b] G. M. Maggio, N. Rulkov, y L. Reggiani, “Pseudo-Chaotic Time Hopping for UWB Impulse Radio.” *IEEE Trans. on Circuits and Systems I: Fundamental Theory and Applications*, 48 (12), 1424–1435, Dec. 2001.
- [Malthu1990] T. R. Malthus, *Ensayo sobre el Principio de la Población*, Ediciones Akal, Los Berrocales del Jarama, Madrid, 1990.
- [Man1997] K. F. Man y K. S. Tang, “Genetic Algorithms for Control and Signal Processing.”, en *Proc. IEEE Int. Conf. on Industrial Electronics, Control and Instrumentation (IECON)*, tomo 4, 1541–1555, New Orleans (LA), USA, 9–14 Nov. 1997.
- [Mandel1996] B. Mandelbrot, *Los Objetos Fractales*, 4^a ed., Tusquets Editores, 1996.
- [Mandel2003] B. Mandelbrot, *La Geometría Fractal de la Naturaleza*, Tusquets Editores, 2003.
- [Marcus1985] P. S. Marcus, “Coherent Vortical Features in a Turbulent Two-Dimensional Flow and the Great Red Spot of Jupiter.”, en *Proc. 110th Meeting of the Acoustical Soc. of America*, Nashville, TN (USA), 5 Nov. 1985.
- [Martin1998] M. A. Martín, M. Morán, y M. Reyes, *Iniciación al Caos*, Editorial Síntesis, 1998.
- [Matola1996] D. W. Matolak y S. G. Wilson, “Variable-Complexity Trellis Decoding of Binary Convolutional Codes.” *IEEE Trans. on Communications*, 44 (2), 121–126, Feb. 1996.

- [Matsum1984] T. Matsumoto, "A Chaotic Attractor from Chua's Circuit." *IEEE Trans. on Circuits and Systems*, CAS-31 (12), 1055–1058, Dec. 1984.
- [Matsum1985] T. Matsumoto, L. O. Chua, y M. Komuro, "The Double Scroll." *IEEE Trans. on Circuits and Systems*, CAS-32 (8), 798–818, Aug. 1985.
- [Matsum1987] G. Matsumoto, K. Aihara, Y. Hanyu, N. Takahashi, S. Yoshizawa, y J. Nagumo, "Chaos and Phase Locking in Normal Squid Axons." *Physics Letters A*, 123 (4), 162–166, 3 Aug. 1987.
- [May1974] R. M. May, "Biological Populations with Nonoverlapping Generations: Stable Points, Stable Cycles and Chaos." *Science*, 186, 645–647, 1974.
- [May1976] R. M. May, "Simple Mathematical Models with Very Complicated Dynamics." *Nature*, 261 (5560), 459–467, 1976.
- [Mazzi1997] G. Mazzini, G. Setti, y R. Rovatti, "Chaotic Complex Spreading Sequences for Asynchronous DS-CDMA – Part I: System Modeling and Results." *IEEE Trans. on Circuits and Systems I: Fundamental Theory and Applications*, 44 (10), 937–947, Oct. 1997.
- [Mazzi1999] G. Mazzini, R. Rovatti, y G. Setti, "Interference Minimisation by Autocorrelation Shaping in Asynchronous DS-CDMA Systems: Chaos-Based Spreading is Nearly Optimal." *IEE Electronics Letters*, 35 (13), 1054–1055, 24 Jun. 1999.
- [Mees1992] A. I. Mees, "Tesselations and Dynamical Systems.", en M. Casdagli y S. Eubank (eds.) *Nonlinear Modeling and Forecasting*, 3–24, Addison-Wesley Pub. Co., Cambridge (UK), 1992.
- [Mendel1987] J. M. Mendel, *Lessons in Digital Estimation Theory*, Prentice-Hall, 1987.
- [Meng1997] X. L. Meng y D. van Dyk, "The EM Algorithm - An Old Folk-Song Sung to a Fast New Tune." *Journal of the Royal Statistical Society. Series B (Methodological)*, 59 (3), 511–567, 1997.
- [Metro1953] N. Metropolis, A. W. Rosenbluth, M. Rosenbluth, A. H. Teller, y E. Teller, "Equation of State Calculations by Fast Computing Machines." *Journal of Chemical Physics*, 21, 1087–1092, 1953.
- [Metro1973] M. Metropolis, M. L. Stein, y P. R. Stein, "On Finite Limit Sets for Transformations on the Unit Interval." *Journal of Combinatorial Theory*, 15, 25–44, 1973.
- [Milnor2001] J. Milnor, "Dynamics: Introductory Lectures.", Oct. 2001, Stony Brook University (<http://www.math.sunysb.edu/~jack/DYNOTES>).

- [Miras1996] C. R. Mirasso, P. Colet, y P. García-Fernández, “Synchronization of Chaotic Semiconductor Lasers: Application to Encoded Communications.” *IEEE Photonics Technology Letters*, 8 (2), 299–301, Feb. 1996.
- [Mischa1995] K. Mischaikow y M. Mrozek, “Chaos in the Lorenz Equations: A Computer Assisted Proof.” *Bulletin of the American Mathematical Soc.*, 33, 66–72, 1995.
- [Mischa1998] K. Mischaikow y M. Mrozek, “Chaos in the Lorenz Equations: A Computer Assisted Proof. Part II: Details.” *Mathematics of Computation*, 67, 1023–1046, 1998.
- [Moody1989] J. Moody y C. J. Darken, “Fast Learning in Networks of Locally-Tuned Processing Units.” *Neural Computation*, 1, 281–294, 1989.
- [Morgul1996] O. Morgül y E. Solak, “Observer Based Synchronization of Chaotic Systems.” *Physical Review E*, 54, 4803–4811, 1996.
- [Myers1992a] C. Myers, S. Kay, y M. Richard, “Signal Separation for Nonlinear Dynamical Systems.”, en *Proc. IEEE Int. Conf. Acoustics, Speech, and Signal Processing (ICASSP)*, tomo 4, 129–132, San Francisco, CA (USA), 23–26 Mar. 1992.
- [Myers1992b] C. Myers, A. C. Singer, B. Shin, y E. Church, “Modeling Chaotic Systems with Hidden Markov Models.”, en *Proc. IEEE Int. Conf. on Acoustics, Speech and Signal Processing (ICASSP)*, tomo 4, 565–568, San Francisco, CA (USA), 23–26 Mar. 1992.
- [Neal1993] R. M. Neal, *Probabilistic Inference Using Markov Chain Monte Carlo Methods, Technical report CRG-TR-93-1*, Dep. of Computer Science, University of Toronto, Sep. 1993.
- [Nelson1996] L. B. Nelson y H. V. Poor, “Iterative Multiuser Receivers for CDMA Channels: An EM-Based Approach.” *IEEE Trans. on Communications*, 44 (12), 1700–1710, Dec. 1996.
- [Nijmei1997] H. Nijmeijer y I. M. Y. Mareels, “An Observer Looks at Synchronization.” *IEEE Trans. on Circuits and Systems I: Fundamental Theory and Applications*, 44 (10), 882–890, Oct. 1997.
- [Nusse1988] H. E. Nusse y J. A. Yorke, “Is Every Approximate Trajectory of Some Process Near an Exact Trajectory of a Nearby Process?” *Communications in Mathematical Physics*, 114 (3), 363–379, 1988.
- [Occult] “Optical Chaotic Communications Using Laser Transmitters (OCCULT).”, página web <http://www.imedeia.uib.es/project/occult/>.

- [Olmo2000] G. Olmo, E. Magli, y L. L. Presti, “Joint Statistical Signal Detection and Estimation. Part I: Theoretical Aspects of the Problem.” *Signal Processing*, 80, 57–73, 2000.
- [Omura1971] J. K. Omura, “Optimal Receiver Design for Convolutional Codes and Channels with Memory via Control Theoretical Concepts.” *Information Sciences*, 3, 243–266, Jul. 1971.
- [Oppen1989] A. V. Oppenheim y R. W. Schaffer, *Discrete-Time Signal Processing*, Signal Processing Series, Prentice Hall Int., Englewood Cliffs, NJ, 1989.
- [Oppen1992] A. V. Oppenheim, G. W. Wornell, S. H. Isabelle, y K. M. Cuomo, “Signal Processing in the Context of Chaotic Signals.”, en *Proc. IEEE Int. Conf. Acoustics, Speech, and Signal Processing (ICASSP)*, tomo IV, 117–120, San Francisco, CA (USA), 23–26 Mar. 1992.
- [Oppen1997] A. V. Oppenheim, A. S. Willsky, y S. H. Nawab, *Señales y Sistemas*, 2ª ed., Prentice Hall, 1997.
- [Ott1990] E. Ott, C. Grebogi, y J. A. Yorke, “Controlling Chaos.” *Physical Review Letters*, 64, 1196–1199, 1990.
- [Ott1993] E. Ott, *Chaos in Dynamical Systems*, Cambridge University Press, 1993.
- [Panta1994] C. Pantaleón, *Nuevos Métodos de Modelado Localmente Lineal*, Tesis Doctoral, Universidad Politécnica de Madrid, 1994.
- [Panta1996] C. Pantaleón, I. Santamaría, y A. R. Figueiras-Vidal, “Competitive Local Linear Modeling.” *Signal Processing*, 49, 73–83, 1996.
- [Panta2000a] C. Pantaleón, D. Luengo, y I. Santamaría, “Bayesian Estimation of a Class of Chaotic Signals.”, en *Proc. IEEE Int. Conf. Acoustics, Speech and Signal Processing (ICASSP)*, tomo 1, 193–196, Istanbul (Turkey), 5–9 Jun. 2000.
- [Panta2000b] C. Pantaleón, D. Luengo, y I. Santamaría, “Optimal Estimation of Chaotic Signals Generated by Piecewise-Linear Maps.” *IEEE Signal Processing Letters*, 7 (8), 235–237, Aug. 2000.
- [Panta2000c] C. Pantaleón, D. Luengo, y I. Santamaría, “An Efficient Method for Chaotic Signal Parameter Estimation.”, en *Proc. European Signal Processing Conf. (EUSIPCO)*, tomo 3, Tampere (Finland), 4–8 Sep. 2000.

- [Panta2000d] C. Pantaleón, D. Luengo, y I. Santamaría, “Optimal Estimation of a Class of Chaotic Signals.”, en *Proc. 16th World Computer and Communications Conf. - Int. Conf. on Signal Processing (WCCC-ICSP)*, tomo 1, 276–280, Beijing (China), 21–25 Aug. 2000.
- [Panta2001a] C. Pantaleón, D. Luengo, y I. Santamaría, “Chaotic AR(1) Model Estimation.”, en *Proc. IEEE Int. Conf. Acoustics, Speech and Signal Processing (ICASSP)*, tomo 6, 3477–3480, Salt Lake City, Utah (USA), 7–11 May 2001.
- [Panta2001b] C. Pantaleón, L. Vielva, D. Luengo, y I. Santamaría, “Estimación Bayesiana de Señales Caóticas Generadas por Mapas PWL.”, en *Actas del XV Simposium Nacional de la Unión Científica Internacional de Radio (URSI)*, 241–242, Villaviciosa de Odón (Madrid), 19–21 Sep. 2001.
- [Panta2002] C. Pantaleón, D. Luengo, y I. Santamaría, “Estimation of a Certain Class of Chaotic Signals: An EM-Based Approach.”, en *Proc. IEEE Int. Conf. Acoustics, Speech, and Signal Processing (ICASSP)*, tomo 2, 1129–1132, Orlando, Florida (USA), 12–17 May 2002.
- [Panta2003] C. Pantaleón, L. Vielva, D. Luengo, y I. Santamaría, “Bayesian Estimation of Chaotic Signals Generated by Piecewise-Linear Maps.” *Signal Processing*, 83 (3), 659–664, Mar. 2003.
- [Papado1993] H. C. Papadopoulos y G. W. Wornell, “Optimal Detection of a Class of Chaotic Signals.”, en *Proc. IEEE Int. Conf. Acoustics, Speech, and Signal Processing (ICASSP)*, tomo 3, 117–120, Minneapolis, MN (USA), 27–30 Apr. 1993.
- [Papado1995] H. C. Papadopoulos y G. W. Wornell, “Maximum-Likelihood Estimation of a Class of Chaotic Signals.” *IEEE Trans. on Information Theory*, 41 (1), 312–317, Jan. 1995.
- [Papou1991] A. Papoulis, *Probability, Random Variables, and Stochastic Processes*, 3^a ed., McGraw-Hill, 1991.
- [Parlit1992] U. Parlitz, L. O. Chua, L. Kocarev, K. S. Halle, y A. Shang, “Transmission of Digital Signals by Chaotic Synchronization.” *International Journal of Bifurcation and Chaos*, 2 (4), 973–977, 1992.
- [Parlit1994] U. Parlitz y S. Ergezinger, “Robust Communication Based on Chaotic Spreading Sequences.” *Physics Letters A*, 188, 146–150, 16 May 1994.
- [Pecora1990] L. M. Pecora y T. L. Carroll, “Synchronization in Chaotic Systems.” *Physical Review Letters*, 64 (8), 821–825, 19 Feb. 1990.

- [Peit1992] H. O. Peitgen, H. Jürgens, y D. Saupe, *Chaos and Fractals: New Frontiers of Science*, Springer-Verlag, 1992.
- [Peters1996] E. E. Peters, *Chaos and Order in the Capital Markets: A New View of Cycles, Prices, and Market Volatility*, 2ª ed., John Wiley & Sons, 1996.
- [Pikov1986] A. S. Pikovsky, “Discrete-Time Dynamic Noise Filtering.” *Sovietic Journal of Communications in Technology & Electronics*, 31, 81–85, 1986.
- [Poin1957] J. H. Poincaré, *New Methods of Celestial Mechanics*, Dover, 1957.
- [Poin2001] J. H. Poincaré, *The Value of Science: Essential Writings of Henri Poincaré*, The Modern Library, 2001.
- [Potapo2000] A. Potapov y M. K. Ali, “Robust Chaos in Neural Networks.” *Physics Letters A*, 277 (6), 310–322, Dec. 11 2000.
- [Princi1992] J. C. Principe, A. Rathie, y J. M. Kuo, “Prediction of Chaotic Time Series with Neural Networks and the Issue of Dynamic Modeling.” *Int. Journal of Bifurcation and Chaos*, 2 (4), 989–996, 1992.
- [Princi2000] J. C. Principe, N. R. Euliano, y W. C. Lefebvre, *Neural and Adaptive Systems: Fundamentals through Simulations*, John Wiley & Sons, New York, NY (USA), 2000.
- [Proak1998] J. G. Proakis y D. G. Manolakis, *Tratamiento Digital de Señales: Principios, Algoritmos y Aplicaciones*, 3ª ed., Prentice Hall, 1998.
- [Quresh1973a] S. U. H. Qureshi y E. E. Newhall, “An Adaptive Receiver for Data Transmission over Time-Dispersive Channels.” *IEEE Trans. on Information Theory*, IT-19 (4), 448–457, Jul. 1973.
- [Rabino1998] M. I. Rabinovich y H. D. I. Abarbanel, “The Role of Chaos in Neural Systems.” *Neuroscience*, 87 (1), 5–14, 1998.
- [RAE1992] Real Academia Española, *Diccionario de la Lengua Española*, 21ª ed., Real Academia Española, 1992.
- [Richar1993] M. D. Richard, “Properties and Discrimination of Chaotic Maps.”, en *Proc. IEEE Int. Conf. Acoustics, Speech, and Signal Processing (ICASSP)*, tomo 3, 141–144, Minneapolis, MN (USA), 27–20 Apr. 1993.
- [Rissan1978] J. Rissanen, “Modeling by Shortest Data Description.” *Automatica*, 14, 465–471, 1978.

- [Robbin1951] H. Robbins y S. Monro, "A Stochastic Approximation Method." *The Annals of Mathematical Statistics*, 22, 400–407, 1951.
- [Rodri1987] A. Rodríguez-Vazquez, J. L. Huertas, A. Rueda, B. Pérez-Verdú, y L. O. Chua, "Chaos from Switched-Capacitor Circuits: Discrete Maps." *Proceedings of the IEEE*, 75 (8), 1090–1106, Aug. 1987.
- [Rossle1976] O. E. Rössler, "An Equation for Continuous Chaos." *Physical Letters*, 57A, 397–398, 1976.
- [Rossle1979] O. E. Rössler, "Continuous Chaos – Four Prototype Equations.", en O. Gurel y O. E. Rössler (eds.) *Bifurcation Theory and Applications in Scientific Disciplines*, 376–392, New York Academy of Sciences, New York, NY (USA), 1979.
- [Roukes1990] M. L. Roukes y O. L. Alerhand, "Mesoscopic Junctions, Random Scattering and Strange Repellers." *Physical Review Letters*, 65, 1651–1654, 24 Sep. 1990.
- [Roux1980] J. C. Roux, A. Rossi, S. Bachelart, y C. Vidal, "Representation of a Strange Attractor from an Experimental Study of Chemical Turbulence." *Physics Letters*, 77A, 391–393, 1980.
- [Rovat1998a] R. Rovatti, G. Setti, y G. Mazzini, "Chaotic Complex Spreading Sequences for Asynchronous DS-CDMA – Part II: Some Theoretical Performance Bounds." *IEEE Trans. on Circuits and Systems I: Fundamental Theory and Applications*, 45 (4), 496–506, Apr. 1998.
- [Rovat1998b] R. Rovatti, G. Setti, y G. Mazzini, "Toward Sequences Optimization for Chaos-Based Asynchronous DS-CDMA Systems.", en *Proc. IEEE Global Telecom. Conf. (GLOBECOM)*, tomo 4, 2174–2179, Sydney (Australia), 8 Nov. – 12 Nov. 1998.
- [Rovat1998c] R. Rovatti y G. Mazzini, "Interference in DS-CDMA Systems with Exponentially Vanishing Autocorrelations: Chaos-Based Spreading is Optimal." *IEE Electronics Letters*, 34 (20), 1911–1913, 1 Oct. 1998.
- [Ruanai1996] J. J. K. O. Ruanaidh y W. J. Fitzgerald, *Numerical Bayesian Methods Applied to Signal Processing*, Springer-Verlag, New York (NY), USA, 1996.
- [Ruelle1971] D. Ruelle y F. Takens, "On the Nature of Turbulence." *Communications in Mathematical Physics*, 20, 167–192, 1971.
- [Ruelle1993] D. Ruelle, *Azar y Caos*, Alianza Editorial, 1993.

- [Rugh1981] W. J. Rugh, *Nonlinear System Theory: The Volterra/Wiener Approach*, John Hopkins University Press, 1981.
- [Sagdee1990] R. Z. Sagdeev, D. A. Usikov, y G. M. Zaslavsky, *Nonlinear Physics*, Harwood Academic Publishers, New York, NY (USA), 1990.
- [Sakai1980] H. Sakai y H. Tokumaru, "Autocorrelation of a Certain Chaos." *IEEE Trans. on Acoustics, Speech, and Signal Processing*, ASSP-28 (5), 588–590, Oct. 1980.
- [Sarkov1964] A. N. Sarkovskii, "Coexistence of Cycles of a Continuous Mapping of the Line into Itself (en Ruso)." *Ukrain. Mat. Z.*, 16 (1), 61–71, 1964.
- [Schim1999] T. Schimming y J. Schweizer, "Chaos Communication from a Maximum Likelihood Perspective.", en *Proc. Int. Workshop on Nonlinear Dynamics of Electronic Systems (NDES)*, 179–182, Ronne (Denmark), 15–17 Jul. 1999.
- [Schim2000] T. Schimming y M. Hasler, "Chaos Communication in the Presence of Channel Noise." *Journal of Signal Processing*, 4 (1), 21–28, 2000.
- [Schwar1975] M. Schwartz y L. Shaw, *Signal Processing: Discrete Spectral Analysis, Detection, and Estimation*, McGraw-Hill, 1975.
- [Schwei1995] J. Schweizer y M. P. Kennedy, "Predictive Poincaré Control: A Control Theory for Chaotic Systems." *Physical Review E*, 52 (5), 4865–4876, Nov. 1995.
- [Schwei1996] S. M. Schweizer, V. L. Stonick, y J. L. Evans, "TLS Parameter Estimation for Filtering Chaotic Time Series.", en *Proc. IEEE Int. Conf. on Acoustics, Speech, and Signal Processing (ICASSP)*, 1609–1612, Atlanta, GA (USA), 1996.
- [Schwei2001a] J. Schweizer y T. Schimming, "Symbolic Dynamics for Processing Chaotic Signals I: Noise Reduction of Chaotic Sequences." *IEEE Trans. on Circuits and Systems I: Fundamental Theory and Applications*, 48 (11), 1269–1282, Nov. 2001.
- [Schwei2001b] J. Schweizer y T. Schimming, "Symbolic Dynamics for Processing Chaotic Signals II: Communication and Coding." *IEEE Trans. on Circuits and Systems I: Fundamental Theory and Applications*, 48 (11), 1283–1295, Nov. 2001.
- [Silva2000b] C. P. Silva y A. M. Young, "Introduction to Chaos-Based Communications and Signal Processing.", en *Proc. IEEE Aerospace Conf.*, tomo 1, 279–299, Big Sky, MT (USA), 18–25 Mar. 2000.

- [Simmon1990] S. J. Simmons, "Breadth-First Trellis Decoding with Adaptive Effort." *IEEE Trans. on Communications*, 38 (1), 3–12, Jan. 1990.
- [Sinai1977] Y. G. Sinai, *Introduction to Ergodic Theory*, Princeton University Press, Princeton, NJ (USA), 1977.
- [Singer1978] D. Singer, "Stable Orbits and Bifurcations of Maps of the Interval." *SIAM Journal of Applied Mathematics*, 35, 260–268, 1978.
- [Singer1994] A. C. Singer, G. W. Wornell, y A. V. Oppenheim, "Nonlinear Auto-regressive Modeling and Estimation in the Presence of Noise." *Digital Signal Processing*, 4, 1994.
- [Skarda1987] C. A. Skarda y W. J. Freeman, "How Brains Make Chaos in Order to Make Sense of the World." *Behavioral and Brain Sciences*, 10, 161–165, 1987.
- [Sklar2003] B. Sklar, "How I Learned to Love the Trellis." *IEEE Signal Processing Mag.*, 20 (3), 87–102, May 2003.
- [Smale1967] S. Smale, "Differentiable Dynamical Systems." *Bulletin of the American Mathematical Soc.*, 747–817, 1967.
- [Stanko2003] L. Stankovic, I. Djuric, A. Ohsumi, y H. Ijima, "Instantaneous Frequency Estimation by Using Wigner Distribution and Viterbi Algorithm.", en *Proc. IEEE Int. Conf. on Acoustics, Speech and Signal Processing (ICASSP)*, tomo VI, 121–124, Hong Kong (China), 6–10 Apr. 2003.
- [Stark2002] H. Stark y J. W. Woods, *Probability and Random Processes with Applications to Signal Processing*, 3ª ed., Prentice-Hall, Upper Saddle River, NJ (USA), 2002.
- [Stewar2001] I. Stewart, *¿Juega Dios a los Dados?*, Crítica, 2001.
- [Sushch2000a] M. M. Sushchik, N. Rulkov, L. Larson, L. S. Tsimring, H. Abarbanel, K. Yao, y A. R. Volkovskii, "Chaotic Pulse Position Modulation: A Robust Method of Communicating with Chaos." *IEEE Communication Letters*, 4 (4), 128–130, Apr. 2000.
- [Sushch2000b] M. M. Sushchik y L. S. Tsimring, "Correlation Detection in Chaos-Based Spread Spectrum Communication Schemes.", en *Proc. IEEE Int. Conf. on Control of Oscillations and Chaos (COC)*, 526–529, St. Petersburg (Russia), 5–7 Jul. 2000.

- [Sushch2000c] M. M. Sushchik, L. S. Tsimring, y A. R. Volkovskii, "Performance Analysis of Correlation-Based Communication Schemes Utilizing Chaos." *IEEE Trans. on Circuits and Systems I: Fundamental Theory and Applications*, 47 (12), 1684–1691, Dec. 2000.
- [Syvri2006] D. Syvridis, A. Argyris, y A. Bogris, "Chaos-Based Communications at High Bit Rates Using Commercial Fibre-Optic Links.", en *Proc. Asian-Pacific Optics Conf.*, Korea, Sep. 2006.
- [Takens1981] F. Takens, "Detecting Strange Attractors in Fluid Turbulence.", en D. Rand y L. S. Young (eds.) *Dynamical Systems and Turbulence*, 366–381, Springer-Verlag, 1981.
- [Tam2006] W. M. Tam, F. C. M. Lau, y C. K. Tse, "Generalized Correlation-Delay-Shift-Keying Scheme for Noncoherent Chaos-Based Communication Systems." *IEEE Trans. on Circuits and Systems I: Regular Papers*, 53 (3), 712–721, Mar. 2006.
- [Tanaka2004] K. Tanaka y E. Kondo, "Robot Detection with Multi-Target Tracking.", en *IEEE Conf. on Cybernetics and Intelligent Systems*, 117–122, Singapore, 1–3 Dec. 2004.
- [Tang1983] Y. S. Tang, A. I. Mees, y L. O. Chua, "Synchronization and Chaos." *IEEE Trans. on Circuits and Systems*, CAS-30 (9), 620–626, Sep. 1983.
- [Teager1990] H. Teager y S. Teager, "Evidence for Nonlinear Sound Production Mechanisms in the Vocal Tract.", en *Proc. NATO ASI on Speech Production and Speech Modelling*, 241–261, 1990.
- [Testa1982] J. Testa, J. Pérez, y C. Jeffries, "Evidence for Universal Chaotic Behavior of a Driven Nonlinear Oscillator." *Physical Review Letters*, 48, 714–717, 1982.
- [Thomps2002] J. M. T. Thompson y H. B. Stewart, *Nonlinear Dynamics and Chaos*, 2ª ed., John Wiley & Sons, 2002.
- [Tong1983] H. Tong, *Threshold Models in Non-Linear Time Series Analysis*, Lecture Notes in Statistics (Vol. 21), Springer-Verlag, 1983.
- [Tong1990] H. Tong, *Non-Linear Time Series: A Dynamical System Approach*, Oxford University Press, 1990.
- [Tronci2003] S. Tronci, M. Giona, y R. Baratti, "Reconstruction of Chaotic Time Series by Neural Models: A Case Study." *Neurocomputing*, 55, 581–591, 2003.

- [Tse1994] C. K. Tse, “Flip Bifurcation and Chaos in Three-State Boost Switching Regulators.” *IEEE Trans. on Circuits and Systems I: Fundamental Theory and Applications*, 41 (1), 16–23, Jan. 1994.
- [Tufil1992] N. B. Tufillaro, T. Abbott, y J. Reilly, *An Experimental Approach to Nonlinear Dynamics and Chaos*, Addison–Wesley Pub. Co., 1992.
- [Ueda1980b] Y. Ueda, “Explosion of Strange Attractors Exhibited by Duffing’s Equation.”, en R. H. G. Helleman (ed.) *Nonlinear Dynamics*, 422–434, New York Academy of Sciences, New York, NY (USA), 1980.
- [Ueda1980a] Y. Ueda, “Steady Motions Exhibited by Duffing’s Equation: A Picture Book of Regular and Chaotic Motions.”, en P. J. Holmes (ed.) *New Approaches to Nonlinear Problems in Dynamics*, 311–322, SIAM, Philadelphia (USA), 1980.
- [Ulam1947] S. M. Ulam y J. Von Neumann, “On Combinations of Stochastic and Deterministic Processes.” *Bulletin of the American Mathematical Soc.*, 53, 1120, 1947.
- [VanTre1968] H. L. Van Trees, *Detection, Estimation and Modulation Theory*, John Wiley and Sons, 1968.
- [Vepsta2005] L. Vepstas, “Symmetries of Period-Doubling Maps.”, no publicado, disponible en <http://linas.org/math/chap-takagi.pdf>.
- [Vermeu1974] F. L. Vermeulen y M. E. Hellman, “Reduced-State Viterbi Decoding for Channels with Intersymbol Interference.”, en *Proc. IEEE Int. Communications Conf.*, Minneapolis (MN), USA, Jun. 1974.
- [Vikalo2003a] H. Vikalo, B. Hassibi, y U. Mitra, “Sphere-Constrained ML Detection for Frequency-Selective Channels.”, en *Proc. IEEE Int. Conf. on Acoustics, Speech and Signal Processing (ICASSP)*, tomo IV, 1–4, Hong Kong (China), 6–10 Apr. 2003.
- [Vikalo2005] H. Vikalo y B. Hassibi, “On the Sphere Decoding Algorithm II: Generalizations, Second-Order Statistics, and Applications to Communications.” *IEEE Trans. on Signal Processing*, 53 (8), 2819–2834, Aug. 2005, part 1/2.
- [Viter1967] A. J. Viterbi, “Error Bounds for Convolutional Codes and an Asymptotically Optimum Decoding Algorithm.” *IEEE Trans. on Information Theory*, IT-13, 260–269, Apr. 1967.
- [Walter1982] P. Walters, *An Introduction to Ergodic Theory*, Springer, New York, NY (USA), 1982.

- [Wang1999] S. Wang, P. C. Yip, y H. Leung, “Estimating Initial Conditions of Noisy Chaotic Signals Generated by Piece-Wise Linear Markov Maps Using Itineraries.” *IEEE Trans. on Signal Processing*, 47 (12), 3289–3302, Dec. 1999.
- [Wang2000] X. Wang y R. Chen, “Adaptive Bayesian Multiuser Detection for Synchronous CDMA with Gaussian and Impulsive Noise.” *IEEE Trans. on Signal Processing*, 47 (7), 2013–2028, Jul. 2000.
- [Wang2001] X. Wang y R. Chen, “Blind Turbo Equalization in Gaussian and Impulsive Noise.” *IEEE Trans. on Vehicular Technology*, 50 (4), 1092–1105, Jul. 2001.
- [Weigen1990] A. S. Weigend, B. A. Huberman, y D. E. Rumelhart, “Predicting the Future: A Connectionist Approach.” *Int. Journal of Neural Systems*, 1, 193–209, 1990.
- [Wesolo1987] K. Wesolowski, “An Efficient DFE & ML Suboptimum Receiver for Data Transmission over Dispersive Channels Using Two-Dimensional Signal Constellations.” *IEEE Trans. on Communications*, COM-35 (3), 336–339, Mar. 1987.
- [Wiggin1990] S. Wiggins, *Introduction to Applied Nonlinear Dynamical Systems and Chaos*, Springer, 1990.
- [Wilf1986] H. Wilf, *Algorithms and Complexity*, Prentice-Hall, Englewood Cliffs, NJ (USA), 1986.
- [Willi1997] G. P. Williams, *Chaos Theory Tamed*, Joseph Henry Press, 1997.
- [Wisdom1984] J. Wisdom, S. Peale, y F. Mignard, “The Chaotic Rotation of Hyperion.” *Icarus*, 1984.
- [Wisdom1985] J. Wisdom, “Meteorites may Follow a Chaotic Route to Earth.” *Nature*, 315, 731–733, 27 Jun. 1985.
- [Wisdom1987a] J. Wisdom, “Rotational Dynamics of Irregularly Shaped Natural Satellites.” *Astronomical Journal*, 94, 1350–1360, Nov. 1987.
- [Wisdom1987b] J. Wisdom, “Chaotic Behaviour in the Solar System.” *Proc. Royal Society, Series A - Mathematical and Physical Sciences*, 413 (1844), 109–129, 8 Sep. 1987.
- [Wisdom1988] J. Wisdom y G. J. Sussman, “Numerical Evidence that the Motion of Pluto is Chaotic.” *Bulletin of the American Astronomical Soc.*, 20, 901, Jun. 1988.

- [Wood1989] J. R. Wood, "Chaos: A Real Phenomenon in Power Electronics.", en *IEEE Applied Power Electronics Conf. and Exposition (APEC)*, 115–124, Baltimore, MD (USA), 13–17 Mar. 1989.
- [Wu1983] C. F. Wu, "On the Convergence of the EM Algorithm." *Annals of Statistics*, 11 (1), 95–103, Jan. 1983.
- [Xie2004] N. Xie y H. Leung, "Reconstruction of Piecewise Chaotic Dynamic Using a Genetic Algorithm Multiple Model Approach." *IEEE Trans. on Circuits and Systems I: Regular Papers*, 51 (6), 1210–1222, Jun. 2004.
- [Yang1997] T. Yang y L. O. Chua, "Chaotic Digital Code-Division Multiple Access (CDMA) Communication Systems." *International Journal of Bifurcation and Chaos*, 7 (12), 2789–2805, 1997.
- [Yoma2003] N. B. Yoma, J. Silva, C. Busso, y I. Brito, "Compensation Additive Noise and CS-CELP Distortion in Speech Recognition Using Stochastic Weighted Viterbi Algorithm." *IEE Electronics Letters*, 39 (4), 409–411, 20 Feb. 2003.
- [Zacks1971] S. Zacks, *The Theory of Statistical Inference*, John Wiley & Sons, New York (NY), USA, 1971.
- [Zamiri1999b] H. Zamiri-Jafarian y S. Pasupathy, "Adaptive T-Algorithm in MLSD/MLSDE Receivers for Fading Channels.", en *Proc. IEEE Int. Communications Conf. (ICC)*, tomo I, 539–543, Vancouver (Canada), 6–10 Jun. 1999.
- [Zamiri2002] H. Zamiri-Jafarian y S. Pasupathy, "Complexity Reduction of the MLSD/MLSDE Receiver Using the Adaptive State Allocation Algorithm." *IEEE Trans. on Wireless Communications*, 1 (1), 101–111, Jan. 2002.
- [Zhong1985] G. Q. Zhong y F. Ayrom, "Experimental Confirmation of Chaos from Chua's Circuit." *Int. Journal of Circuit Theory Applications*, 13 (11), 93–98, 1985.
- [Zhu2005] H. Zhu, Z. Shi, y B. Farhang-Boroujeny, "MIMO Detection Using Markov Chain Monte Carlo Techniques for Near-Capacity Performance.", en *Proc. IEEE Int. Conf. on Acoustics, Speech and Signal Proc. (ICASSP)*, tomo III, 1017–1020, Philadelphia (PA), USA, 18–23 Mar. 2005.
- [Zou1993] F. Zou y J. A. Nossek, "Bifurcation and Chaos in Cellular Neural Networks." *IEEE Trans. on Circuits and Systems I: Fundamental Theory and Applications*, 40 (3), 166–173, Mar. 1986.

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