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PUBLICATIONS

a. Refereed Publications

"Renormalized Hamiltonian Dynamics in Model Field Theories," Thesis, University of Michigan, Ann Arbor, (1970).

"Renormalization of the One-space Dimensional Yukawa Model by Unitary Transformation," (with P. Federbush), Ann. of Phys. 68, (1971) 98-101.

"Quadratic Fermi Interaction Hamiltonian," J. Math. Phys., 12, (1971) 1414-1419.

"Properties of the φ42 Interaction Hamiltonian", Jour. Of Math. Physics 15, (1974) 861-866.

"On the Self-Adroitness of the Lorentz Generator for $(\varphi^4)_{1+1}$," Jour. Of Math. Physics 15, (1974) 867-869.

"Renormalization, Hamiltonian, Pressure and All that, for the Generalized Yukawa Interaction in Two-Space Dimensions," Proceedings on Quantum Dynamics (1976), 1-27. Zentrum fur inderdisziplinare Forschung, Universit¨at Bielefeld, Bielefeld, West Germany.

"Soliton Mass and Surface Tension in the $(\lambda|\varphi^4|)_2$ Quantum Field Theory," (with J. Bellisard and J. Froehlich), Physical Review Letters 38, (1977) 619-622.

"Soliton Mass and Surface Tension in the $(\lambda|\varphi^4|)_2$ Quantum Field Theory," (with J. Bellisard and J. Froehlich), Common. Mathem. Phys. 60, (1978) 37-72.

"The Glimm-Jaffe-Spencer Expansion for Classical Boundary Conditions and Coexistence of Phases in the $\lambda\varphi^4_2$ Euclidean (Quantum) Field Theory," Annals of Physics 118, (1979) 18-83.

"Deformations and Spectral Properties of Merons," Jour. Math. Physics 20, (1979) 2097-2109.

"Symmetry and Related Properties via the Maximum Principle," (with W. M. Ni and L. Nirenberg), Comm. Math. Physics 68, (1979) 209-243.

"Euclidean Yang-Mills and Related Equations", in Bifurcation Phenomena in

Mathematical Physics and Related Topics, D. Reidel Publ. Co. (1980) pp.243-267, eds: C. Bardos and D. Bessis.

"Symmetry Properties and Isolated Singularities of Positive Solutions of it Nonlinear Elliptic Equations," in Nonlinear Partial Differential Equations and Applied Science, Marcel Dekker, Inc. (1980) 225-273, eds: R. Sternberg, A. Kalinowski, and J. Papadakis.

"Symmetry Properties of Positive Solutions of Nonlinear Elliptic Equations", (with W.M. Ni and L. Nirenberg), Mathematical Analysis, Adv. in Math., Suppl. Studies 7A (1981) 364-402.

"Global and Local Behavior of Positive Solutions of Nonlinear Elliptic Equations," (with J. Spruck), Comm. in Pure and Applied Math, 34 (1981) 525-598

"A Priori Bounds for Positive Solutions of Nonlinear Elliptic Equations" (with J. Spruck), Comm. in Partial Deferential Equations 6, (1981) 883-902.

"Symmetry and Isolated Singularities of Conformally Flat Metrics, and of Solutions of the Yang-Mills Equations," Annals of Mathematical Studies 102, (1982) 423-441.

"On Multimeron Solutions of the Yang-Mills Equations", (with L. Caffarelli and J. Spruck), Comm. Math. Phys. 87, (1983) 485-495.

"Non-Stationary Markov Chains and Convergence of the Annealing Algorithm," Jour. Statistical Physics 39, (1985) 73-131.

"The Langevin Equation as a Global Minimization Algorithm", in Disordered Systems and Biological Organization, Springer-Verlag (1985) p.p. 321-326 eds: Bienenstock, F. Folgeman, and G. Weisbuch.

"Global Minimization via the Langevin Equation," Proceedings of 24th Conference on Decision and Control, Ft. Lauderdale, Florida, December 1985, pp. 774-778.

"Consistency of Maximum Likelihood and Pseudo-Likelihood Estimators for Gibbs Distributions", in Stochastic Deferential Systems, Stochastic Control Theory, and Applications, IMA Vol. 10, Springer-Verlag (1986), 129-145, eds.: W. Fleming and P.L. Lions.

"Simulations and Global Optimization," in Random Media, IMA Volumes in Mathematics and Its Applications Vol. 7 (1987) pp. 129-145, ed: G. Papanicolaou.

"A Hierarchical Multiscale Processing of Images", Transactions of the Fourth Army Conference on Applied Mathematics and Computing (1987) 215-225.

"A Multilevel-Multiresolution Technique for Computer Vision via Renormalization Group Ideas", Proceedings on Optoelectronics and Laser Applications in Science and

Engineering, SPIE, January 1988, 214-218, ed: D. P. Casusent.

"Asymptotic Symmetry and Local Behavior of Semilinear Elliptic Equations with Critical Sobolev Growth," (with L. Caffarelli and J. Spruck), Comm. Pure and Appl. Math. Vol. XLII, No. 3 (1989) 271–297.

"A Renormalization Group Approach to Image Processing Problems", IEEE Transactions, PAMI, Vol. 11, No. 2 (1989) 164-180.

"A Bayesian Framework for the Estimation of 3-D Shapes in Robot Vision" (with J. Torreao) High Speed Computing II, SPIE Vol 1058 (1989) 86–93.

"A New Method for Estimating Markov Random Fields" (with M. Almeida), High Performance Computing in Science and Engineering, Proceedings TENCON 1989, pp. 340– 341, Bombay, India

"Asymptotics of Maximum Likelihood Estimators for the Curie-Weiss Model", (with F. Comets) Annals of Statistics 19 (1991) 557–578.

"Image Analysis and Computer Vision" (with D. Geman), Spatial Statistics and Image Processing, National Research Council, National Academy Press (1991) pp. 1–36.

"Parameter Estimation for Gibbs Distributions from Partially Observed Data", (with F. Comets), Annals of Applied Probability 2 (1992) 142–170.

"Parameter Estimation for Gibbs Distributions from Fully Observed Data" in Markov Random Fields: Theory and Applications, Academic Press (1993), 471–498, eds.: R. Chellappa and A. Jain.

"A Variational Method for Estimating the Parameters of MRF from Complete or Incomplete Data" (with M. Almeida), Annals of Applied Probability 3 (1993), 103–136.

"Metropolis-type Monte Carlo Simulation Algorithms and Simulated Annealing", Topics in Contemporary Probability and Its Applications, CRC Series Stochastics and Probability, 1995, pp 159–232, ed.: J. Laurie Snell.

"A Nonlinear Discriminant Analysis and Clustering with Applications to Speech Problems" (with A. Murua), in Image Models and Their Speech Cousins, IMA Series Vol. 80, pp. 13–63, Springer-Verlag 1996, eds.: Larry Shepp and Steve Levinson.

"Motion Detection and Tracking Using Deformable Templates" (with P. Perez), Proceeding of the 1994 IEEE International Conference on Image Processing, Austin, Texas, Vol. II, pp272-276.

"Classification and Clustering of Stop Consonants via Nonparametric Transformations and Wavelets" (with A. Murua), Proceeding of the 1995 IEEE International Conference on Acoustics, Speech, and Signal Processing, Detroit, Michigan Vol. IV,

pp. 872–875.

“Discussion of Analysis and Reconstruction of Medical Images Using Prior Information, by V. Johnson et. al.”, Case Studies in Bayesian Statistics, Lecture Notes in Statistics Vol. 105, pp. 219–224, Springer-Verlag 2995.

“Optimal Transformations for Prediction in Continuous – Time Stochastic Processes” (with A. Murua), Stochastic Processes and Related Topics, Birkhäuser 1998, pp. 167-183, eds: I. Karatzas, B.S. Rajput, and M.S. Taqqu.

“Estimation of Nonparametric Linear Functionals of Continuous–Time Processes from a Finite Data Set: Optimal Transformations for Prediction” (with A. Murua), to appear in The Annals of Statistics.

“Object Recognition via Hierarchical and Syntactic Models” (with A. Zelic), Proceedings of the 13th International Conference in Digital Signal Processing, Santorini, Greece, 1997, pp. 1117–1121.

”Stochastic Models for Generic Images” (with D. Mumford), Quarterly of Applied Mathematics, Vol. LIX, Number 1, 2001, pp. 85-111.

”Tracking of Moving Objects in Cluttered Environments via Monte Carlo Filter” (with M. Almeida and C. Robertson), Proceedings, International Conference on Pattern Recognition (ICPR2000), Barcelona, Spain, 2000, pp. 175-179

”Model-Based Simultaneous Tracking and Recognition of Moving Objects” (with M. Almeida), Proceedings of International Conference on Artificial Intelligence/Computer Vision, Rio de Janeiro, Brazil, November 2000, pp. 892-897.

”tRNA Secondary Structure via Stochastic Context-Free-Grammrs”, Proceedings Inter-national Conference on Mathematical Analysis and Its Applications.

”Simultaneous Tracking and Recognition via Hierarchical Syntactic Models” (with F. Gomes) Proceedings of Symposium on Computer Graphics and Image Processing, pp.225-229 October 7-11, 2002, Fortaleza, Brazil.

”Model-Based Tracking of Moving Objects in Cluttered Environments” (with F. Gomes and C. Robertson), Quarterly of Applied Mathematics VolLX, No 4 (2002), pp.737-771.

“Construction of Optimal Transformations for Prediction in Continuous–Time Stochastic Process: Finite Past and Present” (with A. Murua), Probability Theory and Related Fields Vol. 131, No.4, 2005, pp. 479-492.

“Estimation of Nonparametric Linear Functionals of continuous–Time Processes from a Finite Data Set: Linear Predictors” (with A. Murua), Journal of Time-Series Analysis preprint.

Papers in Preparation

"A New Method for MS/MS Time Data Analysis and Applications to Mast Cell Signaling Pathways"

"MYC GEnomic Targets Identification via Microarray and ChIp-chip data"

Technical Reports

"Unitary Renormalization in Model Field Theories," Randall Lab. of Physics, Report No. HE: 72-21 (1972), University of Michigan.

"On Two Soluble Field Theoretic Models," Randall Lab. of Physics, Report No. HE: 72-30 (1972), University of Michigan.

"Free Boundary Problems, Degenerate Elliptic Equations, and Applications to Quark Confinement," Report, Rutgers University (1984).

"Zero Crossings and the Heat Equation" (with B. Hummel), Robotics and Vision Lab., Report (1984), Courant Institute, New York University.

"A Lower Bound for the Dynamic Critical Exponent of the One-Dimensional Potts Model," (with S. Adachi, P.O. Weir, and J.M. Kosterlitz), Reports in Pattern Analysis No. 149, Div. of Applied Mathematics, Brown University (1987).

"A Multilevel-Multiresolution Analysis of Stationary Gaussian Processes on Z," Complex Systems Report No. 34, Division of Applied Mathematics, Brown University (1987).

"A Two-stage EM Algorithm with Applications to Emission Tomography" (with M. Hudson), submitted to IEEE Trans. Med. Imaging (1991).

"A Nonlinear Multi-Grid EM Algorithm for Emission Tomography" (with M. Hudson), submitted to IEEE Trans. Med. Imaging (1991).

RESEARCH IN PROGRESS

The main projects of research in 2010 were a continuation of our efforts to understand gene networks and signal transduction pathways. These are long range projects that we began two plus years ago. The below is nearly the same as that of last year (2009).

1. A New Method for MS/MS Time Data Analysis and Applications to Mast Cell Signaling Pathways: Mast cells have a physiological role (contribute to the immune system), and a pathological role (they play central role in allergies, including asthma). Our work focuses mainly on their pathological role. Upon activation by an allergen, mast cells signaling pathways have three main branches: (a) towards *degranulation* (and the associated production of toxic molecules such as histamine), (b) towards gene transcription of cytokines and chmokines, and (c) towards production of eicosanoids (lipid type mediators). Tandem mass spectrometry (MS/MS) is the most promising

high throughput technology for collecting data for signaling pathways. The data we use are provided by Arthur Salomon lab in the Laboratory for Molecular Medicine at Brown; these are time series data for phosphorylated proteins. There are three computational problems associated with such data: (i) identification of the proteins that participate in the pathways, (ii) identification of phosphorylation sites, and (iii) clustering of the proteins on the basis of their phosphorylation profiles. Our work introduces Bayesian procedures for (i) and (iii). The procedure for protein identification has three components: (1) a discriminant analysis based on rank-type statistics of the data, that identifies the ”good” spectra, (2) a database search procedure to identify candidate peptides with masses ”similar” to the precursor peptide; the procedure incorporates mass changes due to various types of post translational modifications such as phosphorylation and methylation, and (3) a Bayesian statistical model for fragmentation and ”theoretical” spectra generation (this model is a key contribution of our work); a nice feature of the model is that it provides a well-defined statistical score for ranking that candidate peptides. The clustering procedure is based on a mixture of Gaussian densities. The parameters of the model are estimated via the EM algorithm; in a technical sense, this procedure generalizes that of the well-known K-means clustering algorithm.

2. **MYC Network Determination**: The c-MYC protein (a Transcription Factor) has been implicated in a number of biological processes including cell-growth, apoptosis, cell proliferation and cancer. It is believed that MYC regulates the expression of about 10-15% of human genes (more than any typical transcription factor). Some of these genes are regulated directly (MYC binds in the promoter or somewhere in the vicinity of a gene), while others are regulated indirectly (MYC regulates directly or indirectly genes of other Transcription Factors which, in turn, regulate a particular gene directly). To find the”MYC Regulatory Network” (i.e. which genes are regulated directly and which are regulated indirectly by MYC and the relation between the level of expression of a given gene and the level of abundance of MYC) is a problem of fundamental importance. To this end, we explore three types of information or data: (i) Cross-species DNA sequence comparison (especially Human and mouse) to identify genome segments that have been conserved by evolution. Such regions typically have a functional role, and MYC binding sites tend to conserved by evolution; (ii) Chromatin Immuniprecipitation array (ChIp-chip) data. This is a new experimental technology that localizes MYC (or any specific Transcription Factor) binding sites within 1000-2000 DNA base pairs; we use this information together with known MYC motifs (E-box) and a Monte Carlo type procedure to find potential binding sites for MYC; (iii) Gene expression microarray data; these data are employed to cluster genes into genes that are affected by MYC and genes that are not affected by MYC.

In contrast to a general belief, the type (iii) data (gene expression data) provide minimal information about direct and indirect gene regulation by MYC. It is here that our main contribution comes in: We articulate simultaneously all three types of information ((i)-(iii)) via a statistical/probabilistic model (variant of graphical models) to identify the topology of the graph (i.e. direct and indirect regulations) as well as the random dependence of the level of expression of a particular gene given the level of abundance of MYC.

6. HONORS AND SOCIETY MEMBERSHIPS

Honor:

Elected Fellow of the Institute of Mathematical Statistics

Society Memberships:

American Mathematical Society

American Statistical Society

Institute of Mathematical Statistics

7. TEACHING, 2010

Spring 2010: APMA 1660 – Statistical Inference II Fall 2010: APMA 2670 – Mathematical Statistics II

8. DATE OF PREPARATION

January 2012