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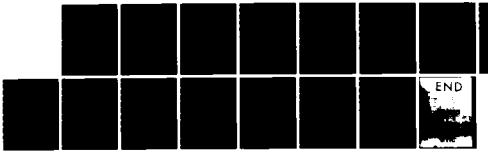

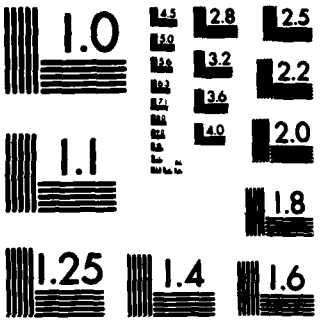

STANFORD ELECTRONICS LABORATORIES

DEPARTMENT OF ELECTRICAL ENGINEERING
STANFORD UNIVERSITY · STANFORD, CA 94305

JSEP FINAL REPORT

April 1981 - March 1984

Dr. Stephen F. Lundstrom
Program Director

June 1984

U.S. Army Research Office
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Stanford Electronics Laboratories

Stanford University

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This is the final report of the research conducted at the Stanford Electronics Laboratories under the sponsorship of the Joint Services Electronics Program from April 1981 through March 1984. This report summarizes the areas of research, identifies the most significant results, and lists the dissertations and publications sponsored by the contract (DAAG29-81-K-0057).

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Abstract

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A1

1. Introduction

This report summarizes the activities in the research programs at the Stanford Electronics Laboratories which have been sponsored by the Joint Services Electronics Program under contract DAAG29-81-K-0057. This contract has been monitored by the Army Research Office, Research Triangle Park, North Carolina.

The research programs were divided into two main areas:

- Very Large Scale Integration
- Information Systems

The work units and tasks within them are summarized in the following table, together with the investigators involved.

1. VERY LARGE SCALE INTEGRATION

   a. Application of Channeling Radiation to a Study of the Properties of Materials *R. Pantell*

   b. Submicron Device Physics and Technology

      i. Physics and Technology of Submicron Devices *J. Plummer, K. Saraswat*

         - Isolation Techniques Suitable for Submicron Technologies
         - Electrical Performance and Physics of Isolation Region Structures for VLSI
         - Alternative Gate Dielectrics for Submicron MOS VLSI
         - Electronic Properties of Polycrystalline Silicon

      ii. Ohmic Semiconductor Contacts with Low Minority-Carrier Recombination Velocity *R. M. Swanson*

      iii. Silicide:Si Interface including Effects of and on Oxygen *I. Lindau and W. E. Spicer*

      iv. Interaction of Transition Metals with Silicon Surfaces *W. E. Spicer and I. Lindau*

      v. Interaction of Arsenic and Other Impurities with Silicon Surfaces and Interfaces *C. R. Helms*

      vi. Failure Mechanisms Associated with Submicron Metallic Interconnects in VLSI *R. F. W. Pease*

      vii. Interconnections for High Density, High Performance VLSI *R. F. W. Pease*

      viii. Study of Compound Semiconductor Device and Materials Physics *J. Harris*

2. INFORMATION SYSTEMS

   a. Real-Time Statistical Data Processing *T. Kailath*

- Error Analysis of Lattice Algorithms
- Harmonic Retrieval
- Estimating the location of radiating sources by a passive array
- Determining the Number of Sources
- Coherent Signals and Interference

b. Signal Processing Algorithms and Architectures *M. Morf*

- Analysis and Modeling of Multichannel Autoregressive Stationary Processes
- Algorithms for System Identification and Source Location
- Recursive Identification Logarithms for Right Matrix Fraction Description Models

c. Signal Processing and Compression

i. Vector Quantization *R. M. Gray*

- Feedback Vector Quantizers
- Adaptive Vector Quantization for Speech
- Quantization and Classification in Distributed Sensor Networks

ii. Advances in Cryptography *M. E. Hellman*

- Discrete Logarithms
- Coin Flipping by Telephone
- The First Repetition of a Pattern in a Symmetric Bernoulli Sequence

iii. Multiple-User Communications and Information Theory *T. M. Cover*

- Multiple Descriptions Problem
- Compounding the growth of information
- Hadamard inequality (unsuspected new proof)
- Asymptotic equipartition property for multiplicative processes
- Brunn-Minkowski inequality
- Burg's Theorem

iv. Tree Compression (Data Compression for Computer Data Structures) *J. Gill*

The work during the contract has been reported in three annual reports (Annual Progress Report No.1, No.2 and No.3). Following the identification of the most significant results of this research, the dissertations and publications sponsored, at least in part, by the JSEP program are listed.

2. Significant Results

The three most significant accomplishments, as determined by the Director, are summarized as:

1. *Real-Time Statistical Data Processing*

   The goals of this research program include focusing on methods for determining the number of sources when the signal is completely coherent with one or more interferences. A new approach to the problem of determining the number of sources for a passive array was developed [7]. The method is based on *information theoretic criteria* concepts for model selection. Rather than requiring the definition of thresholds (as needed in the conventional hypothesis testing approaches for determining the number of sources in the eigenstructure framework), the new approach does not require any *subjective* threshold settings. Simulation studies yield good results under varying situations including low signal to noise ratios, small number of data samples and closely spaced signals.

   The new approach is equally applicable in other areas where eigenstructure methods have been used. Some examples are determining the number sinusoids in time series data, the number of poles from the natural response of a linear system and the number of overlapped echoes in backscatter data typical in radar, etc.

2. *Physics and Technology of Submicron Devices*

   This research program was divided into a number of projects. Two of these projects have matured to the point that these seed projects have spawned new, larger projects which endeavor to carry these studies forward and to study the application of the capabilities shown to be possible with the work sponsored by this JSEP contract.

   One of the projects has been aimed at developing SIPOS (Semi-Insulating Poly Silicon) emitters for bipolar transistor applications [8, 6, 5]. Using heterojunction contacts to emitter regions as discussed in previous JSEP reports, the transistor current gain increased by an order of magnitude over that attainable with conventional diffused emittters and metal contacts. This makes substantial improvements in device performance and optimization of bipolar devices for VLSI applications possible. Follow-on work is expect to continue under a contract under negotiation with Sandia.

   In another of the projects, a mathematical analysis of the physics of trench-like isolation region structures resulted in new physical understanding of these structures and in an equation relating the leakage current to the radius of the interface [2, 1, 3]. The strong dependence of the corner effect on the radius was verified by the fabrication of several test transistors with different radii. Measurements of these transistors also demonstrated the improved isolation properties with substrate bias and drain voltage. Burying the oxide and sharpening oxide corners means improved isolation and more compact VLSI layouts. This work is continuing under DARPA sponsorship on contracts MDA903-79-C-0257 and MDA903-84-K-0062.

3. *Signal Processing and Compression*

This research program was also divided into a number of projects. Of special interest is the work in vector quantization. The project has focused on three principal problems: The design of feedback vector quantizers for data compression, the design of adaptive vector quantizers for speech compression, and the extension of vector quantizer design algorithms to the design of combined quantization/classification distributed sensor networks. In the area of **Feedback Vector Quantizers**, a stochastic gradient algorithm for designing predictive vector quantizers (PVQ) was developed in order to get better codebooks and faster design speed. To further improve the performance, adaptive VQ's which combine the waveform coding techniques and linear predictive coding (LPC) techniques were studied.

Codebook and predictor design based on a stochastic gradient algorithm simultaneously improves the linear predictive coefficients and the vector quantizer in the feedback loop iteratively for a given training sequence. This provides better performance and faster convergence. Further details are reported in [4].

An NSF contract will be supporting the related theory of the finite state vector quantizers in the future. Related practical work is now being pursued at the University of California, Berkeley and at Bell Labs.

A paper, which was sponsored by a previous JSEP contract, and which was coauthored by Professor Gray, won the IEEE ASSP 1983 Senior Award at ICASSP. The paper is "Speech coding based upon vector quantization" by A. Buzo, A. H. Gray, Jr., R. M. Gray, and J. D. Markel. It appeared in the IEEE Transactions on ASSP in the October 1980 issue (pages 562-574). Over 16 papers at the ICASSP 1983 were explicitly based on that paper while several others drew heavily on it.

References

1. S. H. Goodwin and J. D. Plummer. Trench Isolation Technology and Device Physics. VLSI Symposium, IEEE, September, 1983.

2. S. Goodwin. Isolation Structures for VLSI -- Device Physics and Electrical Characteristics of Deep Groove Structures. Tech. Rept. TR # G725, Stanford Electronics Laboratories, January, 1984.

3. S. H. Goodwin and J. D. Plummer. "Electrical Performance and Physics of Isolation Region Structures for VLSI." *IEEE Trans. on Electron Devices ED-31* (July 1984).

4. Gray, R.M. "Vector Quantization." *IEEE ASSP Magazine* (April 1984).

5. Kwark,Y.H., and Swanson,R.M. Technology and Performance of SIPOS Heterojunction Emitters. Proc. 40th Annual Device Research Conference, IEEE, 1982. Conference Held at Ft. Collins, CO

6. Kwark,Y. and Swanson,R.M. "Optical Absorption of Thin SIPOS Films." *J. Electrochemical Soc. 129*, 1 (January 1982), 197-201.

7. Wax, M. and Kailath,T. Determining the Number of Signals by Akaike's Information Criterion. Proc. ICASSP, San Diego, CA, March, 1984, pp. 6.3.1-6.3.4.

8. Yablanovich, E., Swanson, R. M., and Kwark, Y. H. An n-SIPOS:p-SIPOS Homojunctionn and a SIPOS-Si-SIPOS double heterostructure. Proceedings 17th IEEE Photovoltaics Specialists Conference, 1984.

3. PhD Dissertations

Following is a list of the Ph.D. Dissertations sponsored, at least in part, by this JSEP contract:

1. Delosme,J-M. *Algorithms for Finite Shift-Rank Processes*. Ph.D. Th., Information Systems Laboratory, Department of Electrical Engineering, Stanford University, August 1982.

2. S. Goodwin. Isolation Structures for VLSI -- Device Physics and Electrical Characteristics of Deep Groove Structures. Tech. Rept. TR # G725, Stanford Electronics Laboratories, January, 1984.

3. Lev-Ari,H. *Nonstationary Lattice-Filter Modeling*. Ph.D. Th., Information Systems Laboratory, Department of Electrical Engineering, Stanford University, Stanford, CA, December 1983.

4. Perino, Stanley C. The Electronic Structure and Deposition Kinetics of Arsenic on the Silicon Surface. Tech. Rept. J302-1, Stanford University, Solid State Electronics Laboratory, Stanford Electronics Laboratories, Dept. of Elec. Engr., September, 1983.

5. Stewart, L. C. *Trellis Data Compression, TR No. L905-1*. Ph.D. Th., Stanford University, Elec. Eng. Dept., Information Systems Lab., July 1981.

6. Swent,R.L. *Channeling Radiation from Positrons and Electrons*. Ph.D. Th., Stanford University, Dept. of Elec. Engr., 1982.

4. Publications

Following is a list of those publications sponsored, at least in part, by this JSEP contract:

1. Andersen,J.U., Bonderup,E., and Pantell,R.H. "Channeling Radiation." *Annual Rev. of Nuc. and Part. Sci. 33* (1983), 453-504. Sponsored by JSEP

2. Berman, B. Positron and Electron Channeling Radiation from LiF. Proceedings of Conference on Atomic Collisions in Solids, Munich, West Germany, July, 1983.

3. Berman,B.L., Datz,S., Fearick,R.W., Swent,R.L., Pantell,R.H., Park,H., Kephart,J.O., and Klein,R.K. "Planar Channeling Radiation from Relativistic Positrons and Electrons in LiF." *Nucl. Instrum. Meth. B2* (1984), 90-94. Sponsored by JSEP

4. Berman, B. Channeling Radiation: (General Review). Abstract of Talk Presented at LLL, MIT, Los Alamos

5. Berman, B.L., Datz,S., Fearick,R.W., Kephart,J.O., Pantell,R.H., Park,H. and Swent,R.W. "Channeling Radiation from Relativistic Positrons in LiF." *Physical Review Letters 49*, 7 (August 16 1982), 474-477.

6. Bloom,S.D., Berman,B.L., Hamilton,D.C., Alguard,M.J., Barrett,J.H., Datz,S., Pantell,R.H., and Swent,R.L. Monte Carlo Calculations of Channeling Radiation. In *Nuclear Instrumentation Methods*, North-Holland Publishing Company, 1982, pp. 229-233.

7. Bruckstein,A.M. and Kailath,T. The Scattering Formulation for Linear State-Space Estimation and Control Problems. Stanford University, Information Systems Laboratory, 1982.

8. Bruckstein,A. M., Levy,B. C. and Kailath,T. Differential Methods in Inverse Scattering. Accepted for publication in *SIAM J. Appl. Math*

9. Citron,T.K., Kailath,T., and Reddy,V.U. A Comparison of Some Spectral Estimation Techniques for Short Data Lengths. Intern'l. IEEE Conference on Acoustics, Speech and Signal Processing, IEEE, Boston, MA, April, 1983.

10. Citron,T. K. and Kailath,T. Eigenvector Methods and Beamforming A First Approach. 17th Asilomar Conference on Circuits, Systems and Computers, Monterey, CA, October, 1983.

11. Citron,T. K. and Kailath,T. An Improved Eigenvector Beamformer. Proc. ICASSP, San Diego, CA, March, 1984, pp. 33.3.1-33.3.4.

12. Costa, M. and Cover, T. On the Similarity of the Entropy Power Inequality and the Brunn Minkowski Inequality. Stat. Report # 48, submitted as a Correspondence to IEEE Trans. on Information Theory, September 1983

13. Cover,T. and El Gamal,A. "Achievable Rates for Multiple Descriptions." *IEEE Transactions on Information Theory IT-28*, 6 (November 1982), 851-857.

14. Cover,T. An Algorithm for Maximizing Expected Log Investment Return. to appear in IEEE Transactions on Information Theory, March 1984

15. Cover,T. Log-Optimal Investment Strategies. IEEE Symposium on Information Theory, Les Arcs, France, June 1982

16. Cover, T. Multiple User Information Theory for the Gaussian Channel. Proceedings of the Advanced Study Institue, England.

17. Cover, T. M. Network Information Flow. abstract of talk at URSI Meeting, January 13-15, 1982

18. Cover,T., and El Gamal,A. "An Information Theoretic Proof of Hadamard's Inequality." *IEEE Transactions on Information Theory IT-29*, 6 (November 1983), 930-931.

19. Datz,S. Electron and Positron Channeling Radiaiton from Type-Ia and Type-IIa Diamonds. Proceedings of Conference on Atomic Collisions in Solids, Munich, West Germany, July, 1983.

20. Datz,S., Fearick,R.W., Park,H., Pantell,R.H., Swent,R.L., Kephart,J.O., and Berman,B.L. "Electron and Positron Channeling Radiation from Type-Ia and Type-IIa Diamonds." *Nucl. Instrum. Meth. B2* (1984), 74-79. Sponsored by JSEP

21. Datz,S., Fearick,R.W., Park,H., Pantell,R.H., Swent,R.L., Kepart,J.O., Klein,R.K., and Berman,B.L. Electron and Positron Planar Chaneling Radiation from Diamond. accepted by Phys. Lett. A, 1983

22. Delosme,J.-M. and Morf,M. Scattering Arrays for Matrix Computations. Proc. SPIE 25th Annual International Technical Symposium, SPIE, August 24-28, 1981. San Diego, CA

23. Delosme,J.-M. and Morf,M. A Unified Stochastic Description of Efficient Algorithms for Second-Order Processes. Proc. Fast Algorithms for Linear Dynamical Systems Workshop, Sept. 21-25, 1981, pp. 13.1-13.22. Aussois, France

24. Delosme,J-M. *Algorithms for Finite Shift-Rank Processes*. Ph.D. Th., Information Systems Laboratory, Department of Electrical Engineering, Stanford University, August 1982.

25. Delosme,J.-M. and Morf,M. Fast Algorithms for Finite Shift-Rank Processes: A Geometric Approach. In *Mathematical Tools and Models for Control Systems Analysis and Signal Processing*, CNRS Editions, Paris, 1982, pp. 499-527.

26. Delsarte,Ph., Genin,Y., and Kamp,Y. "A Proof of the Daniel-Moore Conjectures for A-Stable Multi-step Two-Derivative Integration Formulas." *Phillips J. Res. 1(?)* (1981).

27. Egardt,B., Kailath,T. and Reddy,V. U. "High-Resolution Spectral Analysis using Multi-Step Adaptive Prediction," *Circuits, Systems and Signal Processing 2*, 4 (1983), 422-443.

28. Gluss, D. and Cover, T.M. Convergence to Empirical Bayes Risk in Repeated Play Against the Stock Market. abstract of talk at IT Symposium, Les Arcs, France, June 1982

29. Goodwin,S.H., and Plummer,J.D. The Use of 2D Effects in LOCOS Structures to Improve Device Isolation. 1982 IEDM Technical Digest, IEEE, 1982, pp. 2294-2297.

30. S. Goodwin. Isolation Structures for VLSI -- Device Physics and Electrical Characteristics of Deep Groove Structures. Tech. Rept. TR # G725, Stanford Electronics Laboratories, January, 1984.

31. Goodwin,S.H., and Plummer,J.D. Trench Isolation Technology and Device Physics. to be presented at IEEE VLSI Symposium, Maui, Hawaii, Sept. 1983

32. Goodwin,S.H., and Plummer,J.D. Electrical Performance and Physics of Isolation Region Structures for VLSI. to be published in IEEE Transactions for Electronic Devices, Spring 1984

33. Gray, Robert M. Vector Quantization. to appear in the ASSP Magazine, 1984

34. Gray, R. M. and Y. Linde. "Vector Quantizers and Predictive Quantizers for Gauss-Markov Sources." *IEEE Trans. on Communications* , (Feb. 1982), 381-389.

35. Hayes, J.F., Cover,T.M., and Riera, J.B. "Optimal Sequence Detection and Optimal Symbol-by-Symbol Detection: Similar Algorithms." *IEEE Transactions on Communications COM-30*, 1 (January 1982), 152-157.

36. Jarett,K. and Cover,T. "Asymmetries in Relativistic Information Flow." *IEEE Transactions on Information Theory IT-27*, 2 (March 1981), 152-159.

37. Kailath, T. "Redheffer Scattering Theory and Linear State-Space Estimation Problems." *Ricerche di Automatica, special Issue on Mathematics, Physics, and System Theory, 10* , (Dec. 1979), 136-162.

38. Kailath,T. Time-Variant and Time-Invariant Lattice Filters for Non-Stationary Processes. Proceedings of Fast Algorithms for Linear Dynamical Systems, Aussois, France, September, 1981.

39. Kailath, T. Proc. IFAC Symp. on Digital Control. Recent Developments in Statistical Signal Processing, , , , 1982, pp. .

40. Kailath,T.and Lev-Ari,H. Constant-Parameter Lattice Filters for Nonstationary Processes. Outils et Modeles Mathematiques pour l'Automatique e'Analyse de Systemes et le Traitement du Signal, CNRS National Conf., CNRS, Belle-Ile, France, September, 1982.

41. Kailath,T. Real Time Statistical Signal Processing. Proceedings of IFAC Conference, New Delhi, India, 1982.

42. Kailath,T. Estimation and Control in the VLSI Era. The 22nd IEEE Conf. on Decision & Contr., San Antonio, TX, December, 1983.

43. Kailath, T. Estimation and Control in the VLSI Era. 22nd IEEE Conf. on Decision and Control, IEEE, San Antonio, TX, December, 1983.

44. Kailath,T. and Ljung,L. Strict Sense State-Space Realizations of Nonstationary Gaussian Processes. to appear in IEEE Trans. on AC

45. Kailath,T., Ljung,L. and Morf,M. "Recursive Input-Output and State-Space Solutions for Continuous-Time Linear Estimation Problems." *IEEE Trans. Autom. Contr. AC-28*, 9 (September 1983), 897-906.

46. Kailath,T. and Wax,M. A Note on the Complementary Model of Weinert and Desai. accepted for publication in *IEEE Trans. Autom. Contr.*, Vol. AC-29, no.6

47. Kailath, T. and Wax, M. A Note on the Complementary Model of Weinert and Desai. to appear in IEEE Trans. on Automatic Control

48. Karnin,E.D., Greene, J.W., and Hellman,M.E. "On secret sharing systems." *IEEE Transactions on Information Theory IT-29* (January 1983), 35-42.

49. Karnin,E.D. and Hellman,M.E. "The largest super-increasing subset of a random set." *IEEE Transactions on Information Theory IT-29* (January 1983), 146-148.

50. Kwark,Y.H., and Swanson,R.M. Technology and Performance of SIPOS Heterojunction Emitters. Proc. 40th Annual Device Research Conference, IEEE, 1982. Conference Held at Ft. Collins, CO

51. Kwark,Y. and Swanson,R.M. "Optical Absorption of Thin SIPOS Films." *J. Electrochemical Soc. 129*, 1 (January 1982), 197-201.

52. Kwon,W.H., Bruckstein,A.M., and Kailath,T. "Stabilizing State-Feedback Design via the Moving Horizon Method." *Int. J. Control 37*, 3 (March 1983), 631-643.

53. Kwon,W. H., Bruckstein,A. M. and Kailath,T. "Stabilizing State-Feedback Design via the Moving Horizon Method." *Int. J. Control 37*, 3 (March 1983), 631-643.

54. Lashkari,K. *A New Deconvolution Technique for Periodically Excited Systems*. Ph.D. Th., Information Systems Laboratory, Department of Electrical Engineering, Stanford University, March 1982.

55. Lev-Ari,H. *Nonstationary Lattice-Filter Modeling*. Ph.D. Th., Information Systems Laboratory, Department of Electrical Engineering, Stanford University, Stanford, CA, December 1983.

56. Lev-Ari,H., Cioffi,J. and Kailath,T. Least-Squares Adaptive-Lattice and Transversal Filters: A Unified Geometric Theory. Accepted for publication in special issue of *IEEE Trans. on Inform. Thy.*

57. Lev-Ari,H. and Kailath,T. Spectral Analysis of Nonstationary Processes. IEEE Inter'l. Symp. on Inform. Thy., St. Jovite, Quebec, Canada, Sept., 1983. Abstract

58. Lev-Ari,H. and Kailath,T. "Lattice Filter Parametrization and Modeling of Nonstationary Processes." *IEEE Trans. Inform. Thy. IT-30*, 1 (January 1984), 2-16.

59. Lev-Ari,H. and Kailath,T. Parametrization and Modeling of Nonstationary Processes. Preprint, submitted to Proc. IEEE in 1982

60. Lev-Ari, H., Kailath, T., and Cioffi, J. Least-Squares Adaptive Lattice and Transversal Filters; A Unified Geometric Theory. to appear in IEEE Trans. on Information Theory, June 1984

61. Matsuyama, Y. and R. M. Gray. "Voice Coding and Tree Encoding Speech Compression Systems Based on Inverse Filter Matching." *IEEE Trans. on Commun.* , (April 1982), 721-727.

62. Moslehi,M.M. and Saraswat,K.C. Thermal Nitridation of Silicon and Silicon Dioxide in a Cold-Wall RF-Heated Reactor. Proceedings of the Symposium on Silicon Nitride Thin Insulating Films, The Electrochemical Society, 1983, pp. 324-345.

63. Moslehi,M.M. and Saraswat,K.C. Electrical Characteristics of Devices Fabricated with Ultrathin Thermally Grown Silicon Nitride and Nitroxide Gate Insulators. To be presented at the 1983 Symposium on VLSI Technology, Maui, September 1983

64. Moslehi,M.M., and Saraswat,K.C. Thermal Nitridation of Silicon in a Cold Wall Reactor. Extended Abstracts of Spring Meeting of Electrochem. Soc., Electrochem. Soc., 1983, pp. 199.

65. Nehorai,A. and Morf,M. "Enhancement of Sinusoids in Colored Noise and the Whitening Performance of Exact Least-Squares Predictors." *IEEE Transactions on ASSP ASSP-30*, 3 (June 1982), 353-363.

66. Nehorai,A., and Morf,M. Recursive Identification Logarithms for Right Matrix Fraction Description Models. Submitted to IEEE Trans. AC and 22nd CDC, Jan 1983

67. Pantell, R.H. Introduction to Channeling Radiation. Proceedings of Gordon Conference on Particle-Solid Interactions, New Hampshire, July, 1982. abstract of talk

68. Pantell,R.H., Park,H., Swent,R.L., Kephart,J.O., Klein,R.K., Datz, S., and Berman,B.L. Characteristics and Applications of Radiation from Channeled Particles. to be published in IEEE Trans. Nucl. Sci., Dec 1983

69. Park,H., Swent,R.L., Kephart,J.O., Pantell,R.H., Berman,B.L., Datz,S., and Fearick,R.W. "Positron and Electron Planar Channeling Radiation from Germanium." *Phys. Lett. A 96A* (1983), 45.

70. Park,H., Pantell,R.H., Swent,R.L., Kephart,J.O., Berman,B.L., Datz,S., and Fearick,R.W. Comparison of Channeling Radiation from Diamonds with and without Platelets. accepted by the Journal of Applied Physics, 1983

71. Perino,S.C. and Helms,C.R. "Interaction of Arsine with the Si (100) Surface." *J. Vac. Sci. Tech. 20* (1982), 903.

72. Perino, Stanley C. The Electronic Structure and Deposition Kinetics of Arsenic on the Silicon Surface. Tech. Rept. J302-1, Stanford University, Solid State Electronics Laboratory, Stanford Electronics Laboratories, Dept. of Elec. Engr., September, 1983.

73. Reddy,V.U., Kailath,T. and Citron,T.K. Adaptive Algorithms for Two-Dimensional Harmonic Retrieval. Proc. Sixteenth Asilomar Conf. on Circuits, Systems and Computers, Naval Postgraduate School, Monterey, CA, November, 1982.

74. Reddy,V.U., Egardt,B., and Kailath,T. "Least-Squares Type Algorithm for Adaptive Implementation of Pisarenko's Harmonic Retrieval Method." *IEEE Transactions on ASSP ASSP-30*, 3 (June 1982), 399-405.

75. Reddy,V.U., Shan,T-J. and Kailath,T. Application of Modified Least-Square Algorithm to Adaptive Echo Cancellation. Intern'l. IEEE Conference on Acoustics, Speech and Signal Processing, IEEE, Boston, MA, April, 1983.

76. Reddy, V. U., B. Egardt, and T. Kailath. "Optimized Lattice-Form Adaptive Line Enhancer for a Sinusoidal Signal in Broadband Noise." *IEEE Trans. on Circuits and Systems, CAS-28* , (June 1981), 542-550.

77. Reddy,V.U., Egardt,B., and Kailath,T. On the Adaptive Implementation of Pisarenko's Harmonic Retrieval Method. International Symposium on Microwaves and Communication, Karagpur, India, 1981.

78. Reddy,V.U. and Nehorai,A. "Response of Adaptive Line Enhancer to a Sinusoid in Lowpass Noise." *Proceedings of the IEEE 128* (1981), 161-166.

79. Reddy,V. U., Shan,T-J. and Kailath,T. Application of Modified Least-Square Algorithm to Adaptive Echo Cancellation, 1983 ICASSP, Boston, MA, April, 1983, pp. 53-56.

80. Rossi,G., Nogami,J., Yeh,J.J., and Lindau,I. "Chemical Reaction at the Annealed Si/Yb Interface." *J. Vac. Sci. Technol. 1B* (July/Aug 1983). in press

81. Rossi,G. and Lindau,I. "Compound formation and bonding configuration at the Si-Cu interface." *Physical Review B 228*, 6 (15 September 1983), 3597-3600.

82. Rossi,G. and Lindau,I. Compound Formation and bonding Configuration at the Si/Cu Interface. submitted.

83. Sabin, M.J. and Gray, R.M. Product code vector quantizers for waveform and voice coding. to appear in IEEE Transactions ASSP

84. Samson,C. "A Unified Treatment of Fast Algorithms for Identification." *Intern'l. Journal of Control 35*, 5 (May 1982), 909-934.

85. Samson,C. and Reddy,V.U. Fixed Point Error Analysis of the Normalized Ladder Algorithm. Intern'l. IEEE Conference on Acoustics, Speech and Signal Processing, IEEE, Paris, France, May, 1982.

86. Samson,C. and Reddy,V.U. "Fixed Point Error Analysis of the Normalized Ladder Algorithm." *IEEE Trans. on ASSP ASSP-31*, 5 (October 1983), 1177-1191.

87. Samson,C. Stability Analysis of Adaptively Controlled Not-Necessarily Minimum Phase Systems with Disturbances. accepted for publication in *Automatica*

88. Samson,C. An Adaptive LQ Controller for Non-Minimum-Phase Systems. reprint

89. Samson, C. An Adaptive L.Q. Controller for Nonminimum Phase Systems. accepted for publication in International Journal of Control 1982

90. Samson,C. and Reddy,V. U. "Fixed Point Error Analysis of the Normalized Ladder Algorithm." *IEEE Trans. on ASSP ASSP-31*, 5 (October 1983), 1177-1191.

91. Shan,T. J. and Kailath,T. New Adaptive Processor for Coherent Signals and Interference. Proc. ICASSP, San Diego, CA, March, 1984, pp. 33.5.1-33.5.4.

92. Shan, T.J., and Kailath, T. A New Adaptive Antenna System for Coherent Signals and Interference. Proceedings of 17th Asilomar Conference on Circuits, systems and Computers, IEEE, Monterey, CA, October, 1983.

93. Shan, T.J., and Kailath, T. Adaptive Beamforming for Coherent Signals and Interference. 22nd IEEE Workshop on Spectral Estimation, IEEE, Tampa, FL, November, 1983.

94. Shan, T.J., Wax, M., and Kailath,T. Spatial Smoothing Approach for Location Estimation of Coherent Sources. Proceedings of 17th Asilomar Conference on Circuits, Systems and Computers, IEEE, Monterey, CA, October, 1983.

95. Stewart, L. C. *Trellis Data Compression, TR No. L905-1.* Ph.D. Th., Stanford University, Elec. Eng. Dept., Information Systems Lab., July 1981.

96. Stewart, L. C., R. M. Gray, and Y. Linde. "The Design of Trellis Waveform Coders." *IEEE Trans. on Communications* , (April 1982), 702-710.

97. Swent,R.L., and Pantell,R.H. "A Model of Crystal Potential from Axial-Channeling Radiation." *J. Appl. Phys. 52* (1981), 3403-3404.

98. Swent,R.L. *Channeling Radiation from Positrons and Electrons.* Ph.D. Th., Stanford University, Dept. of Elec. Engr., 1982.

99. Swent, R. L. New Directions in Channeling Radiation. Proceedings of Gordon Conference on Particle-Solid Interactions, New Hampshire, July, 1982.

100. Swent,R.L., Pantell,R.H., Park,H., Kephart,J.O., Klein,R.K., Datz,S., Fearick,R.W., and Berman,B.L. Planar and Axial Channeling Radiation from Relativistic Electrons in LIF. accepted by Phys. Rev. B (1983)

101. Swent,R.L., Pantell,R.H., Datz,S., and Alvarez,R. "The Effects of Temperature and Crystal Defects on Electron Channeling Radiation." *Nuclear Instruments and Methods 194* (1982), 235-237.

102. Tao,B., Abut,H., and Gray,R.M. Hardware Realization of Waveform Vector Quantizers. submitted for publication

103. Van Campenhout, J.M. and Cover, T.M. "Maximum Entropy and Conditional Probability." *IEEE Transactions on Information Theory IT-27*, 4 (July 1981), 483-489.

104. Verghese,G.C., Levy,B., and Kailath,T. "A Generalized State-Space for Singular Systems." *IEEE Trans. on Automatic Control AC-26* (Aug 1981), 811-831.

105. Wax,M. "The Estimate of Time Delay between Two Signals with Random Relative Phase Shift." *IEEE Trans. on Acoustics, Speech and Signal Processing* (1981).

106. Wax,M., Shan,T-J. and Kailath,T. Location and The Spectral Density Estimation of Multiple Sources. Proc. Sixteenth Asilomar Conference, Naval Postgraduate School, Monterey, CA, November, 1982.

107. Wax,M. "Position-Location from Sensors with Position Uncertainty." *IEEE Trans. AES 19*, 5 (September 1983), 658-602.

108. Wax,M. and Kailath,T. Efficient Inversion of Doubly Block Toeplitz Matrix. Intern'l. IEEE Conference on Acoustics, Speech and Signal Processing, IEEE, Boston, MA, April, 1983.

109. Wax,M., Shan,T-J., and Kailath,T. Covariance Eigenstructure Approach to 2-D Harmonic Retrieval. Intern'l. IEEE Conference on Acoustics, Speech and Signal Processing, IEEE, Boston, MA., April, 1983.

110. Wax,M. and Kailath,T. Efficient Inversion of Doubly Block Toeplitz Matrix. to be published in IEEE Trans. on Acoustic, Speech and Signal Processing

111. Wax,M. and Kailath,T. Optimum Localization of Multiple Sources in Passive Arrays. To appear IEEE Trans. ASSP, 1983

112. Wax,M., Shan,T-J., and Kailath,T. Covariance Eigenstructure Approach to Detection and Estimation by Passive Arrays, Pt. I: Direction-of-Arrival and Frequency Estimation of Multiple Narrowband Sources. to appear IEEE Trans. ASSP, October 1983

113. Wax,M., Shan,T-J. and Kailath,T. Covariance Eigenstructure Approach to Detection and Estimation by Passive Arrays - Pt. II: Source Location and Spectral Density Estimation of Wideband Sources. To appear IEEE Trans. ASSP, December 1983

114. Wax,M. Position-Location from Sensors with Position Uncertainty. preprint

115. Wax,M. and Kailath,T. "Optimum Localization of Multiple Sources in Passive Arrays." *IEEE Trans. ASSP* (October 1983).

116. Wax,M. and Kailath,T. "Efficient Inversion of Toeplitz-Block Toeplitz Matrix." *IEEE Trans. ASSP ASSP-31*, 5 (October 1983), 1218-1221.

117. Wax,M. and Kailath,T. Efficient Inversion of Doubly Block Toeplitz Matrix. 1983 ICASSP, Boston, MA, April, 1983, pp. 170-173.

118. Wax,M. and Kailath,T. Determining the Number of Signals by Akaike's Information Criterion. Proc. ICASSP, San Diego, CA, March, 1984, pp. 6.3.1-6.3.4.

119. Wax,M. and Kailath,T. A New Approach to Decentralized Array Processing. Proc. ICASSP, San Diego, CA, March, 1984, pp. 40.7.1-40.7.4.

120. Wax, M. and Kailath, T. A New Approach to Decentralized Array Processing. submitted to ICASSP 1984

121. Wax,M., Kailath,T. and Schmidt,R. O. Retrieving the Poles from the Natural Response by Eigenstructure Method. The 22nd IEEE Conf. on Decision and Control, San Antonio, TX, December, 1983.

122. Wax, M., Kailath, T., and Schmidt, R.O. Retrieving the Poles from the Natural Response by Eigenstructure Method. IEEE Conference on Decision & Control, IEEE, San Antonio, TX, December, 1983.

123. Wax, M. and Kailath, T. Determining the Number of Signals by Information Theoretic Criteria. 2nd IEEE Workshop on Spectral Estimation, IEEE, Tampa, FL, November, 1983.

124. Wax,M., Shan,T-J. and Kailath,T. Covariance Eigenstructure Approach to 2-D Harmonic Retrieval. 1983 ICASSP, Boston, MA, April, 1983, pp. 891-894.

125. Wax,M., Shan,T-J. and Kailath,T. Covariance Eigenstructure Approach to Detection and Estimation by Passive Arrays; Pt. I: Direction-of-Arrival and Frequency Estimation of Multiple Narrowband Sources. IEEE International Symp. on Inform Thy., Canada, September, 1983.

126. Wax,M., Shan,T-J. and Kailath,T. Covariance Eigenstructure Approach to Detection and Estimation by Passive Arrays; Pt. II: Source Location and Spectral Density Estimation of Wideband Sources. IEEE International Symp. on Inform. Thy., Canada, September, 1983.

127. Wax,M., Shan,T-J. and Kailath,T. Spatio-Temporal Spectral Analysis by Eigenstructure Methods. Accepted for publication in *IEEE Trans. ASSP.*

128. Yablanovich, E., Swanson, R. M., and Kwark, Y. H. An n-SIPOS:p-SIPOS Homojunctionn and a SIPOS-Si-SIPOS double heterostructure. Proceedings 17th IEEE Photovoltaics Specialists Conference, 1984.

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