University of Pennsylvania

THE MOORE SCHOOL OF ELECTRICAL ENGINEERING

July 1985

NAME: Raymond S. Berkowitz DATE OF BIRTH: 2/21/23

PLACE OF BIRTH: Philadelphia, Pennsylvania CITIZENSHIP: U.S.A.

POSITION: Professor

EDUCATIONAL BACKGROUND:

B.S.E.E. University of Pennsylvania, 1943
M.S.E.E. University of Pennsylvania, 1948
Ph.D. University of Pennsylvania, 1951

PROFESSIONAL EXPERIENCE:

1943-44 Engineer at RCA, Camden, N. J., Television Terminal Equipment design and development. Some work on microwave relay link.

1944-46 Active service in U. S. Naval Reserve. Received training in theory and maintenance of Navy electronic equipment at service schools, including seven month standard course at Naval Research Laboratory, Washington, D. C., plus six week advanced course in Electronic Countermeasures. Served as electronic technician (ETM 2/C) on U.S.S. Asheville (Patrol Frigate) and U.S.S. Joseph P. Kennedy, Jr. (Destroyer) responsible for maintenance of electronic equipment.

1946-51 Graduate student, University of Pennsylvania, Moore School Graduate Division and GSAS.

1947-Present On Professional Staff of University of Pennsylvania, Moore School of Electrical Engineering. Have had titles of Research Assistant, Research Associate, Assistant Professor, Associate Professor and Professor. Have taught and worked on research projects as a member of the Engineering Schools Faculty continually since 1951. Have served as Task Leader or Principal Investigator for several research projects.

1956-Summer Worked with Systems Group at RCA, Moorestown, N. J.

1976-77 On sabbatical leave. Appointed Visiting Professor at the Technion Israel Institute of Technology, Department of Electrical Engineering, Haifa, Israel, 1976-77.

1984 On Sabbatical leave. Invited Lecturer, Modern Radar, Institute of Electronic & Radio Technology Chengdu, P.R.C.

Raymond S. Berkowitz

CONSULTING POSITIONS:

1956-1977 RCA, Defense Electronic Products Division, N. J., continually, on a regular basis (one day per week) since 1956. My work there has been in the areas of system engineering and data processing with particular emphasis on effects of noise on system performance. Specific contributions have included: optimization of data smoothing parameters for guidance of Talos missile system, study of track-while-scan data systems, assisting in preparation of mathematical specifications for computer program of the BMEWS radar system, development of detailed simulation programs for predicting the performance and providing data for optimization of the BMEWS data processing formulation, assisting in the development of techniques for improving BMEWS performance in the presence of multipath and aurora effects, studies in depth of the vulnerability of BMEWS to multiple-target situations and the development of fine report association techniques for enhancement of resolution performance, and more recently studies evaluating the effectiveness of a variety of countermeasures devices against high-power radar systems.

a. Principle radar systems consultant on Space Object Identification project concerned with estimating size and shape by advanced processing of echo data. (Summer 1969-1970).

b. Continued work on countermeasures against high powered radars - in particular a study of data capabilities of over-the-horizon radar techniques. (Spring 1970).

c. Radar systems consultant on a study concerned with radar techniques of observing atmospheric effects of fast moving objects entering the atmosphere from space. (Spring 1970).

d. Radar systems consultant on multi-function array radar of the AEGIS project for the U. S. Navy. Original contributions made in the area of phased-array monopulse radar system error sensitivity calculation techniques. (Summer 1970 - Present).

e. Assisted in the preparation of a proposal for a Microwave Landing System to be installed at airports for general use.

f. Additional work through 1974 has been concerned with evaluation and refinement of AEGIS-ANSPY-1 multifunction phased array radar system signal process techniques, including parameter estimation, automatic decision features, and adaptive sidelobe cancellation methods.

CONSULTING POSITIONS (Continued):

g. 1974 and continuing through summer 1976. Continuing design refinements and evaluation of AN/SPY-1 multi-function array radar system. Particular emphasis on development of operational doctrine of adaptive coherent sidelobe canceller system for jammer signal suppression.

1970-1971: Analytics Corporation, Jenkintown, Pennsylvania. Radar systems consultant on a project concerned with setting up of a computer simulation of airborne surveillance systems involving a variety of radar and other electronic sensors.

1969-1971: Consultant to Radar Systems Group of ECOM, Fort Monmouth, New Jersey (Summer 1969-1971). Project concerned with development of a system for the determination of trajectories of fast-moving ballistic bodies. I participated together with groups from Mitre Corporation, Technology Systems Corporation (California), and Lincoln Laboratory in carrying out this effort, concerned primarily with data processing and extrapolation techniques.

Numerous short-term consulting activities have included:

- Spectrum Analyzer Design for AEL
- Evaluation of Automatic Checkout Technique for RCA (Camden, N. J.)
- Evaluation of a Radar Harbor Navigation idea for P. Schauffler of the Philadelphia Port Authority
- Participation in an evaluation of in-house radar system capability at an Air Force Laboratory at Huntsville, Alabama
- Study of Spurious Jamming Signals in Europe (for NSA).

Additional consulting items:

a. W. L. Maxson Corporation - Study of Digital Range Tracking System.
b. Burroughs - Study of optical aid to carrier landings.
c. Academic Press - Reviewed book manuscript by R. B. Blackman.
d. John Wiley and Sons, Inc. - Reviewed books on Synthetic Aperture Radar and phased-array radars.
e. Borders Corporation - Electronic countermeasures.
f. Auerbach Corporation - Radar systems.
g. January 10 and 17, 1972 - I participated as a member of an Independent Design Review Board for evaluation of an advanced Helicopter Sensor Proposal for the Norden Division of United Aircraft Corporation, Norwalk, Conn.
h. During the summer, 1972, I participated in concept review sessions for the Aironics Laboratory at ECOM, Fort Monmouth, concerned with the utilization of time-ordered

CONSULTING POSITIONS (Continued):

waveform techniques for army field communication and data handling.

1978-82 Worked with American Electronic Laboratories as radar systems consultant. Helped design a signal processing system for reduction of clutter for a fire control radar. Also did some feasibility analysis for a jammer system and also for an anti-jam technique for control guidance.

Present - 1985 RCA - Missile and Surface Radar Division - Radar Systems consultant for AEGIS-AN/SPY-1 Multifunction Phased Array Radar.

RECENT AND CURRENT RESEARCH PROJECT WORK:

Since summer of 1972 I have been associated with a variety of research programs based at the Moore School's Valley Forge Research Center. One project was concerned with developing an interferometric technique for accurate determination, unambiguously, of angle of a wideband signal from an airborne transmitter. The results of this work were presented at the URSI meeting in Boulder, Colorado, August, 1973. Another project was concerned with the analysis of adaptive processing techniques for achieving rejection of clutter echoes so as to provide efficient moving target detection from an airborne radar.

During 1973-74 I was responsible for the conceptual design of a large high resolution receiving array system to operate at HF(3-30MHz) for imaging of surface targets at ranges of 500 to 5000 km. This work continued 1974-1975 with the design and conduct of an experiment to determine spatial coherence properties of the ionosphere by Dr. H. Taheri.

A radar systems chapter was completed for the Electromagnetic Interference Handbook being prepared under the supervision of Dr. Showers (Spring 1975).

Principal Investigator "Study of Adaptive Phase Control Techniques" project with Naval Air Development Center, Warminster, Pennsylvania, Summer and Fall, 1975.

Principal Investigator "Research in Large Adaptive Antenna Arrays for Space Technology Applications" project with Goddard Space Flight Center, NASA. (Summer 1975 through Spring 1976).

Co-principal investigator (with N. Prywes) on project for automatic generation of test programs for use with automatic test equipment for electronic chasses. This project is supported by a contract with the Frankford Arsenal. (Summer 1975 through Spring 1976).

Leader on ARPA project concerned with research on large space-borne array surveillance radar, starting Summer, 1977.

Collaborator on Navelex project, concerned with adaptive nulling techniques, starting Summer, 1977.

Currently collaborator and co-principal investigator on ECOM project concerned with agile high resolution airborne array radar, starting also in Summer, 1977.

Also currently (starting 1979), I am collaborator and leader on projects with NADC and Fort Monmouth, concerned with application of large array technology to direction finding of communication and radar signals.

Remote antenna project for U. S. Army, CORADCOM, contributed theory concepts, 1978-79.

Proposal activity is presently underway (preliminary discussion, etc.) with the following potential sponsors:
(1) NADC-ASW group, DF and imaging applications
(2) Fort Monmouth - communications/radar group on direction finding techniques
(3) Fort Monmouth - electronic warfare group, on remote distributed antenna techniques

Work on giant radio camera design and characteristics has begun.

OTHER PREVIOUS RESEARCH PROJECT WORK:

Project RATRAN - Research on the Estimation of Trajectories from Radar Data ($70,000.00). This was a one-year project with USAECOM, Fort Monmouth, New Jersey; it started May 1, 1971; I was Principal Investigator. Also active on the project were Morris Plotkin and three graduate students. This study was intended to develop algorithms for smoothing (filtering) radar data so as to obtain definitive estimates of trajectory parameters for bodies moving through the atmosphere. In addition to development and preparation of computer algorithms, techniques were developed for evaluation and optimization of the algorithms generated as well as comparison with previously available methods. This work resulted in one doctoral dissertation, and two M. S. theses as well as several technical papers.

During 1970-1971 I worked with Dr. Haber on the NASA project concerned with satellite-aided navigation techniques. I worked closely with G. W. Thomas on the development of analysis techniques for evaluation of interferometric location techniques; several joint papers describing this work have been presented and Mr. Thomas included some of the techniques suggested in his Doctoral Dissertation completed 1971.

Project Votact - for Air Force Aero-Propulsion Laboratory, Wright-Patterson Air Force Base, Ohio ($270,000.00). Wrote the initial proposal and was principal investigator for the three-year duration of the project. The purpose was the Validation of Theoretical Automatic Checkout Techniques. The work involved theoretical development, hardware and software design.

During 1966-1967 I carried out research projects in collaboration with the Israeli Department of Defense, concerned with the efficient use of jammers against tracking radars and with the interpretation of radar data to identify and track echoes from rotating helicopter blades.

RECENT AND CURRENT RESEARCH PROJECT WORK (Continued):

Avionics Project - Was involved in the preparation of the proposal for this project and served as leader of the Radar Systems task group. Contributions have been made in the areas of multifunction radar system design, laser radar applications, terrain sensing analysis and simulation. This project has been for the U. S. Army, ECOM, Fort Monmouth, New Jersey.

Polarization Programming - Was leader of a group that worked with AEL Corporation for a group at the Air Force, RADC, Rome, New York. Contributions were made suggesting techniques for utilization of polarization preserving properties of propagation media for the enhancement of communication links.

Project Summit - for U. S. Army Chemical Corps. Was leader of a group concerned with prediction of dissemination characteristics of airborne agents. Contributions were made enabling variability of expected effects to be related to the random variable nature of system characteristics.

Project SARL - for U. S. Naval Air Development Center, Johnsville, Pennsylvania. Contributions were made to the determination of simulation models for the prediction of atmospheric effects on aircraft performance.

Project ROTEK - for U. S. Army, Frankford Arsenal, Philadelphia, Pennsylvania. Original work was done here defining a systematic procedure for fault isolation of electrical networks that could be adapted to control by a general purpose digital computer.

Additional projects to which contributions have been made include:

Study of Noise Modulation Communication Systems

Prediction of Interference Effects in Communication Networks

Design of Optimum Interconnection of Communication Nets

A variety of contributions to the design of anti-aircraft defense systems.

In addition to the sponsored project research described, many unsponsored contributions have been made in connection with the M. S. theses and dissertations supervised as described on following pages.

1983-1985 - DHR - Development of subsurface radar for specialized applications (1985).

IBM - Improvements to LAMPS surveillance radar system (1983-85).

VFRC - High Resolution Radar Imaging Signal Processing.

Raymond S. Berkowitz

TEACHING SPECIALTIES:

General teaching areas have included linear system theory, applications of probability and statistics, analysis of random processes, noise in communication and control circuits. Specific courses have included:

*EE 616 - Statistical Theory in Communication and Control Circuit Analysis. New course developed and presented every other year since 1952-1953. (Now EES634/SE675, Statistical Theory Processing.)

*ES 301 - Undergraduate course in Engineering Probability and Statistics. New course developed, now a standard part of the curriculum.

*ES 402 - Undergraduate course in Engineering Applications of Statistics. New elective course developed and given for several years.

*EE 641 - Introduction to Random Processes. New, one-semester course developed and given every year since 1964. (This course has been expanded into EE 641A.)

EE 641A - Introduction to Random Signals. One semester course offered for the first time in Fall 1971.

*EE 608 - Sampled-Data Systems. New course developed in 1959 and given several times (including 1970-71).

*EE 635 - Radar Systems. Developed and given every other year since 1961. (This course was modified into a one-semester, three-hour format. Offered in Spring 1972. Now EES633/SE687.)

EE 600 601 - Transient Analysis, Laplace and Fourier transforms. Taught in 1950's.

EE 665C - Introduction to Probability, Random Variables, and Stochastic Processes. New three-hour, one-semester course given Fall 1971.

EE 665D - Discrete Stochastic Processes. New three-hour course offered Spring 1972.

EE 314 - Undergraduate course in Circuit Theory. Taught several years.

EE 614 - Tube and Transistor Circuits. Given one year.

*These courses were initially developed and taught by me.

TEACHING SPECIALTIES (Continued):

EE 414 - Signal Theory I, Fall 1969. Also given Fall 1974. (Now EES/SE414, Deterministic Signal Theory.)

*EE 530/ SE 609 - Signal Theory and Processing Techniques. New core course for EES and SE graduate groups. Presented for the first time in Fall 1973.

Courses Taught 1976 - 1985:

EES530/SE609 - Signal Theory and Processing Techniques.

EES633/SE687 - Radar Systems.

EES634/SE675 - Statistical Signal Processing.

SE621 - Introduction to Random Processes.

SE611 - Linear Systems.

EES/SSE414 - Signal Theory, Modulation, and Communication.

SSE301 - Engineering Probability and Statistics

Special Courses and Programs:

Special Summer Program in Radar Systems, organized and presented in summers of 1960 and 1961. Was senior lecturer, joined by 12-15 radar system experts.

Special Summer Program in Automatic Checkout Techniques, presented in summer of 1965. Senior Lecturer.

Gave one three-hour lecture on "Monopulse, Interferometry, and Related Direction Sensing Array Systems" as part of C. E. S. course on "Modern Developments in Antenna Arrays," July, 1972. I assisted Dr. B. D. Steinberg in developing this course.

*These courses were initially developed and taught by me.

PROFESSIONAL SOCIETIES:

Scientific and Professional Societies

American Association for the Advancement of Science
Institute of Electrical and Electronics Engineers, Senior Member and Fellow
Sigma Tau
Sigma Xi
Society for Industrial and Applied Mathematics

Specific activities have included:

Miscellaneous offices, including Chairman of Philadelphia Chapters of IRE professional groups on Information Theory, Circuit Theory and Military Electronics.

Chairman for one year of Philadelphia Section IRE Program Committee.

Chairman and organizer of several IRE technical symposia in Philadelphia.

Member of committee that initially organized SIAM (in 1950's).

Served for two years as member of EIA-AIEE committee concerned with maintainability standards.

Elected chairman of Philadelphia Chapter of IEEE Professional Group on Aerospace and Electronic Systems for 1969-1970.

Honors and Awards

Lady Davis Fellowship, The Technion, Israel, 1976-77.

January 1981 - Elected to grade of Fellow in IEEE "for contributions to advanced data processing techniques in modern radar and engineering education."

Member of Sigma Xi and Sigma Tau Engineering Honorary Societies.

Four Chaplains Legion of Honor Membership presented January 22, 1984, by the Chapel of Four Chaplains, Philadelphia, Pa.

TECHNICAL ACTIVITIES:

A. University of Pennsylvania

University Council Subcommittee on Continuing Education and Community Services.

University Council Research Committee, Subcommittee on Faculty Awards and Grants (Chairman 1967-1968).

University Council Advisory Committee to the University Librarian.

Member, University Council Committee on Undergraduate admissions and Financial Aid (1970-1976).

Chairman, University Council Subcommittee on Planning (1970-1971).

Chairman, University Council Subcommittee on Class Size (1971-1972).

Member, Search Committee for a new Dean of Undergraduate Admissions and Financial Aid (Spring and Summer 1971).

Proposed several topics for independent study courses for University Liberal Arts undergraduates (1968-present).

Member, University Council Committee on Research. Organized symposium on University Research Centers and Institutes held March 29, 1979.

Member, University Council Committee on Research, 1978-80. Organized symposium on University Research Centers and Institutes held March 29, 1979.

Organized and moderated symposium on non-tenure alternatives for research personnel. Spring 1980.

Member of University Council Committee on "Communications"

B. College of Engineering and Applied Science

Towne School Library Committee, served for several years.

Member of advisory committee for Engineering Research project with U. S. Navy Electronics Laboratory (1969).

Member, Teaching Aids Committee of Engineering Schools (1971-1972).

Member, Stochastic Processes Committee (ad hoc) to examine relevant course offerings (1972-1974).

C. Moore School of Electrical Engineering

Member of Graduate Groups in Electrical Engineering, Systems Engineering and Operations Research.

TECHNICAL ACTIVITIES (Continued):

C. Moore School of Electrical Engineering (continued)

In addition to regular work as assigned adviser to Undergraduate and Graduate students, served for several years as adviser to the students in the RCA graduate study program.

Chairman of Statistical Techniques Panel of EE Graduate Group (to Spring 1970).

Member of Communications Panel of EE Graduate Group.

Chairman of Ad Hoc Committee of EE Graduate Group to explore revision of Graduate Course Structure (1968-1969).

Adviser for several years to Student Branch, IRE-AIEE (1950-1960).

Chairman of Curriculum Subcommittee of EE Graduate Group (1969-1972).

Chairman of Communications/Information Theory and Systems Panel of EE Graduate Group (1970-1973).

Chairman, Research Goals Subcommittee of EE Graduate Group (1971-1972).

Library Committee, Chairman for over five years. Concerned with book and periodical selection, selection and direction of professional personnel, operational policies, and expansion of physical facilities.

Member, Advisory Committee for planning TV instructional facility (Spring 1971).

Member, Educational Objectives Committee (1972-present).

Member, EES Department and Graduate Group (1973-present).

Member, SE Department and Graduate Group (1973-present).

Member, Committee to Develop Communications Curriculum (1972-1978).

Served as visiting judge-examiner for evaluation of student joint-project presentations for EE 661 classes, Spring and Fall, 1971.

Preliminary planning carried out for development of communications research program together with other departments of the University.

Contacting several potential sponsors and preparing research proposals in the areas of radar systems and navigation systems.

Raymond S. Berkowitz

TECHNICAL ACTIVITIES (Continued):

C. Moore School of Electrical Engineering (continued)

Member, Chairman of EES Graduate Qualifying Examination Committee (1978-19800.

Member, SE Graduate Qualifying Examination Committee (1978-present).

Member, EES Faculty Budget Committee (1977-1979).

D. Technical Community

Gave invited lectures on Radar Systems Research progress at Princeton University and University of Minnesota.

Invited to give a seminar on "Adaptive Antenna Arrays for Airborne and Ground-based Radar Systems," Communications Research Laboratory, Faculty of Engineering, McMaster University, Hamilton, Ontario, Canada, March 1974.

Reviewed a manuscript for a new book on Radar Systems for the technical editor of John Wiley and Sons, Inc.

Informal consulting with group at Philadelphia Board of Education developing ideas for mechanized teaching aids.

Invited to present a talk on "Radar" for the Southern New Jersey Section of the IEEE, January 27, 1972, Somers Point, New Jersey.

"Experimental Effort," Workshop on Remote and Distributed Electromagnetic Radiators, Moore School of Electrical Engineering, University of Pennsylvania, April, 1979.

Member, Organizing Committee and Program Committee, 22nd Midwest Symposium on Circuits and Systems, Philadelphia, Pennsylvania, June 1979.

Co-chairman of Tech. Session on Fault Analysis (TP-2), 22nd Midwest Symposium on Circuits and Systems.

Frequent reviewer of papers submitted to IEEE transactions on Aerospace and Electronic Systems in the Radar Systems subject area, 1970-present.

NONTECHNICAL ACTIVITIES:

Leader Cub Scout den and Boy Scout troop, 1958-1962.

Assisted with West Oak Lane Boys Club baseball activities, 1961-1966.

Member, Germantown Jewish Center Schools Committee, 1960-1970.

Charter member of Association for Advancement of Central High School; Member Board of Directors, 1963-present; Vice-Chairman, 1966-1967.

Adult leader on canoe trips for Central High Outing Club, 1968-1970.

Informal assistance to wife who was coordinator of Germantown Area Schools Project, 1968-1970.

Germantown Jewish Center College Relations Committee member, 1970-1974.

Member of Faculty Steering Committee for Hillel organization at University of Pennsylvania campus, 1971-present.

Member, Sierra Club.

Raymond S. Berkowitz

PUBLICATIONS:

A. BOOKS

Modern Radar, Analysis, Evaluation and System Design, editor and co-editor (with 13 other co-authors), John Wiley and Sons, Inc., New York, 1965.

"Synthetic Noise Power," Section 5.3.6 of Microwave Power Engineering, edited by E. C. Okress, Academic Press, New York, 1968, pp. 286-293.

B. JOURNAL ARTICLES

"Networks for which Magnitude or Phase Angle of Input Impedance or Transfer Admittance Remains Constant as Load Varies," (presented at AIEE National Convention), Trans. of the AIEE, Vol. 70, Part 1, 1951.

"Optimum Linear Shaping and Filtering Networks," Proc. IRE, 41, No. 4, April 1953, pp. 532.

"Methods of Sampling Band-limited Functions," Proc. IRE, rr, No. 2, February 1956, pp. 231-235.

"A Study of the Transfer Function of Contact Modulated Amplifiers," with F. H. Krantz, and O. M. Salati, Trans. AIEE, Applications and Industry Section, March 1957, No. 29, pp. 23.

"Conditions for Network Element Value Solvability," IRE Trans. on Circuit Theory, March 1962.

"Statistical Considerations in Element Value Solutions," with R. L. Wexelblat, IRE Trans. on Military Electronics, July 1962, Vol. MIL-6, No. 3.

"Mathematical Models for Engineers," Electronic Industries, September 1963, pp. 39-70.

"Multiple-Target Monopulse Radar Processing Techniques," with P. Z. Peebles, Jr., IEEE Trans. on Aerospace and Electronic Systems, November 1968.

"Information Derivable from Monopulse Radar Measurements of Two Unresolved Targets," with S. Sherman, IEEE Transactions on Aerospace and Electronic Systems, Vol. AES-7, No. 5, September 1971.

"A Hybrid Navigation Concept Using a Spinning Satellite-borne Interferometer and Self-contained Equipment," with G. R. Thoma, IEEE Trans. on Aerospace and Electronic Systems, Vol. AES-8, No. , July 1972, pp. 528-537.

PUBLICATIONS (Continued:

"Application of Sequencing Policies to Telephone Switching Facilities," with L. J. Ackerman and H. Suss, IEEE Transactions on Systems, Man and Cybernetics, Vol. SMC-7, No. 8, August 1977, pp. 604-609.

"An Implicit Enumeration Algorithm for Sequencing Policies Applied to Telephone Switching Facilities," with L. J. Ackerman, H. Suss, IEEE Trans. on Systems, Science and Cybernetics, Vol. SMC-8, No. 4, April 1978.

"Parameters of a Spherical Random Antenna Array," with T. A. Dzekov, Electronics Letters, Vol. 14, No. 16, August 1978, pp. 495-496.

"First Experimental Results from the Valley Forge Radio Camera Program," with B. D. Steinberg, E. N. Powers, D. Carlson, B. Meagher, Jr., C. N. Dorny, and S. H. Seeleman, Proc. of the IEEE, Vol. 67, No. 9, September 1979, pp. 1370-1371.

"Comparison of Phase Only and Conventional Monopulse in Thermal Noise," with C. N. Campopiano, RCA Review, Vol. 41, June 1980, pp. 213-226.

"Minimum Spacing of Radar Returns Required to Accomplish Range Discrimination," with J. W. Parnell, submitted to IEEE Transactions on Aerospace and Electronic Systems.

J. Vespoli, F. Haber, R. S. Berkowitz, D. Yavuz, "A Self-Organizing Random Array Communications Relay," IEEE Trans. on Communications, Vol. COM-31, No. 4, pp. 484-492, April 1983.

C. ARTICLES IN THE TECHNICAL LITERATURE

"Approximate Formulas for Probability of Interference," Proc. Symposium on Electromagnetic Interference, Nov. 1957, published by USASRDL, No. 78-90.

"Computation of Probability of Interference Due to Adjacent Channel, Cross-modulation, and Intermodulation Effects for Randomly Spaced Equipments Operating in the VHF and UHF Bands," Proc. of the Fourth Conference on Radio Interference Reduction and Electronic Compatibility, held October 1958, Chicago, Illinois, by Armour Research Foundation and IRE-PGRF.

"Solution Procedures for Single-Element Kind Networks," with S. D. Bedrosian, 1962 IRE Inter. Convention Record, Part II, pp. 16-24.

"Comparison of Certain Probability Theory Concepts with Linear Circuit Analysis," J. A. C. Conference Proc., 1963.

"Research Guidelines for Digital Computer Controlled Systems for Checkout and Fault Isolation," with C. Beckman, S. D. Bedrosian, and T. C. Chen, Proc. of Aerospace Support Conference, Washington, D. C., August 1963.

"Computer Techniques for Solving Electric Circuits for Fault Isolation," with P. Krishnaswamy, Proc. of Aerospace Support Conference, Washington, D. C., August 1963.

"Evaluation of Multipurpose Radar Systems for Army Helicopter Sensing Needs," with H. Gershman, J. Jastrozembski and N. S. Kopeika. Presented at PPAAR Symposium, May 1968 and published in Symposium record.

PUBLICATIONS (Continued):

C. ARTICLES IN THE TECHNICAL LITERATURE (Continued)

"Spinning Interferometer Navigation Satellite Concept," with G. R. Thomas, presented at the International Electrical, Electronics Conference and Exposition, Toronto, Canada, October 1971, published in digest form in convention record.

"Suboptimal Fixed-Point Smoothing for Continuous Non-Linear Systems with Discrete Observations," with D. B. Luber, presented at the Sixth Annual Princeton Conference on Information Sciences and Systems, March 1972, published in conference record.

"Microwave Holographic Imaging of Aircraft with Spaceborne Illuminating Source," with T. A. Dzekov, Proc. of Bicentennial National Aerospace Symposium, NADC, Warminster, Pennsylvania, April 1976, published by the Institute of Navigation, 815 15th St., N. W., Suite 832, Washington, D. C., 20005.

"Automatic Test Design," with N. Prywes and C. Tinaztepe, IEEE MIDCON/77, Chicago, Illinois, November 1977, preprint Vol. 30, paper #2, pp. 1-10.

"TASAR, A Thinned Adaptive Synthetic Aperture Radar," with E. N. Powers, presented at EASCON '78, Arlington, Virginia, September 1978, published in EASCON '78 Record, IEEE Publication 78CH 1354-4 AES.

"A Self-organizing Random Array Communication Relay," with J. Vespoli, F. Haber, and D. Yavuz, 22nd Midwest Symposium on Circuits and Systems, Philadelphia, Pennsylvania, June 1979 (published in symposim proceedings).

"The Widely Dispersed Random Array as a Radio Relay," with J. Vespoli, F. Haber and D. Yavuz, 22nd Midwest Symposium on Circuits and Systems, Philadelphia, Pennsylvania, June 1979.

D. MISCELLANEOUS

"Survey and Review of Modern Mathematics in Industrial Engineering Applications," notes distributed at lecture at AIEE 1959 Fall Lecture Series No. II, November 1959.

Raymond S. Berkowitz

REPORTS AND PRESENTATIONS:

1. A Procedure for Determining the Characteristics and Capabilities of Fire Control Computing Systems - Report No. 4855-1, Project No. MS-4855, Contract NO RD 8717, October 1, 1948.

2. "Certain Equivocation Criteria in the Optimum Design of Linear Communication Systems, Ph.D. Dissertation.

3. Patent No. 2, 764, 679 Issued 25 September 1956 for Absolute Value System.

4. May 15, 1957, Traffic Load Considerations for Grid Communications Systems, Mono. Rept. No. WE-56-U-M-2, DA Proj. No. 3-99-12-023.

5. "Data Transmission in the Presence of Interference," by R. M. Showers, R. S. Berkowitz and H. Kritikos, 30 June 1959. Monograph-Final Report No. AD59VR1, under Contract No. DA-36-039-SC-75047.

6. "Study and Investigation of Polarization Programming;" Volume II, Polarization Systems Analysis, August 1964. Technical Documentary Report No. RADC-TDR-64-258 Volume II, by R. S. Berkowitz, J. Choder, R. G. Mulholland and P. Hahn, under Contract No. AF30(602)-3105.

7. "Progress under the Pennsylvania-Princeton Army Avionics Program," R and D Technical Report ECOM-02411-1, October 1967 - First Annual Report. R. S. Berkowitz responsible for Task D, Avionics Radar Systems Study, pp. 443-465.

8. "A Procedure for Computing Expectation and Variability of Casualties Achievable by an Attack with Airborne Agents,", June 1967, Rept. No. SU67UR3 - Monograph under Contract No. DA-18-064-AMC-2757(A).

9. "Validation of Theoretical Automatic Checkout Techniques," with W. G. Faust and M. M. Vartanian. Published as Air Force Technical Report AFAPL-TR-68-120, October 1968.

10. 10-15 Contributions to reports for Navy and Army AA Fire Control Projects, 1947-52.

11. Quarterly and final reports for NSA Project on Noise Communication System, 1953-56.

12. Quarterly and final reports on Projects ADAR, WESCON, 1956-59. (Weapon System Communications)

13. Quarterly and final reports on Project SARL, 1960-62 (for USNADC). (Aircraft simulation, noise).

REPORTS AND PRESENTATIONS (Continued):

14. Quarterly Reports on Project ROTEK, 1961-1963. (Automatic Checkout Techniques).

15. Quarterly Reports on Polarization Programming Project (GUMDROP), 1963-1965.

16. 11 Quarterly Reports for Project VOTACT (Validation of Theoretical Automatic Checkout Techniques) (1965-1968).

17. Radar Systems Task Quarterly and Annual reports for Avionics Project, 1966-1968.

18. Memorandum reports on Fire Control Radar Systems for RCA-DEP, 1957-1961.

19. BMEWS System documentation contributions at RCA-DEP, 1961-1968. These consisted of some 25 or 30 technical memoranda, most of which were incorporated into the final reports on the BMEWS system.

20. Technical memoranda concerned with the Multi-Function Array Radar (RCA project with U.S. Navy) - papers written between 1970-1973 concerned with development of theoretical techniques for evaluation of performance of phased-array radar system currently under development. This work is continuing and several papers are being planned for submission to technical journals.

21. "Project Ratran, Research on the Estimation of Trajectories from Radar Data" - October 1971, February, April and November 1972 (with M. Plotkin, D. Luber, S. Gottesman and T. Rabkin). Quarterly and Final reports published as ECOM - 0212 - 1, 2, 3 and 4 for work under Contract DAAB07-71-C-0212 with U. S. Army Electronics Command. Also as contributions to Valley Forge Research Center Quarterly Progress Report Nos. 3 and 4 (November 1972 and February 1973).

22. "Deterministic Array with Small Number of Elements." Contributions to VFRC QPR No. 3 (November 1972, pp. 44-50), VFRC QPR No. 4 (February 1973, pp. 21-37), VFRC QPR No. 5 (May 1973, pp. 21-30) and VFRC QPR No. 6 (August 1973). Also major contribution to final project report.

23. "Adaptive Antenna Array for Airborne MTI Radar." Contribution to VFRC QPR No. 5, pp. 49-53, also in VFRC QPR No. 6 (August 1973).

24. "An Interferometric Technique for Azimuth Angle Estimation." Paper presented at 1973 International IEEE/G-AP Symposium and USNC/URSI Meeting on 24 August 1973.

25. "Adaptive Antenna Arrays for Airborne and Groundbased Radar Systems." Paper presented at URSI meeting in Atlanta, Georgia, June 1974.

REPORTS AND PRESENTATIONS (Continued):

26. Between 5 and 10 technical reports written for RCA and U. S. Navy concerned with evaluation and design of the AEGIS-ASPY-1 radar system.

27. Contributions to VFRC Quarterly Progress Reports (1973-1975) and final report preparation on ONR Project concerned with conceptual design of an HF radar system using a large randomly distributed receiving array for high resolution imaging of surface targets at ranges of 500-5000 km.

28. "High Angular Resolution and Accuracy at HF," VFRC-73, November 1974.

29. "Conceptual Design of a High Angular Resolution Long Range Radar," Moore School Research Symposium, University of Pennsylvania, Philadelphia, Pennsylvania, October 1975.

30. "Microwave Holographic Imaging of Aircraft with Spaceborne Illuminating Source," National Aerospace Symposium of the Institute of Navigation, Naval Air Development Center, Warminster, Pennsylvania, April 1976.

31. "Research in Large Adaptive Antenna Arrays," with Tomislav Dzekov, VFRC-86, March 1976.

32. "Study of Large Adaptive Arrays for Space Technology Applications," with B. D. Steinberg, Y. Shamash, E. N. Powers, and T. L. Lim, VFRC-112, June 1977.

33. "Study of Adaptive Phase Control Technique," with B. D. Steinberg, final report submitted to Naval Air Development Center, Warminster, Pennsylvania, in completion of Contract No. N62269-75-C-0561, July 1977.

34. "Automatic Test Design" with N. Prywes and C. Tinaztepe, MIDCON/77, Electronic Show and Convention, Chicago, Illinois, November 1978.

35. "Random Sampling Adaptively Focusing Synthetic Aperture Radar," with E. N. Powers, Synthetic Aperture Radar Technology Conference, Las Cruces, New Mexico, March 1978.

36. "Random Sampling Adaptively Focusing Synthetic Aperture Radar," Valley Forge Research Center Seminar, University of Pennsylvania, Philadelphia, Pennsylvania, March 1978.

37. "TASAR, A Thinned Adaptive Synthetic Aperture Radar," with E. N. Powers, EASCON '78, Arlington, Virginia, September 1978.

38. "Adaptive Synthetic Aperture Radar," EES Colloquium, The Moore School of Electrical Engineering, University of Pennsylvania, September 1978.

39. "Evaluation and Performance Prediction for a Thin Adaptive Synthetic Array Radio Camera," with E. N. Powers, 2nd International Conference on Information Sciences and Systems, Patras, Greece, July 1979.

40. "Design Limitations on Adaptive Array Control Loop Nulling Time," with L. R. Burgess, International IEEE/APS Symposium and National Radio Science Meeting at Los Angeles, June 15-19, 1981, Session 10, Adaptive Antennas, paper #4.

REPORTS AND PRESENTATIONS (Continued):

41. "VFRC Radio Camera Research," Electrical Engineering and Science Dept. Faculty Seminar, 1 Oct. 1981.

42. "Subarray Organization of Large Adaptive Steered Phased-Array Antennas with Randomly Located Elements," with S. T. Juang, Benjamin Franklin 1982 Symposium on Advances in Antenna and Microwave Technology, May 15, 1982.

43. S. T. Juang and R. S. Berkowitz, "Design of a Large Random Array with Ordered Partitioned Subarrays," Benjamin Franklin 1982 Symposium on Advances in Antenna and Microwave Technology, May 15, 1982.

44. "Design of a Large Random Array with Ordered-Partitioned Subarrays", UP-VFRC-10-82, May 15, 1982.

45. Subarray Organization of Large, Adaptively Steered Phased-Array Tennas with Randomly Located Elements, UP-VFRC-11-82, May 15, 1982, with S.T.Juang.

46. "Crossed-Beam System for Elevation Coverage," July 1982, UP-VFRC-15-82.

47. "Periodic Array Characteristics," July 1982, UP-VFRC-23-82, with S. T. Juang.

48. "Beamforming and Scanning with a Wide Bandwidth High Resolution Array," Nov. 1982, UP-VFRC-24-82, with B. Yang.

49. E. Yadin, R. S. Berkowitz, S. T. Juang and E. N. Powers, "High Resolution Radar System: Candidate System Study," Dec. 1982, UP-VFRC-30-82.

50. "Properties of High Resolution Periodic Arrays," VFRC Seminar, 8 Oct. 1982.

51. "Mean and Variance of Far Field Power Pattern of Periodic and Random Arrays with Adaptive Beamforming and Open-Loop Scanning," Third Annual Benjamin Franklin Symposium on Advances in Antennas and Microwave Technology, Holiday Inn, Phila., Pa., April 30, 1983, with S. T. Juang.

52. "Beamsteering Algorithms for Wideband Arrays," Third Annual Benjamin Franklin Symposium on Advances in Antenna and Microwave Technology, Holiday Inn, Phila., Pa., April 30, 1983, with B. Yang and S. T. Juang; Symposium Digest, pp. 34-37.

53. "Mean and Variance of Far Field Power Pattern of Periodic and Random Arrays with Adaptive Beamforming and Open-Loop Scanning," April 1983, UP-VFRC-12-83, with S. T. Juang.

54. "Beamsteering Algorithms for Wideband Arrays," April 1983, UP-VFRC-13-83, with B. Yang and S. T. Juang.

55. "Wideband Waveform and Synthesized Aperture Considerations for a High Resolution Imaging Radar," Sept. 1983, UP-VFRC-28-83, with S.T. Juang and B. Yang.

56. "Final Report for Signal Processing Improvements for the LAMPS MK-III AN/APS-124 Radar," Dec. 1983, UP-VFRC-40-83, with K. Parhi.

57. B. Yang and R. S. Berkowitz,"Chirp Radar Beamforming in a Large Array," Dec. 1983, UP-VFRC-41-83.

REPORTS AND PRESENTATIONS (Continued):

58. "Wideband Waveform and Synthesized Aperture Considerations for a High Resolution Imaging Radar," 1984 National Radar Conference, Radar Systems Panel of the IEEE Aerosp. & Electron. Syst. Society and The Atlanta Section, IEEE, March 13-14, 1984, Atlanta, Ga., with S. T. Juang and B. Yang.

59. 15 lectures on Radar System Theory, Chengdu Institute of Electronic Engineering, Chengdu, Sichuan, People's Republic of China, April 3-24, 1984.

60. Four research seminars presented at Chengdu Institute of Electronic Engineering, Chengdu, Sichuan, People's Republic of China, April 3-24, 1984: 1) Valley Forge Research Center Large Array Antenna Research, 2) Processing Techniques for Radio Camera Imaging, 3) Mean and Variance of Far Field Power Pattern of Periodic and Random Arrays with Adaptive Beamforming and Open Loop Scanning, 4) A Statistical Approach to Radar Range Discrimination.

61. J. W. Parnell, R. S. Berkowitz, "A Statistical Approach to Radar Range Discrimination," Intern'tl Conference on Radar, Paris, France, May 21-24, 1984.

62. "Processing Techniques for High Resolution Radio Camera Imaging," International Conference on Radar, Paris, France, May 21-24, with S. T. Juang & B. Yang.

63. "Signal Processing Improvements to LAMPS Radar: System Modifications and Performance with (Staggered PRF) Coherent-on-Receive MTI Processing, Oct. 1984, UP-VFRC-16-84, with K. K. Parhi.

64. J. W. Parnell, R. S. Berkowitz, "A Statistical Approach to Radar Range Discrimination, May 1984, UP-VFRC-18-84.

65. "Processing Techniques for High Resolution Radio Camera Imaging," May 1984, UP-VFRC-19-84, with S. T. Juang and B. Yang.

66. "Identification of Targets at Sea," May 1985, UP-VFRC-15-85.

67. Y.-W. Chen and R. S. Berkowitz, "Effect of Multipath on the Propagation of Electromagnetic Waves," May 1985, UP-VFRC-17-85.

68. "Subsurface Radar for Power Cable Leak Location: Propagation Model Verification," 11 July 1985, UP-VFRC-20-85.

ARTICLES PUBLISHED IN VALLEY FORGE RESEARCH CENTER QUARTERLY PROGRESS REPORTS

1982:

QPR NO. 41 - "Bistatic Test Program"

"High Resolution Microwave Imaging"
"Periodic Array Characteristics"

1982-1983:

QPR NO. 42 - "Wideband Array Studies"
"Beamforming and Scanning with a Wide Bandwidth, High Resolution Array"
"A Simplified Steering Scheme for a Large Array with Wide Bandwidth"

QPR NO. 43 - "Wideband Array Studies"
"Implementation of the Data Processing Algorithms for a Wideband High Resolution System"
"Application of FFT in Radar Imaging Processing for a Wideband Array"
"Velocity Constraints on Moving Targets for a Wideband High Resolution System"

"Passive Imaging of Wideband Sources Using Coherent Sensors"

"Improvement of Target Detection Probability by Using a Square Law Integration Scheme Rather Than Binary Integration and Its Applicability to MTI"

1983-1984:

QPR NO. 44 - "Bistatic Test Program"

"Signal Processing Improvements for the LAMPS Radar"

QPR NO. 45 - "Radar Signal Processing"
"Signal Processing Improvements to LAMPS Radar with Staggered PRF Coherent-On-Receive MTI Processing"

1984-1985:

QPR NO. 46 - "Threshold Imaging Experiments"

Raymond S. Berkowitz

COMPLETED DISSERTATIONS SUPERVISED:

1.	1958	T. T. N. Bucher	Frequency Modulation Response of Linear Passive Networks
2.	1958	D. Joseph	Blocking Probabilities and Trunking Requirements in Multiexchange Telephone Communication Systems
3.	1960	F. Haber	The Statistical Properties of the Output of Radio Receivers Subjected to Intermodulation Interference
4.	1961	S. Shucker	Application of Integral Equations to Approximate Solutions of Electrical Engineering Problems
5.	1961	L. E. Matson, Jr.	Basic Theory of Surveillance System Decision Processors
6.	1961	S. D. Bedrosian	On Elements Value Solution of Single-Elements-Kind Networks
7.	1961	L. G. Callahan (with W. Brown of Univ. of Michigan	Optimum Linear Filtering for Line Scan Imaging Systems
8.	1963	I. Maron	Statistical Analysis of Pseudo-Random Coded Pulsed Radar Applied to Radar Astronomy
9.	1963	O. M. Salati (with R. M. Showers)	The Applicability of Signal Density Studies in Interference Prediction
10.	1964	W. W. Weinstock	Target Cross-Section Models for Radar Systems Analysis
11.	1964	J. Wilder	Adaptive Control of Communication Systems Based on Sequential Channel Measuring Techniques
12.	1964	A. Rosenberg (with D. W. C. Shen and J. T. Chu)	The Identification of Time-Varying Linear Systems from Multiple Input-Output Records
13.	1965	H. Finn	Efficient Multiple Stage Decision Processors for Radar Surveillance
14.	1965	S. M. Sherman	Complex Indicated Angles in Monopulse Radar

COMPLETED DISSERTATIONS SUPERVISED (Continued):

15.	1965	M. J. Campanella	Investigation into the Fluctuation of Laser Signals caused by Simultaneous Multimode Oscillations
16.	1966	M. Feryszka	An Antijam Communication Technique Based on Frequency Hopping
17.	1967	P. Z. Peebles	Processing Methods and Basic Limitations of Multiple Target Monopulse Radar
18.	1967	J. T. Nessmith, Jr.	Modulation of Wideband Radar Signals by Diffraction Effects
19.	1968	T. H. Levine	Statistical Models for the Design and Evaluation of a Store and Forward Communication System
20.	1968	A. J. Bogush, Jr.	Target Cross-Section Models for Wide Bandwidth Radar System Analysis
21.	1969	W. G. Faust	The Application and Development of Search Techniques for Fault Isolation
22.	1969	R. A. Ternus	Detection of Stationary Targets in the Ground Clutter Environment
23.	1969	M. M. Vartanian	An Algorithm for Fault Isolation of Multi-State Electronic Networks
24.	1969	E. L. Frost	Criteria for Radar System Design Based on Ortho-normal Function Expansions of the Target Impulse
25.	1970	T. Murakami	Radar Clutter Attenuation
26.	1970	A. D. Korbin	Radar Resolution in a Non-Deterministic Environment
27.	1970	L. Weinberg	Detection in Clutter and Noise
28.	1971	S. Goldman	Minimax Solution of Second Order Phase Lock Loop Acquisition Time
29.	1971	L. W. Yoder	The Angular Resolution of Multiple Radar Targets as a Parameter Estimation Problem with Some A Priori Information

COMPLETED DISSERTATIONS SUPERVISED (Continued):

30.	1971	B. D. Steinberg	A Probabilistic Estimator of the Peak Sidelobe of an Antenna Array with Randomly Located Elements
31.	1972	H. Urkowitz	Direction Sensitive Radar Moving Target Indication
32.	1972	D. B. Luber	Nonlinear Fixed-Point Smoothing for the Estimation of Ballistic Trajectories from Radar Data
33.	1972	P. F. Guarguaglini	Digital Sequential Procedure in a Range-Sampled System
34.	1973	J. L. LaCava	Overload Controls in Switched Communication Networks
35.	1973	E. Rawdin	Network Connection Probabilities with Orc-Limited Pattis
36.	1975	Thomas J. Duffy	Decoupled State and Bias Estimation Applied to Trajectory Reconstruction
37.	1976	D. V. Manoogian	Phase Scanned Array Bandwidth Limitations in a Wideband Radar System
38.	1976	L. J. Ackerman	The Capacity Expansion Problem Applied to the Telephone Switching Network
39.	1976	T. A. Dzekov	Microwave Holographic Imaging of Aircraft with Spaceborne Illuminating Source
40.	1977	S. J. Rosasco	Detection of Quasi-Periodic Arrival Time Sequences
41.	1977	C. Tinaztepe (with N. Prywes)	Automated Test Design
42.	1978	M. Rozansky	Digital Radar Clutter Processing

Most of these men have positions of engineering responsibility in industry. Haber, Bedrosian, Salati, and Steinberg are on the Moore School faculty. Shucker and Maron have taught graduate courses at Drexel. Vartanian is on the faculty at PMC colleges; Peebles has just joined the faculty as an Associate Professor at the University of Tennessee. Bucher, Matson and Nessmith have important managerial responsibilities. Guarguaglini is in charge of a group at Selenia Corporation, Rome, Italy.

COMPLETED DISSERTATIONS SUPERVISED (Continued):

43.	1981	L. R. Burgess	Design Constraints on the Realization of Adaptive Nulling Arrays.
44.	1984	S. T. Juang	Time-Deduced Processing Techniques for Two-Dimensional High-Resolution Microwave Radar Imaging of Far-Field and Near-Field Targets.

CURRENT PH.D. RESEARCH EFFORTS UNDER WAY:

1985	Yin-Wu Chen	On IBM project - work related to Inverse Synthetic Aperture imaging - related to target imaging, identification of sea vessels from airborne radar. Ready soon for oral exam.
1985	Stanley Yuen	Work on adaptive Interference Suppression using modular efficient orthogonatization networks. Also ready soon for oral exam.
1985	Mike Friedman	Work on digital antennas, beamforming - software and hardware architectures for array itilization.
1985	Chang-Gua Zhou	DHR project - work on development of synthetic aperture algorithms and soft ware for subsurface radar application.

Raymond S. Berkowitz

M. S. THESES SUPERVISED:

1.	1954	A. A. Wolf	A Mathematical Theory of Automatic Frequency Control
2.	1954	H. Urkowitz	Video Integration of Pulsed Radar Signals
3.	1955	L. E. Matson, Jr.	Fire Control Prediction for Random Target Paths
4.	1955	W. V. Goodwin	Frequency Response of the Barrier Grid Storage Tube in MTI Application
5.	1957	C. Pappas	Inverse Diode Protective Circuit for Megawatt Peak-power Line Type Modulators
6.	1957	L. Siegel	Accuracy Analysis and Design Considerations for a Chopper Type Amplifier
7.	1958	R. Mekel	A Study of the Response Function of a Contact Modulated Chopper Amplifier Circuit
8.	1958	K. H. Fischbeck	On the Optimum Use of Data from Multiple Radars Tracking a Single Target
9.	1958	F. Kugler	Spurious Oscillation in Contact Modulated Feedback Amplifiers
10.	1959	E. Taenzer	On the Angular Accuracy of Pulsed Search Radar With an Application to a Particular Detection and Estimation Scheme
11.	1959	R. J. Kern	Determination of Characteristics of Intermixed Pulsed Trains
12.	1959	J. C. Balon	Nonlinear Distortion in Single Sideband Transmission: A Quantitative Comparison of Methods of Testing For and Measuring This Distortion
13.	1959	E. J. Faust	An Automatic Microwave Phase Measuring Circuit With Linear Voltage Output
14.	1959	K. K. Nambiar	Lossless Multiconductor Transmission Lines
15.	1959	A. J. Lisicky	Automatic Target Acquisition Circuit for Tracking Radars
16.	1959	D. M. Taylor	Video Level Metering
17.	1959	E. D. Grim	A Steady State Analysis of Chopper Networks

M. S. THESES SUPERVISED (Continued):

18.	1960	J. E. Palmer	Variable Data Rate Transmission as Applied to Communication Systems
19.	1960	J. D. Rittenhouse	Minimum Bandwidth Video Recording
20.	1960	D. H. Sapp	A Synchronous Detection System Utilizing a New Method of Frequency and Phase Control
21.	1961	S. Kuflik	Bandwidth Reduction in Pulse Code Modulation Systems
22.	1961	J. L. Cristensen	The Linear Array as a Matched Filter
23.	1961	H. Scheuer, Jr.	Real Time Computation of Radar Target Cross Section
24.	1961	L. H. Fink	The Temperature Rise of Cyclical Loaded Underground Cable Systems as Affected by Statistical
25.	1962	R. J. Brachman	Applications of Digital Computers to Multipurpose Automatic Inspection and Diagnostic Systems
26.	1962	L. Siegel	RF Backscattering Properties of Metallic and Di-electric Objects
27.	1962	W. S. Kozak	Aspects of the Mean Square Error in the Discrete Case with Applications to the Guidance Problem
28.	1962	D. Loev	A Neighbor Listing System
29.	1962	R. J. Wimberger	Checkout and Automatic Monitoring of Radar Systems
30.	1962	H. P. Birnkrant	A Logical Framework for the Checkout Phase of Complex Systems
31.	1962	J. C. Bry	Phase Lock Demodulation for Wideband Signals
32.	1962	A. D. Korbin	Use of the Fine Structure of Swept Frequency Modulated Radar Signals for Range Resolution
33.	1962	G. A. Ripsom	An Experimental Investigation of Radar Range Tracking Accuracy
34.	1962	L. P. Harding	Introduction to PMC/FM System Parameters

M. S. THESES SUPERVISED (Continued):

35.	1962	R. A. Harger	Investigation of the Synchronous Descent Orbit: A Possible Phase of the Lunar Orbital Rendezvous Mission
36.	1962	C. J. Hughes	Random Staggering of Array Columns as a Technique for Reduction of Grating Lobes
37.	1962	J. L. Laude	Dual Loss and Delay Operation of a Multiple Channel Queue
38.	1962	F. W. Fairman	Periodic Drift in Suppressed Carrier Self-Balancing Potentiometers
39.	1962	S. Ruben	Elimination of Phase Shift Effect in Bottom Bounced Underwater Sound
40.	1962	L. R. Miamidian	A Mathematical Analysis of the Simultaneous Processing of Range and Azimuth Information In a High Resolution Airborne Radar System That Uses Pulse Stretching and Compression
41.	1962	R. Barone	Application of Digital Techniques to the Problem of Measuring Slant Range of Space Vehicles
42.	1963	M. Flomenhoft	Error Analysis of Satellite Orbit and Position Estimates Based on Radar Observations
43.	1963	J. Liston	A Phase-Frequency Scanned Radar Conceptually Applied to the Detection and Tracking of Low Elevation Angle Suborbital Targets
44.	1963	A. E. Franz	Application of Monte Carlo Techniques to Predict Statistical Performance of Radar Networks Engaged in Satellite Surveillance
45.	1963	K. Abend	Nonparametric Signal Detection
46.	1963	R. L Gayer	Fault Isolation In Solid State Circuits
47.	1963	M. W. Wall	Satellite Communication System
48.	1963	R. L. Stegall	A Computer Oriented Radar System
49.	1963	E. E. Fox	The Video Storage Tube Integrator
50.	1963	E. G. McCall	Investigation of Linear Phase Detector Performance in a New Pulse-Radar System

M. S. THESES SUPERVISED (Continued):

51.	1963	L. J. Clayton	Radar Tracking of Objects with Low Signal to Noise Using Video Integration
52.	1963	J. G. Kammerer	A Study of an Earth-Moon-Earth Radio Frequency Communications System
53.	1963	T. A. Dorsey	A Satellite Information Processing System
54.	1963	A. Hoffman	Programmed Learning: A Simulation Study In Clinical Data Processing
55.	1963	F. I. Zonis	The Theoretical Performance of a Diversity Combining System with AGC Weighted Combining
56.	1963	A. Bezgin and	Advanced Defense System Simulator
57.		E. J. Hartnett	
58.	1964	A. J. Lisicky	Correlated Noise and the Phase Sensitive Detector
59.	1964	J. J. Cashen	A Decision Criterion to Compensate for Intersymbol Interference
60.	1964	R. E. Hartwell	The Application of Sampling Theory to Waveform Measurements in Automatic Test Systems
61.	1964	J. Choder	Evaluation of a Technique for Interference Reduction Using Polarization Control
62.	1964	J. W. Modestino	A Statistical Decision Theory Approach to Practical Feedback Communication Schemes
63.	1964	C. Moir	Transversal Equalization in the Transmitter Path
64.	1964	G. B. Mitchell	Gaussian Noise Driving a Complementary Bistable Multivibrator
65.	1964	L. W. Martenson	A Time Dispersed Rayleigh Fading Channel Simulator
66.	1964	G. R. North	Simulation of Dynamic Radar Cross-Section of a Near Earth Satellite
67	1964	J. R. Allen and	An Anti-Jam Communications System
68		J. B. Feller	

M. S. THESES SUPERVISED (Continued):

69.	1965	C. E. Steen	An Analysis of Jamming Problems in Aircraft Transponders with Consideration to Restricting the Pulse Response Bandwidths
70.	1965	T. J. Harley, Jr.	Classification Procedures for Multivariate Normal Populations When the Covariance Matrices May be Singular
71.	1965	J. M. Chambers	A System for Computing Control Range Tracking
72.	1965	L. L. Brassaw, Jr.	Synthetic Array Patterns and Waiting Functions
73.	1965	O. G. Gabbard	Study of a PDAM Space Telemetry System
74.	1965	W. V. Steuteville	Estimating the Operational Effectiveness of Chemical Agents of Intermediate Volatility
75.	1966	H. R. Nonken	The Adaptation of a Programming Language for Automatic Checkout Equipment
76.	1966	L. A. Naglak	Resolution in the Presence of Scattering Layer Reverberation
77.	1966	F. I. Johnson	A Study of Reticle Patterns to Optimize the Signal to Noise Ratio of an Infrared Tracker
78.	1966	L. A. Casciotti	An Application of Neighbor Listing to the Radar Target Association Problem
79.	1966	J. L. Worst	Orientation of Phased Array Radars to Minimize Average Scanning Loss
80.	1966	R. P. Perry	Signal Analysis Using Instantaneous Power Spectra
81.	1966	J. R. Richards	Comparison of Statistical Techniques for the Classification of Complex Patterns in Photographic Data
82.	1966	W. Blau	Random Time-Frequency Radar Codes
83.	1967	J. E. Freedman	A Model for the Detection of Steady Targets in Exospheric Chaff Clouds
84.	1967	B. W. MacDermid	Application of the ITF/ATC Transponder in a Satellite Communications Link for Aircraft
85.	1967	R. L. Baer	Digital Computer Simulation of the Ecology of a Trout Stream

M. S. THESES SUPERVISED (Continued):

86.	1967	R. A. Ternus	A Comparison of Monopulse Techniques for a Terrain Following Terrain Avoidance Radar
87.	1967	G. L. Snyder	S-66 Satellite Laser Tracking Experiment
88.	1967	M. M. Vartanian	Validation Study of an Electric Network Fault Isolation Procedure
89.	1967	S. M. Worthington, III	Application of Automatic Checkout and Fault Isolation Techniques to Automatic Control Systems
90.	1968	D. E. Easterday	On Determining the Orientation of a Stable Satellite
91.	1968	T. P. Sanks	Investigation of Several Methods of Obtaining CRAF in Non-Stationary Backgrounds
92.	1968	J. E. Bowser	Radiometry Detection of Acoustic Signals
93.	1968	J. F. O'Brien, Jr.	A Monopulse Instrumentation Tracking Radar Pulse Doppler System
94.	1968	E. K. Emerle	A Technique to Enhance Security in a Radar Command Link
95.	1959	Don E. Easterday	On Determining the Orientation of a Stable Satellite
96.	1969	Paul H. Jackson	Fault Isolation by Transfer Characteristics
97.	1970	Donald Wexler	On Choosing the Optimum Coordinate System in Which to Use Digital Predication Filters for Various Radar Schemes
98.	1970	Marvin Dubin	Investigation of a Coherent and a Noncoherent Noise Cancellation Technique for Partially Correlated Noise Fields
99.	1970	C. P. Ausschnitt	Effects of a Scattering Point on a Wide Band Pulse
100.	1971	H. J. Schroeder, Jr.	Determining the Motion of a Re-Entry Vehicle from Radar Cross-Section
101.	1971	E. A. Spaans	Application of Codes in Satellite Ranging

M. S. THESES SUPERVISED (Continued):

102.	1972	R. L Bates	Automatic Checkout for Apollo
103.	1972	S. Gottesman	An Investigation of the Effects of Random Radar Date Errors on Trajectory Parameter Estimation Accuracy
104.	1972	T. P. Rabkin	Realization and Evaluation of an Extended Kalman Filter and Smoother
105.	1973	M. L. Morgan	A Digital Signal Processing Design
106.	1973	C. H. Haber	Spectral Purity Improvement of a Digital Frequency Synthesizer by Discriminator Feedback
107.	1973	R. J. Smith	A Digital Pulse Compression Matched Filter
108.	1973	W. M. Norr	The Measurement of Muzzle Velocity
109.	1973	P. J. Lay	Software Considerations in the Implementation of a Defense - Phased Array Radar Manager
110.	1973	S. K. Kashanian	"Analysis of Adaptive Antenna Array Techniques for Airborne MTl Radar
111.	1974	L. R. Moyer	The Calculation of Detection Probabilities for Targets Having Intermediate Rates of Fluctuation
112.	1976	Gerald J. Mayer	The Application of the Chirp Z Transform to Pulse Compression (MSEE Thesis)
113.	1978	Bernard Turowski	Design and Analysis of a Microprocessor-Based Digital Range Tracker
114.	1979	Frank Linguitty	Automatic Test Design: A Case Study
115.	1980	John W. Parnell	"The Probability of Range Resolution of Closely Spaced Radar Targets"
116.	1980	John A. Lunsford	"A Digital Linear Correlation Matched Filter and its Application to a Radar Antenna Sidelobe Blanking System"
117.	1982	Shauh Teh Juang	"Subarray Considerations in the Design of a Large Radio Camera.
118.	1984	Francis M. Reininger	"Discrimination of Multiple Wideband Sources Using Passive Coherent Sensors.
119.	1984	Keshaba K. Parhi	"Application of Importance Sampling for False Alarm Threshold Setting in Complex Multidimensional Signal Processing Systems."

M. S. THESES SUPERVISED (Continued):

120.	1985	Michael A. Mayor	"Performance Analysis of a Digital Receiver for Correlative Encoded FSK Signals in the Presence of both Gaussian and Impulse Noise.

CURRENT M.S. THESES RESEARCH EFFORTS:

1985	Robert Cipolla	Work on optimum clutter suppression for IBM project.
1985	Wan Lin Yang	Analysis of high resolution imaging data runs using 2-D array structure at Valley Forge Research Center.

M. S. THESES SUPERVISED (Continued)

120.	1985	Michael A. Mayor	"Performance Analysis of a Digital Receiver for Correlative Encoded FSK Signals in the Presence of both Gaussian and Impulse Noise.

SUPERVISION OF OTHER M. S. THESES RESEARCH EFFORTS

1985	Robert Cipolla	Work on optimum clutter suppression for IBM project.
	Wan Lin Yang	Analysis of high resolution imaging data runs using 2-D array structure at Valley Forge Research Center.

OTHER PROFESSIONAL AND PERSONAL ACTIVITIES

1987: Retired from University of Pennsylvania and regular consulting assignments

1987 through January 8, 1993:
Occasional consulting
Volunteer teacher, Electronics, J. S. Jenks School, once a week
Volunteer, Franklin Institute, once a week
Mentor, Jewish Education and Vocational Services for Russian immigrants
Chair, Program Committee, Maimonides Chapter, B'Nai Brith
Student, Adult Education Courses, Germantown Jewish Centre and Beaver College, Community Scholars Program
Travel -- Europe and United States