

1979

College of Engineering research activities and annual report, July 1, 1978 - June 30, 1979

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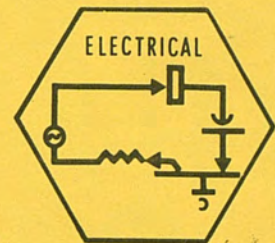
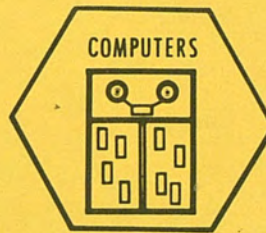
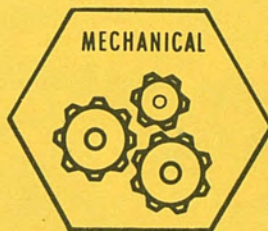
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COLLEGE OF ENGINEERING

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AND
ANNUAL
REPORT

JULY 1, 1978 - JUNE 30, 1979

UNIVERSITY OF CENTRAL FLORIDA • COLLEGE OF ENGINEERING

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Dr. C. B. Gambrell

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INTRODUCTION

Engineering education has long been recognized as a major force for economic growth. The creation of a vigorous, highly profitable, rapidly expanding industrial development which will bring substantial increases in per capita income, diversify and stabilize the economic base of the State, and provide attractive jobs for an expanding population will depend largely on the attraction of "growth industries" to the State. These growth industries are achieved through and thrive on innovation. Innovation depends essentially upon the creative talents of engineers and applied scientists.

The Blue-Ribbon Commission on the Future of Florida's Public Universities presented its report to the Board of Regents during the year. This report has been reviewed and editorialized in many of the major newspapers in the State under the various captions: FUTURE IS HITCHED TO OUR UNIVERSITIES (Fort Myers News-Press), CHALLENGE TO QUALITY (St. Petersburg Times), FLORIDA'S UNIVERSITIES: BUILD ON FOUNDATION (The Pensacola News), ACHING PLETHORA (Gainesville Sun), FLORIDA'S HIGHER EDUCATION SHORTCHANGED TOO LONG (The Miami Herald), UNIVERSITIES AND THE ECONOMY (Lakeland Ledger), UNIVERSITIES' FLAWS TIED TO SOCIETY (Miami News), NEED FOR QUALITY IN STATE SCHOOLS MUST BE ADDRESSED (Fort Lauderdale News), and HIGHER GOALS NEEDED FOR STATE UNIVERSITIES (Tallahassee Democrat).

Commenting on the Commission's report, one of these articles cites, "An improved university system would help attract more of the clean industries Florida needs to assure a healthy economy and environment. Moreover, improved universities would serve our economy by bringing in more federal contracts and grants. The point, of course, is that higher education is truly an investment."

A good nucleus of growth industries and agencies is now present in the Central Florida region. Many well known trade marks and logos are becoming familiar neighbors General Electric, Westinghouse, NCR, Stromberg-Carlson, Martin-Marietta, Pratt Whitney, Motorola, Exxon, Harris Corporation, IBM, Qwip Systems, NRL, NTEC, NASA . . . to name a few. It should be noted that the presence of these major entities has already led to the development of new high technology "spin-offs".

As professional engineers and educators, we readily recognize that quality universities are important to the enhancement of our industrial and economic base. Central Florida is on the verge of becoming the next center of growth industries. Such centers have tended to evolve around major university engineering schools in relatively urban-cultural centers. Examples of well established centers include U. S. Route 128 in Boston (Harvard and M.I.T.), San Francisco Bay Area (U.C.-Berkeley, Stanford), and Los Angeles (USC, UCLA, Cal. Tech.). Rapidly growing evolving centers include Phoenix (Arizona State Univ.), Dallas-Fort Worth (SMU, UT-Arlington), N.C. Triangle (Duke, Univ. of N.C. and N.C. State) and Atlanta (Ga. Tech.). Several such complexes could develop in Florida, especially in the Tampa Bay and Orlando environs.

To that end the creative efforts of the College of Engineering faculty and students (as reflected herein) are dedicated. Personal, professional, institutional, and governmental policies must facilitate rather than obstruct the crucial creative process.

We are pleased to present herewith the eighth Resume of Research Activities of the faculty and students of the College of Engineering. The dollar volume of income exceeded \$700,000 and the value of "research-in-force" approached the million dollar mark for the year. The number of persons involved, the number of sponsored and unsponsored projects, and the number of publications and presentations resulting therefrom all show increases over last year.

Robert D. Kersten
Dean

FORWARD

This year marked the second year of activity under the Letter of Agreement between the University of Florida and the University of Central Florida to extend the mission of the Engineering and Industrial Experiment Station (EIES) to include UCF. According to the Florida Statutes governing the conduct of this activity, ". . . the EIES is responsible for organizing and promoting research projects of engineering and related sciences, with special reference to problems that are important to the development of industries of Florida." In order to provide a basis for being responsive to the intent of EIES, Dr. George F. Schrader, Associate Dean of Engineering conducted a study of industry in the UCF service area during the summer of 1978. A brief summary of Dr. Schrader's report is included here as a Forward to the Annual Report:

ASSESSMENT OF INDUSTRY NEEDS FOR ENGINEERING EDUCATION AND RESEARCH IN THE UNIVERSITY OF CENTRAL FLORIDA SERVICE AREA

Impetus for Study

The College of Engineering at UCF has grown and matured considerably since it first opened its doors to 184 students in the fall of 1968. During the ten year period 1968 - 1978 the College has initiated and received full accreditation by the Engineers Council for Professional Development (ECPD) for five engineering curriculum options at both the basic and advanced levels. Also during that period, a two year upper division program in Engineering Technology was established by the College of Engineering, and undergraduate and graduate program options in Civil Engineering were initiated in the fall of 1978. Enrollment in the College of Engineering was nearly 1300 students in the fall of 1978, and such enrollment is expected to exceed 1500 students by the fall of 1979. In addition to its academic programs, the College of Engineering has developed a sizeable research activity under the auspices of the UCF Engineering and Industrial Experiment Station (EIES) program.

Considering the milestones achieved during the first ten years of operation and the need to develop appropriate plans for the future, the College of Engineering has initiated a review of its engineering curricula and other programs in terms of the needs of the eleven county UCF service area and contemporary trends in engineering education. As a part of this review process, a survey of industry was conducted during the summer of 1978 to obtain estimates of, (1) the number of engineers currently employed, (2) the future needs for engineers and, (3) the continuing education and research needs of industry in the eleven county UCF service area.

UCF Service Area

The service area of the University of Central Florida has been established by the Board of Regents to include the following eleven counties:

Brevard	Lake	Orange	Sumter
Citrus	Levy	Osceola	Volusia
Flagler	Marion	Seminole	

The population of those eleven counties was estimated to be 1,356,290 in 1977 with a total population of the State of Florida estimated to be 8,713,877 for that same year. Since there are a total of 67 counties in the State, the UCF service area contains approximately 16 percent of the counties and 16 percent of the population of the State. According to the 1978 Directory of Florida Industries, there were a total of 8,421 manufacturing establishments in the State of Florida with 430,868 persons employed by those firms. According to that same directory, there were 1,346 manufacturing establishments in the eleven county UCF service area and 67,825 persons were employed by those firms. Thus, the UCF service area contains about 16 percent of the industrial establishments and 16 percent of the industrial employees in the State.

Industry Survey

During the summer of 1978, the UCF College of Engineering sent out survey questionnaires to a sample of approximately one-half of the manufacturing establishments located in the UCF service area. The survey forms were approximately equally distributed among the 22 SIC (Standard Industrial Classification) manufacturing industries in the eleven counties. The questionnaire solicited information on the number of engineers currently employed and an estimate of the need for additional engineers during the next 5 years. In addition, information was requested about the continuing education, new technology, and research needs of the firms contacted. Approximately 10 percent of the firms contacted responded to the survey.

Summary of Survey Analysis

A statistical treatment of the industry responses to this survey revealed some very interesting estimates about the make-up of the technical community in the UCF service area:

1. Engineers Currently Employed in the UCF Service Area

According to the estimates derived from the industry responses, approximately 18,000 engineers were employed by manufacturing establishments in the UCF service area during 1978. Based on U. S. Census data and U. S. Department of Labor statistics, it is estimated that there were approximately 37,000 gainfully employed engineers located in the State of Florida in 1978. Thus, from this information, it is apparent that nearly 50 percent of the engineers in Florida are employed by industrial firms in the Central Florida area. It should be pointed out here that the survey data reflect only the manufacturing sector of this area and does not include the service or governmental sectors which nominally employ a considerable number of engineers.

Of the 18,000 engineers employed in this area, over 9,000 of these were employed by electrical and electronic equipment manufacturing firms (SIC Code 36) and over 4,000 were employed in transportation equipment manufacturing companies (SIC Code 37). This reflects the high concentration of high technology electronics and aerospace type industrial establishments in the UCF service area.

The distribution of engineering disciplines among the 18,000 engineers employed by manufacturing industries in the UCF service area was as follows:

<u>Engineering Discipline</u>	<u>Number Employed</u>	<u>Percent of Total</u>
Electrical	9,010	50.2
Mechanical	2,391	13.3
Computer	1,554	8.7
Civil	728	4.1
Industrial	649	3.6
Environmental	181	1.0
Other	2,771	15.6
Engineering Technology	632	3.5
Total	17,916	100.0

2. Future Needs for Engineers in the UCF Service Area

Estimates made from industry responses to the survey indicated that the existing 1,346 manufacturing establishments in the UCF service area will require 15,335 new engineering employees during the next 5 years (1979 - 1984). This represents an increase of approximately 86 percent over the current level of employment. Perhaps of greater interest, however, is that their anticipated additional engineering manpower needs at the graduate level are greater than that of the undergraduate level, i.e. MS = 91.5 percent and Ph.D. = 108 percent of current level of employment. This increase in demand for higher degree levels reflects again the continuing increase in the high technology orientation of industry in the UCF service area.

Cooperative efforts among all SWS Engineering Colleges (UCF, USF, UF, FAU) continued. The UCF Engineering and Industrial Experiment Station activities under a letter agreement with the University of Florida continued to show improvement. The State Technical Assistance Centers (STAC) program at UCF, USF and UF continued to be successful. George F. Schrader, Ph.D., P.E. was named Associate Dean of the College of Engineering.

Engineering students continue to receive a variety of scholarly and professional recognitions. A local chapter of Tau Alpha Eta, national honor society for engineering technology students was installed during the year. The ASME student chapter won the national Mini Baja Competition for the second year. Industrial Engineering students were recognized by an "Award of Excellence" from the AIEE. Civil Engineering students hosted the ASCE Southeastern Regional Student Conference.

Drs. Gambrell, Kersten, Schrader, and Whitehouse served on the Engineer's Council for Professional Development ad hoc accreditation visitor committee during the year. Professor Mohler was named to the ad hoc visitors list in Engineering Technology. Drs. Dending and Kersten served on Southern Association for Colleges and Schools visiting committee during the year. Dr. Gambrell served as a member of the board of Directors of ECFD; Dr. Schrader was elected Executive Vice President of AIEE; Dr. Kersten continued as Chairman of the Board of Trustees of the NSPE Institute for Certification of Engineering Technicians and was named

DEAN'S OFFICE REPORT

The College of Engineering experienced another excellent year during 1978 - 79. Every significant parameter (e.g. enrollments, faculty, degrees granted, research income, community service activities, extended studies activities, etc.) showed substantial increases during the year. This report describes the more important developments of the year and summarizes research activities for the year.

This year marked the end of the fifth year of operation under the "professional school" concept. This step, taken by the Engineering Faculty in the Fall of 1974, places emphasis on a total engineering education program dedicated to the preparation of students for the professional practice of Engineering and to continue research and service activities responsive to the State of Florida and National needs.

COE Faculty have responded extremely well to this concept. They are going the "second mile" in guaranteeing continued professional competence, achieving professional registration, and interacting with the many professional, technical and learned societies that impact on our way of life.

These activities, aimed at preparing students for professional practice were recognized during the year by the National Society of Professional Engineers. The College of Engineering was selected to receive the prestigious NSPE Koerper College Professional Development Award for 1979.

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Chairman of the Professional Schools of Engineering Task Force;
Dr. McLellon was elected President of the Florida Engineering Society.

Two faculty (Dr. Nuckolls and Mr. Bullard) received USAF/ASEE Summer Faculty Fellowships during the year. Dr. Gambrell served on the Scientific Advisory Group of the U. S. Army Test and Evaluation Command and the Board of Trustees of Winter Park Memorial Hospital and Embry-Riddle Aeronautical University. Dr. Petrasko completed a two year assignment as Director of Science and Engineering on the Vice Chancellor's staff. Dr. Aicha Riad was named as one of the Outstanding Young Women of America, and Dr. Bauer was selected as the Outstanding Young Educator by the Orlando Jaycees. Drs. Block and Ventre continue to serve at the Florida Solar Energy Center.

The COE Board of Visitors continued active. Membership includes:

Dr. George Burnet - Iowa State University
Mr. Emory Dawkins - Dawkins and Associates, Inc.
Mr. Richard Forberg - Proctor & Gamble Company
Dr. Richard E. Grace - Purdue University
Dr. Marvin Gustavson - Lawrence Livermore Laboratory
Dr. George Huebner, Jr. - Environmental Research Instit. of Michigan
Mr. Donald C. Latham - Martin Marietta Aerospace
Mr. Paul D. O'Donnell - Florida Power Corporation (In Memorium)
Dr. Carmen J. Palermo - Harris Corporation
Mr. Robert L. Rynearson - Honeywell, Inc.
Mr. Lee Scherer - National Aeronautics and Space Administration
Senator John Vogt - Florida Senate District 17 (Consulting Engineer)

Agenda items considered during the year were (1) future doctoral level programs, (2) center of excellence, (3) long range planning and (4) general review of UCF activities with President Colbourn. Dr. Gustavson completed a term as chairman and Dr. Palermo was named as chairman for 1979 - 80. The Board of Visitors continue to be a vital element in the development of COE programs.

The COE joined with other major engineering colleges in the Southeastern Consortium for Minorities in Engineering (partially funded by the Sloan Foundation) during the year and remained active in the Florida Organization to Recruit Minorities into Engineering. Minority enrollments have increased significantly in the last four years.

Honorary degrees were conferred upon Major General Albert F. Hegenberger USAF (Ret.) and Mr. Lee B. Scherer, Director of John F. Kennedy Space Center - NASA at the spring commencement.

Persons interested in any of the topics included in this report are invited to contact the Dean's Office or the appropriate Principal Investigator.

CIVIL ENGINEERING AND ENVIRONMENTAL SCIENCES

DEPARTMENTAL REPORT

Chairman: M. P. Wanielista

Faculty: D. L. Block, J. C. Brown, W. E. Carroll, C. D. Cooper,
R. H. Fagan, H. H. Harper, D. R. Jenkins, R. D. Kersten,
W. M. McLellon, S. Mohan, M. I. Muiga, B. R. Snyder,
J. S. Taylor, Y. A. Yousef

The Civil Engineering and Environmental Sciences Department formally initiated a Civil Engineering option during the 1978 - 79 year. The Environmental Engineering option continues in a strong status. Dr. Satish Mohan, Dr. Michael I. Muiga, Mr. Harvey H. Harper and Mr. Bruce R. Snyder joined the Department this year greatly enhancing the teaching and research capabilities. Dr. Block continues on leave, serving as Director of the Florida Solar Energy Center. Dr. David Jenkins was on sabbatical leave during the year serving at the National Bureau of Standards under an Intergovernmental Personnel Act assignment.

Focused research for the continued development of students and faculty is one of the primary goals that was achieved by the faculty. Dr. Yousef, Director of the Environmental Systems Engineering Institute, initiated work on stormwater impacts from bridge runoff in lake environments. Also, Dr. Yousef is completing research on stormwater impacts using productivity measures. Information transfer continues with numerous conferences and workshops. Of note was the Florida Federation of Garden Club's Environmental workshop for high school students, the Environmental Protection Agency (EPA) Solid Waste Management Conference, and the American Society of Civil Engineers' Stormwater Management Workshop. The Department was responsible for technical programs and local arrangements for each of these activities. Stormwater management treatment studies are being conducted by Dr. Taylor. These are sponsored by the EPA and will be applied to the local area. In addition, production levels of methane from the anaerobic digestion of cattle waste was initiated by Dr. Taylor. Recently initiated were studies in suspect carcinogens. Dr. Wanielista continued stormwater management research. Efficiencies of diversion/retention areas, swales, catch-basin cleaning and street-cleaning were developed. Overland flow of highway runoff waters was analyzed and a mathematical model for selecting best management practices was developed. Stormwater management research continues. Mr. Brown conducted studies for the occurrence of air pollutants in the Orlando area. Dr. Mohan has worked on mass transit alternatives and methods for determining pavement roughness characteristics. Dr. Muiga has initiated international studies for environmental health and determination of mixing zones for stormwater discharges. Continued work in finite element research was done by Dr. Carroll. Mr. Fagan continues analytical chemistry support for both stormwater and drinking water research. Dr. Jenkins was resident with the U. S. Bureau of Standards conducting moisture studies using infrared thermography. Dr. Jenkins conducted a short course on structural designs for disaster conditions. Mr. Cooper was with the Department for only one quarter and left for additional graduate studies. However, he completed research in hazardous waste management and energy utilization in Florida.

Departmental faculty have been active in technical society and professional development work and are members of local, regional or national committees within the American Society of Civil Engineers, Florida Engineering Society, National Society of Professional Engineers, American Society for Metals, American Society for Engineering Education, Water Pollution Control Federation, American Water Works Association and the Association of Environmental Engineering Professors. Dr. Carroll has been the faculty advisor for the ASCE Student Chapter. Dr. McLellon served on various task committees for the Florida Engineering Society and is the President-Elect in 1978 - 79. He will be the President during 1979 - 80.

CEES students, both undergraduate and graduate, continue to be active on faculty research projects. The ASCE student chapter was very active this year and participated in the concrete canoe competition. Statistically, the CEES department ranked in the top 25 (Master's) and in the top 10 (Bachelor's) in degree productivity nationally in Environmental Engineering.

PUBLICATIONS AND PRESENTATIONS OF PROFESSIONAL PAPERS

1. BROWN, J. C., Jr. "Site Selection for Air Pollution Monitoring in the Vicinity of Point Sources." UCF, Research Report, M.S. Degree.
2. BROWN, J. C., Jr. and COOPER, C. D. "The Effects of Relaxed Emissions Standards and Heavy Duty Vehicles on Projected Highway Emissions Through 1990." Published by 71st APCA Annual Meeting and Exhibition, Houston, TX, June 17, 1978.
3. CARROLL, W. E. "Boundary Integral Analysis." Paper prepared for the Proceedings of the SAE 3rd International Conference on Vehicle Structural Mechanics, Detroit, MI, October, 1978.
4. CARROLL, W. E. "Boundary Integral Fracture Mechanics." Presented to NASA-Marshall Space Flight Center, March, 1979.
5. CARROLL, W. E. "Boundary Integral Fracture Mechanics Code." NASA-Marshall Space Flight Center, Report, June, 1979.
6. CARROLL, W. E. "Modeling Comments on the BIE Technique." Paper prepared for the Proceedings of the ASCE 7th Electronics Computation Conference, St. Louis, MO, August, 1979.
7. CARROLL, W. E. "Recent Developments Dealing with Optimum Finite Element Analysis Techniques." ASME 3rd National Congress on Pressure Vessels and Piping, San Francisco, CA, June, 1979.
8. CARROLL, W. E. "User Oriented Mesh Refinements in the Discrete Element Analysis Techniques." Transactions SAE, Vol. 86, August, 1978.
9. FAGAN, R. H., YOUSEF, Y. A., McLELLON, W. M., ZEBUTH, H. H. and LARRABEE, C. R. "Mixing Effects Due to Boating Activities in Shallow Lakes." Final Report to the U.S. Department of Interior, Office of Water Research and Technology, project #C-7020, Grant # 14-34-00001-6203, Technical Report ESEI No. 78-10, UCF, COE, June, 1978.
10. HARPER, H. H., YOUSEF, Y. A. and WANIELISTA, M. P. "Algal Productivity Responses of Lake Eola Water to Urban Runoff." 43rd Annual Florida Academy of Sciences, Miami, FL, March, 1979.
11. HARPER, H. H., YOUSEF, Y. A., TRAVER, R. P. and FIELD, R. "Algal Productivity Responses of Lake Eola Water to Urban Runoff." An abstract submitted to be presented at the WPCF Conference, Houston, TX, October, 1979.
12. HARPER, H. H. "Algal Responses to Urban Runoff in Lake Eola." 3rd Annual Environmental Engineering Student Conference, USF, May 19, 1979.

13. HARPER, H. H., YOUSEF, Y. A. and WANIELISTA, M. P. "Responses of Chlorella and Selenastrum to Urban Runoff in Lake Eola." Presented at the Environmental Chemistry Section, 43rd Annual Florida Academy of Sciences, Miami, FL, March 22 - 24, 1979.
14. HARTMAN, J. P. "CLEP, TSD, and the LSD." Liberal Studies Division Session, ASEE Annual Meeting, June, 1978 (invited panelist).
15. HARTMAN, J. P. "Energy Through History." Teaching Solar Energy Winter Workshop '79, Cape Canaveral, FL, January 18, 1979.
16. HARTMAN, J. P. Engineering History Compendium, 3rd Edition, August, 1978, notes developed for EGN 4814 - printed by MEAS Department, for sale in UCF Bookstore.
17. HARTMAN, J. P. "Historic Engineering Works in Florida." Longwood SERTOMA Club, Longwood, FL, February 27, 1979.
18. HARTMAN, J. P. "Historic Engineering Works in Florida." Humanities in America Conference, Jacksonville Beach, FL, March 31, 1979.
19. HARTMAN, J. P. Discussion of "History of Esthetics in Suspension Bridges." Journal of the Structural Division, ASCE, Proc. Paper 13857, July, 1978, pp. 1174 - 1176.
20. HARTMAN, J. P., (with SCHMERTMANN, J. H. and BROWN, P. R.) "Improved Strain Influence Factor Diagrams." Journal of the Geotechnical Engineering Division, ASCE, Technical Note, August, 1978, pp. 1131 - 1135.
21. HARTMAN, J. P. "Our American Civil Engineering Heritage." ASCE Southeastern Regional Student Conference, UCF, Orlando, FL, May 10, 1979.
22. HARTMAN, J. P. "Professional Development for Engineering Faculty." ASEE Southeastern Section Meeting, Raleigh, NC, April 1 - 3, 1979.
23. HARTMAN, J. P. "Underground Water Resources." Presented at SEEK 78, UCF, Orlando, FL, August 7, 1978.
24. JENKINS, D. R. and HUBLER, B. "Performance Characteristics and Design Criteria of Industrial, Commercial and Institutional Buildings in Florida." UCF-EIES Report, August, 1978.
25. JENKINS, D. R. and GORDON, T. E., Jr. "Photoelastic Determination of Stresses Caused by Dental Implants." 43rd Annual Academy of Sciences, Miami, FL, March, 1979.
26. JENKINS, D. R. and WILLIAMS, R. V. "Thermal Elastic Energy Effects in a Cylinder Due to Thermal Shock." Society of Engineering Sciences, University of Florida, Gainesville, FL, December 4-6, 1978.

27. KERSTEN, R. D. "Current Programs for Non-engineers, The FTU Experience." Conference for Engineering Deans--Developing Engineering Programs and Courses for Non-engineers, Sponsored by University of Wisconsin - Madison and National Science Foundation, November 1 - 3, 1979.
28. KERSTEN, R. D. and HARTMAN, J. P. "Professional Development for Engineering Faculty." Proceedings ASEE Southeastern Section Annual Meeting, N. C. State University, Raleigh, NC, April 1 - 3, 1979.
29. KERSTEN, R. D. "Professional Schools of Engineering for Florida: Faculty Considerations." Forum on Professional Schools, Florida Council of Engineering Societies, Tampa, FL, October 20, 1978.
30. McLELLON, W. M. "Chapter 471." Presented at the Education Workshop, FEE, FES, Orlando, FL, March 8, 1979.
31. McLELLON, W. M. "Membership Retention." Florida Engineering Society, 40 pages, July, 1978.
32. McLELLON, W. M. "Process Selection Fundamentals." Advances in Water and Wastewater Treatment, Biological Nutrient Removal, M. P. Wanielista and W. W. Eckenfelder, Jr., Editors, pp. 1 - 11, Ann Arbor Science Publishers, Ann Arbor, MI, 1978.
33. MOHAN, S. "A Pavement Evaluation System." FICE Engineering Laboratories Forum Symposium, Florida, February 16, 1979.
34. MOHAN, S. and PHILLIPS, R. "Measurement of the Surface Characteristics of Pavements Using EMV Scattering Techniques." TRB Annual Meeting, Washington, D. C., January 17, 1979.
35. MOHAN, S. "Various Carpool Alternatives for UCF Commuters." Regional Energy Action Committee Meeting, Disney World, FL, November, 1978.
36. MUIGA, M. I. "Community Health Analysis for Less Developed Countries." 43rd Annual Florida Academy of Sciences, Miami, FL, March 22 - 24, 1979.
37. MUIGA, M. I. "Community Water Management Planning Tool." 43rd Annual Florida Academy of Sciences, Miami, FL, March, 1979.
38. MUIGA, M. I. and REID, G. W. "Cost Analysis of Water and Wastewater Treatment Processes in Developing Countries." Water Resources Bulletin, American Water Resources Association, June, 1979.
39. MUIGA, M. I. "Development of Appropriate Environmental Health Sanitation Technology for Developing Countries." Second International Conference on Engineering Technology Appropriate to Underdeveloped Countries, San Salvador, El Salvador, February, 1979.

40. MUIGA, M. I. and JORDAN, T. L. "Development of Engineering Technology in Developing Countries." Pan American Union Engineering Association Congress. Santiago, Chile, October 1 - 7, 1978.
41. MUIGA, M. I. "Development of Postgraduate Sanitary Engineering at Federal University of Paraiba." Tenth Brazilian Congress of Sanitary Engineering, Manaus, Brazil, January 21 - 26, 1979.
42. MUIGA, M. I. and REID, G. W. "Low Cost Water and Wastewater Treatment in Developing Countries and Appropriate Technology Problems." Second International Conference on Engineering Technology Appropriate to Underdeveloped Countries, San Salvador, El Salvador, February 19 - 23, 1979.
43. MUIGA, M. I. "Scientific Manpower Planning and Training for Development: East Africa." Fourth Annual ASEE College-Industry-Education Conference, Tampa, FL, January 30 - February 2, 1979.
44. MUIGA, M. I. "Technology Transfer from Industrialized Countries to Emerging Countries." Pan American Union Engineering Association Congress, Santiago, Chile, October 1 - 7, 1978.
45. MUIGA, M. I. and REID, G. W. "Water Knowledge Transfer - A Water Demand and Wastewater Disposal Model for Optimum Transfer of Water Resources Technology in Developing Countries." Water Resources Publications, Fort Collins, CO, 1978.
46. SNYDER, B. R., BREZONIK, P. L., et al. "Factors Limiting Primary Production in Lake Okeechobee." Report submitted to Florida Sugar Cane League.
47. TAYLOR, J. S. "Heavy Metal Removal from Colored and Non-colored Aqueous Environments." FPCA-AWWA Annual Conference, Miami Beach, FL, October, 1978.
48. TAYLOR, J. S. "Molecular Size Correlations of Natural Organics with Heavy Metals and Precursors of Halogenated Methyl Groups." 43rd Annual Florida Academy of Sciences, abstract only, Hollywood, FL, March, 1979.
49. TAYLOR, J. S. "Organics Removal by Coagulation - A Review and Research Needs." National AWWA Conference, Atlantic City, NJ, June 24 - 29, 1979.
50. TAYLOR, J. S. "Physical-Chemical Wastewater Treatment." TREEO Magic Number Conference, St. Petersburg, FL, September 7, 1978.
51. TAYLOR, J. S. "Swamp Discharge as an Alternate for AWT." TREEO Magic Number Conference, St. Petersburg, FL, September 7, 1978.
52. TAYLOR, J. S. "Treatment Process Variations to Reduce TTHM Residual in a Finished Water." FPCE-AWWA Annual Conference, Miami Beach, FL, October, 1978.

53. TAYLOR, J. S. "Trophic State of the Upper St. John's River." Proceedings of the Second Annual Brevard Water Resources Conference, FIT, Melbourne, FL, September, 1978.
54. TAYLOR, J. S. "Trophic Status of Lakes in the Upper St. John's River Basin." Second Annual Brevard Water Resources Conference, FIT, Melbourne, FL, September 23, 1978.
55. WANIELISTA, M. P. and ECKENFELDER, W. W., editors. Advances in Water and Wastewater Treatment: Biological Nutrient Removal, Ann Arbor Science Publishers, Ann Arbor, MI, 307 pp., October, 1978.
56. WANIELISTA, M. P. and BELL, J. H. "Affinity of Roadside Soils for Lead, Zinc and Chromium." 43rd Annual Florida Academy of Sciences, Miami, FL, March 22 - 24, 1979.
57. WANIELISTA, M. P., RILEY, WIGHT, and PRICE. "Effect of Air Pollution Regulations on Highway Construction and Maintenance." Transportation Research Board, Report # 191, 1978.
58. WANIELISTA, M. P. "Highway Stormwater Management." National Academy of Sciences, Transportation Research Board, Orlando, FL, July, 1978.
59. WANIELISTA, M. P. Moderator and Welcome Address at 2 Conferences: (1) Solid and Hazardous Waste Research Divison, 5th Annual Research Symposium, EPA, Orlando, FL, March 26 - 28, 1979, and (2) Pump Selection Conference, UCF, Orlando, FL, June 15, 1979.
60. WANIELISTA, M. P. and JOHNSON, J., et al. "Petroleum-Degrading Potential of Mixed Bacterial Populations from Roadside Environments." American Society of Microbiologists Annual Meeting, Los Angeles, CA, May 4 - 8, 1979.
61. WANIELISTA, M. P. "Restoration of Central Florida Lakes." American Society of Civil Engineers, Florida Section Annual Meeting, Cypress Gardens, FL, September 22, 1978.
62. WANIELISTA, M. P. "Retention of Stormwaters." Department of Environmental Regulation Seminar, Orlando, FL, July 18, 1978.
63. WANIELISTA, M. P. "Stormwater and Lake Restoration." Maitland Chamber of Commerce, Maitland, FL, November 21, 1978.
64. WANIELISTA, M. P. "Stormwater Management." Florida State Science Teachers Conference, Orlando, FL, November, 1978.
65. WANIELISTA, M. P. "Stormwater Management." University of Florida Environmental Engineering Seminar, Gainesville, FL, January 12, 1979.
66. WANIELISTA, M. P. and BELL, J. H. "Stormwater Management Using Overland Flow on Interstate Highways." Transportation Research Board, 58th Annual Meeting, Washington, D. C., January 16, 1979.

67. WANIELISTA, M. P. Stormwater Management: Quantity and Quality. Ann Arbor Science Publishers, Ann Arbor, MI, September, 1978, 404pp.
68. WANIELISTA, M. P. "Water Resources of Central Florida." SEEK 78, UCF Campus, August 7, 1978.
69. YOUSEF, Y. A. "Are Pleasure Boat Owners Steering Into Rules on Use?" Emphasis, November, 1978.
70. YOUSEF, Y. A., McLELLON, W. M. and ZEBUTH, H. H. "Changes in Phosphorus Concentrations Due to Mixing by Motorboats in Shallow Lakes." Presented and published at the 1979 North American Lake Management Conference, Kellogg Center for Continuing Education, Michigan State University, East Lansing, MI, April 16-18, 1979.
71. YOUSEF, Y. A. "Motorboats Harm Shallow Lakes." Sentinel Star, Friday, October 27, 1978.
72. YOUSEF, Y. A. "Wastewater Systems in Florida." Presented at the 5th Annual Youth Conference, SEEK 78, University of Central Florida, Orlando, FL, August 6 - 9, 1978.

CONFERENCES, WORKSHOPS, SHORT COURSES AT
WHICH RESULTS OF RESEARCH WERE COMMUNICATED

1. 71st Air Pollution Control Association Annual Meeting and Exhibition, Houston, TX, June 27, 1978, "The Effects of Relaxed Emissions Standards and Heavy Duty Vehicles on Projected Highway Emissions Through 1990." (Brown/Cooper)
2. ASME 3rd National Congress on Pressure Vessels and Piping, San Francisco, CA, June, 1979, "Recent Developments Dealing with Optimum Finite Element Analysis Techniques." (Carroll)
3. 43rd Annual Meeting of the Florida Academy of Sciences, Florida International University, Miami, FL, March, 1979.
 - a) "Responses of Chlorella and Selenastrum to Urban Runoff in Lake Eola." (Harper/Yousef/Wanielista)
 - b) "Affinity of Roadside Soils for Lead, Zinc, and Chromium." (Wanielista)
 - c) "Community Water Management Planning Tool." (Muiga)
 - d) "Community Health Analysis for Less Developed Countries." (Muiga)
 - e) "Molecular Size Corelation of Natural Organics with Heavy Metals and Precursors of Halogenated Methyl Groups." (Taylor)
4. American Society of Microbiologists Annual Meeting, Los Angeles, CA, May 4 - 8, 1979, "Petroleum-Degrading Potential of Mixed Bacterial Populations from Roadside Environments." (Wanielista)
5. American Society of Civil Engineers Annual Meeting, Florida Section, Cypress Gardens, FL, September, 1978, "Restoration of Central Florida Lakes." (Wanielista)
6. Transportation Research Board, 58th Annual Meeting, Washington, D.C., January 16, 1979, "Stormwater Management Using Overland Flow on Interstate Highways." (Wanielista)
7. Department of Environmental Regulation Seminar, Orlando, FL, July 18, 1978, "Retention of Stormwater." (Wanielista)
8. National Academy of Science Transportation Research Board, Orlando, FL, July 25 - 26, 1978, "Highway Stormwater Management." (Wanielista)
9. University of Florida Environmental Engineering Seminar, Gainesville, FL, January 12, 1979, "Stormwater Management." (Wanielista)
10. SEEK 78, UCF, Orlando, FL, August 7, 1978.
 - a) "Water Resources of Central Florida." (Wanielista)
 - b) "Wastewater Systems in Florida." (Yousef)
11. 1979 North American Lake Management Conference, Kellogg Center for Continuing Education, Michigan State University, April 16 - 18, 1979, "Changes in Phosphorus Concentrations Due to Mixing by Motorboats in Shallow Lakes." (Yousef/McLellon)

12. Regional Energy Action Committee Meeting, Disney World, FL, November 27, 1978, "Various Carpool Alternatives for UCF Commuters." (Mohan)
13. Transportation Research Board Annual Meeting, Washington, D.C., January 17, 1979, "Measurement of the Surface Characteristics of Pavements Using Electro-Magnetic Vehicle Scattering Techniques." (Mohan)
14. Florida Institute of Consulting Engineers Engineering Laboratories Forum Symposium, Florida, February 16, 1979, "A Pavement Evaluation System." (Mohan)
15. Pan American Union Engineering Association Congress, Santiago, Chile, October 1 - 7, 1978. (Muiga)
 - a) "Development of Engineering Technology in Developing Countries."
 - b) "Technology Transfer from Industrialized Countries to Emerging Countries."
16. Tenth Brazilian Congress of Sanitary Engineering, Manaus, Brazil, January 21 - 26, 1979, "Development of Postgraduate Sanitary Engineering at Federal University of Paraiba." (Muiga)
17. Second International Conference on Engineering Technology Appropriate to Underdeveloped Countries, San Salvador, El Salvador, February 19 - 23, 1979.
 - a) "Low Cost Water and Wastewater Treatment in Developing Countries and Appropriate Technology Problems." (Muiga)
 - b) "Development of Appropriate Environmental Health Sanitation Technology for Developing Countries." (Muiga)
18. Fourth Annual ASEE College-Industry-Education Conference, Tampa, FL, January 30 - February 2, 1979, "Scientific Manpower Planning and Training for Development: East Africa." (Muiga)
19. Training Research and Education for Environmental Occupations Magic Number Conference, St. Petersburg, FL, September 7, 1978. (Taylor)
 - a) "Physical-Chemical Wastewater Treatment."
 - b) "Swamp Discharge as an Alternate for Advanced Waste Treatment."
20. Second Annual Brevard Water Resources Conference, Florida Institute of Technology, Melbourne, FL, September 23, 1978, "Trophic Status of Lakes in the Upper St. John's River Basin." (Taylor)
21. National American Waterworks Association Conference, Atlantic City, NJ, June 24 - 29, 1979, "Organics Removal by Coagulation - A Review and Research Needs." (Taylor)
22. Florida Pollution Control Association-American Waterworks Association Annual Conference, Miami Beach, FL, October, 1978.
 - a) "Treatment Process Variations to Reduce TTHM Residuals in a Finished Water." (Taylor)
 - b) "Heavy Metal Removal from Colored and Non-colored Aqueous Environments." (Taylor)

RESUMES OF SPONSORED RESEARCH

TITLE: An Investigation of the Hydrocarbon Air Pollution Problem in Orange County

PRINCIPAL INVESTIGATOR: Mr. John C. Brown, Jr.

SPONSORING AGENCY: UCF - EIES

GRANT NUMBER: 11-1699-020

A B S T R A C T

This investigation was initiated to review the photochemical oxidant air pollution problem in Orange County by the Environmental Protection Agency. This report deals with the extent of the ozone problem and a study of the probable effectiveness of potential mitigating measures to deal with the problem. Preliminary research has revealed that, based on the author's judgement, considerably more data is needed to do a meaningful analysis of the best means to control ozone levels, if indeed they can be controlled by actions taken within the community. Considerable controversy exists in regard to the predominant source of ozone. An expanded and properly instrumented monitoring network should help to answer some of the questions which are not unique to the Orlando area, thus providing a service of much broader impact.

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TITLE: Boundary Integral Study

PRINCIPAL INVESTIGATOR: Dr. W. E. Carroll

SPONSORING AGENCY: NASA and UCF - EIES

GRANT NUMBER: 10-1620-003 and 11-1699-009

A B S T R A C T

A General Boundary Integral Program is given for the linear elastic static analysis of a two-dimensional anisotropic continuum. Special kernel functions described by Cruse (1,8) have been used in the development of the computer code and allow the user to easily model through type cracks. The use of these functions also allows for the direct calculation of the MODE I and MODE II Stress Intensity factors. Provision for the calculation of internal stresses and/or displacements once the boundary solution has been found have been included.

In the formulation of this computer program parabolic variations of displacements and surface stresses are assumed on the boundary of the problem. Example problems are given which illustrate the accuracy of the parabolic integral program.

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TITLE: Environmental Planning for the Treatment and Disposal of Hazardous Wastes in the East Central Florida Area

PRINCIPAL INVESTIGATOR: Professor C. D. Cooper, P.E.

SPONSORING AGENCY: UCF - EIES

GRANT NUMBER: 11-1699-007

A B S T R A C T

Hazardous wastes include toxic chemicals, oxidizing agents, acids and bases, biological agents, radioactive isotopes, etc. Hazardous wastes may result from accidental spills or from continuous low level discharges. They may be generated by manufacturers, transporters, users or disposers of products. A "non-industrialized" area may still have a hazardous waste problem depending on the environmental characteristics of the area, the types and quantities of wastes present, and the treatment/disposal practices in use.

The East Central Florida area was studied in order to define its environmental characteristics, to enumerate types of industry in the area, to define their "typical" wastes and methods of treatment/disposal practices, and to determine the regulatory framework present for dealing with hazardous wastes.

Due to the nature of the industry present, there is not an excessive amount of hazardous waste generation in this area. However, a large portion of the potentially hazardous wastes generated in the area come from small, hard to control segments such as non-manufacturing distributors, and even consumers. Due to the absence of a chemical landfill in the area, the final disposition of these hazardous materials is usually into ordinary sanitary landfills. Because of the area's heavy dependence on aquifers for water supplies, the potential impacts of present waste disposal practices on aquifer water quality are extremely important. Further study is needed to quantify the potential impacts and to define cost effective treatment/disposal alternatives.

A generalized program for the management of hazardous wastes is proposed which can be applied to the East Central Florida Area. This study shows that a potential problem exists and the environmental planning is necessary now to avoid future adverse effects. Further in-depth studies are required to formulate a specific program using existing agencies where possible to manage hazardous wastes in the area. The question of funding for such a program also remains to be addressed.

TITLE: Building Performance
PRINCIPAL INVESTIGATOR: Dr. D. R. Jenkins, P.E. and Professor J. W. Hubler, P.E.
SPONSORING AGENCY: UCF - EIES
GRANT NUMBER: 11-1699-005

A B S T R A C T

The primary thrust of this program has been an analysis of the structural performance of large one-story buildings. Field inspections have been made of warehouses, light industrial buildings, shopping centers and schools in the central Florida and north Florida areas. Buildings of the type listed are a major factor in the construction industry. Most of the buildings which have been studied have walls of masonry or tilt-up concrete slabs with steel roof framing, and built-up roofing which is flat or at very low pitch. While high-rise buildings are designed to rigid, nationally accepted standards and specifications, one-story buildings do not receive such careful design attention even though rules of prudent practice should apply. As a result of our work to date, it is concluded that the most pervasive problem in these one story structures is unsatisfactory roof performance. A number of factors appear to be responsible for this and these, as well as other observations from our field investigations will be presented in a forthcoming summary report.

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TITLE: Roofing Systems and Impact Resistance
PRINCIPAL INVESTIGATOR: Dr. David R. Jenkins, P.E.
SPONSORING AGENCY: National Bureau of Standards
GRANT NUMBER: IPA 10-1620-005

A B S T R A C T

A state-of-the-art survey report on non-destructive evaluation techniques for determining moisture in built-up roofing systems is being developed. This is a cooperative research project involving the Bureau of Standards, U. S. Army Cold Regions Research Laboratory and the University of Central Florida. Another project on the impact resistance of solar collectors has been initiated. Cover plate materials, both flexible and rigid with various edge support conditions are being evaluated. The ultimate goal of these research projects is the development of standard methods for testing.

PUBLICATIONS: WILLIAM, A. V. and JENKINS, D. R. "Thermal Elastic Energy Effects in a Cylinder Due to Thermal Shock." Society of Engineering Sciences, December, 1978.

JENKINS, D. R. and GORDON, T. E., Jr. "Photoelastic Determination of Stresses Caused by Dental Implants." Florida Academy of Sciences, March, 1979.

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TITLE: The Flocfil Process
PRINCIPAL INVESTIGATOR: Dr. W. M. McLellon, P.E.
SPONSORING AGENCY: UCF - EIES
GRANT NUMBER: 11-1699-033

A B S T R A C T

Filtration in water supply is an expensive part of the treatment process. Current technology uses granular filters with pretreatment by coagulation, flocculation, and sedimentation in removal of suspended solids. Membranes are employed for removal of soluble ionic and molecular species. The thrust of this research is to examine use of a membrane with large pores with a metal coagulant. The metal precipitate would form a fine pore filtering medium, as observed in laboratory experience. Of interest is whether an operational filter constructed in this matter is a practical alternative to the granular filter in removal of suspended solids. Current research will examine performance of a bench scale model.

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TITLE: Community Level Environmental Health Sanitation Management Tool
PRINCIPAL INVESTIGATOR: Dr. Michael I. Muiga
SPONSORING AGENCY: UCF - EIES
GRANT NUMBER: 11-1699-025

A B S T R A C T

The objective of this research has been an analysis of the environmental health sanitation in Central Florida. Field survey to determine environmental sanitation awareness at the community level and the problems facing communities in achieving more effective management are being made. Criteria for selection of community environmental health sanitation management alternatives and reduce cost of operation and improve the efficiency of services are developed.

* * * * *

TITLE: An Optimal Model for Economic and Industrial Development with Limited Water Resources

PRINCIPAL INVESTIGATOR: Dr. James S. Taylor, P.E. (David Foster, Graduate Research Assistant)

SPONSORING AGENCY: UCF - EIES

GRANT NUMBER: 11-1699-006

A B S T R A C T

This research project utilizes existing water quality measurements of the Upper St. John's River made by various state and federal agencies, river discharge quantity records, rainfall and evaporation amounts, soil surveys, and land use determinations to evaluate and predict runoff quantities and water quality in the Upper Basin. The initial investigations incorporated the aforementioned records into Vollenweider, Dillon, Carlson, Larson-Mercier, and Florida DER (hand) trophic status indices to demonstrate the definite eutrophic state of Lake Helen Blazes and Lake Sawgrass and the borderline eutrophy of Lake Washington. Further investigations in this research project are utilizing the computer program "RIVER" to show the point and nonpoint source effects of the existing land use in the Upper Basin on the dissolved oxygen concentrations in the river and lakes for both the seasonal and average effect, and for any specific storm event. This project will then project the various effects of land use changes on drainage system changes on the overall quality of the Upper St. Johns River Basin.

* * * * *

TITLE: Optimization of a Potable Water Quality

PRINCIPAL INVESTIGATOR: Dr. James S. Taylor, P.E. (Graduate Research Assistants: Edward L. Hatcher, Jalil Fouroozi)

SPONSORING AGENCY: UCF - EIES

GRANT NUMBER: 11-1699-018

A B S T R A C T

Drinking water standards have been endangered in the Interim Primary Drinking Water Standards to include tri-halogenated methanes (THM's). These are single carbon chlorinated organic compounds that are formed during the chlorination or disinfection process. Only two constituents are necessary to form chlorinated hydrocarbons, free chlorine and organics. Conventional water treatment operations have not been optimized for THM removal but for apparent color or turbidity removal. Research has been completed that optimized standard coagulation parameters for THM precursor removal using three inorganic coagulants in conjunction with polymers and/or filtration. Results indicate: (1) that there is no significant difference in THM precursor removal from either alum, ferric or magnesium coagulation, (2) organic polymers used as settling aids are

not THM precursors but reduce THM concentrations in the finished water due to enhanced settling and (3) that high pH significantly increased the formation of THM's in the finished water. Research is currently in process that is investigating the relationship among molecular size and THM formation, acidic strength, TOC and color. This research is expected to conclude in September, 1979.

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TITLE: Reduction of Potential Carcinogens from a Potable Water

PRINCIPAL INVESTIGATOR: Dr. James S. Taylor, P.E. (Research Associate: Bruce R. Snyder, M.S. and Graduate Research Assistant: Kent Kimes, EIT)

SPONSORING AGENCY: UCF - EIES

GRANT NUMBER: 11-1699-026

A B S T R A C T

Halogenated hydrocarbons are produced when water containing dissolved and colloidal organic material is chlorinated during the water treatment process. Tri-halomethanes (THM's) are often the predominant species produced and have been measured in several municipal water systems. The removal or deactivation of THM precursor molecules before chlorination can be accomplished in several ways with varying degrees of success. In this study, two methods of pre-oxidizing the THM precursors are being investigated. Water samples from Lake Washington, a highly colored, shallow lake in the Upper St. Johns River, are being chlorinated with or without pre-treatment by chlorine dioxide (ClO₂) or ozone (O₃). Preliminary results indicate the ClO₂ might be effective in oxidizing THM precursors thereby reducing the quantity of THM's formed when the water is eventually chlorinated.

An ozone generator is being constructed which will produce ozone gas when a stream of oxygen is passed by a series of ultra violet lights. The ozone thus produced will be evaluated for its ability to oxidize THM precursor molecules. In addition to evaluating ClO₂ and O₃ as oxidants in water treatment, methodologies are being developed for further study of THM production during potable water treatment.

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TITLE: Roadside Deposition of Automobile Related Pollutants

PRINCIPAL INVESTIGATOR: Dr. M. P. Wanielista, P.E. and Dr. R. Gennaro

SPONSORING AGENCIES: State Board of Regents, State Department of Transportation, and UCF - EIES

GRANT NUMBERS: STAR 76-7093, 11-1620-006, and 11-1699-017

A B S T R A C T

This is a final report for an 18 month research project.

Transportation right-of-ways have and will continue to be vital in our American social and economic system. Efforts to minimize the environmental impact of the activities within these right-of-ways are consistent with primary concerns related to our natural resources and secondary concerns related to health and general environmental management.

Because of the need for safety, transportation systems (especially highways) are elevated above water levels. Therefore, drainage for stormwater runoff must be provided. However, this drainage carries roadway pollutants (oil, nutrients, and organics) into the shallow-water roadside ditches and environments adjacent to the roadways. Information received from the Florida Department of Transportation (DOT) indicates that over 58 square miles of land, in Florida, are committed to roadside ditching.

The eventual disposition of the pollutants in the environment is relatively unknown. Questions regarding the concentrations of these pollutants in the plants, animals, soil and water with their ultimate levels of concentrations were documented to determine ultimate environmental management practices of the shallow-water roadside ditch. Field collected samples for metals and hydrocarbons were evaluated. Results indicate that the metals are being stored in the soils immediately adjacent to the roadway. Design equations for the storage and drainage of stormwater were derived.

PUBLICATIONS: WANIELISTA, M. P. and BELL, J. "Management of Heavy Metals in a Roadside Area," South Florida Section ASCE Annual Meeting, Miami, FL, December 9 - 10, 1977.

BELL, J. and WANIELISTA, M. P. "Stormwater Management Using Overland Flow on Interstate Highways," Transportation Research Board.

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TITLE: Stormwater Mangement to Improve Lake Water Quality

PRINCIPAL INVESTIGATOR: Dr. M. P. Wanielista, P.E., Dr. Y. A. Yousef, and Dr. J. S. Taylor, P.E.

SPONSORING AGENCIES: State Department of Environmental Regulation, Environmental Protection Agency, City of Orlando, and UCF - EIES

GRANT NUMBERS: 18-1621-002, 11-1620-005, 10-1620-004, and 11-1699-013

A B S T R A C T

This abstract is for phase 1 of a 3-phase project to determine minimum cost highly effective means to restore lake water quality by management of stormwater runoff. Phase 1 defines the effectiveness of source management and treatment resulting from removals characteristic of settling and diversion. The lake productivity due to these reduced effluents will be examined. The fate of pollutants will be documented. Nutrients, organics, solids, metals, pathogens, and other quality parameters will be used. Current desk top (SWMM, level 1 and trophic state) equations were used to predict runoff quantity and quality and lake impacts. These analyses were verified by field measurements. Capital and O&M cost data for management practices were used. Lake impacts were measured by nutrient and TOC mass balances with productivity measures. Additional documentation of the fate of pollutants will be provided by laboratory column studies. Lake impacts are used for constraints on the selection of the best parallel or series combination of management practices. The subject of the experiments is Lake Eola in a high density urban area of Orlando, Florida. Stormwater and lake quality data with water budgets are available from previous studies. A computer methodology for stormwater management will be done in phase 2 with verification and manuals for design being the products of phase 3.

PUBLICATIONS: WANIELISTA, M. P. and CALABRESE, M. M. "Lake Water Quality and Stormwater," South Florida Section/ASCE Annual Meeting, Naples, FL, October 28, 1978.

WANIELISTA, M. P. and YOUSEF, Y. A. "Design and Operation of Stormwater Diversion/Retention Systems," First International Conference on Stormwater Drainage, Southampton, UK, April 11 - 15, 1978.

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TITLE: Water Quality From an Underdrain System in Seminole County, Florida

PRINCIPAL INVESTIGATOR: Dr. M. P. Wanielista, P.E.

SPONSORING AGENCIES: Seminole County Planning Division and UCF - EIES

GRANT NUMBER: 11-1620-004

A B S T R A C T

Relative to non-drained environments, drained areas provide environments which reduce the probability of disease transmission by reducing standing water. Drainage of land areas will also improve economic value and recreation activities. When land is drained, increases in water volume peak discharge, and pollutants are possible. However, an underdrain (french drain) system would slowly release water, thus peak discharges may be less than pre-drainage conditions, and the soil acts to filter pollutants.

Water quality and flow estimates were done on a bi-monthly basis. Sampling was done for nutrients, bacteriological, organics, and physico-chemical parameters. Conclusive results were obtained by evidence of a lower water table.

TITLE: Management of Runoff from Highway Bridges

PRINCIPAL INVESTIGATOR: Dr. Y. A. Yousef, and Dr. M. P. Wanielista, P.E.

SPONSORING AGENCY: Florida Department of Transportation

GRANT NUMBER: 11-1620-006

A B S T R A C T

Work was initiated to determine the concentration and mass of metals near highway bridge runoff areas relative to the surrounding environments including heavy metal analyses for water, plant, and sediment samples included Pb, Cu, Cr, Zn, Cd, As, Fe, and Ni. Dissolved oxygen and temperature profiles are measured in the field. Results of the research will be used to determine the extent of pollution near bridges.

TITLE: Mixing Effects Due to Boating Activities in Shallow Lakes

PRINCIPAL INVESTIGATOR: Dr. Y. A. Yousef, P.E., Dr. W. M. McLellon, P.E., and Professor R. Fagan

SPONSORING AGENCY: U. S. Department of Interior, Office of Water Research and Technology

GRANT NUMBER: 14-34-00001-6203

A B S T R A C T

A two year study sponsored by the Office of Water Research and Technology, OWRT, Department of Interior was undertaken to investigate the "Mixing Effects due to Boating in Shallow Lakes". Recreational boats equipped with engines varying from 28 to 165 horsepower were used for agitation on Lakes Claire, Mizell and Jessup in Central Florida. Lake Claire is located on the campus of the University of Central Florida (UCF) and motorboating activity on the lake is restricted to research related projects. The surface area of the lake is 8.1 hectares and a mean depth of 2.3 meters. Lake Mizell is located in the chain of lakes in the city of Winter Park. It has a surface area of 25.1 hectares and an average depth of 4.0 meters. Lake Jessup is located in Seminole County with an average area of 4422 hectares and water depth of 1.8 meters.

Mixing by motorboats in study lakes resuspended bottom sediments and increased turbidity. The increase in turbidity was accompanied by an increase in the phosphorus content and respiration rates within the water-body. Data from Isolation Chambers for Aquatic Habitat (ICAH) indicated that mixing will increase turbidity and phosphorus at a much faster rate than the rate of decline after cessation of mixing. Also, the lake productivity as measured by the algal count, chlorophyll analysis, and oxygen production, generally increased in the mixing stations of the study lakes as compared to the control stations. A reduction in the overall oxygenation rates was also noticed in the mixing stations of Lake Mizell.

Sediment resuspension is a function of the engine/boat combination, operating parameters, water depth, fineness of bottom sediments, and the depth of sediment deposits over firm soil. Under normal operating conditions, when boat velocities were greater than the square root of the acceleration of gravity and water depth, the average primary wave amplitudes caused by recreational motorboats equipped with engines varying from 28 to 165 HP, decreased exponentially with water depth. An empirical relationship was developed as follows:

$$\frac{A_w}{\sqrt{HP}} = 0.16 e^{-0.23D}$$

where: A_w = average wave amplitude at the sediment-water interface, ft.
 HP = the engine horsepower of the motorboat
 D = water depth in feet

For a known wave amplitude, the scour velocity for sediment particles and the particle diameter to be eroded can be calculated. A set of curves showing the boat/horsepower combination required to scour sediment particles from 0.05 to 1.0 millimeter diameter and specific gravity of 1.10 were developed. The water depth was varied between 3.0 and 10.0 feet.

The work was completed and a final report was issued.

PUBLICATION: YOUSEF, Y. A., McLELLON, W. M., FAGAN, R. H., ZEBUTH, H. H., and LARRABEE, C. R. "Mixing Effects Due to Boating Activities in Shallow Lakes," Final Report submitted to U. S. Department of Interior, Office of Water Research and Technology, EIES No. 78-10, University of Central Florida, Orlando, FL, June, 1978.

YOUSEF, Y. A., McLELLON, W. M., and ZEBUTH, H. H. "Changes in Phosphorus Concentrations Due to Mixing by Motorboats to Shallow Lakes," published at the 1979 North American Lake Management Conference, Michigan State University, East Lansing, Michigan, April, 1979.

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RESUMES OF UNSPONSORED RESEARCH

TITLE: Finite Element Analysis of the Presuremeter Test
in Cohesive Materials

PRINCIPAL INVESTIGATOR: Dr. J. P. Hartman, P.E.

A B S T R A C T

The objective of this research is to extend analytic capability for interpreting presuremeter test data from the one dimensional to the three dimensional case. This will be accomplished by utilizing existing data in conjunction with a recently developed finite element program. Parametric studies of a nonlinear cohesive model include: borehole disturbance and unloading, cohesion, limit pressure and failure criteria.

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TITLE: Historic American Engineering Record

PRINCIPAL INVESTIGATOR: Dr. J. P. Hartman, P.E.

A B S T R A C T

Informal inventory of historic engineering works in Florida continues, and talks on Historic Engineering Works in Florida have been made throughout the State. A talk on Historic American Civil Engineering was given at the Southeastern Region ASCE Student Chapter Meeting. Several additional engineering/industrial works within the State are being pursued.

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TITLE: Economic Development and Technology Transfer

PRINCIPAL INVESTIGATOR: Dr. R. D. Kersten, P.E.

A B S T R A C T

Investigation of cooperative arrangements to deliver educational services, extension services, research related to indigenous problems in the interest of enhancing economic development in less developed countries. Specific emphasis relate to (1) better utilization of natural resources (especially development of potable water supplies), (2) development of new energy sources (especially "mini" hydroelectric sites), (3) the creation of new enterprises. Thus, primary interest must be in the (1) design of low cost technology, (2) careful selection of technology targeted on specific problems, (3) simple technology whose use and maintenance requires little or modest training/education and (4) "people oriented" technology, or as frequently termed, "appropriate technology" or

"on-site technology". Review of sensitive areas and requisites for including a spectrum of alternatives, providing an element of choice, and recognition of political, economic, and cultural differences are essential in the use of engineering in meeting the needs of the people.

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TITLE: The Effects of Science and Technology On Employment

PRINCIPAL INVESTIGATOR: Dr. R. D. Kersten, P.E. and Dr. J. P. Hartman, P.E.

A B S T R A C T

The Principal Investigators have devised a dynamic model of engineer manpower demand based on the following parameters: (a) importance of technology (interpreted as the number of engineers), (b) disposable resources of society, (c) and the ratio of R & D expenditures to the GNP.

This model has been verified/authenticated using U. S. Census data for "technical engineers" for the period 1870 - 1970. Utilizing detailed R & D, GNP Population, and Engineer data for the decade of the 1960's, we now have a current dynamic model which tracks actual engineer demand in the 1970's and serves to give projections of future demand based on the economic indicators assumed.

Development of a complementary model for engineering manpower supply is of current interest. This model should utilize as input (feedback) the output from the demand model. Effects to be included (studied) include (a) job (task) definition (b) degree productivity (c) immigration (d) inflow/outflow from engineering specializations and (e) economic indicators.

The prime objective is to relate demand to sources of supply in such a fashion that appropriate lead time exists for individuals, companies, government agencies to make meaningful decisions based on perceived needs. For such models to be useful, they must indicate time/supply relationships that allow sources of supply to react to meet needs. (Such is not the case now in as much as engineering enrollments, degrees produced, etc. have been out of phase with demand estimates almost continually for the past thirty years.) Once time/supply relationships are rationally modeled, strategic decisions can be made by those responsible for meeting manpower needs. This is perceived as a critical item in view of the large fraction of engineering manpower which hold no academic degree.

Certainly a host of policy decisions could benefit from improved information in this realm. For example, university level decisions relating to program review (i.e. modification of the basic manpower production system); federal decisions relating to immigration policies, import/export of technology, funding of research, funding of fellowship programs; decisions relating to the number of foreign-nationals enrolled in certain degree programs, etc.

* * * * *

TITLE: Florida Water Resources Data Management

PRINCIPAL INVESTIGATOR: Dr. Michael I. Muiga

A B S T R A C T

A review of data management of Florida water Management Districts is the purpose of this research. Identification of the problems facing water management districts in water data management is analyzed. The improved alternative water resources data management and modeling are recommended.

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A B S T R A C T

Although the East Central Florida area is not heavily industrialized, its dependence on groundwater resources makes it especially vulnerable to contamination by poor waste disposal practices. The East Central Florida area was studied to discover the nature and disposal of hazardous wastes generated. It was found that a large portion of hazardous wastes in the region were from very small industries, distributors, and even consumers. Three of the most toxic and/or voluminous waste problems in the area--metal plating wastes, pesticide wastes, and hospital wastes--were studied to determine available alternatives for disposal and their costs.

* * * * *

TITLE: Site Selection for Air Pollution Monitoring in the Vicinity of Point Sources

CANDIDATE: John C. Brown, Jr.

FACULTY ADVISOR: Professor C. David Cooper, P.E.

A B S T R A C T

Ever since air pollution became a national concern in the 1950's, more and more emphasis has been placed on collection of representative air samples for many purposes, to include (1) evaluation of the degree to which national ambient air quality standards are being met and (2) to monitor maximum emission levels from point sources. Until recently efforts were directed toward qualitative methods of siting monitors for representative sampling. Since the dispersion of effluents is most complex, the quality of the data collected on the basis of judgement and, more or less, incremental siting about the source, has become suspect. Furthermore, with the increasing demands for monitoring due to international growth in network monitoring systems, amendments to the Clean Air Act and the legislation on the prevention of Significant Deterioration of Air Quality, it is not cost-effective to encircle point sources with large numbers of equally spaced monitors. This paper discusses the

ABSTRACTS OF MASTER'S DEGREE RESEARCH REPORTS AND THESES

TITLE: Treatment and Disposal of Hazardous Wastes in the East Central Florida Region

CANDIDATE: Tracey Bell

FACULTY ADVISOR: Professor C. David Cooper, P.E.

A B S T R A C T

Although the East Central Florida area is not heavily industrialized, its dependence on groundwater resources makes it especially vulnerable to contamination by poor waste disposal practices. The East Central Florida area was studied to discover the nature and disposal of hazardous wastes generated. It was found that a large portion of hazardous wastes in the region were from very small industries, distributors, and even consumers. Three of the most toxic and/or voluminous waste problems in the area--metal plating wastes, pesticide wastes, and hospital wastes--were studied to determine available alternatives for disposal and their costs.

* * * * *

TITLE: Site Selection for Air Pollution Monitoring in the Vicinity of Point Sources

CANDIDATE: John C. Brown, Jr.

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A B S T R A C T

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history of air pollution concerns that have resulted in the need for monitoring; the development of siting techniques through largely qualitative measures; and finally, summarizes three quantitative methodologies for monitoring point sources. Emphasis is placed on the methodology developed by Noll et al., (1977), based on the author's belief that this methodology represents the state of the art.

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TITLE: Optimization of Stormwater Management Practices and Processes

CANDIDATE: Mark Michael Calabrese

FACULTY ADVISOR: Dr. Martin P. Wanielista, P.E.

A B S T R A C T

In recent years, stormwater has been found to be a major source of pollution to receiving waters. Major research efforts have been directed in this area, primarily as a result of the Federal Water Pollution Control Act and Public law 92-500, the 1972 Amendments to the act. Yet, a need remains for more data in the field of stormwater management. Such needs include cost-performance data and planning methodologies to optimally select best management practices (BMP's).

The research culminating in this report addresses these needs. A computer program, "MANAGE", has been written to generate cost/efficiency curves, and uses these curves to optimally select a combination of management practices. The program was written to FORTRAN language and was run on the IBM 360/370 computer system. It can analyze up to 20 subwatersheds in a given watershed. The optimization routine of the program utilizes a piece-wise linear approximation method in its analysis.

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TITLE: Critical Exposure Pathways: An Analysis of the Environmental Impact of Gaseous Effluents From Light-Water-Cooled Reactors

CANDIDATE: Robert Danna

FACULTY ADVISOR: Dr. Waldron M. McLellon, P.E.

A B S T R A C T

The analysis of the environmental impact of routine radioactive gaseous releases from operating nuclear power stations is discussed using a radiation dose assessment. This analysis included a discussion of the origin of radionuclide effluents, a discussion of federal policies, and a calculation of radiation doses to man. A model for estimating the radioactive dose from gaseous effluents from light-water-cooled reactors is described using guidelines described in the Code of Federal Regulations and the Nuclear Regulatory Commission's Regulatory Guides. The environmental impact of these sources is then analyzed using dose rates calculated along critical exposure pathways for various radioactive nuclides.

Examples are given using reactors that have been heretofore documented in the literature. The major radionuclides in the airborne effluents from a PWR, used as an example are noble gases, H-3, radioiodines, and radioactive particles.

The results from the methodologies described in this paper are compared to federal radiation limits.

* * * * *

TITLE: Wastewater Pretreatment System for a Printed Circuit Board Plant

CANDIDATE: Raymond F. Green

FACULTY ADVISOR: Dr. Waldron M. McLellon, P.E.

A B S T R A C T

The wastewater from the electroplating processes required for the production of printed circuit boards has a high heavy metal content. The regulatory agencies of both the Federal Government and the State of Florida set pretreatment limitations on the quantity of the hazardous heavy metal ions that may be discharged to a receiving body of water or to a Publicly Owned Treatment Works. A number of treatment processes are available for the effective removal of these pollutants. The mechanism behind the more common processes are discussed in this paper.

Many variables must be considered in the design of a wastewater pretreatment system. The more important variables are enumerated and the criteria to integrate these variables into the treatment selection process and ultimately into the design of the pretreatment system are covered in detail. Flow diagrams and equipment lists for the treatment processes selected are given as well as a breakdown of the total construction costs for this project.

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TITLE: Environmental Aspects of the Nuclear Fuel Cycle and High Level Radioactive Waste Disposal

CANDIDATE: Robert S. Kent

FACULTY ADVISOR: Dr. Waldron M. McLellon, P.E.

A B S T R A C T

As assessment of the environmental effects of the nuclear fuel cycle industries is discussed, reactor waste inventory and standards are presented, and the alternatives for high-level radioactive waste disposal reviewed, with particular attention being given to disposal in deep geological formations on land.

One of the major concerns regarding potential impacts of the nuclear fuel cycle industries is the lack of a definite and proven method of disposal of the high-level radioactive wastes from light water moderated reactors. The problem is expected to become more pressing as the nuclear power industry and the associated radioactive waste inventories grow in the strife to meet ever-increasing demands for energy.

The current trend in waste management is towards reprocessing to recover unburned uranium and plutonium from spent reactor fuel and towards final disposal in deep geological formations (hard rock or salt) on land. Studies appear to support the viability of such a waste management and disposal concept for high-level radioactive wastes.

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TITLE: Scrubber Design for Phosphoric Acid Production Facility

CANDIDATE: Edward E. Mayer

FACULTY ADVISOR: Dr. Martin P. Wanielista, P.E.

A B S T R A C T

This report is an examination of the practical design of a phosphoric acid reproduction facility wet scrubber. It includes a brief background of the Florida Phosphate Industry, in addition to the rules and regulations affecting the emission of fluoride contaminants. The theoretical aspects of a packed absorption tower is discussed prior to the actual design of a cross-flow wet scrubber of the type typically found in the Florida Phosphate Industry.

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TITLE: Heavy Metals in the Water and Wastewater Systems
of the University of Central Florida

CANDIDATE: William Keith McCully

FACULTY ADVISOR: Dr. Yousef A. Yousef, P.E.

A B S T R A C T

In large enough quantities, heavy metals may be detrimental to human health. Metals in raw water may pass through a water treatment plant without being completely removed. Once in the distribution system, the water may experience metal pick-up due to corrosion. During the course of this study, an attempt was made to determine the heavy metal concentrations in the University of Central Florida's potable water system.

Samples were run on the plasma spectrophotometer, Spectraspan III, and analyzed for heavy metal content. The results indicate pick-up of Fe, Al, Cu, and Zn in the distribution system. The arsenic and lead concentrations in the drinking water samples should be verified.

The UCF sewage treatment plant offers adequate heavy metal removal with the metal ions being removed concentrating in the activated sludge.

* * * * *

TITLE: Phosphorus Content and Release From Lake Sediments
by Agitation

CANDIDATE: Hsien P. Tang

FACULTY ADVISOR: Dr. Yousef A. Yousef, P.E.

A B S T R A C T

Man-made mixing in shallow lakes will resuspend bottom sediments and increase phosphorus concentration in the water body. The increase in phosphorus content may affect the lake productivity. During the course of this study, a better understanding of the water-sediment-phosphorus relationships of some shallow lakes in Central Florida was attempted.

Column studies and batch experiments were used to investigate the effect of mechanical mixing on the release of phosphorus from bottom sediments collected from Lake Claire and Jessup. The particle size distribution and density distribution of the bottom sediments were studied and the release of phosphorus from each fraction was measured.

The results indicated that dissolved oxygen, turbidity and phosphorus content in the water column increased by mechanical agitation. The total phosphorus released from smaller size particles seemed to be higher than phosphorus released from larger particles. Also, the least and highest density sediment particles showed the highest release of phosphorus.

ABSTRACT

In large enough quantities, heavy metals may be detrimental to human health. Heavy metals in raw water may pass through a water treatment plant without being completely removed. Once in the distribution system, the water may experience metal pick-up due to corrosion. During the course of this study, an attempt was made to determine the heavy metal concentrations in the University of Central Florida's potable water system. To determine the heavy metal concentrations in the water, a series of tests were run on the glass spectrophotometer, Spectrascan III, and analyzed for heavy metal content. The results indicate pick-up of lead, iron, and zinc in the distribution system. The arsenic and lead concentrations in the drinking water samples should be verified. The UCF sewage treatment plant effluent also contains heavy metal removal of which the metal ions being removed are concentrated in the activated sludge. The UCF sewage treatment plant effluent also contains heavy metal removal of which the metal ions being removed are concentrated in the activated sludge.

TITLE: Phosphorus Content and Release from Lake Sediments

CANDIDATE: Helen F. Tang

FACULTY ADVISOR: Dr. Youssef A. Youssef, P.E.

ABSTRACT

Man-made mixing in shallow lakes will resuspend bottom sediments and increase phosphorus concentration in the water body. The increase in phosphorus content may affect the lake productivity. During the course of this study, a better understanding of the water-sediment-phosphorus relationship of some shallow lakes in Central Florida was attempted. A stirred tank reactor was used to investigate the release of phosphorus from bottom sediments collected from Lake Citrus and Jessup. The particle size distribution and density distribution of the bottom sediments were studied and the release of phosphorus from each fraction was measured.

ELECTRICAL ENGINEERING AND COMMUNICATION SCIENCES DEPARTMENTAL REPORT

Acting Chairman: E. E. Erickson

Faculty: R. C. Harden, M. G. Harris, B. E. Mathews,
E. R. McCarter, B. W. Patz, B. E. Petrasko,
R. L. Phillips, A. A. R. Riad, S. M. Riad,
F. O. Simons, Jr., H. C. Towle, and R. L. Walker

Dr. B. E. Mathews was promoted to Assistant Dean in the College of Engineering and Dr. E. E. Erickson was appointed as Acting Chairman of the Department. The search for a new Department Chairman is still under way at this date. Dr. R. L. Phillips and Dr. F. O. Simons, Jr. were promoted to the rank of Professor. Dr. M. G. Harris, from the George Washington University, joined the faculty. Two members were welcomed back from Leaves of Absence; Dr. R. L. Phillips from the Royal Signals and Radar Establishment in England, where he served as a NATO Post Doctoral Fellow, and Dr. F. O. Simons, Jr. from the Naval Training Equipment Center in Orlando, where he served as a NATO Post Doctoral Fellow. Dr. E. R. McCarter and Dr. B. E. Petrasko continued on Leaves of Absence, the latter with the Florida Board of Regents staff. Dr. Basile Dimitriadis returned to Greece after a year as a Visiting Assistant Professor.

Undergraduate enrollment in the Department increased, whereas the graduate enrollment remained stable. Both undergraduate and graduate enrollments are expected to increase for several years as the electronic industry in Central Florida continues to grow. The increased undergraduate enrollment necessitated an increase in the offerings of the required courses in the electrical engineering option from two times to three times per year. The microprocessor teaching laboratory was essentially completed and was used in two courses with large enrollments.

More of the faculty were involved in sponsored research activity this year. Research projects continued with Naval Training Equipment Center, Army Training Devices Office and NASA at Kennedy Space Center. New research projects were initiated with the Naval Training Equipment Center, the Naval Research Laboratory and the Nautilus Sports/Medical Industries. Several of the faculty had research sponsored by UCF - EIES. The research activity contributed to a number of papers being presented at regional, national and international conferences.

The faculty were very active in attending conferences and professional workshops. Several of the faculty continue to be active in the Orlando Section of IEEE. Some hold national positions: Dr. B. Patz on a national technical board of the Computer Society, Dr. R. Phillips as a national director of Eta Kappa Nu, and Dr. F. Simons and Dr. R. Harden as associate editors of SIMULATION, the journal of the Society for Computer Simulation. Faculty members also served their profession as instructors in P.E. review courses. Continuing education courses were taught at the Naval Training Equipment Center and at General Electric Company in Daytona Beach.

Several of the faculty had major roles in the operation of the Frontiers in Education Conference and the International Microwave Symposium in Orlando and the Florida Eclectic Conference in Melbourne. Two more of the faculty, Dr. A. Riad and Dr. S. Riad, became registered as Professional Engineers. Dr. A. Riad was selected for the Outstanding Professor award of Tau Beta Pi for the year by the students of the College of Engineering

F. O. Simons, Jr., M. C. Towles, and W. L. Walker
R. J. Phillips, A. A. Riad, S. M. Riad,
E. R. McCarter, B. W. Parr, D. E. Petraske
R. C. Harben, M. G. Harris, E. E. Mathews

Dr. E. Mathews was promoted to Assistant Dean in the College of Engineering and Dr. E. E. Erickson was appointed as Acting Chairman of the Department. The search for a new Department Chairman is still under way at this date. Dr. R. J. Phillips and Dr. F. O. Simons, Jr. were promoted to the rank of Professor. Dr. M. G. Harris, from the George Washington University, joined the faculty. Two members were welcomed back from leaves of absence; Dr. R. J. Phillips from the Royal Signals and Radar Establishment in England, where he served as a NATO Post Doctoral Fellow and Dr. F. O. Simons, Jr. from the Naval Training Equipment Center in Orlando, where he served as a NATO Post Doctoral Fellow. Dr. E. R. McCarter and Dr. E. E. Petraske continued on leaves of absence, the latter with the Florida Board of Regents staff. Dr. Basil Pimitriadis returned to Greece after a year as a Visiting Assistant Professor.

Undergraduate enrollment in the Department increased, whereas the graduate enrollment remained stable. Both undergraduate and graduate enrollments are expected to increase for several years as the electronic industry in Central Florida continues to grow. The increased undergraduate enrollment necessitated an increase in the offerings of the required courses in the electrical engineering option from two times to three times per year. The microprocessor teaching laboratory was essentially completed and was used in two courses with large enrollments.

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PUBLICATIONS AND PRESENTATIONS OF PROFESSIONAL PAPERS

1. HARRIS, M. G. "A New Weighting Coefficient for Adaptive State Estimation." Dissertation, The George Washington University, Fall, 1978.
2. HARRIS, M. G., et al. "Measurement of Pavement Characteristics Using Electromagnetic Wave Scattering." Presented before The Transportation Board, February, 1979.
3. MATHEWS, B. E. "Re-Certifying the Baccalaureate Degree: An Approach to Continuing Engineering Education." Southeastern ASEE Conference, Raleigh, NC, April, 1979.
4. PATZ, B. W. "The Computer Program in the College of Engineering at UCF." March 23, 1979.
5. PATZ, B. W. and CORDAN, W. "Image Registration Algorithm." LARS Conference, Purdue University, June, 1979.
6. PHILLIPS, R. L. and MOHAN, S. "Pavement Roughness Measurements by Electromagnetic Wave Scattering." National Transportation Research Board, Washington, D. C., February, 1979.
7. PHILLIPS, R. L. "Optical Hydrophones." Acoustical Society of America Orlando, FL, March, 1979.
8. PHILLIPS, R. L. "Fiber Optic Acoustical Probe." Optical Society of America, Orlando, FL, May, 1979.
9. RIAD, A. "InGaAsP-InP Avalanche Photodetectors." 29th Annual Electronic Components Conference, Cherry Hill, NJ, May, 1979.
10. RIAD, A. "Simulation Studies in Both the Frequency and Time Domains of InGaAsP-InP Avalanche Photodetectors." Submitted to Publication of Electron Devices.
11. RIAD, S. and NAHMAN, N. S. "Application of the Homomorphic Transformations to Time Domain Measurement Problems." NBS IR 78-881, June, 1978.
12. RIAD, S. and NAHMAN, N. S. "Modeling of the Wideband (DC - 12.4 GHz) Feed-through Sampling Head." Microwave Theory and Techniques Symposium, Ottawa, Canada, June, 1978.
13. RIAD, S. and NAHMAN, N. S. "Modeling of the Wideband (DC - 12.4 GHz) Feed-through Sampling Head." IEEE Trans in Review.
14. RIAD, S. and PADGETT, M. "Optical Fiber Dispersion Characterization Study at KSC." Fiber Optics Conference, Chicago, September, 1979, accepted for publication.

15. RIAD, S. and PADGETT, M. "Dispersion Properties of Connectors and Splices." IEEE Trans on QE or Applied Optics, in preparation.
16. SIMONS, F. O., Jr. and HARDEN, R. C. "Efficient Utilization of 'Pockulators' for Taking the Professional Engineering Examinations." Proceedings of the Eighth Annual Frontiers in Education Conference, Lake Buena Vista, FL, October 23 - 25, 1978.
17. SIMONS, F. O., Jr. and HARDEN, R. C. "A Closed-Loop Feedback Error-Correcting Homework System." Proceedings of the Eighth Annual Frontiers in Education Conference, Lake Buena Vista, FL, October 23 - 25, 1978.
18. SIMONS, F. O., Jr. and HARDEN, R. C. "Differential Equation Solutions for Up to 10th Order System Theory Models with HP-67 Computers." Proceedings of the Eleventh Annual Southeastern Symposium on System Theory. Clemson University, Clemson, SC, March 12 - 13, 1978.
19. SIMONS, F. O., Jr. and HARDEN, R. C. "Transient and Frequency Responses for Up to 25th Order H(z) Models with a One Mag-Card SR-59 Program." Proceedings of the Tenth Annual Pittsburgh Conference on Modeling and Simulation, Pittsburgh, PA, April 25 - 27, 1979.
20. SIMONS, F. O., Jr. and COHEN, D. "An In-Place Algorithm for Computing the Bilinear Transformation of Polynomids." Submitted and acceptance indicated for publication in IEEE Trans on Acoustics, Speech, and Signal Processing, IEEE, NY.
21. TOWLE, H. C. and MARSHALL, A. H. "Electro-Optic Infantry Weapons Trainer." Electro-Optics 1978 Laser Conference Proceedings, February, 1979.
22. TOWLE, H. C., RIORDAN, T. J., and MARSHALL, A. H. "Microprocessor Control of an Infantry Weapons Training Device." IEEE Eclectic, Melbourne, FL, March 22, 1979.

CONFERENCES, WORKSHOPS, SHORT COURSES AT
WHICH RESULTS OF RESEARCH WERE COMMUNICATED

1. National Transportation Research Board, Washington, D.C., February, 1979, "Pavement Roughness Measurements by Electromagnetic Wave Scattering." (Phillips/Harris)
2. Acoustical Society of America, Orlando, FL, March, 1979, "Optical Hydrophones." (Phillips)
3. Optical Society of America, Orlando, FL, May, 1979, "Fiber Optic Acoustical Probe." (Phillips)
4. Naval Training Equipment Center, Orlando, FL, seminars on "Computer Engineering." (Patz)
5. 29th Annual Electronic Components Conference, Cherry Hill, NJ, May, 1979, "InGaAsP-InP Avalanche Photodetectors." (A. Riad)
6. Microwave Theory and Techniques Symposium, Ottawa, Canada, June, 1978, "Modeling of the Wideband (DC - 12.4 GHz) Feed-Through Sampling Head." (S. Riad)
7. Eighth Annual Frontiers In Education Conference, Lake Buena Vista, FL, October 23 - 25, 1978.
 - a) "Efficient Utilization of 'Pockulators' for Taking the Professional Engineering Examinations." (Harden/Simons)
 - b) "A Closed-Loop Feedback Error-Correcting Homework System." (Harden/Simons)
8. Eleventh Annual Southeastern Symposium on System Theory, Clemson University, Clemson, SC, March 12 - 13, 1979, "Differential Equation Solutions for Up to 10th Order System Theory Models with HP-67 Compulators." (Simons/Harden)
9. Tenth Annual Pittsburgh Conference on Modeling and Simulation, Pittsburgh, PA, April 25 - 27, 1979, "Transient and Frequency Responses for Up to 25th Order $H(z)$ Models with a One Mag-Card SR-59 Program." (Simons/Harden)
10. 1978 Electro-Optic Laser Conference, Boston, MA, September, 1978, "Electro-Optic Infantry Weapons Trainer." (Towle)
11. IEEE Eclectic Conference, Melbourne, FL, March, 1979, "Microprocessor Control of an Infantry Weapons Training Device." (Towle)
12. Southeastern ASEE Conference, Raleigh, NC, April, 1979, "Re-Certifying the Baccalaureate Degree: An Approach to Continuing Engineering Education." (Mathews)

RESUMES OF SPONSORED RESEARCH

TITLE: Microwave Soil Sterilization

PRINCIPAL INVESTIGATOR: Dr. E. E. Erickson, P.E.

SPONSORING AGENCY: UCF Office of Graduate Studies and Research

GRANT NUMBER: 18-2000-079

A B S T R A C T

The project objective is to study the feasibility of sterilizing planting soil by microwave radiation techniques safely and economically for use in the small plant industry of Florida. Extensive literature research conducted indicated that much work has already been accomplished in the general area of microwave energy effects on weeds, seeds, insects, nematodes, etc. Control can be exercised by application of microwave energy without adverse effects, but at higher costs than other methods. Experiments were conducted using citrus nematodes. The nematodes were killed by the thermal effects of high-power microwave energy applied for a very short period.

* * * * *

TITLE: Modeling Solar Cells for Use as Optical Detectors
Background Illumination Effects

PRINCIPAL INVESTIGATOR: Mr. Leo A. Mallette and Dr. Ronald L. Phillips

SPONSORING AGENCY: UCF Office of Graduate Studies and Research

GRANT NUMBER: 10-1622-006

A B S T R A C T

Solar cells have traditionally been used for direct sunlight to energy conversion, but there has been relatively little investigation into their use as a low data rate optical detector. This paper presents an experimental procedure used to determine the AC model of a specified solar cell. A lumped circuit model and governing equations are developed. Open circuit responses to pulses are used to determine values for the internal capacities as a function of background illumination. Possible problems encountered with noise generation are also reviewed.

* * * * *

TITLE: SCEEE Grant
PRINCIPAL INVESTIGATOR: Dr. B. E. Mathews, P.E.
SPONSORING AGENCY: Southeastern Center for Electrical Engineering Education
GRANT NUMBER: 18-1622-002

A B S T R A C T

Under this grant, UCF provides for the Southeastern Center for Electrical Engineering Operations Office at the South Orlando Campus in the interest of the development of education and research in Electrical Engineering.

* * * * *

TITLE: ORTH Image Conversion
PRINCIPAL INVESTIGATOR: Dr. B. W. Patz, P.E.
SPONSORING AGENCY: Naval Training Equipment Center
GRANT NUMBER: 10-2100-038

A B S T R A C T

This project was started in the Spring of 1979. It involves the development and evaluation of a new CGI algorithm.

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TITLE: P M Trade NATO
PRINCIPAL INVESTIGATOR: Dr. R. L. Phillips
SPONSORING AGENCY: U. S. Army, P M Trade
GRANT NUMBER: 10-1622-005

A B S T R A C T

This project is the development of a new integrated laser system for engagement simulation. Theoretical studies are being conducted which calculate the expected mean fade time below any threshold value for laser light passing through both weak and strong turbulence. Experiments on the effects of laser spatial coherence on the fading of the laser beam as it propagates through turbulence were conducted. The analysis of the experimental results is now under way.

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A B S T R A C T

TITLE: Pressure Effects
PRINCIPAL INVESTIGATOR: Dr. R. L. Phillips
SPONSORING AGENCY: Naval Research Laboratory
GRANT NUMBER: 10-1622-011

A B S T R A C T

Optical fibers have been shown that they can be used in an interferometer to detect sound. One leg of the interferometer is immersed in water and subjected to a sound pressure field. The pressure causes a small change in the index of refraction of the glass fiber. The index change produces a shift in the interferometer fringe pattern. This sound pressure sensitivity of the fiber may be deleteriously effected by a large hydrostatic pressure. This project will first test the fiber loss under large pressures of up to 10,000 p.s.i. The dynamic sensitivity will be thus determined also under the same static pressure.

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TITLE: Shock Tube
PRINCIPAL INVESTIGATOR: Dr. Charles Nuckolls, P.E. and Dr. R. L. Phillips
SPONSORING AGENCY: Naval Research Laboratory
GRANT NUMBER: 10-1626-003

A B S T R A C T

If optical fibers are to be used as a hydrophone the fibers will be "strung" through a pressure hull feed-through. This optical fiber feed-through must withstand a considerable shock wave impact if the optical fiber hydrophone is to be used in an operational environment. The project is to test the survivability of an optical fiber feed-through into a pressure hull. The test chamber consists of a conical steel tube. The tube is filled with water and an explosion at the small end of the tube sets up a shock wave which impacts on the test item at the other end of the chamber.

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TITLE: P M Trade Optics
PRINCIPAL INVESTIGATOR: Dr. A. A. Riad
SPONSORING AGENCY: U. S. Army
GRANT NUMBER: 10-1622-006

10-2100-003

GRANT NUMBER:

A B S T R A C T

The project is to perform research and development work on a high brightness integrated optics laser source.

The laser stripes, the Distributed Bragg Reflector mirror, the grating beam expander, and the grating output collimator lie on the same substrate.

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TITLE: A Time Domain Reflectometry/Transmission System for Detection and Characterization of Optical Fiber Waveguide Defects

PRINCIPAL INVESTIGATOR: Dr. S. M. Riad

SPONSORING AGENCY: UCF - EIES

GRANT NUMBER: 11-1699-021

A B S T R A C T

The development of a time domain reflectometry/transmission algorithm for detecting, locating, and characterizing optical fiber defects that affect the quality of transmission in optical fiber communication links.

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TITLE: Optical Fiber Dispersion Characterization Study: Text Algorithm, Data Collection and Analysis, and Related Computer Software

PRINCIPAL INVESTIGATOR: Dr. S. M. Riad

SPONSORING AGENCY: Kennedy Space Center, NASA

GRANT NUMBER: 10-1622-001

A B S T R A C T

The development of an optical fiber dispersion characterization algorithm to be performed on the Kennedy Space Center optical communication link. The work involved technical assistance in designing the test experiment and also writing the required computer software.

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TITLE: Technical Support Simulator Program and Electronic Scoring System: Lasers

PRINCIPAL INVESTIGATOR: Dr. H. C. Towle, P.E.

SPONSORING AGENCY: Naval Training Equipment Center

GRANT NUMBER: 10-2100-003

A B S T R A C T

Technical support was provided for a microprocessor system development capability established at the Naval Training Equipment Center in Code 73. Applications investigated for microprocessor control and scoring included ship-to-shore bombardment trainers, no-drop dive bombing and the universal infantry weapons trainer (UIWT).

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TITLE: Microprocessor Study Project
PRINCIPAL INVESTIGATOR: Dr. H. C. Towle, P.E.
SPONSORING AGENCY: Naval Training Equipment Center
GRANT NUMBER: 10-1622-013

A B S T R A C T

Microprocessor programming and interface hardware development for the Universal Infantry Weapons Trainer (UIWT), continues at the Naval Training Equipment Center. A paper on UIWT was presented at the 10th annual Electro-Optics/Laser 78 Joint Conference and Exposition in Boston, Massachusetts, September 19 - 21, 1978.

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TITLE: Technical Support of the Naval Aircraft Ordinance Simulator Program Ship-to-Shore Bombardment and Universal Infantry Weapons Trainer System
PRINCIPAL INVESTIGATOR: Dr. H. C. Towle, P.E.
SPONSORING AGENCY: Naval Training Equipment Center
GRANT NUMBER: 10-2100-005

A B S T R A C T

Microprocessor System Interface Hardware and Software was developed for the Universal Infantry Weapons Trainer System at the Naval Training Equipment Center, code 73.

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TITLE: Army Multiple Integrated Laser Engagement System
PRINCIPAL INVESTIGATOR: Dr. R. L. Walker, P.E.
SPONSORING AGENCY: U. S. Army
GRANT NUMBER: 10-1622-003

A B S T R A C T

Two systems using laser beams to simulate rifle and other weapon fire were studied, to determine how compatible certain combination systems would be. The Multiple Integrated Laser Engagement System (MILES) was designed to accommodate a wide variety of weapons has been simulated with laser pulse codes. The Marksmanship and Gunnery Laser Device (MAGLAD) system was designed originally for marksmanship training, using only the standard rifle, but targets to record hits must be skillfully designed in order for the accuracy to be a good simulation of rifle-range results. The goal was to combine parts of one system with parts of the other, thereby saving on first cost and improving maintenance features of the system.

RESUMES OF UNSPONSORED RESEARCH

TITLE: On a Branch and Bound Classification Algorithm

PRINCIPAL INVESTIGATOR: Dr. B. Dimitriadis

A B S T R A C T

The Branch and Bound Algorithm examined concerns the problem of Classification of N n -dimensional vectors (like the output vector from a multispectral Remote Sensing Scanner) into M classes (crops or terrain categories), through consecutive enumerations, guaranteed to give either the globally optimal classification, or explicit rejection of the sub-optimal ones. The Algorithm is based on the Combinatorial Optimization Tree-search techniques, and employs a new metric that makes it considerably faster and more flexible than the conventional Search Techniques.

PUBLICATIONS: DIMITRIADIS, B., "On a New Pre-Clustering Algorithm for Pattern Classification in High Dimensional Spaces." 9th Pittsburgh Conference in Modeling and Simulation, Pittsburgh, 1978.

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TITLE: Calculator Usage in P.E. Exams

PRINCIPAL INVESTIGATOR: Dr. R. C. Harden, P.E.

A B S T R A C T

A paper entitled, "Efficient Utilization of 'Pockulators' for taking the Professional Engineering Examinations", by Dr. R. C. Harden, P.E. and Dr. F. O. Simons, Jr., P.E., was presented at the Frontiers in Education Conference and appears in the Proceedings of the Eighth Annual Frontiers in Education Conference, Lake Buena Vista, Florida, October 23 - 25, 1978, pp. 150 - 155.

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TITLE: Error-Correcting Homework System

PRINCIPAL INVESTIGATOR: Dr. R. C. Harden, P.E.

A B S T R A C T

A paper entitled, "A Closed-Loop Feedback Error-Correcting Homework System", by Dr. R. C. Harden, P.E. and Dr. F. O. Simons, Jr., P.E., was presented at the FIE conference and appears in the Proceedings of the Eighth Annual Frontiers in Education Conference, Lake Buena Vista, Florida, October 23 - 25, 1978, pp. 466 - 470.

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TITLE: 10th Order Differential Engineering Solutions on an HP-67

PRINCIPAL INVESTIGATOR: Dr. R. C. Harden, P.E.

A B S T R A C T

A paper entitled, "Differential Equation Solutions for Up to 10th Order System Theory Models with HP-67 Compulators", was prepared, accepted, presented at and appears in the Proceedings of the Eleventh Annual Southeastern Symposium on System Theory, Clemson University, Clemson, South Carolina, March 12 - 13, 1979, pp. 49 - 53. Co-authors: Dr. F. O. Simons, Jr., P.E. and Dr. R. C. Harden, P.E.

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TITLE: 25th Order H(z) Transient and Frequency Responses on a TI-59 Compulator

PRINCIPAL INVESTIGATOR: Dr. R. C. Harden, P.E.

A B S T R A C T

A paper entitled, "Transient and Frequency Responses for Up to 25th Order H(z) Models with a One Mag-Card TI-59 Program", was prepared, accepted, presented at, and appeared in the Proceedings of the 10th Annual Pittsburgh Conference on Modeling and Simulation, Pittsburgh, PA, April 22 - 27, 1979.

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TITLE: The Analysis and Design of InGaAsP Avalanche Photodetectors of Operation in the 918 - 1616 nm Range

PRINCIPAL INVESTIGATOR: Dr. A. A. Riad

A B S T R A C T

The research presents a study of fast solid state avalanche photodetectors fabricated from the quaternary semiconductor InGaAsP. The photodetectors were designed for operation in wavelength band 918 nm to 1616 nm. This band includes the 1060 nm wavelength, an important communication wavelength for optical fiber transmission. The physical structure of the diode is made of quaternary material InGaAsP grown on a heavily doped InP substrate by the liquid phase epitaxy technique. Mathematical analysis of the detector performance resulted in analytical expression for the various device parameters. The parameters considered were the avalanche device multiplication, the noise power, the signal-to-noise power ratio, and the frequency response. The analytical expressions were solved for the above mentioned parameters using numerical methods for P^+NN^+ , P^+PN^+ , N^+PP^+ , and N^+NP^+ detector structures. Simulation studies were performed in both the frequency and time domains. Transfer functions, impulse responses, and responses due to typical light input waveforms were

developed. The physical differences in charge transport between the various detector structures are clearly exhibited by their respective impulse responses. For technologically feasible structures the impulse response (baseline) duration was about 90 ps. Results showed a tradeoff between response and noise performance. Finally, the choice of the detector physical parameters for optimum performance was discussed.

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TITLE: A Time Domaine Reflectory System for Optical Fiber Waveguides

PRINCIPAL INVESTIGATOR: Dr. S. M. Riad

A B S T R A C T

The development of a time domain reflectometry/transmission algorithm for detecting, locating and characterizing optical fiber defects that affect the quality of transmission in optical fiber communication links.

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TITLE: Solar Energy Education

PRINCIPAL INVESTIGATOR: Dr. R. L. Walker, P.E.

A B S T R A C T

Means must be found to disseminate practical information on solar energy applications to Floridians today. Through simple publications, exhibits in shopping centers or other public places, through one or two day workshops around the State, through any other means that comes to light, the availability of practical solar equipment and its proper use must be brought to the attention of the general public; contractors; landlords; heating, ventilating and air conditioning workers; and others who could profit from this knowledge. The present work will be coordinated through the Florida Solar Energy Center and should continue to expand.

The project has progressed primarily in the evaluation of competing energy resources. Solar utilization cannot be successful in a vacuum; it must offer advantages over alternatives in cost, convenience, environmental impact, time-to-develop, etc. These aspects have been investigated.

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ABSTRACTS OF MASTER'S DEGREE RESEARCH REPORTS AND THESES

TITLE: Elimination of Nematodes From the Soil by Microwave and Dry Heat

CANDIDATE: Behrouz Abbassi

FACULTY ADVISOR: Dr. Ernest E. Erickson, P.E.

A B S T R A C T

The harmful effects of certain nematodes present a serious problem in agriculture. This report concerns the effects of microwave energy in the elimination of citrus nematodes in soil. Three areas of investigation were the effects of (1) high power microwave energy at 2.54 GHz, (2) microwave energy compared with a dry heat method, and (3) low power microwave energy at 10 GHz. Results of the experiments indicate that the elimination of nematodes in the soil samples was due to only the thermal effects of the microwave energy.

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TITLE: An Investigation Into a Least Squares Method for Image Registration

CANDIDATE: Ernest William Cordan, Jr.

FACULTY ADVISOR: Dr. Benjamin W. Patz, P.E.

A B S T R A C T

One of the problems associated with the automatic image processing of satellite photographs such as weather maps is the need for image registration; that is, the fitting of a map that has some translational and rotational bias to a known data base. This paper investigates a least square method of image registration using an image that has been converted into a boundary map with a pixel representation of 1 for land, -1 for water and zero for cloud pixels. A sampled correlation array is constructed by shifting the weather map to locations on a given grid, centered around a sampled correlation peak, and performing an accumulation of the pixel-by-pixel comparisons between the weather map and its data base over the whole map or a smaller search window. A least square approximation of the translational and rotational bias is performed using the data from this sampled correlation array, fitted against the shape of an elliptical one.

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TITLE: Realization of a Fast Automatic Correlation Algorithm
for Registration of Satellite Images

CANDIDATE: John E. Kassak

FACULTY ADVISOR: Dr. Benjamin W. Patz, P.E.

A B S T R A C T

The requirement for a fast automated correlation algorithm for registration of satellite images is discussed. An overview of current registration techniques is presented indicating a correlator, matching binary maps compressed from the original imagery, may provide the required throughput when implemented with a dedicated hardware/processor. An actual registration problem utilizing GOES digitally processed imagery is chosen and defined. The realization of a fast correlator, matching image input data with sampled data base reference image data in real time is considered.

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TITLE: Coupling Efficiency and Alignment Sensitivity of
Single Mode Optical Fibers

CANDIDATE: James Mathew Martin

FACULTY ADVISOR: Dr. Sedki Riad, P.E.

A B S T R A C T

Coupling efficiency and alignment sensitivity models for the coupling of light from a fundamental mode Gaussian light beam into a single mode optical fiber are given. Experimental results are presented which verify the coupling and misalignment predictions of the models. Data were taken at two wavelengths: 0.6328 and 0.8460 micrometers. The light sources were a HeNe laser and GaAlAs laser respectively. Coupling efficiencies were measured versus beam spot size; and lateral, axial and angular misalignments of the beam and fiber axes.

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TITLE: Speech Synthesis Utilizing Microcomputer Control

CANDIDATE: Joseph N. Uzel

FACULTY ADVISOR: Dr. Benjamin W. Patz, P.E.

A B S T R A C T

This report explores the subject of speech synthesis. Information given includes a brief explanation of speech production in man, a historical view of speech synthesis, and four types of electronic synthesizers in use today.

Also included is a brief presentation on phonetics, the study of speech sounds. An understanding of this subject is necessary to see how a synthesizer must produce certain sounds, and how these sounds are put together to create words.

Finally, a description of a limited text speech synthesizer is presented. This system allows the user to enter English text via a keyboard and have it output in spoken form.

The future of speech synthesis appears to be very bright. This report also gives some possible applications of verbal computer communication.

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TITLE: Microcomputers: An Alternative for Digital Controllers
CANDIDATE: Richard B. Wavell
FACULTY ADVISOR: Dr. Fred O. Simons, Jr., P.E.

A B S T R A C T

Two candidate microprocessors are selected to demonstrate that microprocessors can be effectively utilized in digital control applications. The Intel 8085A-2 is selected to represent 8-bit microprocessor and the Intel 8086 is selected to represent 16-bit.

A baseline second order digital filter algorithm is developed for comparison of the performance of the two microprocessors for both software and hardware multiply implementations. Emulation techniques are utilized to facilitate performance comparison, without large investments in software and hardware development. In addition, they provide a method for evaluating new microprocessors, before hardware becomes available. The emulations are then used to verify and to determine the sampling frequency realizable with each digital filter implementation.

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ENGINEERING TECHNOLOGY DEPARTMENTAL REPORT

Chairman: R. G. Denning

Faculty: B. D. Bullard, J. C. Debo, H. L. Griffith, C. M. Head,
B. Holbaugh, J. W. Hubler, K. W. Osborne

The Engineering Technology Department continued to experience moderate growth during the 1978 - 79 academic year. The number of graduates for the 1978 - 79 year will very likely place UCF in the top thirty among over one hundred programs in the United States. The employment opportunities for the graduates were excellent and according to data published by the student placement office the starting salaries of the Engineering Technology graduates were among the highest of any UCF graduates.

Dr. C. M. Head and J. C. Debo joined the faculty during the year. The faculty continued to grow professionally with one member gaining the Engineer Intern status and one being granted Professional Engineer status in Florida. One member made significant progress towards his Doctorate and all were active in professional activities and community areas. Mr. Bullard was selected as a Summer Faculty Fellow in the U. S. Air Force/ ASEE program. Professor Hubler was elected to the Committee of 100 of the City of Titusville.

Three new courses were added to better serve the needs of our Electronic and Operations majors. A special topics course in Electronics for the Health-Related College majors was offered and well received - to the extent that the section was closed due to an enrollment of over 50. Two or three courses were offered each quarter at the Brevard Resident Center and also during the evening programs on the main campus. The demand for both the BRC and evening programs are substantiated by strong enrollments in the courses offered.

Dr. Denning served as a Southern Association of Colleges and Schools Ad Hoc Accreditation Visitor during the year. Professor Hubler was named to the Engineers Council for Professional Development (ECPD) Ad Hoc Visitors List for Civil Engineering Technology programs by the American Society of Civil Engineers. Four faculty members continued or initiated research activities during the year. A Career Outreach and Awareness Program under a subcontract with Florida A & M University was initiated during the year. The principal objective of this program is to increase the minority student population in Engineering.

PUBLICATIONS AND PRESENTATIONS OF PROFESSIONAL PAPERS

1. DENNING, R. G. "The Masters Degree in Engineering Technology, Who Needs It?" Proceedings of the 1979 College Industry Education Conference, ASEE, Tampa, FL, January 29 - February 2, 1979.
2. GRIFFITH, H. L. Engineering Technology Articulation, to Florida Technical Association Members, Orlando, FL, August 7, 1978.
3. HUBLER, J. W. and JENKINS, D. "Performance Characteristics and Design Criteria of Industrial, Commercial and Institutional Buildings in Florida." UCF-EIES Report, August, 1978.

CONFERENCES, WORKSHOPS, SHORT COURSES AT WHICH RESULTS OF RESEARCH WERE COMMUNICATED

1. 1979 ASEE College Industry Education Conference, Tampa, FL, January 29 - February 2, 1979, "The Masters Degree in Engineering Technology - Who Needs It?" (Denning)
2. Florida Technical Education Association, Orlando, FL, August, 1978, "Engineering Technology Articulation." (Griffith)
3. Seminars for Counselors ... various locations ... Valencia Community College, Orlando, FL, October, 1978; Gulf Coast Community College, Panama City, FL, April, 1979 ... "Engineering Technology Articulation. (Griffith)

Lack of accurate freeze information precludes the citrus grower from taking proper or timely counter-measures to protect the groves. Freeze temperature and duration is critical to fruit production and the tree condition. The citrus industry estimates 3 - 12% loss in fruit solids per box for each freeze experienced (in groves unprotected/incorrectly protected); the loss translates into a profit loss of 4 - 6% per freeze.

An active early warning network could collect meteorological data and provide both frost and inversion forecasts to small individual areas (e.g. groves) throughout Central Florida. A meteorological collection system has probably never been developed due to the high cost of operating observing stations and the cost of wire communications. Recent developments in electronic sensors, the mini-computer, and the Supreme Court decision permitting the use of the telephone line for digital data transmission may have set the stage for a technological breakthrough. A computer would thus be able to receive data from multiple sites and would render predictions based on statistical models of local air flow patterns.

It is the purpose of this project to study the feasibility of the proposed freeze warning network through an investigation of pertinent electronic instrumentation, computer monitoring methods, and correlation of relevant weather data with important forecasting parameters (i.e. topography, vegetation, upper air patterns).

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TITLE: Building Performance

PRINCIPAL INVESTIGATOR: Professor J. W. Hubler, P.E. and Dr. D. R. Jenkins, P.E.

SPONSORING AGENCY: OCF - KRS

GRANT NUMBER: 11-1699-005

RESUMES OF SPONSORED RESEARCH

TITLE: Feasibility Study of Early Warning Freeze and Inversion Network for Central Florida

PRINCIPAL INVESTIGATOR: Dr. Clarence Head, P.E. and Mr. Harold Griffith, P.E.

SPONSORING AGENCY: UCF - EIES

GRANT NUMBER: 11-1699-030

A B S T R A C T

Lack of accurate freeze information precludes the citrus grower from taking proper or timely counter-measures to protect the groves. Freeze temperature and duration is critical to fruit production and the tree condition. The citrus industry estimates 5 - 7% loss in fruit solids per box for each freeze experienced (in groves unprotected/incorrectly protected); the loss translates into a profit loss of 4 - 6% per freeze.

An active early warning network could collect meteorological data and provide both frost and inversion forecasts to small individual areas (e.g. groves) throughout Central Florida. A meteorological collection system has probably never been developed due to the high cost of operating observing stations and the cost of wire communications. Recent developments in electronic sensors, the mini-computer, and the Supreme Court decision permitting the use of the telephone line for digital data transmission may have set the stage for a technological breakthrough. A computer would thus be able to receive data from multiple sites and would render predictions based on statistical models of local air flow patterns.

It is the purpose of this project to study the feasibility of the proposed freeze warning network through an investigation of pertinent electronic instrumentation, computer monitoring methods, and correlation of relevant weather data with important forecasting parameters (i.e. topography, vegetation, upper air patterns).

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TITLE: Building Performance

PRINCIPAL INVESTIGATOR: Professor J. W. Hubler, P.E. and Dr. D. R. Jenkins, P.E.

SPONSORING AGENCY: UCF - EIES

GRANT NUMBER: 11-1699-005

A B S T R A C T

The primary thrust of this program has been an analysis of the structural performance of large one-story buildings. Field inspections have been made of warehouses, light industrial buildings, shopping centers and schools in the central Florida and north Florida areas. Buildings of the types listed are a major factor in the construction industry. Most of the buildings which have been studied have walls of masonry or tilt-up concrete slabs with steel roof framing, and built-up roofing which is flat or at very low pitch. While high-rise buildings are designed to rigid, nationally accepted standards and specifications, one-story buildings do not receive such careful design attention even though rules of prudent practice should apply. As a result of our work to date, it is concluded that the most pervasive problem in these one-story structures is unsatisfactory roof performance. A number of factors appear to be responsible for this and these, as well as other observations from our field investigations were presented in a summary report.

PUBLICATION: Hubler, J. W., and D. R. Jenkins, "Performance Characteristics and Design Criteria of Industrial, Commercial and Institutional Buildings in Florida," Report, UCF- EIES, August, 1978.

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TITLE: Building Performance

PRINCIPAL INVESTIGATOR: Professor J. W. Hubler, P.E. and Dr. D. R. Jenkins, P.E.

SPONSORING AGENCY: UCF - EIES

GRANT NUMBER: 11-1599-002

RESUMES OF UNSPONSORED RESEARCH

TITLE: Development of Transmit/Receive Microwave Communication System

PRINCIPAL INVESTIGATOR: Mr. B. D. Bullard, E.I.T.

A B S T R A C T

The objective of this project was to investigate the theoretical and hardware feasibility of developing an experimental radar unit utilizing a 10 GHz gunplexer Transmit/Receive communication system.

The research indicated strong feasibility of developing an experimental radar unit utilizing the 10 GHz gunplexer audio/video Transmit/Receive communication system developed Winter Quarter, 1979. Acquisition of hardware and theoretical radar circuit design was being developed during Spring Quarter, 1979.

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TITLE: Process Control Instrumentation Laboratory Development

PRINCIPAL INVESTIGATOR: Mr. B. D. Bullard, E.I.T.

A B S T R A C T

The objective of this project was investigation and laboratory development of electro-mechanical devices and their use in process control systems.

Nine laboratory experiments were successfully developed exposing the Engineering Technology student to parameters and characteristics of thermal and mechanical transducers and their application in process control systems.

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TITLE: Study of Masters Degree Programs in Engineering Technology

PRINCIPAL INVESTIGATOR: Dr. R. G. Denning, P.E.

A B S T R A C T

The objective of this project was to study the existing Master of Science in Engineering Technology programs, establish the needs of industry for the Master of Science graduates, and develop the findings into a paper suitable for publication.

The findings were as follows:

1. At present, industry does not see the need for the Master of Science in Engineering Technology degree program, but is interested in continuing education.
2. The Bachelor of Engineering Technology graduate will generally start at the same salary as the Master of Science in Engineering Technology graduate.
3. Master of Science in Engineering Technology programs can provide an excellent source of Associate of Science and Bachelor of Engineering Technology faculty members but the Master of Science in Engineering Technology graduate's starting salary in education will compare with the Bachelor of Engineering Technology graduate's starting salary in industry.
4. The enrollments in the Master of Science in Engineering Technology programs are small and thus the program is difficult to justify on a cost effectiveness basis.
5. Institutions with large Bachelor of Engineering Technology programs have been reluctant to establish the Master of Science in Engineering Technology program.
6. Additional studies should be conducted to learn if a greater number of the 60 - 63% of the Bachelor of Engineering Technology graduates who plan graduate studies would actually enroll if Master of Science in Engineering Technology programs were more readily available.
7. Finally, the Master of Science in Engineering Technology program could provide Bachelor of Engineering Technology graduates "some place to go after graduation." This idea could serve industry's desire to have technologists benefit from continuing education and provide the student a measure of accomplishment or self reward by working toward an additional degree.

PUBLICATION: Denning, R. G., "The Master's Degree in Engineering Technology, Who Needs It?" Proceedings, 1979 College Industry Education Conference, ASEE, January 29 - February 2, 1979, Tampa, FL.

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TITLE: Needs for Manufacturing Technology in Florida

PRINCIPAL INVESTIGATOR: Mr. H. L. Griffith, P.E.

A B S T R A C T

The objective of this project was to determine if there was a need for a Manufacturing Engineering Technology program in Florida.

The information obtained from the Society of Manufacturing Engineers indicated that four-year Manufacturing Technology graduates are now playing an important role in the development of Industry. Their importance is increasing. Manufacturing Engineering Technologists are used, replacing the conventional engineering graduate in certain manufacturing and service jobs that require a hands-on knowledge.

Florida has no four-year Manufacturing Technology program. There appears to be a state need and development of such a program could contribute to the economic and industrial growth of the State.

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TITLE: The Feasibility of Solar Production of Alcohol
for Use as Heating Fuels

PRINCIPAL INVESTIGATOR: Dr. C. M. Head, P.E.

A B S T R A C T

The objective of this project was to investigate the feasibility of producing alcohol fuels from waste products.

The project was designed to study the feasibility of producing alcohol fuels from citrus wastes. Both small and large scales of production were investigated. Discussions and visits with the Florida Agriculture Research Center and the Minute Maid Orange Juice Plant were conducted. It was found that the residue or wastes from large commercial operations were of a quality impractical for large scale alcohol production. Grove and farm citrus wastes, however, were of a quality sufficient to produce alcoholic fuels. The quantity of such wastes available at a single site would necessitate small scale production that would meet the need of small or local operations.

This project indicates that further investigation into small scale operations is warranted at a future date.

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TITLE: Study of Community College Engineering Technology
Programs

PRINCIPAL INVESTIGATOR: Mr. Bruce Holbaugh

A B S T R A C T

The objective of this project was to prepare a slide presentation to familiarize faculty and visitors with Community College input to this institution.

Several visits to both Valencia Community College and Brevard Community College resulted in the following:

1. Meetings with the instructors to review their course content for each institution.
 - a. BCC: Mathematics, Electronics, Mechanical, Drafting and Physics
 - b. VCC: Mathematics, Electronics, Design and Physics
2. Slide pictures were taken at each community college to prepare a visual presentation at those facilities used by prospective students.

A pictorial and audio tape was prepared as required by objectives. These are now suitable and give an unusual insight to these facilities, BCC and VCC, from which a major portion of the technology students come to this institution for completion of the Bachelor of Engineering Technology.

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TITLE: Biomedical Electronics Course Development

PRINCIPAL INVESTIGATOR: Mr. K. W. Osborne, P.E.

A B S T R A C T

The objective of this project was to survey Biomedical Electronics literature and industry needs, and to determine an appropriate curriculum.

Textbooks were surveyed via interlibrary loan. Ten books were recommended for library purchase. Additional information was obtained from interested people associated with biomedical electronics. A textbook was selected for a special topics course offered spring quarter. Student interest and industry needs in this area are being evaluated.

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TITLE: Microcomputer Course and Laboratory Development

PRINCIPAL INVESTIGATOR: Mr. K. W. Osborne, P.E.

A B S T R A C T

The objective of this project was to develop a laboratory micro-computer for student use. A laboratory microcomputer using nine standard transistor/transistor logic integrated circuits was designed, built, tested, debugged and documented.

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INDUSTRIAL ENGINEERING AND MANAGEMENT SYSTEMS
ENGINEERING MATHEMATICS AND COMPUTER SYSTEMS
DEPARTMENTAL REPORT

Chairman: G. E. Whitehouse

Faculty: C. S. Bauer, C. B. Gambrell, Y. A. Hosni, H. I. Klee,
D. G. Linton, C. S. Park, G. F. Schrader, L. T. Tuliano,
C. J. White

The period 1977 - 79 has been a time of transition for the Industrial Engineering and Management Systems Department at the University of Central Florida. Dr. George Schrader, the founding Chairman, was appointed Associate Dean of the College of Engineering and Dr. Gary E. Whitehouse, formerly of Lehigh University, joined the department in September of 1978 as its new Chairman.

Dr. J. T. Black, from Ohio State University, spent the Winter Quarter on a visiting appointment. Dr. Black was exploring the feasibility of incorporating more manufacturing systems and computer-aided manufacturing concepts into our curriculum. In the Spring Quarter, Dr. C. B. Gambrell returned to full time faculty duty after 11 years as the founding Academic Vice President of the University. Dr. Gambrell spent the Fall and Winter Quarters at Stanford University as a Visiting Professor. The faculty has received a number of awards during this academic year including Dr. Christian Bauer as Young Engineer of the Year by the Florida Engineering Society and as the Outstanding Young Educator by the Orlando Jaycess. Dr. Whitehouse shared AIIE's H. B. Maynard for Innovative Achievement Award for his work dealing with GERT and was selected for the Outstanding Educator Award by Lehigh Valley's AIIE Chapter.

The activity level remains high at the University of Central Florida with over 20 papers and research reports presented by our faculty. Sponsored research included grants dealing with Energy Management Systems in State Buildings by Dr. R. D. Doering, NATO Management Systems Inter-Operability Technical Feasibility Study with Drs. Linton and Hosni, Simulation of Florida Solar Energy Center Solar Cooling Systems by Dr. Harold Klee, Re-engineering for the Blind by Dr. Y. A. Hosni, and XM-1 Training Devices by Dr. C. S. Bauer. The faculty remain active in professional societies, such as American Institute of Industrial Engineers and Florida Engineering Society. Dr. George Schrader was elected Executive Vice President of the American Institute of Industrial Engineers. Dr. Robert Doering continues as Regional Vice President of Alpha Pi Mu. Dr. Chan S. Park is a Reviewer for Engineering Economist. Drs. Gambrell, Schrader, and Whitehouse continue to serve on accreditation visitation teams and Dr. Gambrell is the AIIE representative on the Board of Directors of ECPD.

The College of Engineering Computer Laboratory under the direction of the Industrial Engineering and Management Systems Department continues to grow in the areas of Computer Graphics, Mini/Micro Computer Systems, computer speech generation and robotics.

Our students continue active and for the fifth straight year they won first prize for the group competition in the Annual Engineer's Fair at UCF. The UCF Chapter of Alpha Pi Mu initiated 10 members during the year. The AIIE students developed an 18 minute video tape entitled, "IE and You." The tape describes industrial engineering at the University of Central Florida and will be used as a vehicle for informing students of opportunities in Industrial Engineering and Management Systems. Their activities were recognized by an "Award of Excellence" from the AIIE national organization. An EMCS club is being formed and had over 20 students at its first meeting.

PUBLICATIONS AND PRESENTATIONS OF PROFESSIONAL PAPERS

1. DOERING, R. D., et al. "Industrial Engineers Lead Way in Energy Conservation at Walt Disney World." Industrial Engineering Journal, October, 1978, Vol. 10, No. 10.
2. DOERING, R. D., et al. "A Micro Economic Study of Solar Domestic Water Heating Systems in State Buildings." Proceedings of the American Section of International Solar Energy Society, Denver, CO, August, 1978.
3. DOERING, R. D., et al. "Heat Recovery Techniques and Demand Monitoring of Hot Water Systems in State Buildings." STAR 76-021, Report to State Energy Office, Department of Administration, Tallahassee, FL, December, 1978.
4. DOERING, R. D. and HOSNI, Y. A., et al. "Energy Management for State Buildings." STAR 77-7023, Report to State Energy Office, Department of Administration, Tallahassee, FL, December, 1978.
5. DOERING, R. D. "Break-Even Analysis for Restaurant Decision-Making." The Cornell Hotel and Restaurant Administration Quarterly, February, 1979.
6. DOERING, R. D. "Management Techniques Adapted to Decisions on Store Equipment." Presented at Fall Conference of Society for Advancement of Food Service Research, Lansing, MI, November 1 - 3, 1978.
7. DOERING, R. D. "Psychological Profile of an Engineer." Presented at Society of Women Engineers Fifth Annual Florida State Symposium, Gainesville, FL, November, 1978.
8. DOERING, R. D. "Energy Management Systems." Presented at State Energy Education Conference, Tallahassee, FL, January 18 - 19, 1979.
9. DOERING, R. D. and HOSNI, Y. A. "Computer Based Energy Management Systems, State Buildings in Florida, An Overview." IEEE Florida Eclectic '79, Melbourne, FL, March, 1979.
10. GAMBRELL, C. B., et al. "CLEP English Follow-Up Study." Presented at the 1979 National Meeting of the Association of Institutional Research, San Diego, CA, May 14 - 17, 1979. Published in Proceedings of the Conference.
11. HOSNI, Y. A. and DOERING, R. D. "Sensitivity Analysis for Multi-Variable Models - Methodology and Application for the Economics of Energy Management Systems." Computer and Industrial Engineering, 11th Quarterly Issue, International Journal.

12. HOSNI, Y. A. and DOERING, R. D. "The Economics of Energy Management Systems in State Buildings in Florida." Presented in technical session on Energy Conservation in Building Heating and Air Conditioning Systems at 1978 Winter Annual ASME Meeting, San Francisco, CA, December, 1978.
13. HOSNI, Y. A. and DOERING, R. D. "Energy Management Systems, Factors, Modeling and Modeling and Analysis." First International Symposium of Policy Analysis and Information Systems, Duke University, Durham, NC, June 28 - 30, 1979.
14. HOSNI, Y. A., et al. "Design of Laser Optical System Via Mathematics Modeling." 10th Annual Pittsburgh Conference on Modeling and Simulation, Pittsburgh, PA, April 25 - 27, 1979.
15. HOSNI, Y. A. and BAUER, C. S. "Speech Synthesizers - Development and Impact on Industrial Engineering." 2nd National Conference for Computers and Industrial Engineering, Chicago, IL, March 14 - 16, 1979.
16. HOSNI, Y. A., LINTON, D. C., and BAUER, C. S. "Computer Assistance in Feedback Information System." 2nd National Conference for Computers and Industrial Engineering, Chicago, IL, March 14 - 16, 1979.
17. HOSNI, Y. A. "Job Re-engineering for the Blind." State Area IV Training Seminar, Panama City, April 12 - 13, 1979.
18. KLEE, H. I. "Simulation of the FSEC Solar Cooling System." International Solar Energy Society Meeting, Atlanta, GA, May, 1979. Appears in the Proceedings of 1979 ISES Meetings.
19. KLEE, H. I. "Simulation of the Florida Solar Energy Center Solar Cooling System." Final Report, UCF, March, 1979.
20. LINTON, D. C. and HOSNI, Y. A. "Potential Manual/Instrumentation Requirements to Support Multiple Integrated Laser Engagement System Battalion Lever Exercises." Final Report to U. S. Army, PM Trade, November, 1978.
21. PARK, C. S., et al. "Economic Decision Analysis - Instructor's Manual." Prentice-Hall, 1979.
22. PARK, C. S. "Stochastic Benefit Cost Analysis - Exact Method vs Approximation Method." Presented at the Second National Conference for Computers and Industrial Engineering, Chicago, IL, March, 1979.
23. WHITEHOUSE, G. E. "Genres: A Technique for Project Scheduling With Resource Considerations." 2nd National Conference for Computers and Industrial Engineering, Chicago, IL, March 1979.
24. WHITEHOUSE, G. E. Book Review of Decision Networks by Hastings and Mello in Industrial Engineering, December, 1978, pp. 60.

25. WHITEHOUSE, G. E., et al. "Ocular Pneuoplethysmography in Evaluation of Patients with Brain Ischemia." Proceedings of the 4th International Symposium on Microsurgical Anastomoses for Cerebral Ischemia, London, Ontario, July 1978.
26. WHITEHOUSE, G. E., et al. "Evaluation of Proposed R & D Projects." AIIE News Operations Research, Vol. XIII, No. 3, January, 1979.
 - a) "Computer Assistance in Feedback Information Systems - Special Application in Simulated Battle Engagement Exercises." (Hosni/Linton/Bauer)
 - b) "Speech Synthesizers - Talking Computer: Development and Impact on Industrial Engineering." (Hosni/Bauer)
 - c) "Stochastic Benefit Cost Analysis - Exact Method vs Approximation Method." (Park)
 - d) "Genes A Technique for Project Scheduling with Resource Considerations." (Whitehouse)
2. American Section of International Solar Energy Society, Denver, CO, August, 1978, "A Micro Economic Study of Solar Domestic Water Heating Systems in State Buildings." (Doering)
3. Crimewatch Workshop, UCF, Orlando, FL, September, 1978, Director. (Doering)
4. 1979 National Meeting of the Association of Institutional Research, San Diego, CA, May, 1979, "CLEP English Follow-Up Study." (Gambrell)
5. First International Symposium on Policy Analysis and Information Systems - Duke University, Durham, NC, June 28 - 30, 1979, "Energy Management Systems, Factors, Modeling and Modeling and Analysis." (Hosni/Doering)
6. 10th Annual Pittsburgh Conference on Modeling and Simulation, Pittsburgh, PA, April 25 - 27, 1979, "Design of Laser Optical System via Mathematical Modeling." (Hosni)
7. 2nd International Conference on Mathematical Modeling, St. Louis, MO, July 1 - 13, 1979, "Engineering Design via Mathematical Modeling." (Hosni)
8. Florida Academy of Sciences Annual Meeting, Miami, FL, March 22 - 24, 1979, "The Economics of Automated Energy Management Systems of State Buildings in Florida." (Hosni/Doering)
9. Mini/Micro Computer Symposium and Fair, Melbourne, FL, March, 1979, "Computer Based Energy Management Systems in State Buildings in Florida." (Doering/Hosni)
10. The 1979 Management Division Seminar - AIIE, Orlando, FL, April 7, 1979.
 - a) "Material Handling - Analysis and Requirements in Industry." (Hosni)
 - b) "Buy vs Lease Decisions." (Park)

CONFERENCES, WORKSHOPS, SHORT COURSES AT
WHICH RESULTS OF RESEARCH WERE COMMUNICATED

1. 2nd National Conference on Applications of Computers in Industrial Engineering, Chicago, IL, March, 1979.
 - a) "Computer Assistance in Feedback Information Systems - Special Application in Simulated Battle Engagement Exercises." (Hosni/Linton/Bauer)
 - b) "Speech Synthesizers - Talking Computer: Development and Impact on Industrial Engineering." (Hosni/Bauer)
 - c) "Stochastic Benefit Cost Analysis - Exact Method vs Approximation Method." (Park)
 - d) "Genres A Technique for Project Scheduling with Resource Considerations." (Whitehouse)
2. American Section of International Solar Energy Society, Denver, CO, August, 1978, "A Micro Economic Study of Solar Domestic Water Heating Systems in State Buildings." (Doering)
3. Crimewatch Workshop, UCF, Orlando, FL, September, 1978, Director. (Doering)
4. 1979 National Meeting of the Association of Institutional Research, San Diego, CA, May, 1979, "CLEP English Follow-Up Study." (Gambrell)
5. First International Symposium on Policy Analysis and Information Systems - Duke University, Durham, NC, June 28 - 30, 1979, "Energy Management Systems, Factors, Modeling and Modeling and Analysis." (Hosni/Doering)
6. 10th Annual Pittsburgh Conference on Modeling and Simulation, Pittsburgh, PA, April 25 - 27, 1979, "Design of Laser Optical System via Mathematical Modeling." (Hosni)
7. 2nd International Conference on Mathematical Modeling, St. Louis, MO, July 1 - 13, 1979, "Engineering Design via Mathematical Modeling." (Hosni)
8. Florida Academy of Sciences Annual Meeting, Miami, FL, March 22 - 24, 1979, "The Economics of Automated Energy Management Systems of State Buildings in Florida." (Hosni/Doering)
9. Mini/Micro Computer Symposium and Fair, Melbourne, FL, March, 1979, "Computer Based Energy Management Systems in State Buildings in Florida." (Doering/Hosni)
10. The 1979 Management Division Seminar - AIIE, Orlando, FL, April 7, 1979.
 - a) "Material Handling - Analysis and Requirements in Industry." (Hosni)
 - b) "Buy vs Lease Decisions." (Park)

11. State Area IV Training Seminar, Panama City, FL, April 12 - 13, 1979, "Job Re-Engineering for the Blind." (Hosni)
12. International Solar Energy Society, Atlanta, GA, May, 1979, Simulation of the Florida Solar Energy Center Solar Cooling System." (Klee)
13. Applied Solar Energy Workshop, Orlando, FL, June, 1978. (Klee)
14. Solar Energy Design Workshop, Orlando, FL, October, 1978. (Klee)

RESUMES OF SPONSORED RESEARCH

TITLE: Advanced Technology Studies
PRINCIPAL INVESTIGATOR: Dr. C. S. Bauer, P.E.
SPONSORING AGENCY: U. S. Army Project Manager for Training Devices
GRANT NUMBER: 10-1624-008 and 10-1624-009

A B S T R A C T

This work will consist of the evaluation of a large-scale computer graphics display/animation software package, with particular attention to the potential for its use in scene generation for training device displays. An evaluation of various approaches to the construction of geographical and terrain data bases for such systems will be initiated.

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TITLE: Energy Management Systems for State Buildings
PRINCIPAL INVESTIGATOR: Dr. R. D. Doering, P.E.
SPONSORING AGENCY: Florida Department of Administration, State Energy Office
GRANT NUMBER: STAR Project 77-7023 and 11-1624-002

A B S T R A C T

All State owned or operated buildings with exception of schools K thru 12 were subjected to an evaluation for incorporating Computed Based Energy Management Systems on the basis of a profile of energy usage, physical suitability of facilities for installation of EMS on Heating Ventilating and Air Conditioning (HVAC) Systems. The primary screening analysis was on the basis of Life Cycle Cost (LCC) economics. To be recommended a candidate project was required to have a LCC payback period of less than the estimated life of the facility. The LCC model incorporated projected escalation of fuel cost and inflation factors and 6% interest rate. A sensitivity analysis was used to determine the most critical cost items in the LCC analysis.

Concurrently the performance of existing EMS designs were investigated to match their physical and economic requirements with the types of State building operations. The study provided performance specifications and cost guidelines for several categories of EMS, ranging from localized open loop control to computer based feedback systems to accomodate the spectrum of State building applications.

To ensure its utility the study culminated in recommendations for EMS in specific State buildings by major operating departments such as Universities, Community Colleges, Prisons, Health & Rehabilitative Services (HRS), and Office Buildings. A summary of the phase one recommended projects showed estimated net annual savings of \$515,000 with an investment cost of \$2,140,000 for an overall payback period of about 4 years. The State Energy Office has incorporated these projects into the budget for consideration by the State Legislature.

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TITLE: Evaluation of Weapon Simulation Systems for Tactical Training of Police

PRINCIPAL INVESTIGATOR: Dr. Robert D. Doering, P.E.

SPONSORING AGENCY: UCF - EIES

GRANT NUMBER: 11-1699-031

A B S T R A C T

In recent years there has been a growing interest in Weapons Simulation Systems on the part of the military in this country and its NATO allies. This interest generally reflects the growing costs of training exercises where live ammunition is used and the increased flexibility that simulation weapon firing permits in developing tactics under actual fire without endangering personnel.

The police have the same requirements in their training programs and particularly in "SWAT" team exercises. Additionally, it should be recognized that the police perhaps have a greater need for such systems since as a group they are more frequently subjected to weapons fire and injury. They should be able to take advantage of any training system which would allow them to respond more effectively.

The objective of this research was to demonstrate/evaluate a pilot police training system using Laser Weapons Simulators (LWS) which then could be developed into a prototype program for replication at other locations throughout the country.

There are several suppliers of LWS hardware presently in this country. Generally, the developmental costs of these systems have been defrayed by DOD contracts and the selling price now reflects only production costs. In small quantities the basic system for an M-16 rifle or .38 caliber revolver can be procured for about \$2500/unit. The laser transmitter can be modified to look like a shotgun so that all three basic police weapons could be simulated.

Initially, a pilot training scenario was developed from actual field situations and adapted for incorporation of LWS. Particular attention was given to tactical training and how this might be strengthened by LWS. Criteria were established for measuring the degree of success of a training exercise both in terms of the tactics and on an individual basis.

This was done in cooperation with the Orlando Police Department, Police Rescue Team (SWAT) personnel. Additionally, these criteria were weighted to reflect the relative importance of each to the success of the scenario mission. In this manner a weighted performance score for tactics and individual could be determined for each exercise. These were also the basis for evaluation of training improvements which incorporation of LWS could be expected to effect.

A pilot training exercise, "Convenience Store Armed Robbery" was conducted with OPD personnel to test and refine the training concept. Blank ammunition was used and all action was video taped and scored.

LWS were not formally used in this training but were demonstrated by two vendors who were invited to view the exercise.

The results confirmed that the concept is effective and it received good marks from the instructors and trainees who participated.

A proposal for development of a regional training program for Central Florida has been submitted for consideration to the Training and Education Office of LEAA in Washington, D. C.

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TITLE: Re-engineering for the Blind

PRINCIPAL INVESTIGATOR: Dr. Y. Hosni, P.E.

SPONSORING AGENCIES: Florida Department of Education - Division of Blind Services and UCF - EIES

GRANT NUMBERS: 15-1624-001 and 11-1699-016

A B S T R A C T

Equipment and aids for the blind were surveyed and information pertaining to their applicability in jobs were gathered. Selected jobs in the common agencies in Florida cities were studied, analyzed and re-engineered to suit blind people. This included the addition of newly developed equipment like speech synthesizers, sensory devices, and micro-computers.

The research included providing technical assistance to the job counselors in the field. This included equipment specification and advice in getting jobs on-site. An interim report was submitted to the sponsoring agency in December, 1978. A final report is in progress.

* * * * *

TITLE: Economics of Solar Water Heaters - Short Term Casting

PRINCIPAL INVESTIGATOR: Dr. H. Klee, P.E.

SPONSORING AGENCY: Florida Solar Energy Center

GRANT NUMBER: 07-1056-001

A B S T R A C T

The economics of solar water heaters over the short term is considered. The return on investment (ROI) from the purchase of a solar water heater is computed when the house is sold prior to the expected life of the system. Graphical and tabulated output is available for numerous scenario involving years of ownership, inflation, fuel escalation, maintenance, yearly savings and added value of house due to solar system. A maximum added value is computed based on the assumed minimum return on investment of the buyer. Presently, only cash purchases are considered. Future work will involve long term financing of systems.

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TITLE: Simulation of the Florida Solar Energy Center, Solar Cooling System

PRINCIPAL INVESTIGATOR: Dr. H. Klee, P.E.

SPONSORING AGENCY: Florida Solar Energy Center

GRANT NUMBER: 07-1056-001

A B S T R A C T

A final report on the simulation model and results was prepared and submitted to FSEC. The actual system is now on-line and an empirical verification study is contemplated. The simulation study findings were presented at the 1979 International Solar Energy Society Meeting and will appear in the Proceedings.

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TITLE: Potential Manual/Instrumentation Requirements to Support MILES Battalion Level Exercises

PRINCIPAL INVESTIGATOR: Dr. D. Linton, P.E. and Dr. Y. Hosni, P.E.

SPONSORING AGENCY: U. S. Army

GRANT NUMBER: 10-1622-007

A B S T R A C T

In this report, potential systems (manual and automated) for collecting, analyzing and displaying data from a Multiple Integrated Laser Engagement System (MILES) battalion level exercise are investigated. In addition, the actual data requirements (i.e., the specific information to be collected) are identified.

All system candidates are evaluated with respect to fourteen critical factors (e.g., cost, technical risk, accuracy) and optimal system configurations are formulated as a function of these parameters.

A recent study which compares results from a fully instrumented system with data obtained from a manual system is also discussed.

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TITLE: Assessment of Industry Needs for Engineering Education and Research in the University of Central Florida Service Area

PRINCIPAL INVESTIGATOR: Dr. G. F. Schrader, P.E.

SPONSORING AGENCY: UCF - EIES

GRANT NUMBER: 11-1699-012

A B S T R A C T

In order to provide a basis for future planning, the UCF College of Engineering conducted an industry survey during the summer of 1978 to obtain estimates of, (1) the number of engineers currently employed, (2) the future needs for engineers and, (3) the future continuing education and research needs of industry in the eleven county UCF service area. The survey was accomplished by means of a questionnaire sent to a representative sampling of the 1346 manufacturing establishments within those eleven counties. An analysis of the survey responses and other pertinent data revealed that the UCF service area contains about 16 percent of the manufacturing establishments, about 16 percent of the manufacturing employees, and over 50 percent of the engineers currently employed in the State. Estimates indicated that the existing 1346 manufacturing establishments in the UCF service area will require an additional 15,335 engineers during the next five years (1979 - 1984). This represents an increase of approximately 86 percent over the current level of employment.

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TITLE: Energy Assessment and Coal Conversion Potential of Industrial and Commercial Combustion Systems

PRINCIPAL INVESTIGATOR: Dr. Michael A. Varney, Mr. H. E. Worbs, P.E. and Ms. Lorraine Tuliano, E.I.

SPONSORING AGENCY: Florida State Energy Office

GRANT NUMBER: 11-1626-015

A B S T R A C T

The University of Central Florida, Department of Mechanical Engineering is currently under contract to conduct a technical industrial assessment of the possibilities for significant energy savings in the industrial and commercial sector through the conversion of current liquid fueled systems to systems burning coal and coal-oil-mixtures. Specifically, the project performance is being conducted over a period of nine months and consists of the following major tasks:

Task I (Four Months) A broad engineering study aimed at identifying the major industrial and commercial users of fossil fuels in the State of Florida.

Task II (Three Months) An economic analysis to estimate the annual oil-equivalent energy savings achievable by the conversion of present systems to coal/coal-oil-mixture systems.

Task III (Two Months) The results of the project will be formulated into a broad set of specific recommendations for implementation of a coal conversion plan consistent with the State's Energy Doctrine.

The project is scheduled for completion in September, 1979.

PRINCIPAL INVESTIGATOR: Dr. Michael A. Varney, Mr. H. E. Worbs, P.E. and Ms. Lorraine Tuliano, E.I.

SPONSORING AGENCY: U. S. Army

GRANT NUMBER: 11-1626-015

RESUMES OF UNSPONSORED RESEARCH

TITLE: Computer Graphics Laboratory Development

PRINCIPAL INVESTIGATOR: Dr. C. S. Bauer, P.E.

A B S T R A C T

The project objective is the interfacing of various peripherals and computing systems in COE computer laboratory, as well as development of support and demonstration software for computer graphics applications.

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TITLE: Numerical Control/Process Control Laboratory Development

PRINCIPAL INVESTIGATOR: Dr. C. S. Bauer, P.E.

A B S T R A C T

A number of projects involving computer process monitoring and control are being developed for the College of Engineering Computer Laboratory. These currently include a numerically-controlled wire-wrapping machine, a computer-controlled HO gauge model train layout, an aircraft flight simulator with computer-generated imagery, and a robot device with on-board propulsion and manipulator capabilities.

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TITLE: Laser Optical Systems

PRINCIPAL INVESTIGATOR: Dr. Y. Hosni, P.E. and Mr. David Allemeier

A B S T R A C T

The project objective was to apply optimization techniques in the design of laser optical systems. Mathematical expressions governing the design along with the objective function for the designing criteria were formulated. The laser optical system involves the conflict of various performance parameters which tend to drive the design in opposing directions. For limited number of criteria, the system was modeled and solved resulting in reasonable design concept.

Methodology and results were published in the proceedings of the Tenth Modeling and Simulation Conference, Pittsburgh, PA, April, 1979.

A proposal was submitted to the NSF to continue to study and include more criteria; still pending.

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TITLE: Layout Information System
PRINCIPAL INVESTIGATOR: Dr. Y. A. Hosni, P.E.

A B S T R A C T

A computer system was developed by which information pertaining to plant layout and facilities arrangement can be stored, and retrieved as it is needed. The system has the ability to process this information to aid in planning and scheduling for production. Processing is done via several algorithmic components in the system. An algorithm computes the minimum distances between facilities (departments) in the plant; another computes the backtracks in the production flow, and a third component evaluates the layout with respect to producing a part of a product.

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TITLE: Mathematical Modeling for Motion and Time Study
PRINCIPAL INVESTIGATOR: Dr. Y. A. Hosni, P.E.

A B S T R A C T

The purpose of this project is to review the literature and prepare a paper for submission to the AIIE National Conference program.

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TITLE: Sensitivity Analysis for Multi-Variable Models
PRINCIPAL INVESTIGATOR: Dr. Y. A. Hosni, P.E.

A B S T R A C T

A method has been developed enabling analysts to build models, and measure their sensitivity for greater number of variables. Variables can be directly or indirectly related to the model. The method involves building an intermediary table relating the indirect variables to the direct and modifying a basic model before measuring the sensitivity of the model to a varying variable. The method was formulated analytically and a computer program was written which facilitates using the model for surveying purposes as well as sensitivity analysis, depending upon the mode of application. The research resulted in a paper to be published in the eleventh issue of "Computers and Industrial Engineering," an International journal.

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TITLE: Systems Analysis for the Medical Records Department (Orlando Regional Medical Center, Inc.)
PRINCIPAL INVESTIGATOR: Dr. Y. Hosni, P.E.

A B S T R A C T

A study was conducted for the two departments of Medical Records in the two divisions of O.R.M.C. As a result of the study, recommendations were submitted to the O.R.M.C. management with a new system design. The important features of the new system are: (1) Reducing the personnel to 50 employees, (2) Elimination of Medical Records Department in the Holiday division, (3) Institute a new procedure for completion of the records by Physicians, (4) Change records to Microfiche, (5) New departmental layout, (6) Savings of \$40,000 annually.

A report of the outcome of the study was submitted to the O.R.M.C. management, and a technical paper was presented at the annual conference for Florida Academy of Sciences.

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TITLE: Investigation of Performance of a Solar Space Heating System with Back-up Heat Pump

PRINCIPAL INVESTIGATOR: Dr. H. Klee, P.E.

A B S T R A C T

A TRNSYS simulation of a solar residential space heating system with auxiliary heat supplied by a heat pump was developed. The performance of the system will be compared to that of a solar assisted water to air heat pump. Auxiliary energy costs for both configurations will provide the basis for an economic comparison.

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TITLE: Availability Analysis of Paralleled Systems with General Failure Time Distributions

PRINCIPAL INVESTIGATOR: Dr. D. Linton, P.E.

A B S T R A C T

A two unit parallel redundant system with general failure and repair for one unit and Erlang failure and repair for the second unit is treated. The point-wise availability of the system is derived in terms of its Laplace Transform.

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TITLE: Life Distributions and Secondary Failures for a 2-out-of-N:F System

PRINCIPAL INVESTIGATOR: Dr. D. Linton, P.E.

A B S T R A C T

A 2-out-of-N:F System with exponential failure and Erlang repair time is considered. Under specified assumptions, the probability density

function for the time-to-system-failure (T) is exhibited and the probability generating function for the number of secondary failures occurring during (0,T) is derived.

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TITLE: The Evaluation of Multi-Dimensional Integrals by Simulation

PRINCIPAL INVESTIGATOR: Dr. D. Linton, P.E.

A B S T R A C T

A simulation method is developed for estimating any quantity defined in terms of a multiple integral with variable limits of integration (which may be infinite). The procedure evaluates multiple integrals by sampling uniformly over the multi-dimensional volume defined by the original region of integration and employing the sample variance (associated with Monte Carlo Methods) to obtain a probabilistic representation for the error. The calculation of detection probabilities for a proximity fuze is used to illustrate the results (as well as to show how such problems arise) and comparisons with alternative solution procedures (e.g., Gaussian quadrature, transformation methods) are discussed.

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TITLE: A Comparative Analysis of the Revenue Requirements Principle with the Annual Equivalent Method in Public Utilities

PRINCIPAL INVESTIGATOR: Dr. C. S. Park, P.E.

A B S T R A C T

This paper examines in a purely formal and descriptive manner the relations which exist between the revenue requirements and the annual equivalent cost method. The desirability of using the annual equivalent cost method is addressed as a decision criterion for selecting among mutually exclusive alternatives. Submitted to the Engineering Economist for possible publication.

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TITLE: Case Study: A Buy vs Lease Decision on Automobiles

PRINCIPAL INVESTIGATOR: Dr. C. S. Park, P.E.

A B S T R A C T

One of the more rapidly expanding areas in industry is leasing. It has become, in recent years, a major alternative for debt financing, and is used extensively in connection with the acquisition of automobiles.

A case study is prepared to stimulate a class discussion on buying vs leasing automobiles in a realistic decision environment. Several methods were analyzed for evaluating lease financing in relation to debt financing. The decision to lease or debt purchase were on the basis of the after-tax rate of return on incremental investment.

* * * * *

TITLE: Stochastic Benefit-Cost Analysis

PRINCIPAL INVESTIGATOR: Dr. C. S. Park, P.E.

A B S T R A C T

This paper presents the simulation technique to handle stochastic benefit-cost ratio by assuming a variety of probability distributions of benefit and cost elements. Also discussed is a development of a benefit-cost profile of the differences between two alternatives so that one can ascertain the probability that one alternative will be more attractive than the other. Approximation formulas for the analytical solutions have been examined and compared with the simulation results to more accurately assess the probable impact of utilizing a risk analysis approach in public investment situations.

Presented to Second National Conference for Computers and Industrial Engineering, Chicago, Illinois, March, 1979 and submitted to the Journal of Computers and Industrial Engineering for publication.

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TITLE: The Effectiveness of Using Uncertainty Resolution to Measure Investment Flexibility in a Sequential Capital Rationing

PRINCIPAL INVESTIGATOR: Dr. C. S. Park, P.E.

A B S T R A C T

The manner in which the uncertainty associated with a prospective investment is resolved over the investment's life is an important consideration in judging the desirability of that investment. This paper presents a method for incorporating the idea of uncertainty resolution regarding an investment's flexibility with the traditional measures of investment worth, profitability and variability. The resulting investment criterion is a single index that is referred to as the Project Balance Criterion.

To test the effectiveness of this new criterion for probabilistic cash flows, the Project Balance Criterion is compared to the traditional Mean-Variance criterion for a sequential decision process. This comparison is made for a number of different investment settings. In addition, the improvement in project selection that is possible when future cash flows are certain is contrasted with the results of applying the Project Balance Criterion to probabilistic cash flows. This paper has been accepted for publication in the AIIE Transaction.

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TITLE: Evaluation of Proposed R & D Projects

PRINCIPAL INVESTIGATOR: Dr. Gary E. Whitehouse, P.E.

A B S T R A C T

A survey of the literature on R & D project selection reveals a large number of models and techniques which have been proposed. The different methods evaluate various aspects of the project proposal in determining the relative merit in terms of benefit criteria.

While the techniques available are numerous, few have been tested in application sufficiently enough to say which is the most useful. In fact, it is doubtful whether any one model is applicable in all situations. Rather, the evaluation criteria depend heavily on the goals and objectives of the department involved.

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TITLE: Genres: An Extension of Brooks Algorithm for Projecting Scheduling with Resource Constraints

PRINCIPAL INVESTIGATOR: Dr. Gary E. Whitehouse, P.E.

A B S T R A C T

In project scheduling by network analysis, traditional critical path methods fail to include resource considerations. Other methods must be used to allow for resource considerations. This article explores one area of resource considerations: project scheduling under resource constraints. The specific case investigated is the single resource, single project schedule. A model, entitled the GENRES search model, is developed. The model utilized Brooks Algorithm (BAG) to generate the project schedule. The criteria used are various weighted combinations of ACTIM and ACTRES (Bedworth, Industrial Systems). The best project schedule is that which gives the least project duration.

The GENRES model was found effective in finding project durations equal to or less than that of ACTIM, ACTRES, or TIMRES (the combination of ACTIM and ACTRES with each given equal weight). The research also found that when the project completion time found by the algorithm approaches the critical path duration, resource leveling may be preferred.

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TITLE: Solving I.E. Problems on Small Computers

PRINCIPAL INVESTIGATOR: Dr. G. E. Whitehouse, P.E., Dr. C. S. Park, P.E., and Dr. Y. A. Hosni, P.E.

A B S T R A C T

With the advent of small inexpensive computers such as TRS-80 computer, it is felt that many small Industrial Engineering Departments will be buying such computers. The department is developing software packages written in BASIC to solve traditional Industrial Engineering problems on small computers. It is expected that the department will edit a column for the Industrial Engineering Magazine with these projects.

To date, projects include assembly line balancing, critical path analysis, make vs. buy decisions, equivalent annual cost, work sampling analysis and linear programming.

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TITLE: Energy Management Feasibility Study Via Computerized System

CANDIDATE: Musaid A. Far-Musaid

FACULTY ADVISOR: Dr. Yasser Hozni, P.E.

A B S T R A C T

This report evaluates the economic Feasibility of installing Energy Management System (EMS) in existing facilities using developed computerized methodology.

Factors affecting the feasibility of retrofitting existing facilities to EMS are identified and explained. Classification of EMS by type, technical specification and characteristics are discussed. The developed method uses a life cycle cost economical model in surveying a great number of existing facilities, as well as measuring the sensitivity of the model.

The method used enables analysts to consider large numbers of indirect variables and their effect in models built with a limited number of parameters. It involves building and interface between the indirect and model variables before evaluating its value. The method was formulated analytically and a computer system developed to facilitate its usage. The system was tested successfully using some facility categories in the State of Florida.

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TITLE: A Case Study of a Solar Augmented Heating System Versus a Solar Assisted Heat Pump

CANDIDATE: Louis F. Bralaski

FACULTY ADVISOR: Dr. Harold I. Klee, P.E.

A B S T R A C T

The usage and applications of solar energy are numerous; however, it's still in its infancy. The subject matter discusses two applications of solar energy, a "Solar Augmented Heating System" and a "Solar Assisted Heat Pump."

ABSTRACTS OF MASTER'S DEGREE RESEARCH REPORTS AND THESES

TITLE: Energy Management Feasibility Study Via Computerized Systems

CANDIDATE: Hussein A. Ben-Hussein

FACULTY ADVISOR: Dr. Yasser Hosni, P.E.

A B S T R A C T

This report evaluates the economic Feasibility of installing Energy Management Systems (EMS) in existing facilities using developed computerized methodology.

Factors affecting the feasibility of retrofitting existing facilities to EMS are identified and explained. Classification of EMS by type, technical specification and characteristics are discussed. The developed method uses a life cycle cost economical model in surveying a great number of existing facilities, as well as measuring the sensitivity of the model.

The method used enables analysts to consider large numbers of indirect variables and their effect in models built with a limited number of parameters. It involves building and interface between the indirect and model variables before evaluating its value. The method was formulated analytically and a computer system developed to facilitate its usage. The system was tested successfully using some facility categories in the State of Florida.

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TITLE: A Case Study of a Solar Augmented Heating System Versus a Solar Assisted Heat Pump

CANDIDATE: Louis P. Braleski

FACULTY ADVISOR: Dr. Harold I. Klee, P.E.

A B S T R A C T

The usage and applications of solar energy are numerous; however, it's still in its infancy. The subject matter discusses two applications of solar energy, a "Solar Augmented Heating System" and a "Solar Assisted Heat Pump."

The solar augmented system and the solar assisted system have the same components; however, the way they are used is a primary concern. A solar system in parallel with a heat pump is called "Solar Augmented Heating System" or in series with a heat pump is a "Solar Assisted Heat Pump."

A 2000 ft² house was utilized as the basis of the design. The heating load was calculated from the construction materials. With this information the collector area, tank volume and heat pump size were determined. Once the system size and design was completed, TRNSYS, a "Transient Simulation Program" was used to simulate the two systems. A comparison was made of the two systems for a 21 day period to determine which of the two systems is more advantageous to us.

* * * * *

TITLE: A Co-op Advertising Information System

CANDIDATE: Kay C. Gardner

FACULTY ADVISOR: Dr. Yasser A. Hosni, P. E.

A B S T R A C T

This report presents the development of a business information system for co-op advertising. An underlying assumption is that information systems add value to an organization. It is an application of data bank theory, and demonstrates the techniques required to maintain a current information system, i.e., add, change, and delete capabilities. The master file is sequentially accessed to produce reports by participation percentage, classification, or expiration date.

* * * * *

TITLE: Validation of a Transient Simulation Program (TRNSYS)

CANDIDATE: Brian F. Goldiez

FACULTY ADVISOR: Dr. Harold Klee, P. E.

MECHANICAL ENGINEERING AND AEROSPACE SCIENCES
DEPARTMENTAL REPORT

A B S T R A C T

Although a Transient Simulation Program (TRNSYS) has become a widely used model for simulating a solar energy system, little effort has been devoted to validating this model with actual data. The approach used to validate TRNSYS consisted of using actual data from a solar hot water heating system at the University of Central Florida.

TRNSYS compared favorably with experimental data. The average error for an entire 8 hour simulation with 15 minute intervals was only 3.39 percent for the entire tank and collector combination. The model's major deviations were in the start-up collector outlet temperature and rapid changing in actual hot water demand which the model could not match primarily in amplitude and not phase.

TITLE: A Heuristic Approach for the Scheduling Technical Training Courses in the U.S. Navy

CANDIDATE: William H. Lindahl

FACULTY ADVISOR: Dr. Chris S. Bauer, P. E.

A B S T R A C T

The generation and maintenance of feasible schedules for Navy training courses are labor intensive throughout the Naval Education and Training Command. The major constraints affecting this scheduling are planned input requirements and the suitability/availability of instructors, equipment, and facilities. An addition constraint is that the schedules must be established for the current year, updated and revised as necessary, and projected for the out-year planning requirements of the 5-year Defense Plan.

This thesis documents the essential components of scheduling for training at a representative training center, the Fleet Anti-Submarine Warfare Training Center, Pacific. It provides details for the automation of the current scheduling process, with a limited demonstration for a sample of courses. Conclusions and recommendations for the development of an automated optimal scheduling system are presented.

TITLE: Analysis of System Reliability as a Capital Investment

CANDIDATE: Albert J. Williams

FACULTY ADVISOR: Dr. Harold Klee, P.E.

A B S T R A C T

This report, "Analysis of System Reliability as a Capital Investment", is an analysis of radar system reliability of two similar tracking radar systems as a capital investment. It describes the two tracking radar systems and calculates the mission failure rates based upon field failure data. Additionally, an analysis of a simulation program written in FORTRAN is performed which treats system reliability as a capital investment based on 335 electronic systems that were fabricated with a reliability program versus 564 electronic systems fabricated with a reliability program versus 564 electronic systems fabricated without a reliability program. The data from the two tracking radar systems, one with a reliability program and the other without, is incorporated in the computer program to verify the conclusions of the author of the computer simulation program.

CANDIDATE:

William H. Lindahl

FACULTY ADVISOR:

Dr. Chris S. Hawes, Ph.D.

This thesis documents the essential components of scheduling for training at a representative training center, the Fleet Anti-Submarine Warfare Training Center, Pacific. It provides details for the automation of the current scheduling process, with a limited demonstration for a sample of courses. Conclusions and recommendations for the development of an automated optimal scheduling system are presented.

MECHANICAL ENGINEERING AND AEROSPACE SCIENCES
DEPARTMENTAL REPORT

Chairman: B. E. Eno

Faculty: J. K. Beck, P. J. Bishop, K. K. Chang, R. D. Evans,
A. H. Hagedoorn, E. R. Hosler, B. G. Nimmo, A. Minardi,
C. E. Nuckolls, R. C. Rapson, W. F. Smith, A. M. Varney,
G. G. Ventre, D. B. Wall, H. E. Worbs

The faculty of the Mechanical Engineering and Aerospace Sciences Department continued to develop its academic and research programs during the 1978 - 79 year. During the year, Dr. P. J. Bishop and Dr. E. R. Hosler joined the faculty. Dr. Bruce G. Nimmo continued a third year's leave of absence at the University of Petroleum and Minerals, Dhahran, Saudi Arabia, to assist them in the development of their academic and research programs. Dr. Gerard G. Ventre continued a leave of absence as Director of Education and Information Systems at the Florida Solar Energy Center. Dr. Ronald D. Evans was on faculty development leave at Louisiana Tech University. Dr. D. B. Wall began a leave of absence in January, 1979.

The faculty continued to be active in creative, sponsored research, professional development, and public service activities. The faculty continued technical and professional activities in ASME, AIAA, ASCE, ASM, ASEE, ACS, FES, NSPE, SPE, ISES, SWE, and ASA. Of the 16 current faculty in the department, 12 are now registered professional engineers in the State of Florida. The faculty also participated in numerous civic, educational, and community service activities at the local, state, and national level.

The ASME Student Chapter, under the continued leadership of Dr. Nuckolls, had another banner year. The students designed and built a small 8-horsepower single passenger amphibian vehicle which won the over-all competition in the 1979 Mini-Baja Competition in Tampa, Florida. In October, 1978, students A. Kevin Stoppello, Robert Anderson, S. Frank Kirkconnel, and Emmett Peter, III received an award in the James F. Lincoln Arc Welding Foundation Design Competition. Their work was also supervised by Dr. Nuckolls.

Dr. Burton E. Eno, formerly of the University of South Dakota, assumed his duties as Chairman of the MEAS Department in July, 1979. Dr. J. P. Hartman, who was the Acting Chairman for 1978 - 79, embarked on his new duties as the Assistant Dean of the College of Engineering at that time.

PUBLICATIONS AND PRESENTATIONS OF PROFESSIONAL PAPERS

1. HAGEDOORN, A. H. "Air Cargo: An Integrated System View." NASA Langley Research Center, August 11, 1978.
2. MINARDI, A. and CHANG, K. K. "A Mobile Solar Testing Facility." Southeastern Seminar on Thermal Sciences, Florida Atlantic University, Boca Raton, May 10 - 11, 1979.
3. RAPSON, R. C., Jr. "Modified Maximum Likelihood Estimation Techniques Applied to Pilot Modeling." UCF-EIES Report to NASA, July, 1978.
4. RAPSON, R. C., Jr. "Pilot Modeling Using Modified Maximum Likelihood Estimation." NASA/ASEE Summer Faculty Research Institute, Stanford University, Stanford, CA, 1978.
5. VARNEY, A. M. and KITCHEN, T. D. "Flame Weapons Lethality Methodology." Air Force Armament Test Laboratory, AFATL-TR-78-90, August, 1978.
6. VARNEY, A. M. and KITCHEN, T. D. "Feasibility of Assessing Aerial Gunnery Accuracy." Air Force Armament Test Laboratory, AFATL-TR-79-19, February, 1979.
7. VARNEY, A. M. "Flame Weapons Lethality." JMEM Incendiary Meeting, Naval Surface Weapons Center, White Oak, MD, July, 1979.
8. VARNEY, A. M. "Aerial Gunnery Assessment Systems." 18th Annual Air-to-Air Gunnery Meeting, JTCG, Los Angeles, CA, January, 1979.
9. VARNEY, A. M. "Energy Assessment and Coal Conversion Potential of Industrial Combustion Systems in Florida." Industrial Coal Utilization Symposium, DOE, Pittsburgh, PA, April 3, 1979.
10. ASCE Southeastern District Meeting, Raleigh, NC, April 1 - 3, 1979, "Professional Development for Engineering Faculty." (Kerston/Bartman)
11. Liberal Studies Division Session, ASCE Annual Meeting, June, 1978, "CEP, ISD, and the LEO." (Bartman)
12. ASCE 78, ECF, Orlando, FL, August 7, 1978, "Underground Water Resources." (Bartman)
13. Teaching Solar Energy Winter Workshop '79, Cape Canaveral, FL, January 18, 1979, "Energy Through History." (Bartman)
14. ASCE Southeast Regional Student Conference, ECF, Orlando, FL, May 17, 1978, "Our American Civil Engineering Heritage." (Bartman)
15. Humanities in America Conference, Jacksonville Beach, FL, March 31, 1978, "Historic Engineering Works in Florida." (Bartman)

CONFERENCES, WORKSHOPS, SHORT COURSES AT
WHICH RESULTS OF RESEARCH WERE COMMUNICATED

1. Southeastern Seminar on Thermal Sciences, Florida Atlantic University, Boca Raton, FL, May, 1979, "UCF Mobile Solar Testing Laboratory." (Chang/Minardi)
2. Citizen's Energy Workshops, various locations, Florida Power Energy Workshop for Management, St. Petersburg, FL, February, 1979; Energy Exposition, Gainesville, FL, March, 1979; Energy Conservation in Education for Elementary School Teachers, Seabring, FL, January, 1979. (Hagedoorn)
3. Naval Nuclear Power School, Orlando, FL, "Seminar on Boiling Heat Transfer." (Hosler)
4. American Institute of Mining, Metallurgical, and Petroleum Engineers Conference, Denver, CO, February, 1978, "Early Formation of Alumina in Liquid Iron." (Minardi)
5. NASA/ASEE Symposium, NASA Ames Research Center, Mountain View, CA, August 8, 1978, "Pilot Modeling Using Modified Maximum Likelihood Estimation." (Rapson)
6. Joint Munitions Effectiveness Meeting Incendiary Meeting, Naval Surface Weapons Center, White Oak, MD, July, 1979, "Flame Weapons Lethality." (Varney)
7. 18th Annual Air-to-Air Gunnery Meeting, Los Angeles, CA, January, 1979, "Aerial Gunnery Assessment Systems." (Varney)
8. Industrial Coal Utilization Symposium, Pittsburgh, PA, April 3, 1979, "Energy Assessment and Coal Conversion Potential of Industrial Combustion Systems in Florida." (Varney)
9. ASEE Southeastern Section Meeting, Raleigh, NC, April 1 - 3, 1979, "Professional Development for Engineering Faculty." (Kersten/Hartman)
10. Liberal Studies Division Session, ASEE Annual Meeting, June, 1978, "CLEP, TSD, and the LSD." (Hartman)
11. SEEK 78, UCF, Orlando, FL, August 7, 1978, "Underground Water Resources." (Hartman)
12. Teaching Solar Energy Winter Workshop '79, Cape Canaveral, FL, January 18, 1979, "Energy Through History." (Hartman)
13. ASCE Southeast Regional Student Conference, UCF, Orlando, FL, May 10, 1979, "Our American Civil Engineering Heritage." (Hartman)
14. Humanities in America Conference, Jacksonville Beach, FL, March 31, 1979, "Historic Engineering Works in Florida." (Hartman)

RESUMES OF SPONSORED RESEARCH

TITLE: An Initial Study of Turbulence Level Correlation with Laser Beam Scatter

PRINCIPAL INVESTIGATOR: Mr. J. K. Beck, P.E.

SPONSORING AGENCIES: Division of Sponsored Research and UCF - EIES

GRANT NUMBERS: 18-2000-001 and 11-1699-029

A B S T R A C T

The initial effort is aimed toward the experimental establishment of nearly isotropic homogenous flow fields of known turbulence intensities. It is then desired to propagate a laser beam through the turbulent stream and determine a possible correlation between the statistics of the laser beam scatter with the level of turbulence intensity.

* * * * *

TITLE: Solar-Activated Dessicant System Evaluation

PRINCIPAL INVESTIGATOR: Mr. J. K. Beck, P.E.

SPONSORING AGENCY: Florida Solar Energy Center

GRANT NUMBER: 11-1626-013

A B S T R A C T

A brief experimental program was conducted to obtain some preliminary effectiveness data. The final report has been transmitted to the Florida Solar Energy Center. A proposal was prepared for submission to the U. S. Department of Energy for continued support.

* * * * *

TITLE: Evaluation of Energy Use in the Citrus Industry

PRINCIPAL INVESTIGATOR: Dr. P. Bishop, P.E.

SPONSORING AGENCY: UCF - EIES

GRANT NUMBER: 11-1699-014

A B S T R A C T

The Citrus Industry is an important employer and energy consumer in the State of Florida. A project was established so that UCF could work with the Industry to assist in evaluating and reducing energy consumption.

A representative citrus processing plant combining single strength and frozen concentrate was chosen for an evaluation of its energy use. There are 41 plants of this size in the State. The plant uses approximately \$2 x 10⁶/yr. for oil, gas, and electricity.

Selected processes were the most energy intensive including the boiler, freeze tunnel and freezer rooms, and the peel dryer. Use of heat exchangers (preheaters, economizers), adequate insulation, complete re-design of the freeze tunnel, and other assorted energy conservation measures such as re-use of water condensate and repairing steam leaks, could reduce energy consumption by approximately 1/3 in the plant.

* * * * *

TITLE: Development of the UCF Mobile Solar Testing Laboratory

PRINCIPAL INVESTIGATOR: Dr. K. K. Chang, P.E. and Mr. A. Minardi

SPONSORING AGENCY: UCF - EIES

GRANT NUMBER: 11-1699-019

A B S T R A C T

A fully automated monitory system to obtain dynamic data of solar hot water system is being developed. The data include solar radiation, load flow, mass flow, wind speed and direction, collector inlet, outlet and plate temperature, storage tank temperature, and ambient temperature.

The temperature readings can be taken by means of multiplexing. The load flow rate, mass flow, back energy flow, and solar input will be integrated through the use of Analog-frequency analog design technique.

A written computer program will be used to analyze these data and evaluate the solar systems. The aim is to find the most efficient solar collector brands and ways of installation and control.

The design stage for the automated system has been completed. The system will be able to calculate solar panel and system efficiency with a minimum use of manpower. Contact has been made with several owners of solar hot water systems who have expressed an interest in participating in this project.

* * * * *

TITLE: Energy Management Systems for State Buildings

PRINCIPAL INVESTIGATOR: Dr. R. D. Evans P.E. and Dr. R. D. Doering, P.E.

SPONSORING AGENCY: Florida Department of Administration, State Energy Office

GRANT NUMBER: STAR Project 77-7023 and 11-1624-002

A B S T R A C T

All State owned or operated buildings with exception of schools K thru 12 were subjected to an evaluation for incorporating Computed Based Energy Management Systems on the basis of a profile of energy usage, physical suitability of facilities for installation of EMS on Heating Ventilating and Air Conditioning (HVAC) Systems. The primary screening analysis was on the basis of Life Cycle Cost (LCC) economics. To be recommended a candidate project was required to have a LCC payback period of less than the estimated life of the facility. The LCC model incorporated projected escalation of fuel cost and inflation factors and 6% interest rate. A sensitivity analysis was used to determine the most critical cost items in the LCC analysis.

Concurrently the performance of existing EMS designs were investigated to match their physical and economic requirements with the types of State building operations. The study provided performance specifications and cost guidelines for several categories of EMS, ranging from localized open loop control to computer based feedback systems to accomodate the spectrum of State building applications.

To ensure its utility the study culminated in recommendations for EMS in specific State buildings by major operating departments such as Universities, Community Colleges, Prisons, Health & Rehabilitative Services (HRS), and Office Buildings. A summary of the phase one recommended projects showed estimated net annual savings of \$515,000 with an investment cost of \$2,140,000 for an overall payback period of about 4 years. The State Energy Office has incorporated these projects into the budget for consideration by the State Legislature.

* * * * *

TITLE: Effects of Shock on Fiber-Optic Hydrophones and Data Transmission Components

PRINCIPAL INVESTIGATOR: Dr. Charles Nuckolls, P.E.

SPONSORING AGENCY: Naval Research Laboratory

GRANT NUMBER: 10-1626-003

A B S T R A C T

Investigation and development of techniques for performing simple shock tests on optical and acousto-optical devices to be used in underwater environments. Designed fabrication of a shock tube test facility.

* * * * *

TITLE: Pilot Modeling Using Simulation and Modified
Maximum Likelihood Estimation

PRINCIPAL INVESTIGATOR: Dr. R. C. Rapson, P.E.

SPONSORING AGENCY: NASA

GRANT NUMBER: 10-1626-002

A B S T R A C T

A proposal was prepared and submitted to the National Aeronautics and Space Administration to further investigate identification of the human pilot model utilizing modified maximum likelihood estimation (MMLE). It was proposed to use the aircraft simulator of the College of Engineering computer lab to generate a data base for various tasks. From this data base, digital programming and MMLE would be used to identify dynamic and static parameters. Proper understanding of simulator generated data would lead to utilization of actual flight data to obtain transfer functions for pilots of various tasks.

* * * * *

TITLE: Energy Assessment and Coal Conversion Potential
of Industrial and Commercial Combustion Systems

PRINCIPAL INVESTIGATOR: Dr. M. A. Varney, Mr. H. E. Worbs, P.E., and
Ms. L. Tuliano, E.I.

SPONSORING AGENCY: Florida State Energy Office

GRANT NUMBER: 11-1626-015

A B S T R A C T

The University of Central Florida, Department of Mechanical Engineering is currently under contract to conduct a technical industrial assessment of the possibilities for significant energy savings in the industrial and commercial sector through the conversion of current liquid fueled systems to systems burning coal and coal-oil-mixtures. Specifically, the project performance is being conducted over a period of nine months and consists of the following major tasks:

Task I (Four Months) A broad engineering study aimed at identifying the major industrial and commercial users of fossil fuels in the State of Florida.

Task II (Three Months) An economic analysis to estimate the annual oil-equivalent energy savings achievable by the conversion of present systems to coal/coal-oil-mixture systems.

Task III (Two Months) The results of the project will be formulated into a broad set of specific recommendations for implementation of a coal conversion plan consistent with the State's Energy Doctrine.

The project is scheduled for completion in September, 1979.

* * * * *

TITLE: State Technology Applications Center (STAC)
PRINCIPAL INVESTIGATOR: Mr. H. E. Worbs, P.E.
SPONSORING AGENCIES: NASA/SUS STAR/Florida Department of Commerce
GRANT NUMBER: 11-1610-001

A B S T R A C T

A joint project of the State University System, NASA, and the Florida Department of Commerce, STAC is a computer based information retrieval system which offers users rapid access to NASA and other data bases storing data on more than ten million published articles related to virtually every field of human endeavor. This service to business and industry is available through field offices of the Department of Commerce and the Engineering Colleges at UCF, USF, and UF.

* * * * *

RESUMES OF UNSPONSORED RESEARCH

TITLE: Digital Temperature Dependent Permeability Studies for Improved Enhanced Recovery of Oil by Steamflood Processes

PRINCIPAL INVESTIGATOR: Dr. Ronald D. Evans, P.E.

A B S T R A C T

An investigation has been initiated to determine the influence of temperature dependent permeabilities upon the prediction of ultimate oil recovery by steam-flood processes. A literature survey has been completed and a proposal prepared and submitted to the U. S. Department of Energy for funds to carry out a computer and experimental study of this phenomena.

* * * * *

The development of the differential equations describing the influence of various primary plant components on the dynamics of the reactor have been heretofore documented in the literature. Finite difference equations facilitating the employment of a digital computer solution are fully derived.

Confidence in program validity is supported by the simulation of previously studied accidents and comparison with the safety analyses of a licensed nuclear power generating plant.

A source listing of the computer program is provided in the Appendix.

* * * * *

TITLE: A Computer Model for Comparison of Flat Plate and Focusing Collectors for Solar Air Conditioning

CANDIDATE: H. E. Bucher, Jr.

FACULTY ADVISOR: Dr. Ronald D. Evans, P.E.

A B S T R A C T

Two types of solar collecting systems are frequently employed -- flat plate collectors with spectrally selective windows which trap sunlight with the "greenhouse effect" and focusing systems with curved mirrors which concentrate the sun's rays on an absorbing surface. The flat plate collector is the simpler of the two designs, but cannot readily

ABSTRACTS OF MASTER'S DEGREE RESEARCH REPORTS AND THESES

TITLE: Digital Computer Analysis of the Kinetic Response of a Thermal Pressurized Water Reactor Power Plant

CANDIDATE: John F. Alburger

FACULTY ADVISOR: Dr. Donald B. Wall, P.E.

A B S T R A C T

A digital computer model has been developed to simulate the kinetic response of a thermal pressurized water reactor power plant. The program is capable of predicting core power and plant temperature variations which result from disturbances due to routine demand changes, control rod movement, and fission product poison transients as well as from transients during plausible accident situations.

The development of the differential equations describing the influence of various primary plant components on the dynamics of the reactor have been heretofore documented in the literature. Finite difference equations facilitating the employment of a digital computer solution are fully derived.

Confidence in program validity is supported by the simulation of previously studied accidents and comparison with the safety analyses of a licensed nuclear power generating plant.

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provide temperatures as high as the focusing collector. Both of these collectors are candidates for absorption cycle solar air conditioning systems. This role dictates higher temperatures than are normally required of solar collectors, particularly the flat plate design. Focusing systems of interest here are those which are fixed in orientation and require no elaborate solar tracking mount. Such collectors might be economically competitive with flat plate configurations if the higher energy "quality" or delivery temperature they can provide permitted a smaller installation than would be possible with a flat plate collector. An analysis of the two collector candidates is undertaken here to assess the merits of a fixed orientation focusing collector and a more traditional flat plate system. This analysis indicates that the focusing design is superior to the flat plate for solar air conditioning.

The study of the two designs includes selection of system configurations and the development of their mathematical descriptions. The analytical approach was to incorporate mathematical models of the collectors into a computer program which predicts the performance of both the flat plate and focusing systems. The program has been designed to permit convenient variation of important parameters so that their effect on collector performance may be determined. The results of the collector analysis and the computer program are presented with sufficient information to permit the reader to use the program for his own analyses.

* * * * *

TITLE: An Analysis of the Effect of Vibration Sensitivity on Hydrophone Design

CANDIDATE: George Dickson Hugus, III

FACULTY ADVISOR: Dr. Richard C. Rapson, Jr., P.E.

A B S T R A C T

Hydrophones used in the ocean produce spurious outputs due to vibration sensitivity which can severely degrade measurement accuracy. Sources of these vibration inputs are ocean surface waves, flow turbulence, and induced mechanical vibration. The hydrophone response to these vibrations is a noise voltage output. This can lead to a signal-to-noise problem particularly when measurements of small sound pressure levels are to be made. The objective of this thesis is to analyze the vibration response of three typical piezoelectric hydrophone sensor elements configurations and give design methods and constraints for reducing the problem of vibration sensitivity to an acceptable level. The sensor element configurations analyzed are the radially polarized cylindrical shell, radially polarized spherical shell, and axially polarized cylindrical shell. The analysis is carried out due to two causes. An electro-mechanical analysis is given of the voltage sensitivity of each of the three sensor configurations to the inertial effect of acceleration inputs.

The second effect analyzed is the voltage sensitivity of a pressure sensitive sensor element to the hydrostatic pressure amplitude caused by periodic vertical displacement of a hydrophone. Results of the analyses show that the radially polarized cylindrical and spherical shell configurations have zero acceleration sensitivity to inputs on the axes analyzed. An equation is derived for the axial acceleration sensitivity of the axially polarized cylindrical shell in terms of the equivalent sound pressure. The analysis of hydrophone sensor response to periodic vertical displacements shows high voltage sensitivity to very small displacement amplitudes. Data is given for the maximum permissible vertical displacement amplitude to produce a 20 dB signal-to-noise ratio. Based on these analyses, design considerations are given to minimize hydrophone vibration sensitivity.

* * * * *

TITLE: A Computer Program for Analyzing Moist Air in Fin and Tube Crossflow Heat Exchangers

CANDIDATE: Robert F. Stricker

FACULTY ADVISOR: Dr. Kwei-Kwang Chang, P.E.

A B S T R A C T

A computer model of a fin and tube air-to-air heat exchanger is presented. The model incorporates a computational scheme to account for latent effects due to small amounts of moisture in one or both fluid streams. A testing program is described which was performed in order to mathematically characterize the heat transfer and pressure drop relationships of the tube with turbulator used in the heat exchanger. These relationships are included in the computer model. A comparison of the computer model to heat exchanger test data indicates that the computer model may be relied upon to provide design and analysis information. Finally, a parametric study is performed using the computer model in order to explore the characteristics of the heat exchanger and to demonstrate its usefulness to the heat exchanger designer. It is concluded that, in addition to presenting an analysis tool for heat exchanger design, there are several important secondary results. These include: verification of the modelling technique, the analytical description of the tube with turbulator and identification of a problem area in the header design.

* * * * *

TITLE: The Design and Analysis of a Unique Broadband Underwater Acoustic Source

CANDIDATE: Allan Mark Young

FACULTY ADVISOR: Dr. Richard C. Rapson, Jr., P.E.

A B S T R A C T

Requirements exist for a unique type of underwater acoustic source. The transducer is in the form of a linear array of discrete elements and is required to have a constant transmitting voltage response and carefully controlled directivity characteristics over a two octave bandwidth. A generalized model of a linear array of cylindrical piezoelectric ceramic acoustic radiators is developed and applied to the design of a prototype which operates over approximately one half of the required bandwidth. The prototype transducer was built and the measured results are compared with those predicted by the model. Recommendations are made for improving the performance of both the prototype and the array required to meet the full bandwidth specified.

A B S T R A C T

A computer model of a fin and tube air-to-air heat exchanger is presented. The model incorporates a computational scheme to account for latent effects due to small amounts of moisture in one or both fluid streams. A testing program is described which was performed in order to mathematically characterize the heat transfer and pressure drop relations of the tube with turbulator used in the heat exchanger. These relationships are included in the computer model. A comparison of the computer model to heat exchanger test data indicates that the computer model may be relied upon to provide design and analysis information. Finally, a parametric study is performed using the computer model in order to explore the characteristics of the heat exchanger and to demonstrate its usefulness to the heat exchanger designer. It is concluded that, in addition to presenting an analysis tool for heat exchanger design, there are several important secondary results. These include: verification of the modeling technique, the analytical description of the tube with turbulator and identification of a problem area in the heat exchanger design.

included for evaluation and such as the condensation mass flow rate and latent heat effects as activities contribute to overall heat transfer. The overall heat transfer coefficient is calculated by using the cylindrical shell, radially polarized cylindrical shell, and the cylindrical shell. An analysis is carried out to determine the mechanical stresses in the shell and to determine the effect of the shell on the overall heat transfer.

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