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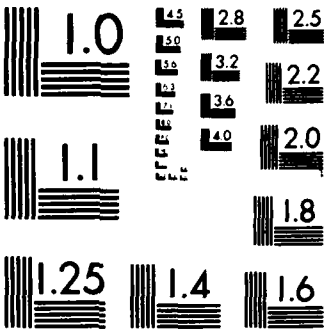

MICROCOPY RESOLUTION TEST CHART
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FINAL REPORT

Office of Naval Technology

1986 Postdoctoral Fellowship Program

N00014-83-D-0689

Administered by

American Society for Engineering Education

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Sammie Giles, Jr.

Introduction

This is the final report as a participant in the Office of Naval Tchnology 1986 Postdoctoral Fellowship Program (Program). In reasing this report, it is helpful to know that this fellow and his Naval advisor (Dr. S. R. Parker) established offices at the Lawrence Livermore Natinal Laboratory, and used the facilities there as the facilities of the host laboratory instead of the facilities of the Naval Postgraduate School. The Naval Postgraduate School, however, technically remained as the host lab for the administration of the Program.

This report contains discussions of the research support under the Program and of the technical work performed by this fellow. Some details of the technical work have already been submitted to ONT/ASEE in the third progress report. Only the technical papers pertinent to this discussion are submitted in this report. The report does not go into great detail on any topic. However, the work already submitted submitted or being should be consulted for details of the technical nature.

Research Support

Fellowship stipends under the ONT/ASEE Program appear sufficient for the conduct of scholarly activities and the support of the average fellow. However, it is advised that some improvements be made in the administration of stipend distributions. Either Federal taxes should be deducted for residents in the U.S. or timely information should be given well in advance on filing estimated taxes, since it is now known that these stipends are normally taxable. Though a large part of the work of this fellow could have taken

place at his home, the Laboratory facilities were more suitable; and, consequently, there was very little need to attempt to claim expenses under the Program as business expenses. To attempt to claim business expense deductions for tax purposes is not the best advise which could be given to fellows, in this fellow's opinion. More specific, sound tax advise is needed for participants.

No consulting for pay was performed under the Program and no expenditure for consulting work was made this year. Office and other supplies were provided by others. Travel to the host lab and to a conference was provided by the Program, the out-of-pocket expenses for which were reimbursed promptly. Educational expenses were paid by the host lab. This fellow incurred no expenses which could be easily considered business expenses.

As structured, the Program has provided adequate research facilities for the Naval interests of the fellow. In this fellow's case those facilities were provided through the Naval Postgraduate School personnel at Lawrence Livermore National Labs. State of the art equipment was used at this site. In the research conducted the computational systems, the measuring equipment and test equipment were very good. In addition, secretarial support and supplies were excellent. After obtaining a clearence, the library was conveniently accessilble and library material was readily available.

Other Program support included the insurance coverage, and extensions of the period of tenure. The insurance cover-

age for a single family was poor. It was simply not enough to sustain a fellow for a year; and each fellow should be given strong advise to this effect before accepting participation. Another very serious problem was the granting of extensions to complete research started under the Program. The exact time of completion is often not known four or five months in advance of the first scheduled termination date. Many things can occurr late in the work to postpone or advance this date; and, to provide for the eventuality of a postponement, some means should be provided for at least a three or four month extension when notice is given of a problem in a reasonable amount of time. In this fellow's case, a number of technical projects have been completed under the Program, but a lot of research is still being performed at the end of the Program. Important work completed is discussed in the next section.

Technical Work Compeleted

The areas where technical work was completed in the sense that the work was logically concluded are lattice modeling, layer-peeling and correlation filtering. In lattice modeling an unpublished paper, "Application of Lattice Filtering Techniques to CW Measured Time Domain Data," was written. This work treated the modeling of several monopole antennae (in the receiving mode). Partial correlation lattice models for the antennae were found by deducing the interdependencies of the received time signal data values. The partial correlation coefficients were used in structuring a lattice autoregressive model. This

model was the whitening filter model and was transformed via algebraic manipulations to the synthesis model. This synthesis filter was then used to produce a simulated signal from a proper input pulse to the filter. In addition to the monopole, data for a cavity backed spiral antenna were obtained and similar models derived.

In the layer-peeling efforts, experimental data was obtained for particle boards and for porous polyethylene dielectric scatterings in the EMPEROR (EMP Enginerring Research Omnidirectional Radiator) facility. The reflected signals from these materials were used in constructing a multi-layered medium model of the materials. The dielectric constant, location and thickness of variours combination of boards and poly-slabs were estimated. A computer algorithm based on layer-peeling was written to assist in the determination of the above parameters. To within 10% , the estimated values checked with the subsequently measured values. This technique enabled the identification of materials from signals scattered from them. Results of this method are in an unfinished unpublised paper, "Layer-Peeling A[pplied to EM Modeling."

Two papers on correlation filtering have been submitted to referred journals. One paper is on a filtering technique, "On a Circular Correlation Technique for Filtering Randomly Noisy Data." The other paper is on the additional pre-filtering processing to find order and period, "Dispersion Eigenvalue Determination of Order and Optimum Sampling

Period."

The interdependency of the critical region and the number of retained harmonics has been investigated and equations relating harmonics to size of the region have been produced in the case of the total correlation filtering technique. Additionally, a computer code to perform the filtering and to do other necessary tests for randomness and normality has been completed. A paper on this program has been written, "The Circular Serial Autocorrelation Computer Program."

Other areas where work has been done under the Program should also be mentioned. Firstly , a number of seminars have been presented where the results of the work have been discussed. Seminars have given on lattice modeling, correlation filtering, dispersion eigenvalue determination of order and layer-peeeling. Secnondly, noise estimation of the EMPEROR facility has been done, i.e., the coherence function for detecting linearity of the input-output relations for the facility was found. A usable frequency range for this important facility was determined. Lastly, results have been studied on the relations of reflection and partial correlation coefficients for scattered signals, which results are near the publication stage.

The following papers mentioned in the above discussion are included as a part of this report:

1) "On a Circular Correlation Technique for Filtering Randomly Noisy Data,"

2) "Application of Lattice Filtering Techniques to CW Measured Time Domain Data,"

3) "The Circular Serial Autocorrelation Computer Program."

Summary

Though there have beeen problems in participating as a fellow in the ONT/ASEE Program, there has not been a single debilitating concern. The Program basically is a good program which works has it is evidently intended to work. This fellow has been able to accomplish his basic research goals in signal processing under the Program.

Two modeling techniques have been studied and results obtained for each technique. Lattice modeling based on partial correlation coefficients has been treated, and layer-peeling modeling based on transmission line reflection coefficients has also been treated. A novel technique has been studied for filtering noisy data. This total circular autocorrelation based technique has been shown to filter down to 20 db SNR data. Finally, the above results have been presented in several technical seminars, submitted to technical journals and/or reported to the sponsoring agency.

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