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13. ABSTRACT (Maximum 200 words) The report summarizes results of the fifth and final year of the grant. Result obtained include development of nonparametric detectors for operation on dependent inputs; optimum quantization for use in envelope detection of narrowband signals; quantization techniques, including the problem of the optimum piecewise-constant representation of the Wiener filter frequency response; and an extension to the author's initial results on robust filters for correlated signals and noise. The report also lists publications which stemmed from the research.			
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FINAL TECHNICAL REPORT
OF ONGOING RESEARCH
ON
"STATISTICAL TECHNIQUES FOR
SIGNAL PROCESSING"

Supported by Grant AFOSR-77-3154 (2)

Grant Year: November 1, 1980 -
October 31, 1981

Report Date: December 1, 1981



Saleem A. Kassam
Principal Investigator

The grant year covered by this report began on November 1, 1980 and was the fifth year of continuing effort under the above grant. The progress made in the first four years of the effort has been described in four previous annual reports (December 1977, December 1978, December 1979 and December 1980). Here we summarize our activity in the fifth year of research on aspects of signal processing based on statistical theory. Several interesting new results have been generated, which are listed as references [1] - [9]. Copies of the references which are currently available and which have not been previously sent to AFOSR have been mailed separately.

Reference [1] is a dissertation which was completed early in the grant year. Its major focus was on the development of nonparametric detectors for operation on dependent inputs. References [2] and [3] are papers which were published this year, arising from results during the previous grant year.

An interesting set of results have been obtained this year on optimum quantization, for use in envelope detection of narrowband signals. This is of obvious interest in radar detection. Our results generalized some previous work in this area, and new quantization techniques were also analysed. Some of these results are contained in [4], and an extended version of this paper will soon be submitted for journal publication.

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MATTHEW J. KERPER
Chief, Technical Information Division

A different type of quantization problem has been considered in a recently published paper [5]. Here we considered the optimum piecewise-constant representation of the Wiener filter frequency response. Such representations are useful in applications such as in optical signal processing and image processing. Piecewise constant filters are easy to implement and update in adaptive systems, and turn out to yield surprisingly good performance with very few allowable levels. In addition, such implementations are inherently robust, as we have shown. The results in [4] and [5], along with new extensions, will be contained in a dissertation [6] which is in the final stages of completion.

In the past year we have also completed an extension to our initial results on robust filters for correlated signals and noise. These new results have recently been submitted for publication [7]. These new results on robustness are interesting because they extend earlier statistical theory into an area of signal processing for which no analog exists in statistical hypothesis testing. The results are also of practical significance whenever signals and noise can be correlated, e.g. in multipath communications. Also on Wiener filtering, results for a new class of signal and noise spectra (the extended p-point class) have recently been obtained. These will be presented at an upcoming conference [8].

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During this grant year the principal investigator was invited to prepare two papers (together with H. V. Poor). One [9] will be a review paper on robust signal processing, and is currently in preparation. It is anticipated that this will be completed early in 1982. A second paper for the IEEE Communications Society Magazine on robust filters will be begun soon. A presentation [10] was also made this year at a special invited session in the Institute of Mathematical Statistics annual meeting.

In the last part of this grant year, the principal investigator has also been engaged in collaborative research with a visiting scholar, who will be working with the principal investigator during the current grant year.

PERSONNEL SUPPORTED UNDER AFOSR GRANT

DURING THE PERIOD

NOVEMBER 1, 1980 to OCTOBER 31, 1981

Dr. Saleem A. Kassam, Principal Investigator
15% Academic Year, 2 months summer

A. Wu, Graduate Student (full-time)

L. Cimini, Graduate Student (one-third time)

REFERENCES

(List of Publications)

1. M. B. DonVito, "Signal Processing in an Uncertain Environment: Multivariate Techniques of Nonparametric and Robust Detection", Ph.D. Dissertation, Department of Systems Engineering, University of Pennsylvania, December 1980.
2. S. A. Kassam, "Robust Hypothesis Testing for Bounded Classes of Probability Densities", IEEE Trans. on Information Theory, Vol. IT-27, pp. 242-247, March 1981.
3. S. A. Kassam, "The Performance Characteristics of Two Extensions of the Sign Detector", IEEE Trans. on Communications Vol. COM-29, pp. 1038-1044, July 1981.
4. L. J. Cimini and S. A. Kassam, "Optimization and Performance of Quantization in Envelope Detection," Proc. IEEE International Conf. on Communications, pp.30.5.1-5, June 1981.
5. L. J. Cimini and S. A. Kassam, "Optimum Piecewise - Constant Wiener Filters," J. Optical Society of America, Vol. 71, pp. 1162 - 1171, October 1981.
6. L. J. Cimini, "Quantization in Filtering and Detection." Ph.D. Dissertation, Department of Electrical Engineering and Science, University of Pennsylvania, January 1982.
7. G. Moustakides and S. A. Kassam, "Robust Filters for Random Signals in Correlated Noise Under Spectral Uncertainty," IEEE Trans. Automatic Control (submitted).
8. S. A. Kassam, "Robust Wiener Filters for the Extended P-Point Class", 16th Annual Conference on Inform. Sciences and Systems, Princeton Univ., March 1982 (To be presented)
9. S. A. Kassam and H. V. Poor "Robust Techniques for Signal Processing: A Review", Proceedings IEEE, (Invited paper, in preparation).
10. S. A. Kassam, "Non parametric and Robust Signal Detection and Filtering", Institute of Mathematical Statistics, 175th Annual Meeting, May 1981. (Invited presentation).