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Data Compression Algorithms

FINAL REPORT

AFOSR Contract F49620-78-C-0087

May 1, 1978 to April 30, 1979

Robert M. Gray

SUMMARY OF RESEARCH

The principal accomplishment of the year was the completion of an experimental and theoretical study of an algorithm for the design of block (or vector) quantizers that are locally optimum in the sense of minimizing average distortion as measured by quite general distortion measures. The algorithm is based either on a probabilistic model of the source to be compressed or on a long sequence of training data produced by the source. This work was begun under AFOSR contract F-44620-73-C-0065 and its initial phases completed during the past year. The chief results were (1) The mathematical development of the fundamental properties of the algorithm and its convergence properties by Gray, Kieffer, and Linde [1], (2) An experimental study of the algorithm applied to (a) block quantizer design for Gaussian sources with the traditional mean squared error distortion measure, and (b) parameter vector quantization of normalized models in Linear Predictive Coded (LPC) speech compression systems using the Itakura-Saito distortion measure by Linde, Buzo, and Gray [2]. Variations of the speech compression algorithm were also reported in Buzo [3], Gray, Buzo, Matsuyama, Gray, and Markel [4], Buzo, Gray, and Gray [5], Buzo, Gray, Gray, and Markel [6]. This work has been in cooperation with J.D. Markel and A.H. Gray, Jr., of Signal Technology Incorporated of Santa Barbara, both world renowned experts in the "real world" and engineering aspects of speech compression. We feel this work constitutes a significant breakthrough in speech compression and this research will be continued under a new AFOSR contract. (3) The development of new performance bounds for block quantizers using difference distortion measures by

Yamada, Tazaki, and Gray [7]. These provide strict improvement over traditional bounds of rate distortion theory and provide a useful yardstick for comparing the performance of block quantizers designed using the algorithm described above.

Additional accomplishments were the completion and publication of the study of Fake Process tree coding systems developed under AFOSR contract F-44620-73-C-0065 by Linde and Gray [8], and the application of this technique by Matsuyama [9] to design a 6000 bps waveform tracking speech compression system. This work has not been actively pursued since because we feel the quantization techniques described above hold more process for low rate compression systems.

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(All supported by AFOSR)

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Ph.D. THESES SUPPORTED BY AFOSR

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