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Scanning the Issue

THE SPECIAL ISSUE ON REDUNDANCY REDUCTION

FOR a longer time than most of us can remember, communication engineers have been trying to compress more information into smaller and smaller bandwidths while at the same time pushing to exploit more frequency space. It has been a losing race against expanding demands. It was a great shock to many when it was proved long ago that modulation of a carrier necessarily produced sidebands, and thus that signals could not be sent in zero bandwidth.

For some time thereafter, there were attempts to beat nature, until the natural limits of noise and bandwidth were established. A sound scientific base for progress was set years ago by men like Hartley, Nyquist, and Shannon, and their work is still much noted and quoted. In due course, sound rules and sound limits were set, but the contest still goes on with ever more sophisticated means and ever more sophisticated demands. New frequency bands and transmission methods are still being opened up and new modulation and signal processing means are still being found.

This issue pays respect to the latter, i.e., new developments in signal processing which promise greater efficiency in the use of transmission means, bandwidth, and power. It was not by editorial intent that most of the papers herein have to do with processing pictures. Rather, it is because it is in this area that much effort is being focused, and progress is being made. The need is made more pressing by the advent of photographic space probes, where the cost as well as the means of communication is astronomical, and by the demands of closed circuit TV, with ever more demand for quality at a price. While most of the papers deal more or less directly with pictures, the techniques described have application to other forms of data.

This issue starts with a rather broad review of redundancy reduction techniques (Kortman), with particular application to processing of weather satellite cloud cover photographs. This is followed by several related papers (Hochman, Katzman, and Weber; and Andrews, Davies, and Schwarz) describing in more detail application of ideas presented in the first. There is some duplication in these papers, coming as they do from different laboratories, but the different points of view may serve the reader well.

Next we have several analytical studies of some redundancy removal techniques (Ehrman) and coding methods which, it is hoped, will help to set a solid base for future studies. One of these (O'Neal) presents some very useful bounds on possible signal-to-noise ratios for pulse coding methods, and two (Golding and Schultheiss; and Abate) discuss theoretically methods of coding which adapt to the signal statistics.

An extreme method of coding which adapts to the nature of the signal is given next (Bello, Lincoln, and Gish). This presents a tantalizing, rather idealistic concept, probably still far from system realization.

The next group of papers deals more specifically with picture transmission. The first (Schreiber) gives a broad description of many problems and methods of picture coding and, although it contains some rather controversial conclusions, will serve as a useful introduction to the subject for many who have not worked in the field. More detail on some specific systems is given in succeeding papers. The paper by Huang, Tretiak, Prasada, and Yamaguchi discusses parameter optimization for PCM transmission, including two-dimensional filtering. Graham carries two-dimensional coding further and finds advantages in contour emphasis.

Up to this point, the papers either have been theoretical, or have relied upon computer simulation for system tests. The final evaluation of a TV system requires real-time operation to show psychological effects of noise and motion, and the next group of papers do describe real systems.

Brainard describes some subjective evaluation of picture defects associated with feedback coding and relates the results to earlier theoretical studies. Thompson and Sparkes demonstrate the striking advantages of noise-dithering added to a quantized system, and Robinson and Cherry describe advantages of run-length coding. Two of these papers describe work in England, and a third comes from the other end of the Earth with a description by Limb of source-receiver encoding of TV signals, a kind of adaptive differential coding using subjective factors to optimize the coding.

The subjective factor is even more seriously considered in the Pearson paper, a more theoretical discussion of picture coding which accounts for the subjective characteristics of the viewer.

The remaining two papers are somewhat of a departure from the rest. The paper by White considers the statistics of printed English, and shows that transmission efficiency can be increased by a factor of two with fairly simple means. Schroeder, Flanagan, and Lundry, on the other hand, describe a computer simulation of a new and promising method of speech compression.

This issue is strongly applications oriented. After 19 years of information theory, with great quantities of highly theoretical treatises, it is good to see some real attempts to use what has been learned.

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