NEW CLASSES OF SYNCHRONOUS CODES

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PRECIS

This thesis deals with classes of fixed length binary codes which can be used for information transmission in a two-state channel. These codes are called synchronous codes.

The synchronous codes constructed here are in general more efficient than codes known to be in use at the moment*, for all possible code lengths. In fact, there is some similarity between the new codes and the less-restricted comma-free codes of Golomb, Gordon and Welch**.

Gilbert uses the technique of fixing certain positions in every code word to achieve synchronisation; in this thesis an entirely new technique of achieving synchronisation is developed, which allows the codes which use it to have high efficiency; the technique consists of constraining pairs of positions instead of fixing positions. The pure technique, which provides highly efficient codes for small code lengths, is developed first, and is used to construct synchronous codes analogous to certain well-known linear and cyclic codes (e.g. the Fire codes); then a hybrid technique is developed which gives high efficiencies for all other code lengths.

* E.N. Gilbert, 'Synchronisation of Binary Messages', I.R.E. Transactions on Information Theory, September, 1963.

** 'Comma-free Codes', Canadian Journal of Maths, 1958.

Precis (cont.).

Synchronous codes of even length are also developed, and these are shown to be only slightly less efficient than corresponding odd length codes.

Next, Gilbert's technique is generalised, and a class of codes is developed which is as efficient as any class of codes which uses a fixed position technique can be.

Finally, it is proved that a synchronous code cannot be as efficient as a comma-free code, except for very small code lengths. In fact, an upper bound on the efficiency of synchronous codes is developed which is considerably lower than that on comma-free codes, and codes are constructed which reach this upper bound for all code lengths up to 93, and which approach the bound for code lengths greater than this.