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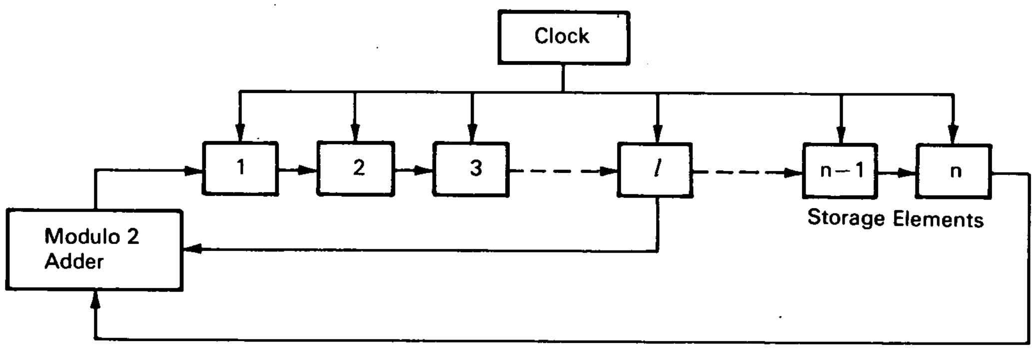
NASA TECH BRIEF

Acquisition of Pseudonoise Signals by Sequential Estimation



Pseudonoise digital modulation is used in a number of tracking and communications systems. In most cases it is necessary that the receivers of such systems bring an identical locally generated pseudonoise signal into time synchronism with the incoming pseudonoise signal. This acquisition process may require a relatively long time because of the period of the pseudonoise signals used and because of the autocorrelation properties of the signals.

A developmental acquisition system, which has been under study, has been given the acronym RASE, Rapid Acquisition by Sequential Estimation. This system has been shown to be particularly suitable for medium input signal-to-noise (S/N) ratios, a common condition of many high-quality tracking systems. The theoretical acquisition times agree closely with experimental values for the case where false alarm and false dismissal probabilities are low. Average acquisition time of 74 milliseconds has been demonstrated for a −10 db S/N ratio using a pseudonoise signal suitable for high-accuracy tracking to a range of 3,300 kilometers. Previous sweeping acquisition techniques for the same conditions would result in an average acquisition time of 1.7 seconds. The system is relatively simple and automatically provides shorter acquisition times and better S/N ratios than swept systems or matched-filter stepping acquisition systems.

The pseudonoise signals are usually generated by feedback shift registers of the form shown in the block diagram. The n-stage shift register shown can produce a binary sequence whose length is 2^n−1 bits. The transmitter and receiver each contain identical shift registers so that identical sequences are formed. In general, the received sequence may initially arrive having any phase with respect to the receiver generated sequence. It has been recognized that, in the absence of noise, the optimum acquisition technique is simply to load the first n received bits into the receiver sequence generator and let the generator start from that initial condition. It will then continue to produce a sequence which is approximately in phase with the incoming sequence. A tracking loop can

(continued overleaf)

maintain the phase from that time on, following any variations of doppler due to target dynamics or other causes.

The RASE system makes its best estimate of the first n received bits, loads the receiver sequence generator with that estimate, and starts operation of the sequence generator and the tracking circuits. If the correct estimate was loaded, tracking will occur. At the same time, a cross-correlation is performed between the input signal and the signal from the local sequence generator. If the cross-correlation indicates the receiver to contain the correct sequence and tracking to be occurring, no further action is taken. If the cross-correlation indicates that an incorrect estimate was made, a new estimate of the input is made, loaded, and tracked. This process is continued until the correct estimate is finally obtained.

Note:

Details may be obtained from:

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Patent status:

No patent action is contemplated by NASA.

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