LOCKING BY DELAY IN DIGITAL PROCESSING OF ULTRALONG RECURRENT SEQUENCES

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A procedure has been proposed for two-stage search for an ultralong recurrent sequence using matched digital filters and a matrix storage device during the first stage. Decisions based on the first stage of the search are adopted on the basis of estimating the information in the matrix storage device utilizing cost-coefficient matrices.

One of the causes retarding extensive application of ultralong linear recurrent sequences (URS) having a number of binary digits $L > 10^6$ in communication and measurement systems is the complexity of establishing locking by delay of the URS at the receiving end. The use of the well-known two-stage procedure for establishing initial delay locking of URS allows the locking time to be reduced. This statement is valid only for low values of the probability of false reception of a segment of the URS - P_{frs} (see [1]). For an increase in P_{frs} caused by an increase in the number of false detections of an URS segment during the first stage, the efficiency of the two-stage search procedure (TSSP) decreases. The utilization of linear recursion properties in URS allows methods of sequential estimation or reception according to the examined URS segment to be employed during the first stage of TSSP; these methods yield good results for comparatively high signal/noise ratios. In order to reduce the probability of false detection of URS delay during the first stage of TSSP, it was proposed in [2] to perform detection of several segments from one URS period by means of digital matched filters (DMF). For detection of a segment, the signal 1 is produced at the DMF output, and in the absence of detection the signal 0 is produced. The signals from the outputs of the DMF are applied to a memory matrix block (MMB) in which the weight of the arrived signals is determined and the time structure of the arrival of 0 (zeros) and 1 (ones) is analyzed. From the result of signal weighting in the MMB and the analysis of the structure with which 0 and 1 are written in the decision making block (DMB), a decision is adopted concerning the value of the magnitude of the URS delay, or search is continued in accordance with the first stage. Under these conditions the search procedure in accordance with the first stage may be terminated by correct detection with probability

$$P_{det} = (1 - P_{mi})^n \cdot (1 - P_{frs})^{m-n} / (1 - P_{mi}^n (1 - P_{frs})^{m-n}), \quad (1)$$

where P_{mi} is the probability of a miss (nondetection) of a segment by the DMF; m is the total number of segments into which the URS is partitioned; n is the number of segments which must be accepted by the DMF.

The principal shortcoming of the search method proposed in [2] for the first stage of TSSP lies in the fact that a fixed set of signals - zeros and ones in the MMB - does not allow the value of a specific 1 written in a cell of the MMB to be evaluated during reception of the i-th URS segment by the corresponding i-th DMF. This 1 may be written in both the time interval having the most probable presence of the i-th URS segment and in a time interval having a low probability of the presence of the i-th URS segment.

It is obvious that if the URS segments to whose reception the DMF are matched have been spaced at unequal time intervals along the length of the URS, it follows that after reception of k - 1 URS segments there is the possibility of predicting the time interval after which the next k-th segment appears with which the k-th DMF is matched; thereby, it is possible to increase the probability of the correct establishment of URS delay during the first stage of TSSP on the basis of taking account of the cost of decisions on the reception of the k + 1 and subsequent URS segments. This allows the probability of the transition of the detector into the absorptive state to be reduced, which is especially important when during the second stage of TSSP checking the correctness of detection requires significant time expenditures. In order to solve this problem, the entire URS is partitioned into

REFERENCES

1. L. E. Varkin, Communications Systems Having Noise-Like Signals [in Russian], Radio i svyaz, Moscow, 1985.
2. USSR Patent Application 1398106 MKI^4H 04L7/02.
3. V. V. Losev, E. B. Brodskaya, and V. I. Korzhik, Search for and Decoding of Complex Discrete Signals [in Russian], V. I. Korzhik (Editor), Radio i svyaz, Moscow, 1988.

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