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DIGITAL DETECTION OF CODED-PULSE IONOSONDE SIGNALS

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Digital Detection of Coded-Pulse Ionosonde Signals

During a recent application of binary-coded and impulse-equivalent pulse compression signals to ionospheric sounding,[1] swept-frequency sounding trials were carried out between Ottawa and Halifax. The equipment shown in Fig. 1 was used to generate ionograms (B-scope displays of radar range vs radar pulse carrier frequency), using various coded-pulse transmissions.

A comparison was made between analog and digital detection of binary-coded signals. The signals were seventeen binary digits long and were usually received in an analog quadrature matched filter, using two low pass tapped delay lines. The matched filters were used to process the outputs of two phase-sensitive demodulators, operating in quadrature. The filter outputs were squared and added and applied to a display

For digital detection, each analog delay line was replaced by a limiter and a digital matched filter. Each digital filter consisted of a tapped shift register. Five samples of the limiter output were taken per binary digit duration.[2] The tap outputs of each shift register were combined in analog adders. The outputs of the adders represent the correlation between the transmitted and received signals. Each output was applied to a threshold device. The binary outputs of these devices were combined in an "inclusive OR" gate and applied to a display

Ionograms generated by the simultaneous outputs of the analog and the digital detectors are shown in Fig. 2. The main features of the digital ionogram are the increased probability of detection, the constant false alarm rate, the two-level display which does not require AGC, the removal of the noise bands associated with frequencies occupied by powerful stations, and the potential for automatic analysis of the digital signal by a digital computer.

For comparison, ionograms produced by binary-coded pulses, processed in the analog matched filters, and by single pulses with the same peak power are shown in Fig. 3.

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[1] Coll, D. C., and J. R. Storey, Ionospheric sounding using coded-pulse signals, *Radio Science* (*J. Res. Nat. Bur. Std./URSI*), vol 68D, Oct 1964.

[2] Coll, D. C., and J. R. Storey. Message generation and reception equipment for a meteor burst communication system (*U*), Defence Research Telecommunications Establishment, Rept. 1108, Ottawa, Ont., Apr 1963.

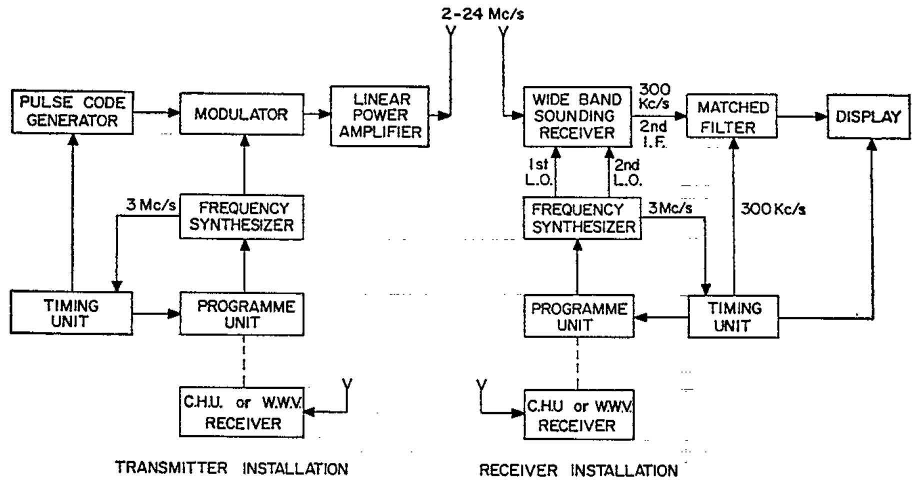

Fig 1—Frequency sounding system

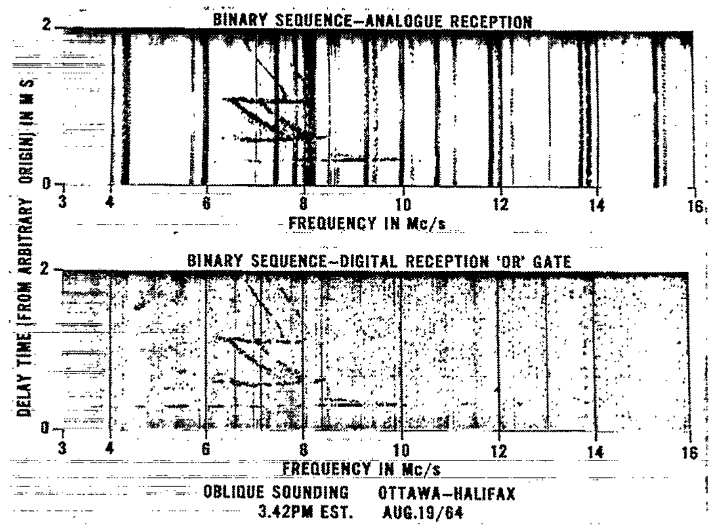

Fig 2

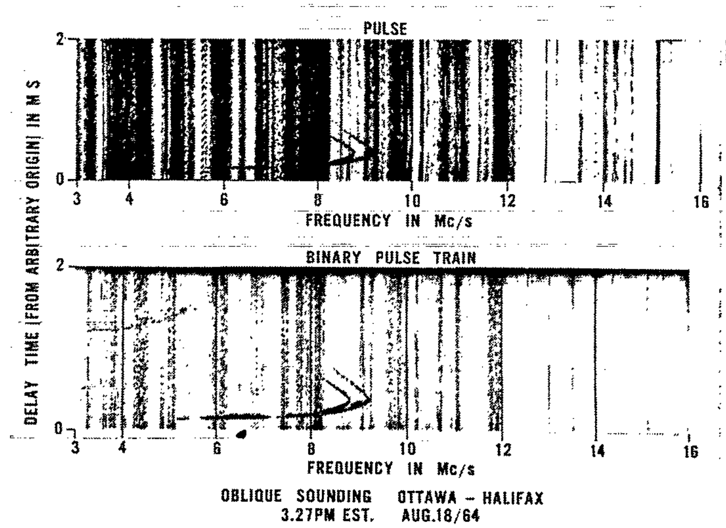

Fig. 3.

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