

XIV. ANALOG COMPUTER RESEARCH

Prof. E. A. Guillemin
Prof. R. E. Scott

N. DeClaris

Y. C. Ho
T. E. Stern

TIME DOMAIN SYNTHESIS BY DELAY LINE TECHNIQUES

Research in the past quarter has resulted in the development of an experimental type of discrete filter and its application to time domain equalization problems in both open- and closed-loop systems.

It has been shown (1, 2) that a discrete filter of the general type

$$D^*(\epsilon^{-sT}) = \sum_{k=0}^N a_k \epsilon^{-skT} \quad (1)$$

can be used to approximate the transfer function

$$F(s) = \frac{\sum_{k=0}^n b_k s^k}{\sum_{k=0}^m c_k s^k} \quad (2)$$

The chief advantage of discrete filters (3) is that mathematically they can be handled easily in time domain, which places in evidence the transient response of a system. Furthermore, discrete filters are more versatile than their conventional counterparts, in the sense that their transfer characteristics can be changed at will after their construction by merely changing the coefficients a_k in Eq. 1. This property is very useful in practical time domain equalization problems, since experimental adjustment over quite a wide range of transfer characteristics is provided.

Preliminary theoretical study shows that discrete filters can be used to equalize closed loop systems with good results. The approach used is in the time domain and is based on the impulse response of the system.

An experimental discrete filter is being constructed with a magnetic recorder having delayed pick-up heads along a continuous tape loop. The unit will be used in the control loop of a servomultiplier. This will serve not only as an experimental check but also as a test of the practicability of the proposed technique for time domain equalization.

Y. C. Ho

References and Footnote

1. Quarterly Progress Report, Research Laboratory of Electronics, M.I.T., April 15, 1954.
2. Freddy Ba Hli, D. Sc. Thesis, M.I.T., 1953.
3. This filter is essentially a tapped delay line filter that handles continuous input and output signals; thus it differs from the type described in sampled-data systems, although mathematically they are almost equivalent.