Abstracts

Linear Signal Processing and Ultrasonic Transversal Filters

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The role of linear transversal filters in signal processing is discussed in Section I. Linear filters for signal processing must often have complicated impulse responses, with large bandwidth and large time bandwidth product. The linear transversal falter, a delay line with weighted and summed taps, is ideally suited for the implementation of such filters because of its simplicity of synthesis. The filter's impulse response is derived by the application of some concepts from the theories of vector spaces and sampling, and is shown to be equal to the tap weighting function. Thus, the synthesis procedure consists merely of sampling the specified impulse response at appropriate intervals and using the sample values as the tap weights. The utility of the transversal filter in signal processing is illustrated by an example from scatterer distribution mapping. The illustration is applied to two hypothetical systems--a sonar and an astronomical radar. In both these cases, it is not possible for a single filter to process the signal in real time. Signal processing in compressed time is discussed as an alternative to the use of a large number of filters in parallel. If the processing filter has a bandwidth capability in excess of the signal's bandwidth, the signal can be time compressed and processed serially in time. A generalized receiver, employing time compression, frequency translation, and multiple-output-port transversal filtering, is developed from these ideas. In Section II, a generalized transversal filter is described and analyzed. A delay line with multiple arrays of taps, each array with a multiplicity of weighting functions, has as the impulse response between any pair of ports the cross-correlation function of the weighting functions for the two ports. A number of implementations of transversal filters employing a variety of delay line types are described and some aspects of transduction and wave propagation in bounded media are presented in relation to these implementations.

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