m20 - An Overview of Discrete-Time Systems*

C. Sidney Burrus

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Abstract

A discrete time system is a map of a discrete time input signal into a discrete time output signal.

1 [Discrete-Time Systems]Discrete-Time Systems

In the context of discussing signal processing, the most general definition of a system is similar to that of a function. A system is a device, formula, rule, or some process that assigns an output signal from some given class to each possible input signal chosen from some allowed class. From this definition one can pose three interesting and practical problems.

1. Analysis: If the input signal and the system are given, find the output signal.
2. Control: If the system and the output signal are given, find the input signal.
3. Synthesis: If the input signal and output signal are given, find the system.

The definition of input and output signal can be quite diverse. They could be scalars, vectors, functions, functionals, or other objects.

All three of these problems are important, but analysis is probably the most basic and its study usually precedes that of the other two. Analysis usually results in a unique solution. Control is often unique but there are some problems where several inputs would give the same output. Synthesis is seldom unique. There are usually many possible systems that will give the same output for a given input.

In order to develop tools for analysis, control, and design of discrete-time systems, specific definitions, restrictions, and classifications must be made. It is the explicit statement of what a system is, not what it isn't, that allows a descriptive theory and design methods to be developed.

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