DIGITAL CONTROL SYSTEM

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INTRODUCTION

Digital control is a branch of control theory that uses digital computers to act as system controllers. Depending on the requirements, a digital control system can take the form of a microcontroller to an ASIC to a standard desktop computer. Since a digital computer is a discrete system, the Laplace transform is replaced with the Z-transform. Also since a digital computer has finite precision (*See quantization*), extra care is needed to ensure the error in coefficients, A/D conversion, D/A conversion, etc. are not producing undesired or unplanned effects.

Digital systems, expressed previously as difference equations or Z-Transform transfer functions can also be used with the state-space representation. Also, all the same techniques for dealing with analog systems can be applied to digital systems, with only minor changes.
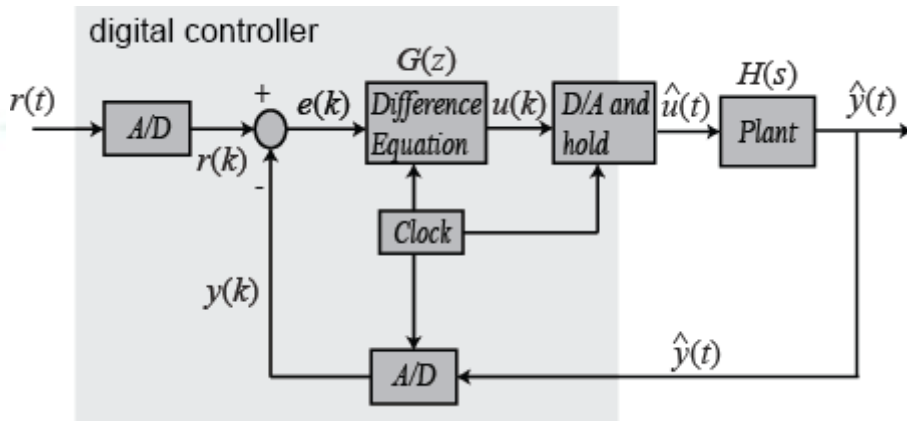

DIGITAL CONTROLLER DESIGN

converting continuous time models into discrete time (or difference equation) models. We will also introduce the z-transform and show how to use it to analyze and design controllers for discrete time systems.

The figure below shows the typical continuous feedback system that we have been considering so far in this tutorial. Almost all of the continuous controllers can be built using analog electronics.
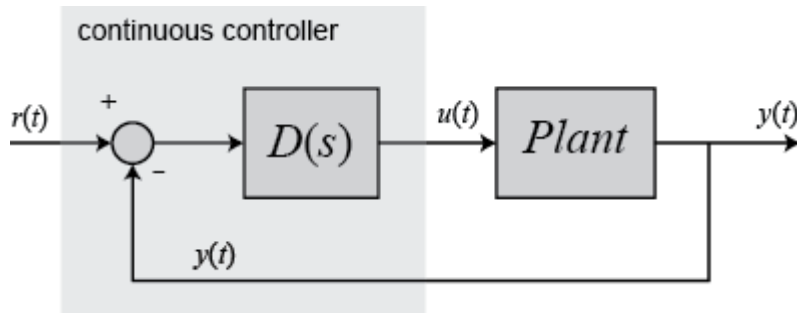
The continuous controller, enclosed in the dashed square, can be replaced by a digital controller, shown below, that performs same control task as the continuous controller. The basic difference between these controllers is that the digital system operates on discrete signals (or samples of the sensed signal) rather than on continuous signals.

Different types of signals in the above digital schematic can be represented by the following plots.
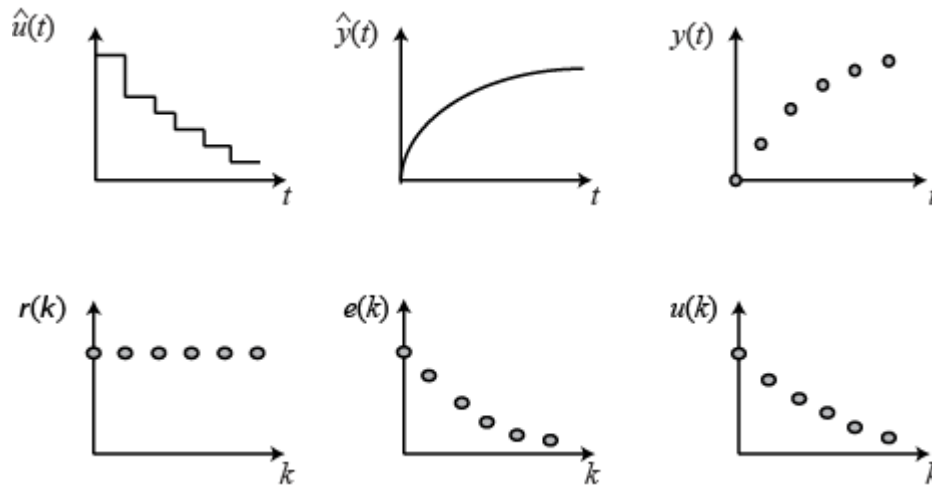
The purpose of this Digital Control Tutorial is to show you how to use MATLAB to work with discrete functions either in transfer function or state-space form to design digital control systems.

DIGITAL CONTROLLER IMPLEMENTATION

The design and digital signal processor (DSP) based implementation of a digital controller are presented for the dc-dc converter. Starting with a dc-dc buck converter and a given set of performance specifications, a digital PID controller is implemented in TMS320F2812 DSP. All the necessary DSP hardware or software techniques and algorithms required to implement the controller are discussed in detail. The steady state and dynamic response performance of the controller is presented in order to demonstrate the effectiveness of the design.

digital controller design for switch mode power converters.

STABILITY

Although a controller may be stable when implemented as an analog controller, it could be unstable when implemented as a digital controller due to a large sampling interval. During sampling the aliasing modifies the cutoff parameters. Thus the sample rate characterizes the transient response and stability of the compensated system, and must update the values at the controller input often enough so as to not cause instability.

When substituting the frequency into the z operator, regular stability criteria still apply to discrete control systems. Nyquist criteria apply to z-domain transfer functions as well as being general for complex valued functions. Bode stability

criteria apply similarly. Jury criterion determines the discrete system stability about its characteristic polynomial.

REFRENCES

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