Introductory Motion and Control
Introduction to Digital Control of Continuous Systems
(Ref: G.F. Franklin, J.D. Powell, A. Emami-Naeini, ***Feedback Control of Dynamic Systems***, 6th Ed., Prentice-Hall, 2010)

Continuous systems are systems whose output signals vary ***continuously*** as the system input signals change. Compensators that control these systems can be implemented using either ***analog*** (continuous) or ***digital*** (discrete) hardware. ***One method*** of designing digital compensators is to ***design*** an ***analog compensator*** and then ***discretize*** it using a sample rate (frequency) that is ***well above*** the system's highest responding frequency. This is referred to by some authors as ***emulation***.

A ***second*** and more accurate ***method*** is to ***design*** the ***digital compensator directly***, so its performance is ***optimized*** for the chosen ***sample rate***. These notes focus on introductory issues associated with ***emulation***.

Fig. 1 shows the ***block diagram*** of a closed-loop system with a ***continuous compensator*** and ***continuous plant.*** All signals ($r(t)$, $e(t)$, $u(t)$, and $y(t)$) represent ***continuous*** functions of time. The compensator is implemented in an ***analog*** electronic circuit.

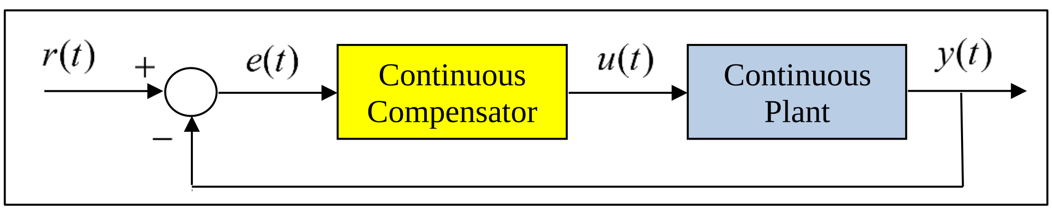

Fig. 1. Block Diagram of a Continuous Closed-Loop System

For comparison, Fig. 2 shows the ***block diagram*** of a system with a ***discrete compensator*** (sample period of T seconds or sample rate of $1/T$ samples/second) and a ***continuous plant***. The compensator is implemented in a ***digital*** electronic circuit. The blocks labeled DAC and ADC represent the processes of ***digital-to-analog*** and ***analog-to-digital*** conversion. The signals $u(t)$ and $y(t)$ represent ***continuous*** functions of time, whereas the signals $r(kT)$, $e(kT)$, $u(kT)$, and $y(kT)$ represent ***sampled values*** of the ***associated continuous functions*** at a set of discrete times $[0, T, 2T, \ldots, kT, \ldots]$.

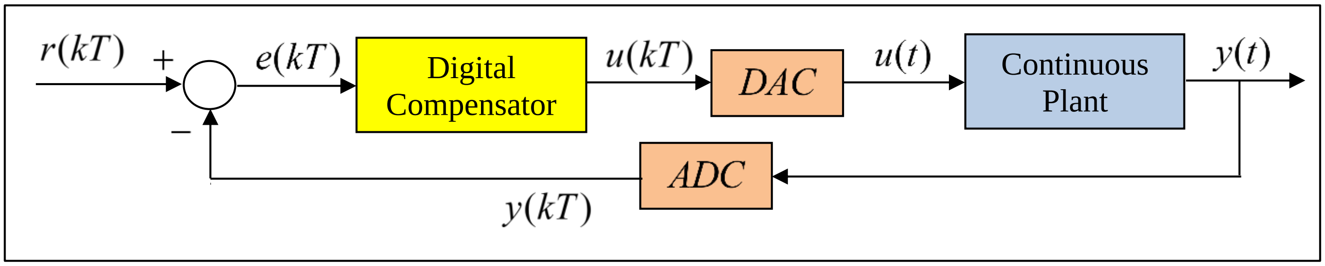

Fig. 2. Block Diagram of a Continuous/Discrete Closed-Loop System