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Lecture 03d
Translating Between State Space, Transfer Function, and ODE Models

The YouTube video entitled 'Translating Between State Space, Transfer Function, and Ordinary Differential Equation Models' that covers this lecture is located at https://youtu.be/CrkAMiCAp5s

Outline

-Introduction
    -Different Models
    -Moving Between Models

Introduction

We know that there are several representations of a dynamic system. It would be useful to be able to translate between them.

Different Models

We now have several methods to represent dynamic systems.

1. Ordinary Differential Equations

$$\frac{d^n}{dt^n} z(t) + a_{n-1} \frac{d^{n-1}}{dt^{n-1}} z(t) + \ldots + a_1 z(t) + a_0 = \frac{d^m}{dt^m} u(t) + b_{n-1} \frac{d^{n-1}}{dt^{n-1}} u(t) + \ldots + b_1 u(t) + b_0$$

Video(s):
-Homogeneous Linear Ordinary Differential Equations https://youtu.be/3Kox-3APznI
-Nonhomogeneous Linear Ordinary Differential Equations https://youtu.be/t98ILS2YdrU

2. Transfer Functions

$$Y(s) = G(s)\, U(s)$$

Video(s):

-Transfer Functions: Introduction and Implementation https://youtu.be/Uh_-RZQIaEs

3. State Space

$$\dot{\overline{x}}(t) = A\,\overline{x}(t) + B\,\overline{u}(t)$$
$$\overline{y}(t) = C\,\overline{x}(t) + D\,\overline{u}(t)$$

Video(s):
-State Space Representation of Differential Equations https://youtu.be/pXvAh1IOO4U

Moving Between Models

We also now have the tools to translate between each of these models.

1. ODE to TF
-The Laplace Transform https://youtu.be/q0nX8uIFZ_k

2. ODE to SS
-State Space Representation of Differential Equations https://youtu.be/pXvAh1IOO4U?t=2833 (47:13)

3. TF to SS
-Transfer Function to State Space https://youtu.be/RG_tdz1VzwY

4. SS to TF
-State Space to Transfer Function https://youtu.be/RG_tdz1VzwY