

EENG226

Signals and Systems

Chapter 2

Time-Domain Representations of Linear Time-Invariant Systems

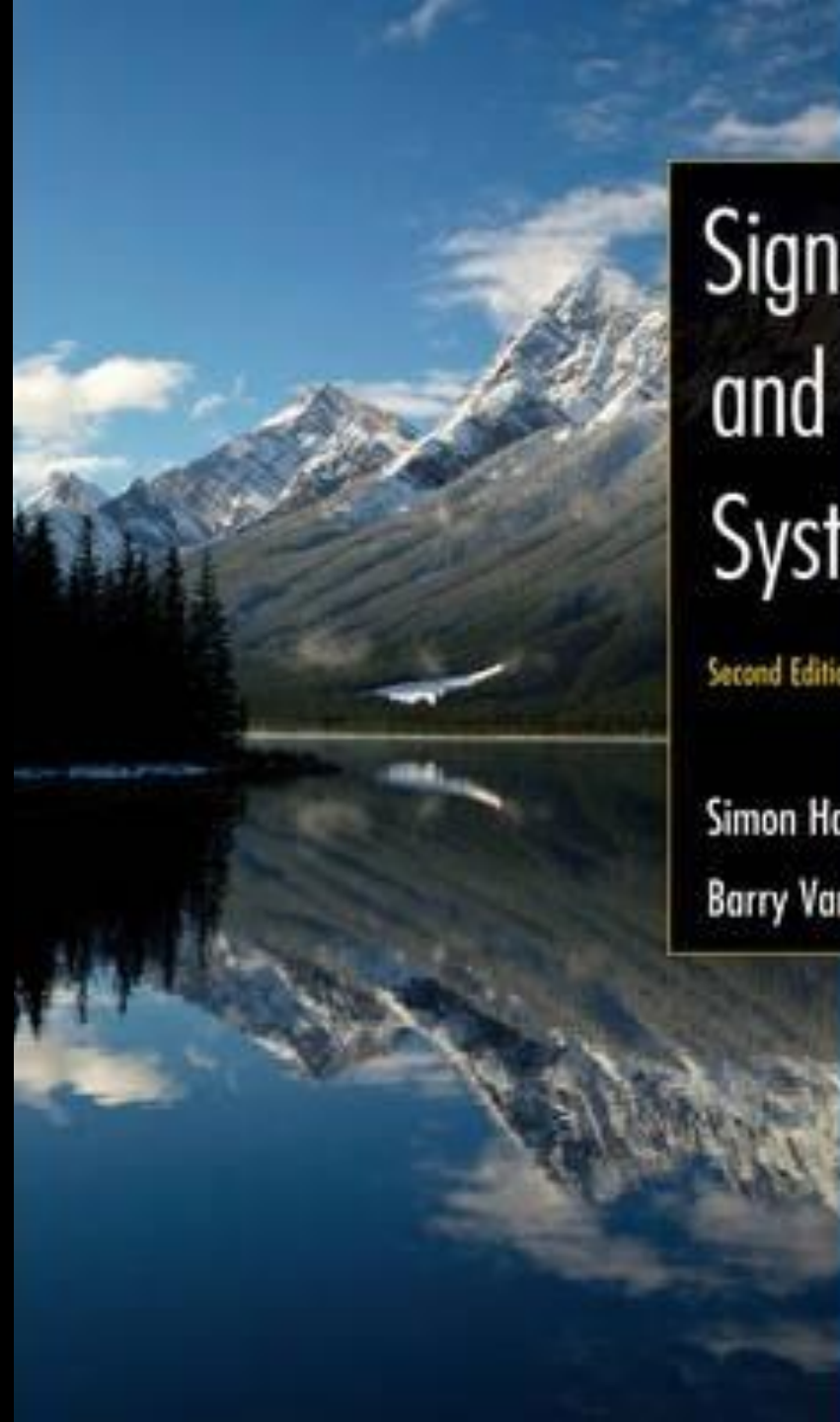
Introduction

Prof. Dr. Hasan AMCA

**Electrical and Electronic Engineering Department
(ee.emu.edu.tr)**

**Eastern Mediterranean University
(emu.edu.tr)**

Signals and Systems, 2/E by Simon Haykin and Barry Van Veen
Copyright © 2003 John Wiley & Sons, Inc. All rights reserved.



Signals and Systems

Second Edition

Simon Haykin
Barry Van Veen

Chapter 2

Time-Domain Representations of Linear Time-Invariant Systems

Objectives of this chapter

- 2.1 Introduction
- 2.2 The Convolution Sum
- 2.3 Convolution Sum Evaluation Procedure
- 2.4 The Convolution Integral
- 2.5 Convolution Integral Evaluation Procedure
- 2.6 Interconnections of LTI Systems
- 2.7 Relations between LTI System Properties and the Impulse Response
- 2.8 Step Response
- 2.9 Differential and Difference Equation Representations of LTI Systems
- 2.10 Solving Differential and Difference Equations
- 2.11 Characteristics of Systems Described by Differential and Difference Equations
- 2.12 Block Diagram Representations
- 2.13 State-Variable Descriptions of LTI Systems
- 2.14 Exploring Concepts with MATLAB
- 2.15 Summary



<https://www.bilmediginseylervar.com/gecmisten-gunumuze-saatlerin-gelisimi/>



2. Time-Domain Representations of Linear Time-Invariant Systems

2.1 Introduction

- Methods for describing the relationship between the input and output signals (as functions of time) of linear time-invariant (LTI) systems in time domain
- Analyzing and predicting the behavior of LTI systems
 - Both continuous-time and discrete-time
- characterizing LTI systems i.t.o. its impulse response,
 - output of system due to unit impulse input applied at $t=0$ or $n = 0$
- Impulse response completely characterizes behavior of any LTI system

2. Time-Domain Representations of Linear Time-Invariant Systems

- Impulse response of a discrete-time system is obtained by setting the input equal to the impulse $\delta[n]$
- In continuous-time case, the impulse signal is approximated by a pulse of large amplitude and brief duration
- By linearity and time invariance, the output signal must be a weighted superposition of time-shifted impulse responses
- This weighted superposition is termed the
 - convolution sum for discrete-time systems and
 - convolution integral for continuous-time systems

2. Time-Domain Representations of Linear Time-Invariant Systems

- The second method we shall examine for characterizing the input-output behavior of LTI systems is the linear constant-coefficient differential equation (for continuous-time) or difference equation (for discrete-time systems)
- The third method of system representation we discuss is the system as an interconnection of three elementary operations:
 - scalar multiplication, addition and either a time shift for discrete-time systems or integration for continuous-time systems
- The final time-domain system representation discussed in this chapter is the state variable description
 - a series of coupled first-order differential or difference equations that represent the behavior of the system's "state" and
 - an equation that relates that state to output of the system
 - The state is a set of variables associated with energy storage or memory devices in the system