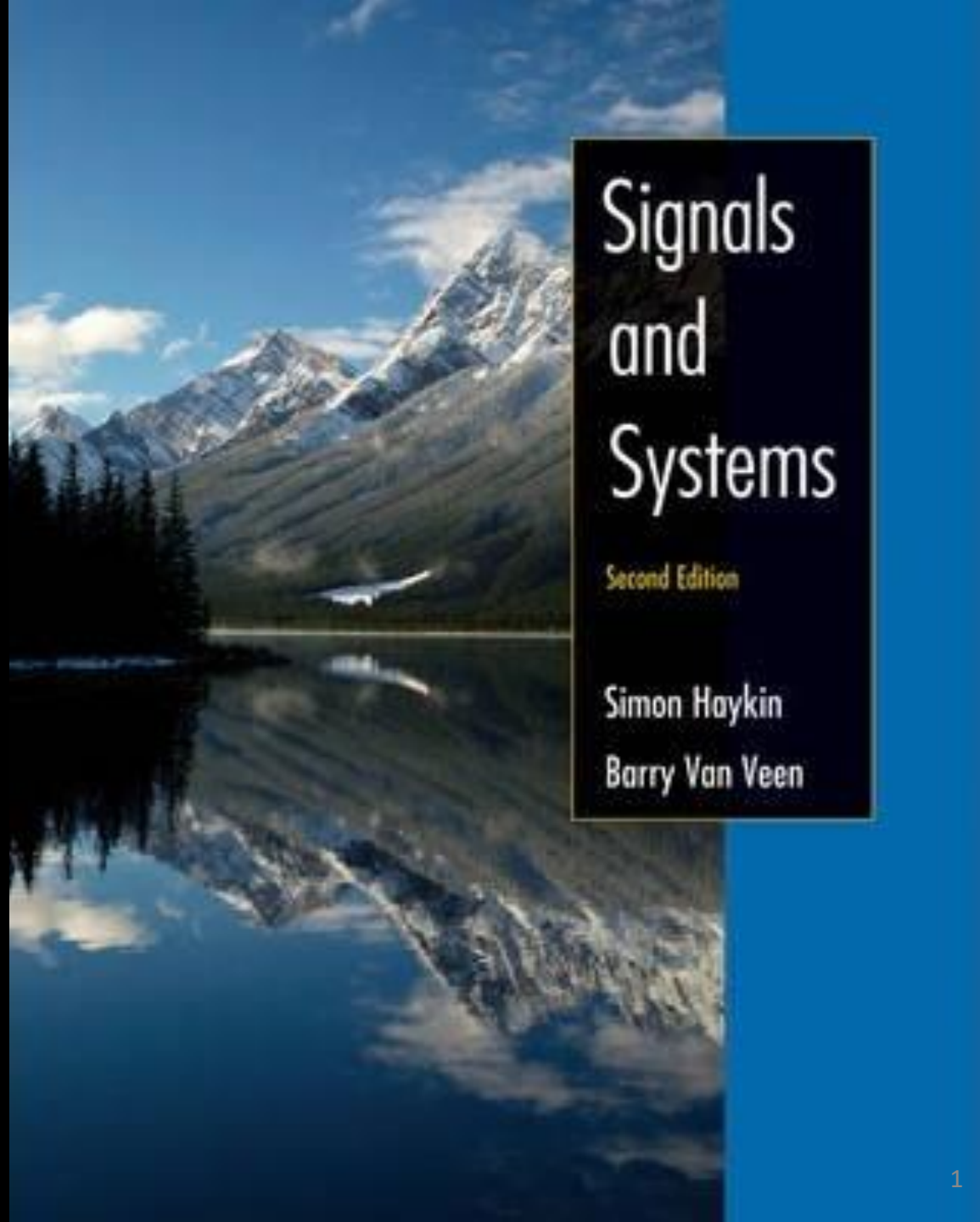
EENG226
Signals and Systems

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)



Chapter 2

Time-Domain Representations of Linear Time-Invariant Systems

Objectives of this chapter

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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