Digital Signal Processing

Chap 1. Introduction

Chang-Su Kim

Course Outline

- Pre-requisites
  - Engineering Mathematics
  - Signals and Systems

- Course Homepage
  - Homepage: http://mcl.korea.ac.kr

- Questions
  - Ask questions any time, but preferably during the lectures
  - Office: Engineering Bldg, Rm 508
  - Tel: 02-3290-3217
  - Email: changsukim@korea.ac.kr

Course Outline

- Assessment Methods
  - Assignments: 15%
  - Attendance & Quizzes: 15%
  - Mid-term Exam: 30% (23 Oct 2023)
  - Final Exam: 40% (11 Dec 2023)
  - No lectures on 19 Oct 2022

- Textbook
  - A. V. Oppenheim and R. W. Schafer, *Discrete-Time Signal Processing*, 3rd edition, Pearson, 2010.

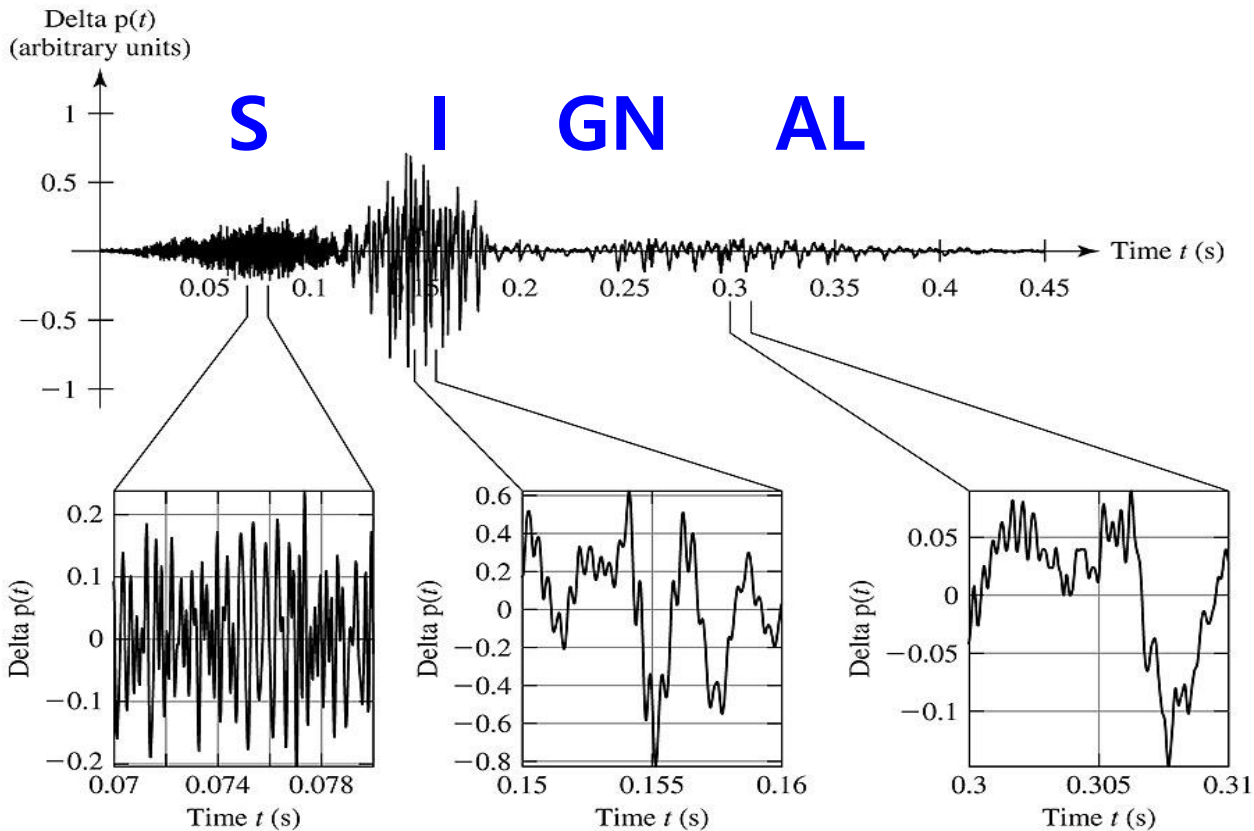
- Reference
  - Sanjit K. Mitra, *Digital Signal Processing: A Computer-Based Approach*, McGraw Hill, 2006.

Course Outline

Week	Topics	Events
1	Chap 1. Introduction	
2	Chap 2. Discrete-Time Signals and Systems	
3	Chap 2. Discrete-Time Signals and Systems	
4	Chap 2. Discrete-Time Signals and Systems	
5	Chap 3. Z-Transform	
6	Chap 3. Z-Transform	
7	Chap 3. Z-Transform	
8	Chap 4. Sampling of Continuous-Time Signals	
9	Chap 4. Sampling of Continuous-Time Signals	
10	Chap 5. Transform Analysis of LTI Systems	
11	Chap 5. Transform Analysis of LTI Systems	
12	Chap 6. Structures for Discrete-Time Systems	
13	Chap 7. Filter Design Techniques	
14	Chap 8. DFT	
15	Chap 9. Computation of DFT	
16	NA	

Signals

- $s(t) = 1.05\ t^2$
- $s(x, y) = 3x+2xy+10y^2$



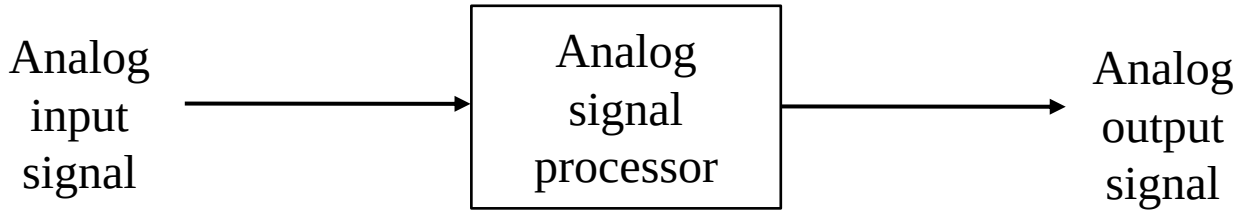
Systems and Signal Processing

- A *system* performs an operation on a signal

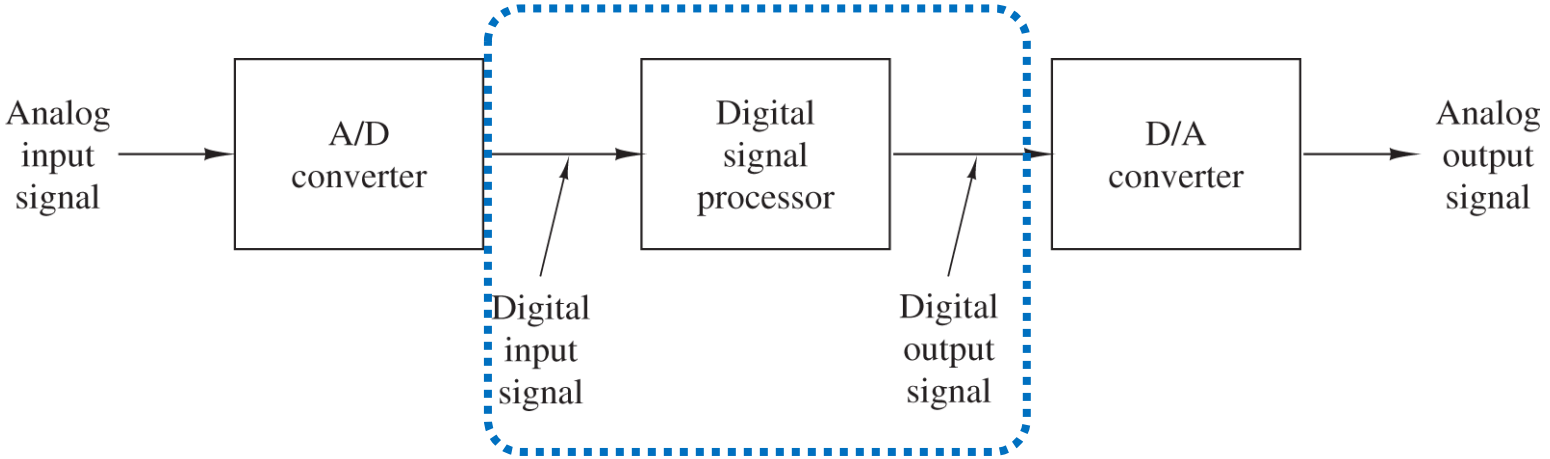
- Such operations are referred to as *Signal Processing*

Analog Signal Processing vs. Digital Signal Processing

- Analog signal processing



- Digital signal processing



Advantages of DSP over Analog Signal Processing

- Flexibility
- Accuracy
  - 16-bit, 32-bit, 64-bit digital comp
  - Extremely difficult to make accurate analog circuit components
- Easy storage and duplication
- Cost
  - Digital computing gets cheaper

Advantages of DSP over Analog Signal Processing

최저가 19,000,000원 최저가 구매하기

배송비포함

AUDIOTRIP	최저가 19,000,000원	무료배송	
AVPLA... N Pay	19,000,000원	무료배송	최대 10개월

A color picture is a **three-channel, two-dimensional** signal

$$\mathbf{S}(x,y) = \begin{bmatrix} r(x,y) \\ g(x,y) \\ b(x,y) \end{bmatrix}$$

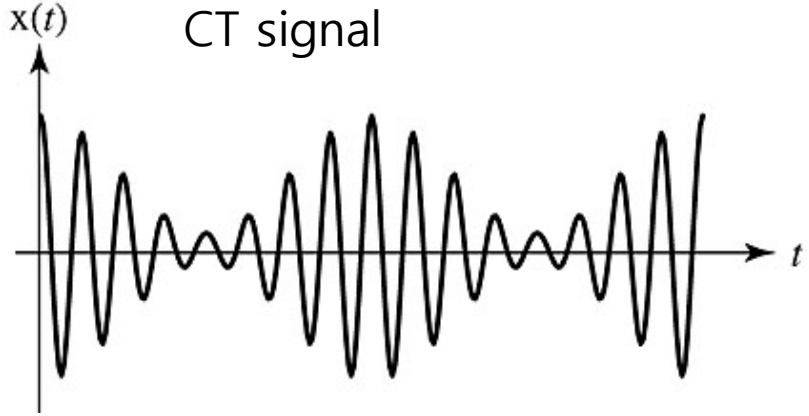
red

Green

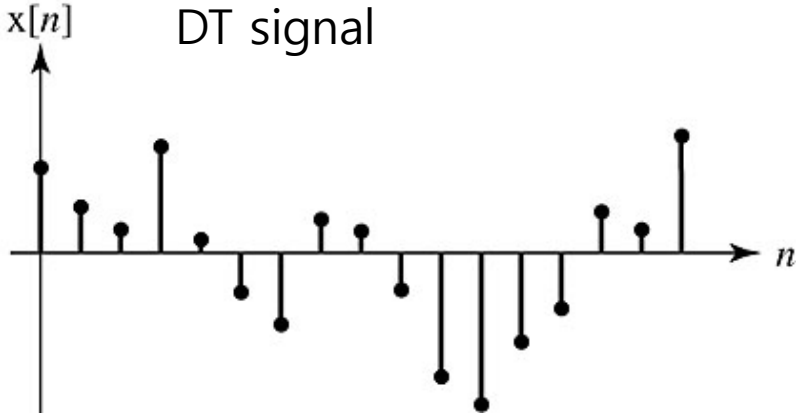
Blue

- In this work, we focus on single-channel, one-dimensional signals
- The single variable is called time

Continuous-Time vs Discrete-Time Signals



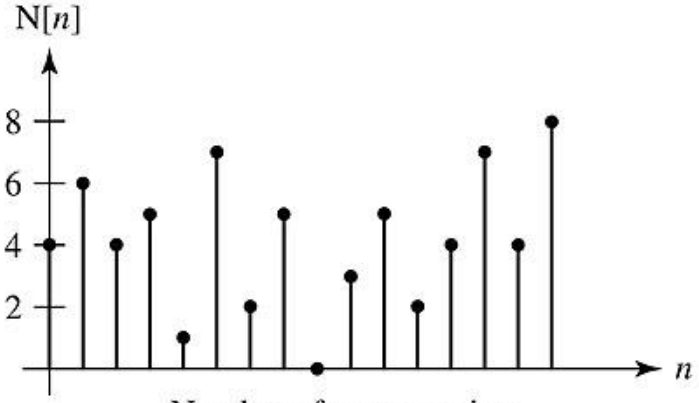
CT signal



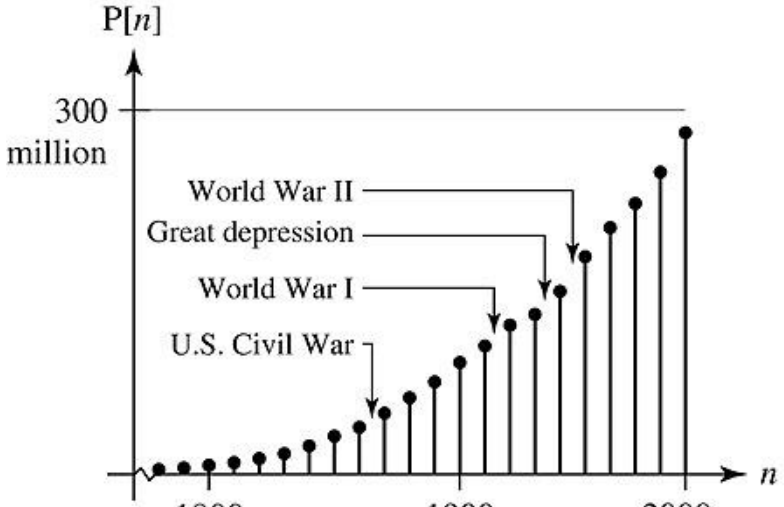
DT signal

- DT signals often arise
  - by selecting values of an analog signal at discrete-time instants
  - by accumulating a variable over a period of time

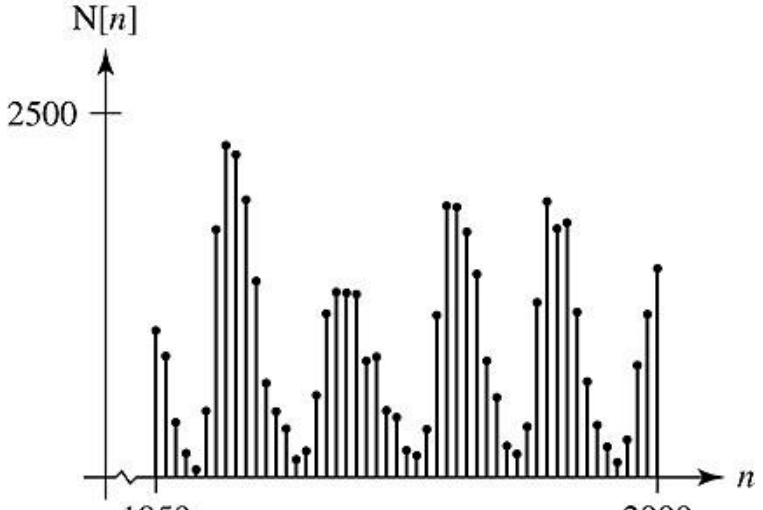
Examples of Discrete-Time Signals



Number of cars crossing
an intersection between red lights



United States population



Number of annual sunspots

Continuous-Valued vs Discrete-Valued Signals

- A discrete-time signal having a set of discrete values is called a **digital signal**
- Digitization =

  sampling (time) + quantization (value)

Analog-to-Digital Conversion

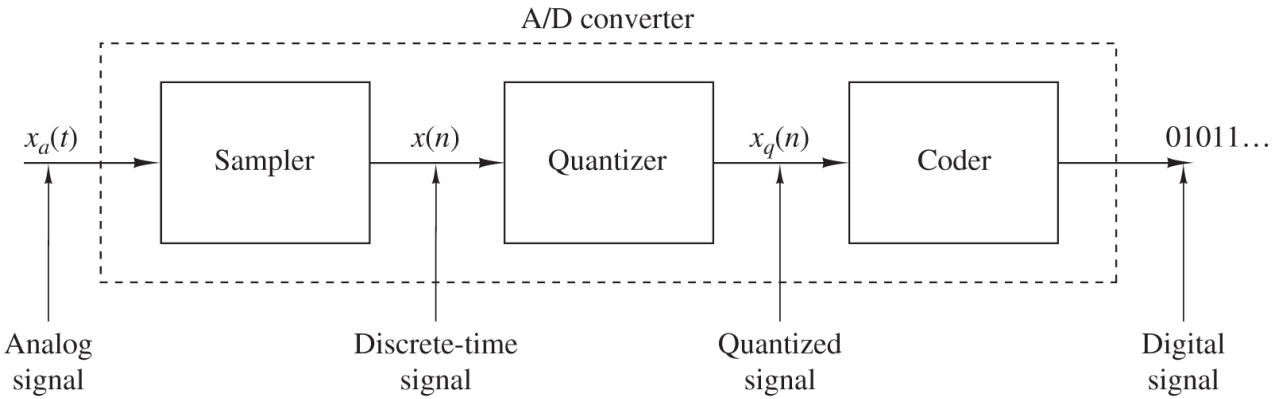


Figure 1.4.1 Basic parts of an analog-to-digital (A/D) converter.

Sampling

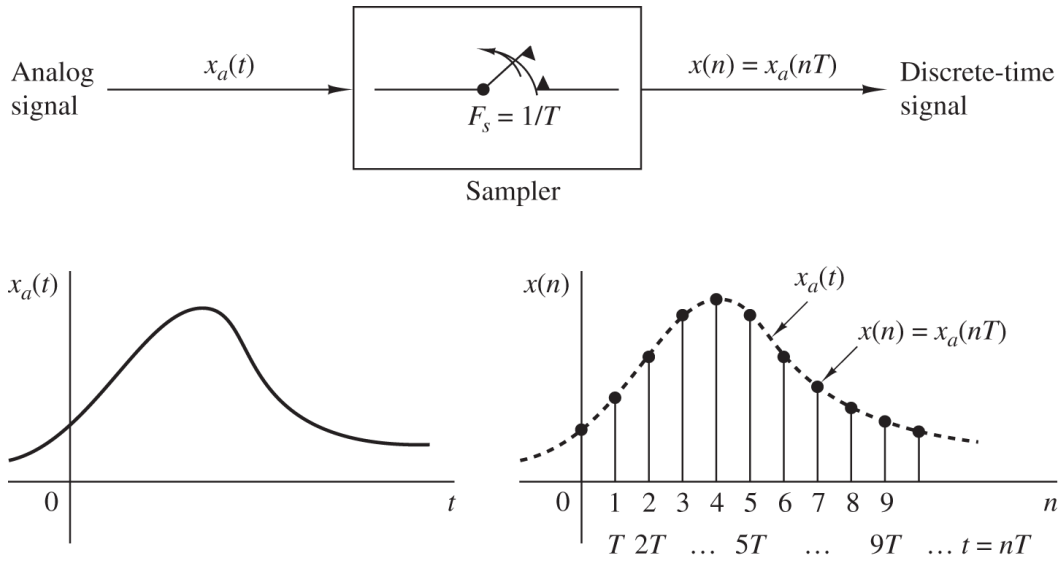
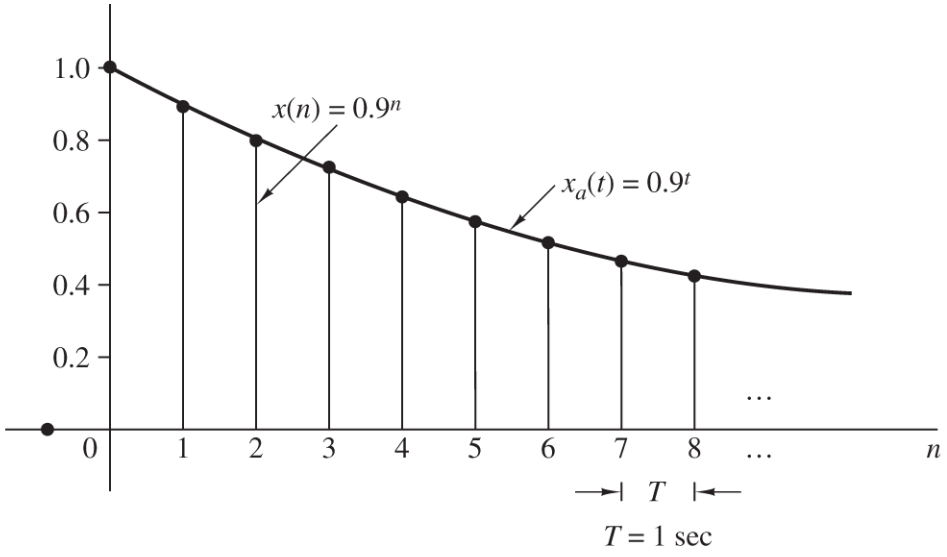


Figure 1.4.3 Periodic sampling of an analog signal.

Analog-to-Digital Conversion

Quantization



$0.9^4 = 0.6561 \rightarrow 0.7$

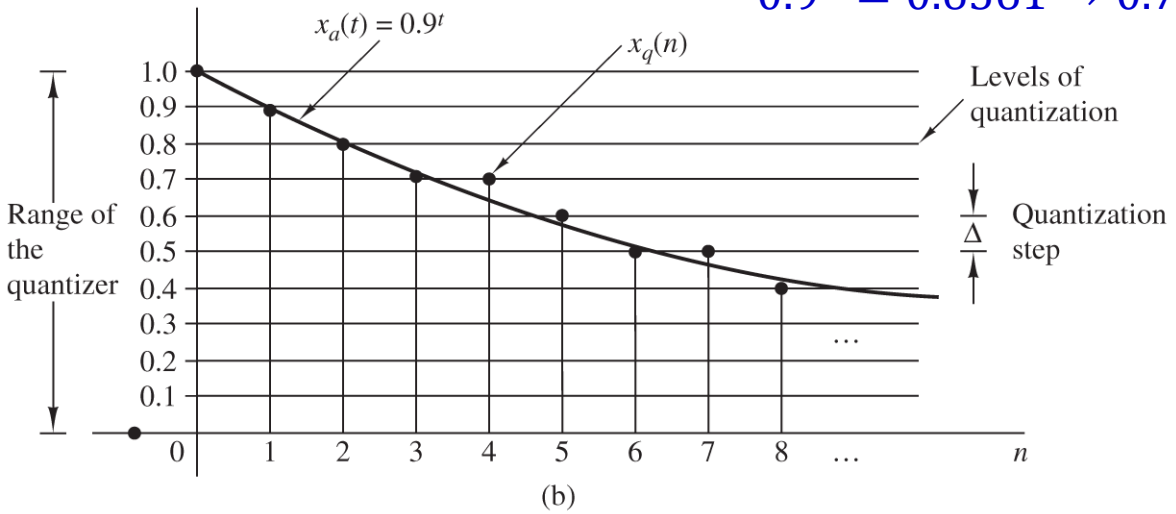


Figure 1.4.7 Illustration of quantization.

Digital-to-Analog Conversion

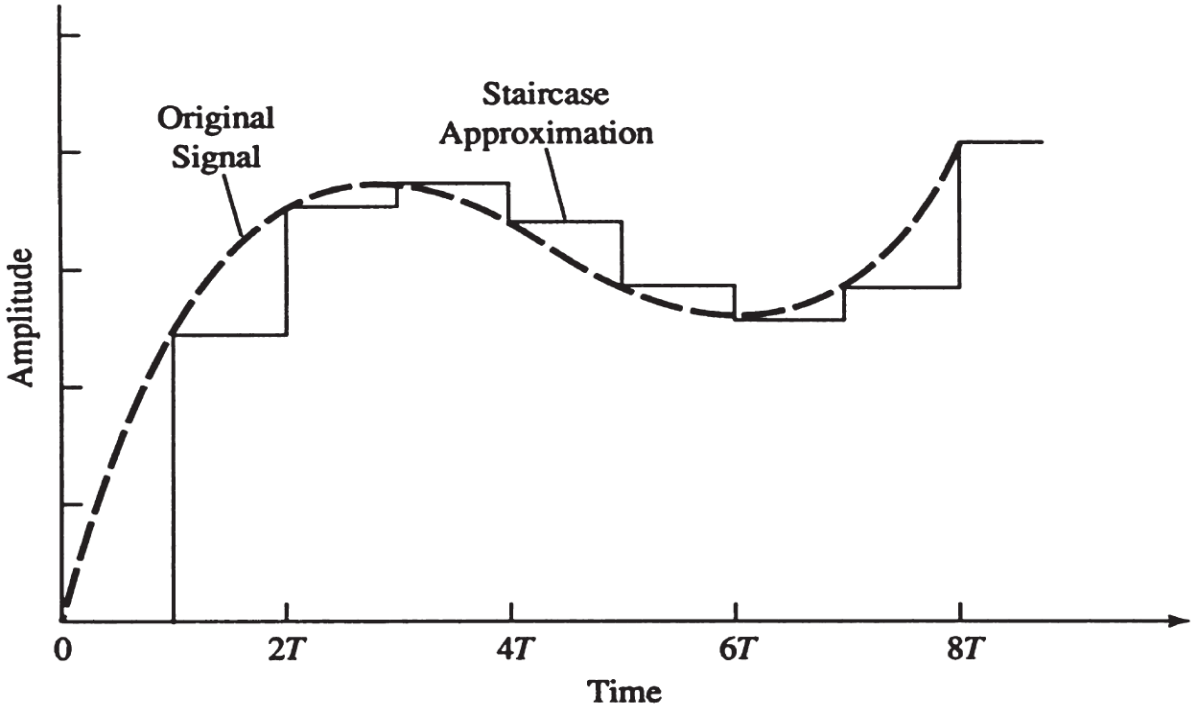


Figure 1.4.2 Zero-order hold digital-to-analog (D/A) conversion.

Examples

DSP LEADS TO …

Supplementary Video

Moving Window Regression: A Novel Approach to Ordinal Regression

Anonymous CVPR 2022 submission
Paper ID 6920

Supplementary Video

Eigenlanes: Data-Driven Lane Descriptors for Structurally Diverse Lanes

Anonymous CVPR 2022 submission
Paper ID 6918

Supplemental Video on

DPICT: Deep Progressive Image Compression Using Trit-Planes

IMAGE PROCESSING, COMPUTER VISION, MACHINE LEARNING

	Publication	h5-index	h5-median
1.	Nature	444	667
2.	The New England Journal of Medicine	432	780
3.	Science	401	614
4.	IEEE/CVF Conference on Computer Vision and Pattern Recognition	389	627
5.	The Lancet	354	635
6.	Advanced Materials	312	418
7.	Nature Communications	307	428
8.	Cell	300	505
9.	International Conference on Learning Representations	286	533
10.	Neural Information Processing Systems	278	436
11.	JAMA	267	425
12.	Chemical Reviews	265	444
13.	Proceedings of the National Academy of Sciences	256	364
14.	Angewandte Chemie	245	332
15.	Chemical Society Reviews	244	386
16.	Journal of the American Chemical Society	242	344
17.	IEEE/CVF International Conference on Computer Vision	239	415
18.	Nucleic Acids Research	238	550
19.	International Conference on Machine Learning	237	421
20.	Nature Medicine	235	389

Opportunities!