



# **CSE 320/EEE361**

# **Data Communications**

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## **Digital Transmission**

## **Chapter 4**





## 4-2 Analog Data → Digital Signal

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# Analog Data → Digital Signal

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***Topics discussed in this section:***

**Pulse Code Modulation (PCM)**

**Delta Modulation (DM)**



# Delta Modulation

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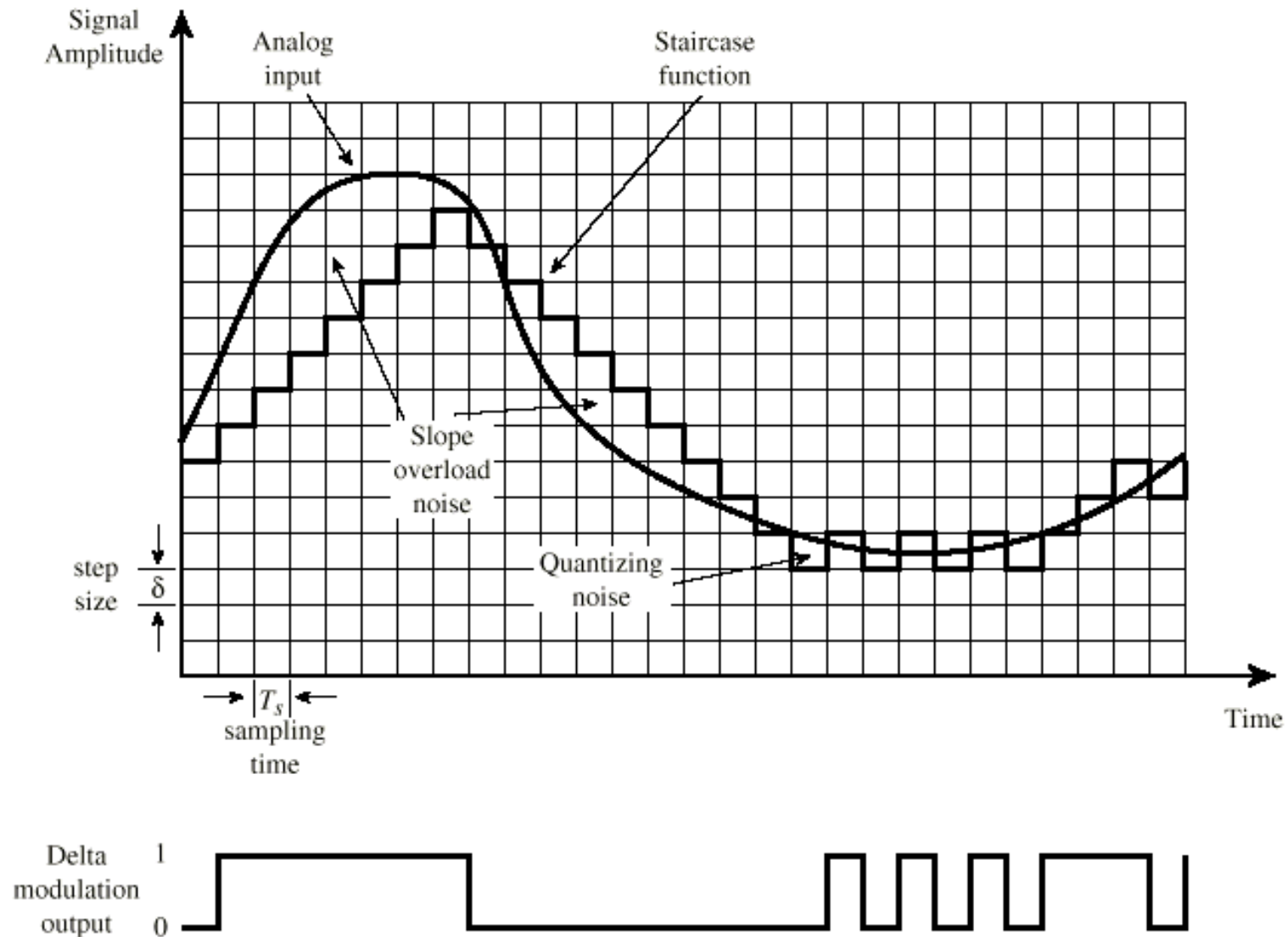
# Delta Modulation

- To improve the performance of PCM (reduce complexity)
- Analog input is approximated by a staircase function
- Move up or down one quantization level ( $\delta$ ) at each sample interval
- Binary behavior—important characteristic
  - Function moves up or down at each sample interval

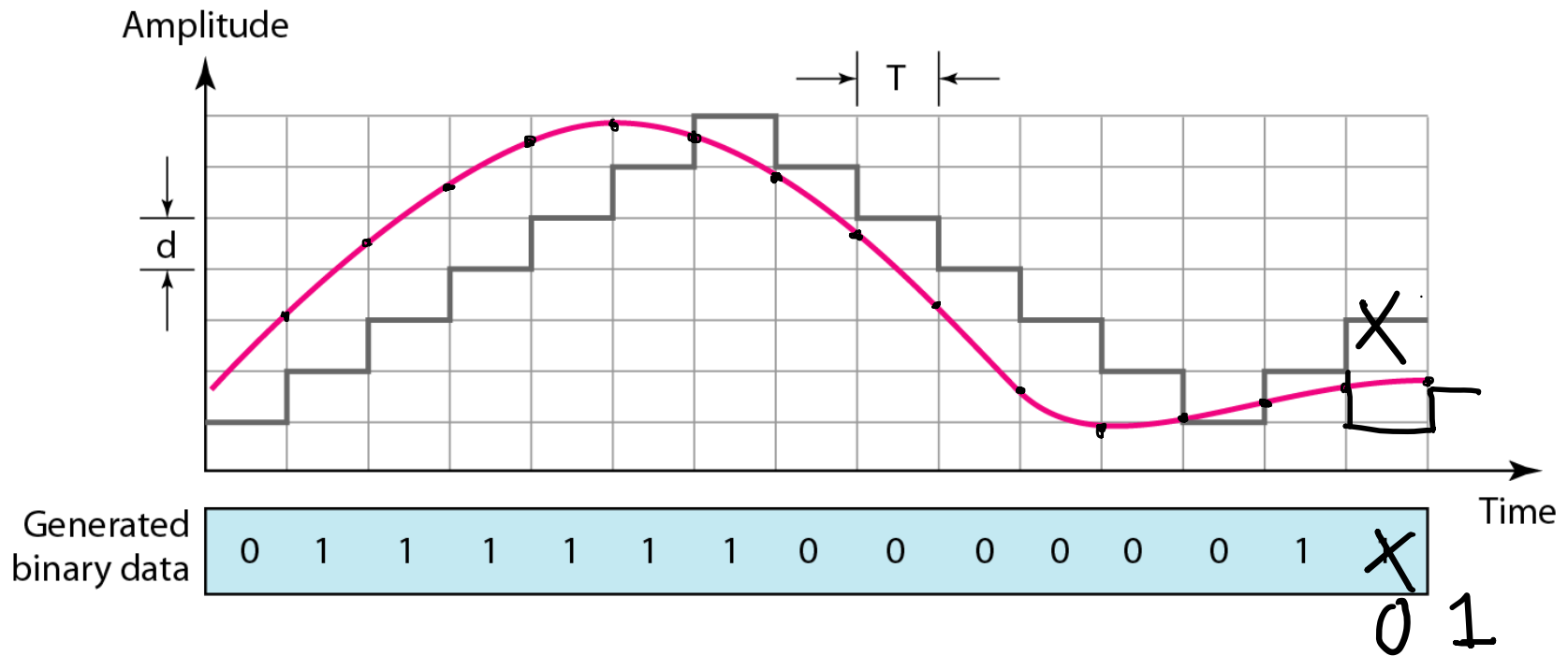
# Delta Modulation

- This scheme sends only the difference between pulses, if the pulse at time  $t_{n+1}$  is higher in amplitude value than the pulse at time  $t_n$ , then a single bit, say a "1", is used to indicate the positive value.
- If the pulse is lower in value, resulting in a negative value, a "0" is used.
- This scheme works well for small changes in signal values between samples.
- If changes in amplitude are large, this will result in large errors.

# Delta Modulation - example

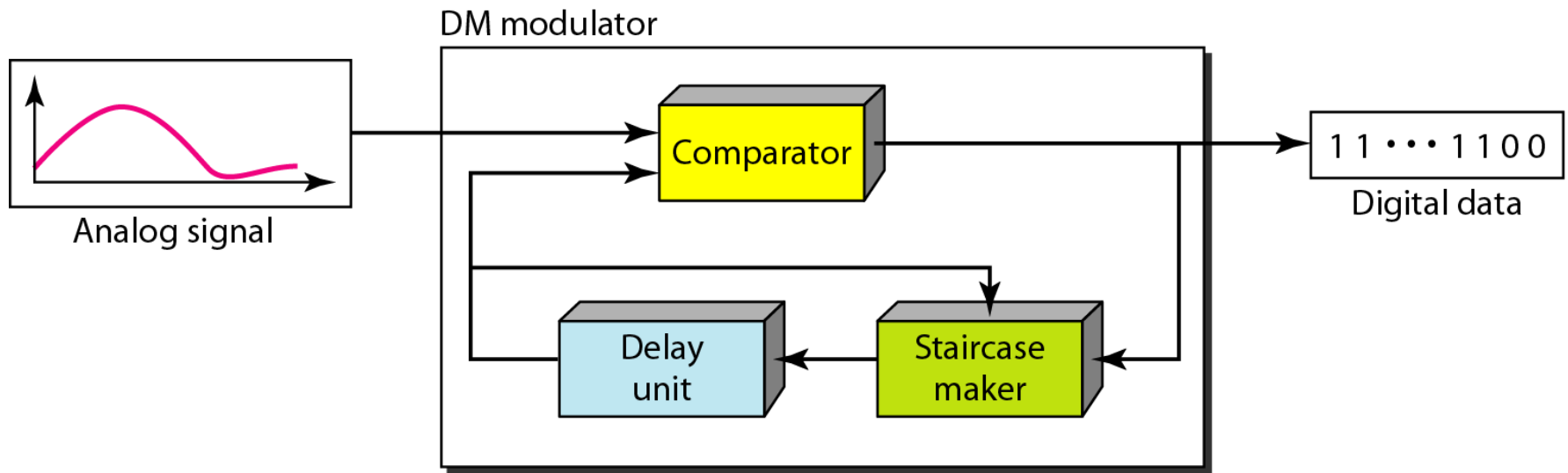


# The process of delta modulation

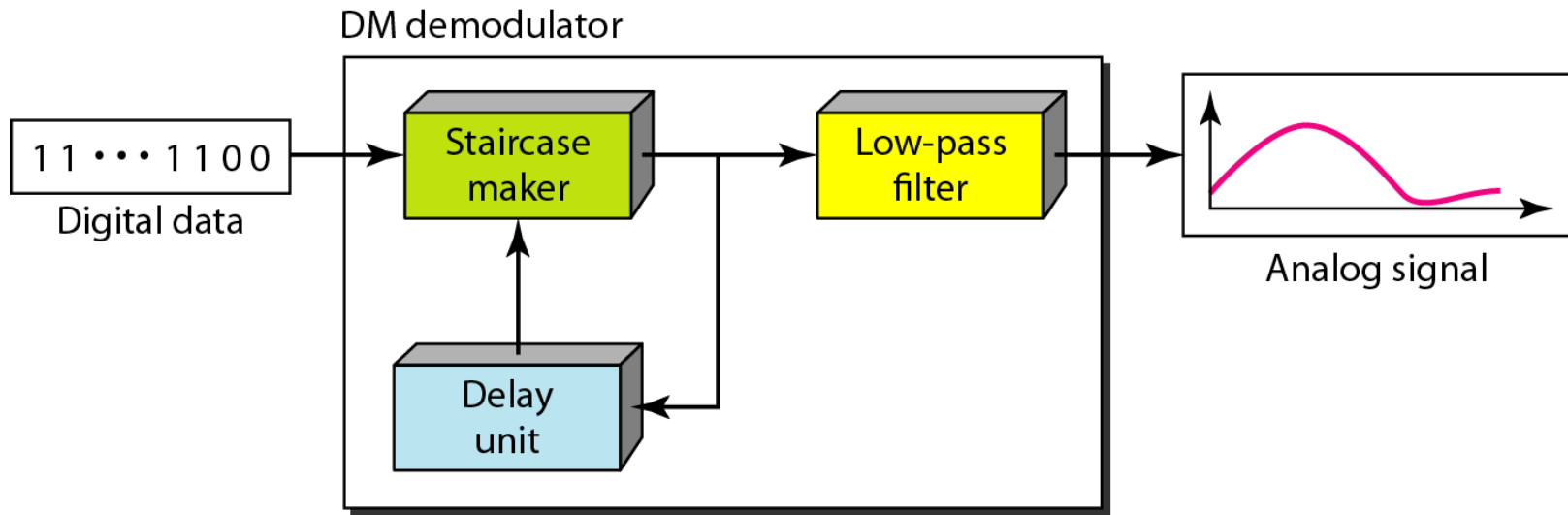




**Figure 4.29** *Delta modulation components*



**Figure 4.30** *Delta demodulation components*



# Delta Modulation

- 2 important parameters are
  - size of the step  $\delta$
  - the sampling rate.