



Discrete Time Signals

ELEC 3004: **Systems**: Signals & Controls
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Lecture 14

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Goals for the Week

- Properties of Discrete Time [DT] Signals
- DT Signal Models
- DT Signal Operations
- DT Convolution
- DT Systems → Friday
- (also for Lab 3 / Exp 4): Introduce FIR Filters → Friday



Today...

Week	Date	Lecture Title
1	27-Feb	Introduction
	1-Mar	Systems Overview
2	6-Mar	Signals & Signal Models
	8-Mar	System Models
3	13-Mar	Linear Dynamical Systems
	15-Mar	Sampling & Data Acquisition
4	20-Mar	Time Domain Analysis of Continuous Time Systems
	22-Mar	System Behaviour & Stability
5	27-Mar	Signal Representation
	29-Mar	Holiday
6	10-Apr	Frequency Response
	12-Apr	- Transform
7	17-Apr	Noise & Filtering
	19-Apr	Analog Filters
8	24-Apr	Discrete-Time Signals
	26-Apr	Discrete-Time Systems
9	1-May	Digital Filters & IIR/FIR Systems
	3-May	Fourier Transform & DTFT
10	8-May	State-Space
	10-May	Controllability & Observability
11	15-May	Introduction to Digital Control
	17-May	Stability of Digital Systems
12	22-May	PID & Computer Control
	24-May	Information Theory & Communications
13	29-May	Applications in Industry
	31-May	Summary and Course Review



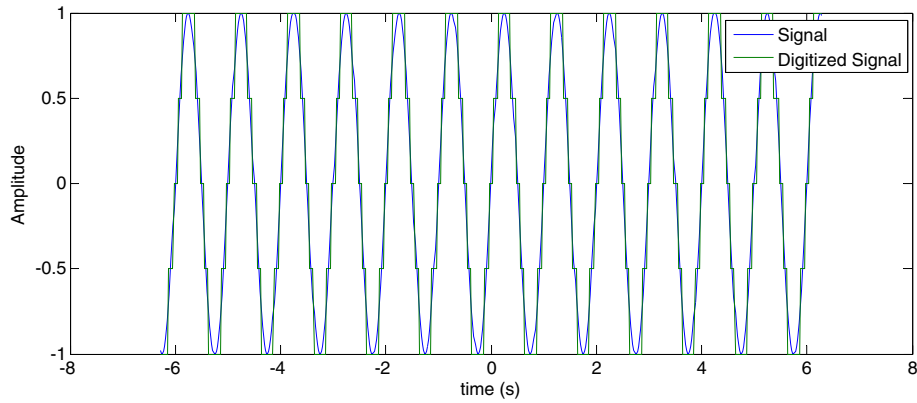
Filter Type Summary ...

Filter Type	Passband Ripple	Stopband Ripple	Transition Band	MATLAB Design Command
Butterworth	No	No	Loose	butter
Chebyshev	Yes	No	Tight	cheby
Chebyshev Type II (Inverse Chebyshev)	No	Yes	Tight	cheby2
Elliptic	Yes	Yes	Tightest	ellip



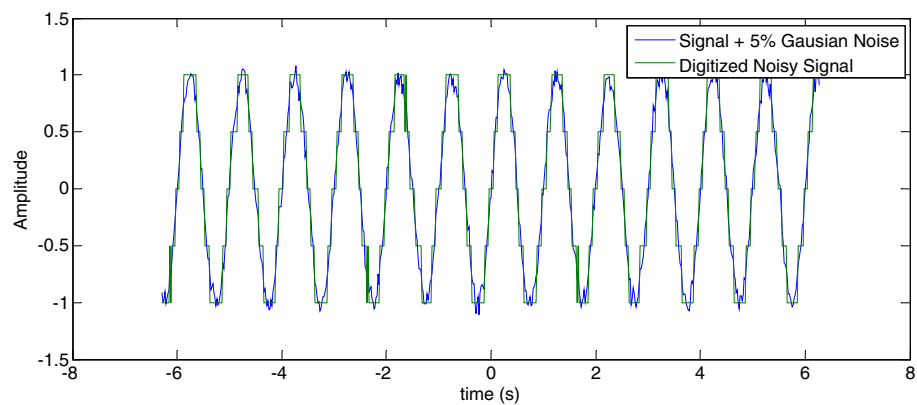
Discrete Time Signal

- Image a signal...



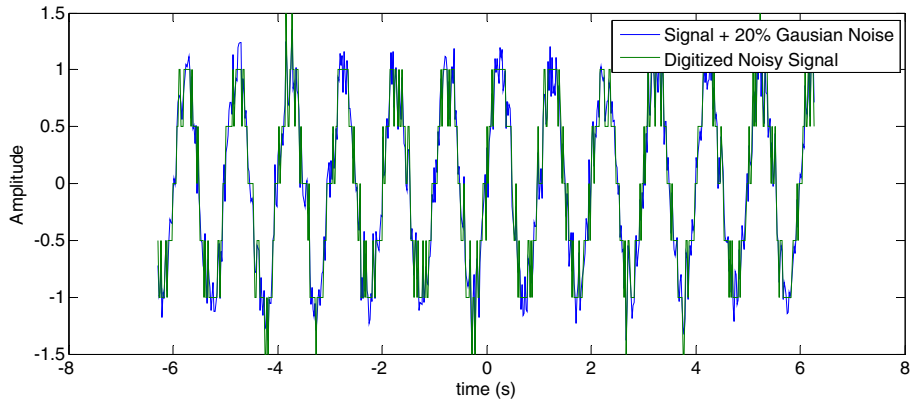
Discrete Time Signals

- Digitization helps beat the Noise!



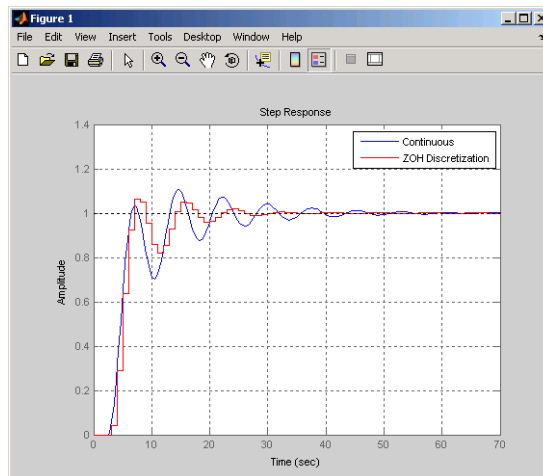
Discrete Time Signals

- But only so much...



Discrete Time Signals

- Can make control tricky!



Signal Manipulations

- Shifting

$$y(n) = x(n - n_0)$$

- Reversal

$$y(n) = x(-n)$$

- Time Scaling
(Down Sampling)

$$y(M) = x(Mn)$$

- (Up Sampling)

$$y(n) = x\left(\frac{n}{N}\right)$$



Announcements:

- Lab 3 (Experiment 4)
 - **Will run on Week 9! (and Week 10)**
 - ∴ Tomorrow is the ANZAC holiday



Next Time in Linear Systems

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