New Jersey's Science & Technology University

THE EDGE IN KNOWLEDGE

Using MATLAB

- In MATLAB signals are represented as vectors

Ex.: $x = [0 \quad 0.5 \quad 1 \quad 0.5 \quad 0]$; % an example of a signal in MATLAB

to start a comment, use %

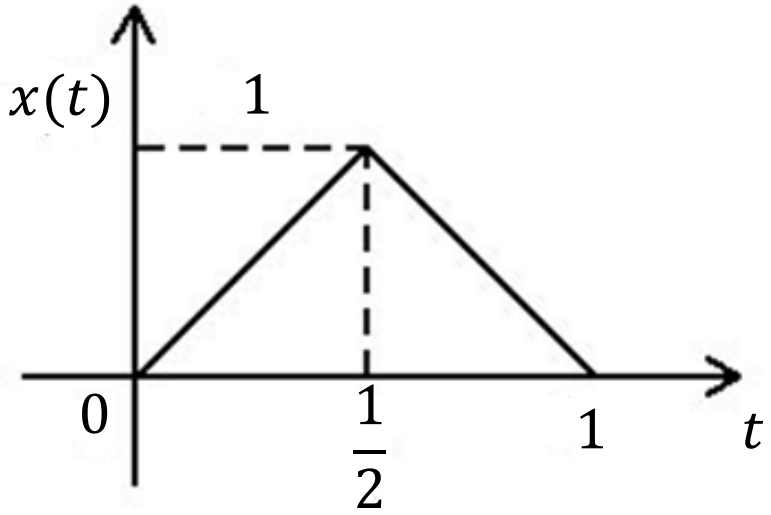
- In this course instead we deal with continuous signals $x(t)$.

Using MATLAB

- How to connect the two representations?

Via sampling

Ex.:



$$x(t) = \begin{cases} t & \text{for } 0 \le t \le \frac{1}{2} \\ 2 - 2t & \text{for } \frac{1}{2} \le t \le 1 \\ 0 & \text{otherwise} \end{cases}$$

continuous signal

Using MATLAB

- By using the sampling period $T_s = \frac{1}{4}$, the discrete-time signal in the interval $[0,1]$ can be represented by the vector:

$$x = [0 \quad 0.5 \quad 1 \quad 0.5 \quad 0]$$

which can be entered and processed in MATLAB

Plotting in MATLAB

Ex.: $x = [0 \quad 0.5 \quad 1 \quad 0.5 \quad 0]$; % discrete-time signal

$T_s = 0.25$; % sampling period

$t = [0 : T_s : 1]$ % time axis – from 0 to 1

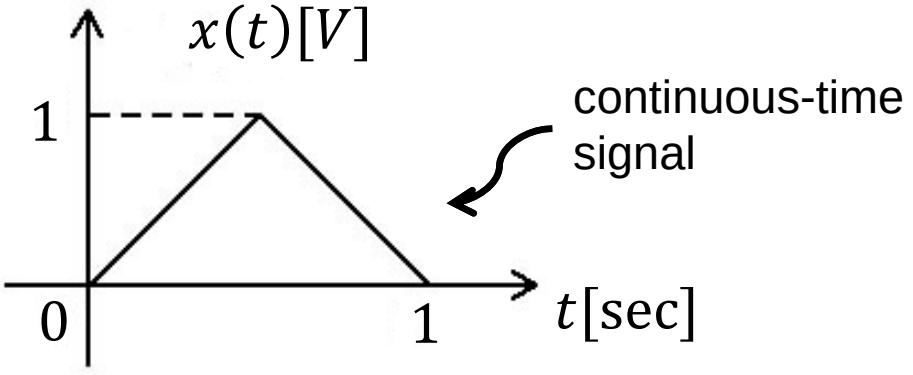
at step size equal to T_s:

$t = [0 \quad 0.25 \quad 0.5 \quad 0.75 \quad 1]$

xlabel ('t [sec]'); % label the x-axis

ylabel ('x(t) [V]'); % label the y-axis

⟶ output on the screen:



Plotting in MATLAB

- In the example on the previous slide, the plot obtained from the discrete-time signal is equal to the continuous-time signal.

- Is it always true that sampling, that is, going from continuous-time to discrete-time, does not cause any loss of information?

Quiz

- Consider the continuous-time signal $x(t) = \text{sinc}(t)$ for $-5 \leq t \leq 5$

  For $T_s = 1$ using MATLAB plot $x(t)$

Quiz

- Consider the continuous-time signal $x(t) = \text{sinc}(t)$ for $-5 \leq t \leq 5$

For $T_s = 1$ using MATLAB plot $x(t)$

$T_s = 1;$

$t = [-5: T_s: 5];$

$x = \sin(pi * t)./(pi * t);$ % "./" is the element by element division

$x(t == 0) = 1;$ % sets $x(0) = 1$

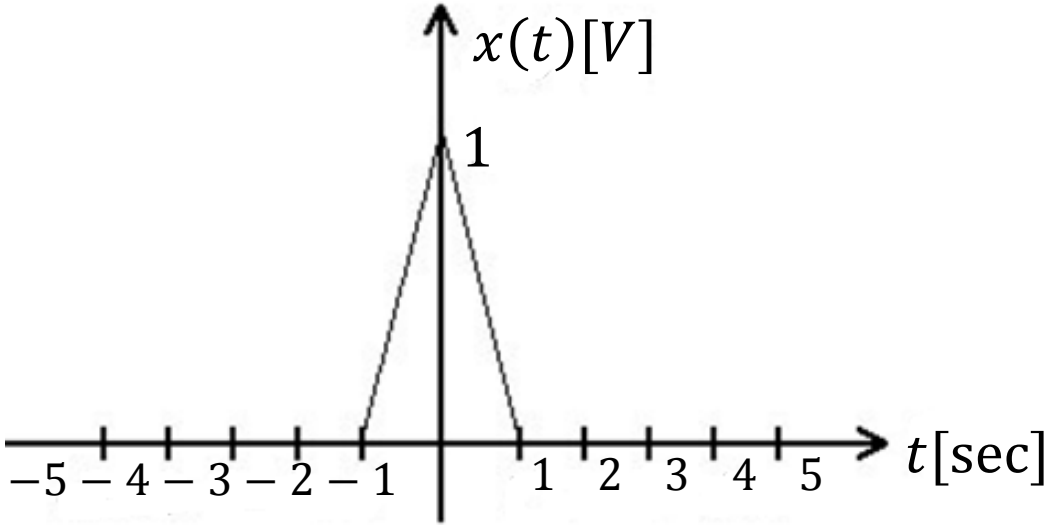
$\text{plot}(t, x);$

$\text{xlabel}('t\ [sec]');$

$\text{ylabel}('x(t)\ [V]');$

Plotting in MATLAB

- You will see this



…quite different from $x(t)$!!

- What is the problem in the example above?

Plotting in MATLAB

- The problem is that T_s is too large.

Quick check:

- Repeat the experiment of the previous quiz with $T_s = 0.1$. You will see $x(t)$ faithfully reproduced.

- We will find the general rule on how to compute the sampling period T_s after discussing the frequency-domain analysis of signals.

Plotting in MATLAB

- You should always label your axes!

Ex.: xlabel (‘t (sec)’);
ylabel (‘x(t) [V]’);

add this code after the use of plot

- Section 2.4 contains a list of MATLAB functions

More on MATLAB

- You can check the operation of any function using the command “help”

  Ex.: help plot % describes the function plot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