Text

Description automatically generated with medium confidenceDigital Communication Systems

**Laboratory Report**

Spring 2024

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| Laboratory Number: | **1** |
| Laboratory Title: | **Standard Signal Generation** |
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**Introduction:**

The purpose of this lab is to utilize MATLAB to generate some standard signals. This includes waves such as sine waves, square waves, rectangular waves, and triangular waves. We then want to modulate these signals to be representative of parameters based on our TUID.

**Procedure:**

Before starting:

1. Define an amplitude and frequency to use based off of your TUID.

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| tuid = [9,1,6,0,2,7,2,0,7];  A = tuid(9) + 2; % amplitude in amps  f = (tuid(8) + 3) \* 1000; % frequency in hz |

Square Wave:

1. Create a time axis that is 5 cycles

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| vec\_size = 500;  t = linspace(0, (1/f)\*5,vec\_size); % x axis |

1. Generate & plot 1 cycle of a square wave with amplitude **A** and frequency **f** as defined above

Rectangular pulse:

1. Define a time axis that is centered around the 6th element of your TUID

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| vec\_size = 500;  t = linspace(tuid(6)-1,tuid(6)+1,vec\_size); % x axis |

1. Generate & plot a rectangular pulse centered around the 6th element of your TUID with width of the 5TH element of your TUID / 10 and amplitude **A** as defined above

Half Sine Wave:

1. Generate a time axis that is 5 cycles as seen in the procedure for the square wave
2. Generate a Sine wave with amplitude **A** and frequency **f** as defined above. Interlace every other half cycle with zeroes so only the positive side of the sine wave is showing.
3. Plot this signal

Triangular Wave:

1. Generate a time axis that is 3 cycles

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| vec\_size = 500;  t = linspace(0,(1/f)\*3,vec\_size); % x axis |

1. Generate & plot a triangular wave with phase shift of (1/(4\*f)), amplitude **A** and frequency **f** as defined above.

Bonus 1:

1. Generate time axis that is 6 cycles

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| vec\_size = 600;  t = linspace(0,(1/f)\*6,vec\_size); |

1. Interlace the positive components of a sine wave with amplitude **A** and frequency **f** as defined above with the negative part of a square wave with amplitude **A** and frequency **f**.
2. Plot this signal.

Bonus 2:

1. Generate time axis that is 6 cycles as shown in Bonus 1
2. Interlace the positive components of a triangular wave with vertical shift **A/2**, amplitude **A/2** and frequency **f** as defined above with the negative part of a square wave with amplitude **A** and frequency **f**.
3. Plot this signal.

**Result:**

Square Wave:

A graph with a line

Description automatically generated

Rectangular Wave:

A graph with numbers and lines

Description automatically generated

Half Sine Wave:

A graph of a wave

Description automatically generated

Triangle Wave:

A graph with blue lines

Description automatically generated

Bonus 1:

A graph with blue lines

Description automatically generated

Bonus 2:

A graph with blue lines

Description automatically generated

**Descriptive Answers to Tasks:**

No answers for tasks

**Conclusion**

No conclusion since no questions

**Code:**

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| clear  close  clc  clf  tuid = [9,1,6,0,2,7,2,0,7];  A = tuid(9) + 2; % amplitude [A]  f = (tuid(8) + 3) \* 1000; % frequency [hz]  **Part 1**  vec\_size = 500;  t = linspace(0,(1/f)\*5,vec\_size); % x axis  part\_1 = [A\*ones(1,vec\_size\*.1),A\*-1\*ones(1,vec\_size\*.1),zeros([1,vec\_size\*.8])]; % 1 cyle with trailing zeros  plot(t,part\_1)  title('Square wave')  xlabel('Time')  grid on  **Part 2**  vec\_size = 500;  t = linspace(tuid(6)-1,tuid(6)+1,vec\_size); % x axis  width = tuid(5)/10;  outer = (1 - width)/2;  part\_2 = [zeros([1,vec\_size\*outer]),A\*ones(1,vec\_size\*width),zeros([1,vec\_size\*outer])]; % 1 cyle with trailing zeros  plot(t,part\_2)  title(strcat(strcat('Rectangule pulse width = ',num2str(width)),'s'));  xlabel('Time')  ylabel('Amplitde')  grid on  **Part 3**  vec\_size = 500;  t = linspace(0,(1/f)\*5,vec\_size); % x axis  section = vec\_size / 10;  part\_3 = A\*sin(2\*pi\*t\*f);  part\_3 = [part\_3(1:section),zeros([1,section]),part\_3(section\*2:section\*3-1),zeros([1,section]),part\_3(section\*4:section\*5-1),zeros([1,section]),part\_3(section\*6:section\*7-1),zeros([1,section]),part\_3(section\*8:section\*9-1),zeros([1,section])];  plot(t,part\_3)  title('Half wave sine')  ylim([0,9])  xlabel('Time')  ylabel('Amplitude')  grid on  **Part 4**  vec\_size = 500;  t = linspace(0,(1/f)\*3,vec\_size); % x axis  part\_4 = A\*sawtooth(2\*pi\*(t+(1/(4\*f))) \* f,.5) ;  plot(t,part\_4)  xlabel('Time');  ylabel('Amplitude');  title('Triangle Wave')  grid on  **Bonus 1**  vec\_size = 600;  t = linspace(0,(1/f)\*6,vec\_size);  section = vec\_size / 6;  bonus = [A\*sin(pi\*f\*t(1:section)),-1\*A\*ones([1,section]),A\*sin(pi\*f\*t(section\*2:section\*3-1)),-1\*A\*ones([1,section]),A\*sin(pi\*f\*t(section\*4:section\*5-1)),-1\*A\*ones([1,section])];  plot(t,bonus)  ylabel('Amplitude');  xlabel('Time');  grid on  **Bonus 2**  vec\_size = 600;  t = linspace(0,(1/f)\*6,vec\_size);  section = vec\_size / 6;  bonus = [A/2+A/2\*sawtooth(2\*pi\*f\*t(1:section),.5),-1\*A\*ones([1,section]),A/2+A/2\*sawtooth(2\*pi\*f\*t(section\*2:section\*3-1),.5),-A\*ones([1,section]),A/2+A/2\*sawtooth(2\*pi\*f\*t(section\*4:section\*5-1),.5),-A\*ones([1,section])];  plot(t,bonus)  ylabel('Amplitude')  xlabel('Time')  grid on |