Introduction to Simulink

Bruno Korst - bkf@comm.utoronto.ca, David Ding - davidy.ding@mail.utoronto.ca

• **Name: Lindy Zhai**	**Student No.:**	**Lab Group No.: 110**
• **Name: Anna Liang**	**Student No.:**	**Grade.:**

IMPORTANT

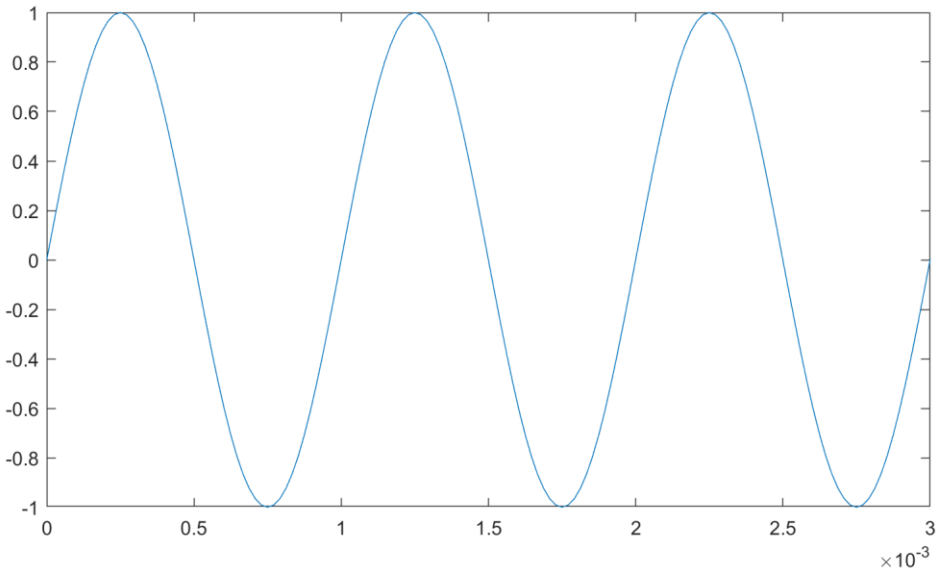
To submit your assignment for this lab, you must upload a SINGLE ZIP file which includes this completed PDF answer sheet (with the screenshots and answers you are asked to provide in the instructions), and Matlab /Simulink files you used.

1. Matlab Exercises

1.1 Creating and Plotting a Sinusoid

a. *Re-write the program to plot three periods of your 1KHz sine wave.* **(0.5pt)**

Include a screenshot.



1.2 Listening to a Sine Wave

a. Play the program and hear the 1KHz sine wave.

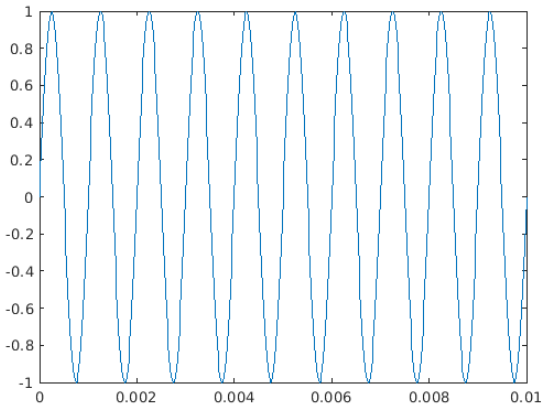
b. Change the frequency to 500Hz and play it again.

c. Now change it to hear 2KHz and play it again.

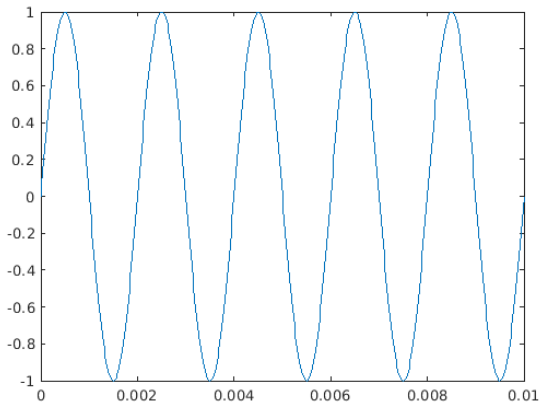
d. *Now change back to 10KHz and explain what you have observed/heard.* **(1.0pts)**

Include a screenshot of the waveform for each of the above.

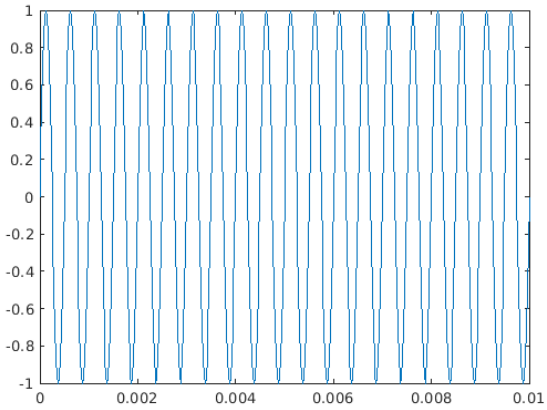
e. *As you doubled the voltage, what is the change in dB of the signal as measured at the load? Note that the dB you are calculating does not represent sound pressure; you are only comparing voltages.* **(0.5pts)**



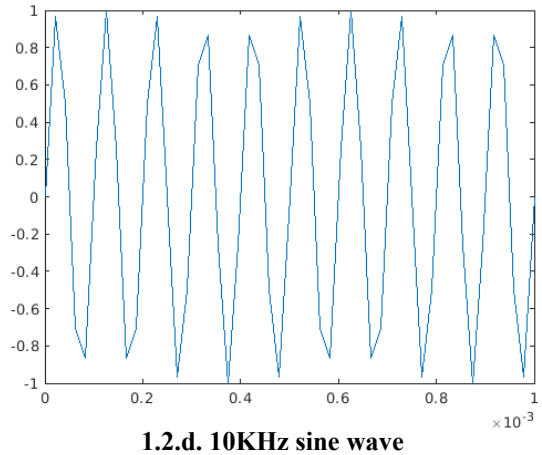
1.2.a. 1KHz sine wave



1.2.b. 500Hz sine wave



1.2.c. 2KHz sine wave



1.2.d. 10KHz sine wave

Observation:

The sine wave is played four times with different frequencies. It can be clearly observed that a higher frequency will result in a sharper (higher) sound. For example, the 10KHz sound is extremely sharp, while the 500Hz just sounds like a regular note. Meanwhile, the shape of the wave becomes less smooth with the increase of the frequency; this is because the same number of points are used to sketch the curve, thus with a smaller frequency interval, fewer points are included in each period, and rougher graphs are formed (this explains the irregular shape of the 10KHz wave).

1.2.e.

$$20\log\left(\sin\left(2000\cdot\pi\cdot t\right)\cdot 2\right)-20\log\left(\sin\left(2000\cdot\pi\cdot t\right)\right)$$

$$=20\cdot\left(\log\left(\sin\left(2000\cdot\pi\cdot t\right)\cdot 2\right)-\log\left(\sin\left(2000\cdot\pi\cdot t\right)\right)\right)$$

$$=20\left(\log\left(\frac{\sin\left(2000\cdot\pi\cdot t\right)\cdot 2}{\sin\left(2000\cdot\pi\cdot t\right)}\right)\right)=20\cdot\log\left(2\right)=6.0206\ dB$$

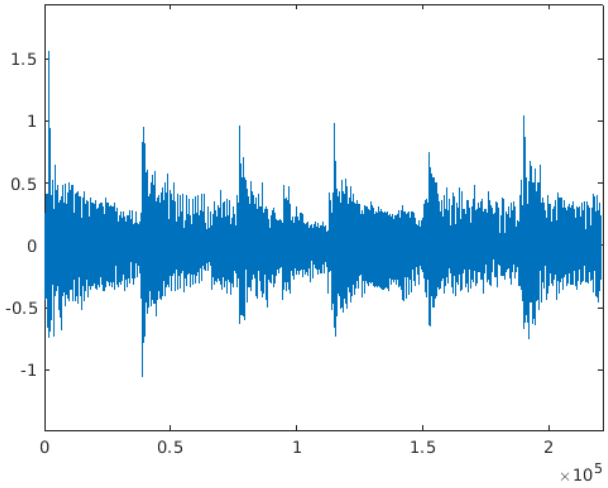
1.3 Audio Signal Processing

a. *What is the duration of the guitar signal in seconds?* **(1.0pts)**

104.1516 seconds

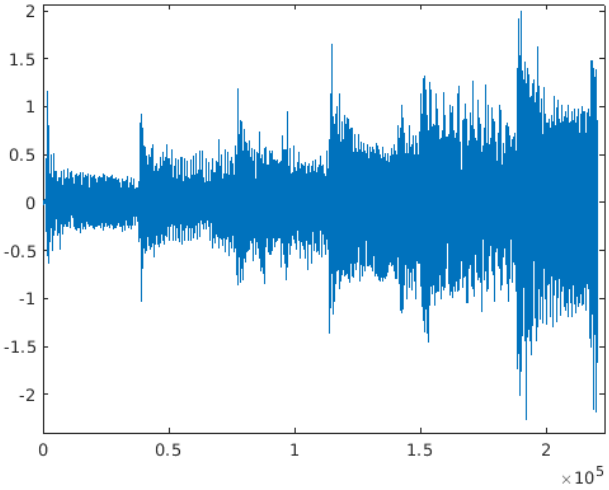
b. *Play the combined bass, drums, and guitar sound.* **(1.0pts)**

Include a screenshot of the waveform.



c. *Synthesize gradual increase of guitar volume with bass and drums volume staying constant.* **(1.0pts)**

Include a screenshot.

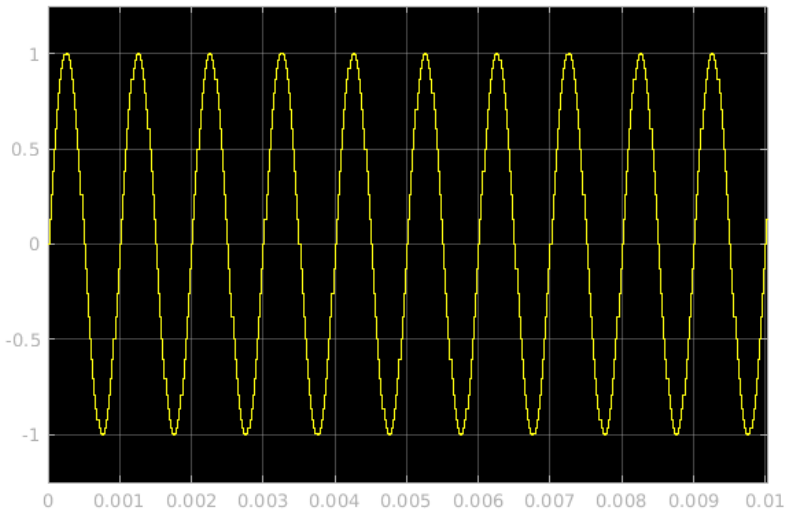


2. Simulink

2.1 First Simulink Model

a. *Show a clear 1KHz sine wave with 1/48000 sampling time displayed on your* Simulink *scope.* **(1.0pts)**

Include a screenshot.

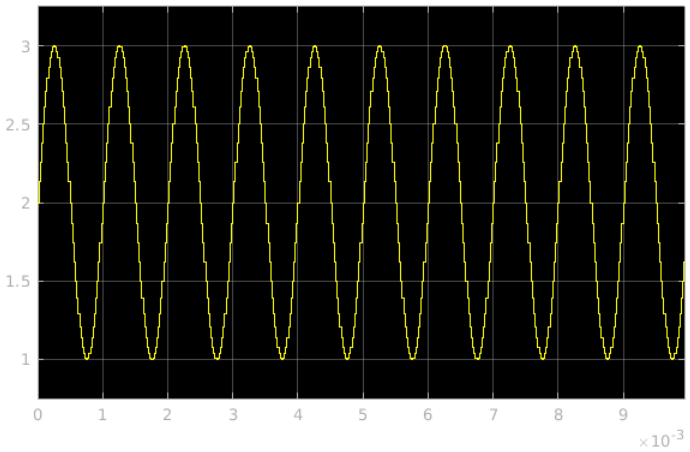


2.2 The Four Operations

2.2.1 Adding and Subtracting a Constant to/from Sinusoid

a. *Show a positive DC shift of 2 on your* Simulink *scope.* **(1.0pt)**

Include a screenshot.

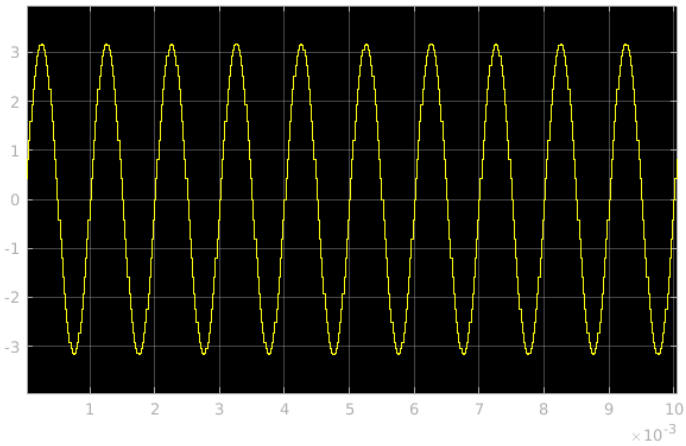


2.2.2 Gain

a. *Apply a 10dB gain to your sine wave and show it on the* Simulink *scope.* **(1.0pt)**

Include a screenshot.

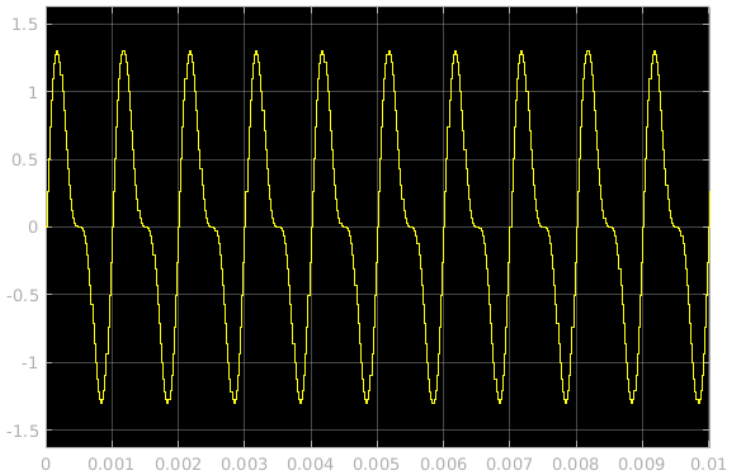
$20 \cdot \log(x) = 10 \quad \Rightarrow \quad x = 10^{0.5} = 3.16228$



2.2.3 Operating on Two Sines

a. *Show on your* Simulink *scope the resulting addition of 2 sinusoids: a 1Vp, 1KHz and a* $\frac{1}{2}$ *Vp, 2KHz. Use the slider gain blocks to assign the magnitudes for the 2 sinusoids.* **(1.0pt)**

Include a screenshot.



2.2.4 Multiplying Two Sines

a. *Show your working (and sounding) model that multiplies two sinusoids: a 31.25Hz and a 500Hz, both with amplitude 1.* **(1.0pt)**

Include a screenshot.