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Math 362 Fourier Analysis

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Class Prep 2

Section 2.2

Key Concepts: In this section, we review key features of sine and cosine graphs including amplitude, period, frequency, and frequency index. We will see more precisely how sine waves play a role in modeling the sound waves of pure notes and chords.

|  |  |
| --- | --- |
| Input Command | Output |
| >> sinecosineplot(3,2\*pi\*2,1) |  |
| >> sinecosineplot(3,2\*pi\*2,1) |  |
| >> sinecosineplot(1,2\*pi\*4/5,5/4) |  |
| >> sinecosineplot(1,2\*pi\*2/3,3/2) |  |
| >> sinecosineplot(1,2\*pi\*5/16,16) |  |
| >> sinecosineplot(1,2\*pi\*4,1) |  |
| >> sinenoteplot(440,1) |  |
| >> sinenoteplot(440,0.01) |  |
| >> sinenoteplot(261.6,1) |  |
| >> sinenoteplot(261.6,0.01) |  |
| >> mbiraplot |  |
| >> sinenoteplot(523.3,0.0113) |  |
| >> sinechordplot(440,554.4,659.3,0.02) |  |

Section 2.3

Key Concepts: In this section, we review the imaginary unit “i” and how it is used to define complex numbers. We will review basic properties of complex numbers and their conjugates and take a look at Euler’s formula.

Section 2.4

Key Concepts: In this section, we will use MATLAB to see how higher frequency sine and cosine waves alias down to lower frequency sine and cosine waves when sampled on a set of N equally spaced nodes. After that, we will establish a theorem concerning aliasing and see how to avoid or minimize the effects of aliasing in musical notes and chords by choosing N large enough, based on the Nyquist frequency.

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| --- | --- |
| Input Command | Output |
| >> AliasingTwoSines(8,7,1,1,-1)  fN =  0  -0.7071  -1.0000  -0.7071  0.0000  0.7071  1.0000  0.7071  gN =  0  -0.7071  -1.0000  -0.7071  -0.0000  0.7071  1.0000  0.7071 |  |
| >> AliasingTwoCosines(8,7,1,1,1)  fN =  1.0000  0.7071  -0.0000  -0.7071  -1.0000  -0.7071  -0.0000  0.7071  gN =  1.0000  0.7071  0.0000  -0.7071  -1.0000  -0.7071  -0.0000  0.7071 |  |
| >> AliasingSineNyquist(8,11)  fN =  0  0.7071  -1.0000  0.7071  0.0000  -0.7071  1.0000  -0.7071  gN =  0  0.7071  -1.0000  0.7071  0.0000  -0.7071  1.0000  -0.7071  Node\_Info =  'Number of nodes: N = 8; Nyquist Freq Index: N/2 = 4.'  Frequency\_Info =  'large freq = 11; remainder = 3; small freq = 3.'  Aliasing\_Conclusion =  'There is aliasing.' |  |

|  |  |
| --- | --- |
| >> AliasingCosineNyquist(8,8)  fN =  1  1  1  1  1  1  1  1  gN =  1  1  1  1  1  1  1  1  Node\_Info =  'Number of nodes: N = 8; Nyquist Freq Index: N/2 = 4.'  Frequency\_Info =  'large freq = 8; remainder = 0; small freq = 0.'  Aliasing\_Conclusion =  'There is aliasing.' |  |
| >> sinechordplot(261.6,329.6,392,0.05) |  |

|  |  |
| --- | --- |
| >> AliasingSineNote(782,880,0.02)  Node\_Info =  'Number of nodes: N = 782; Nyquist Freq Index: N/2 = 391.'  Frequency\_Info =  'large freq = 880; remainder = 98; small freq = 98.'  Aliasing\_Conclusion =  'There is aliasing.' |  |
| >> AliasingSineNote(1024,880,0.02)  Node\_Info =  'Number of nodes: N = 1024; Nyquist Freq Index: N/2 = 512.'  Frequency\_Info =  'large freq = 880; remainder = 880; small freq = 144.'  Aliasing\_Conclusion =  'There is aliasing.' |  |