بسم الله الرحمن الرحيم

درس سیگنال‌ها و سیستم‌ها، جناب آقای دکتر اکبری، نیم‌سال ۹۹۱

تمرین شبیه‌سازی با MATLAB شماره‌ی ۴

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هدف

در این تمرین با استفاده از دستورات MATLAB سری فوریه را محاسبه خواهیم کرد.

تذکر ویژه‌ی تمرین چهارم

لازم است این تمرین را به صورت انفرادی انجام دهید.

۱.۱   توضیحات گزارش

برای این تمرین نیاز است که فایل اسکریپت خود را به همراه گزارش خود بارگذاری نمایید. گزارش شما باید توضیح مناسبی از مراحل انجام این تمرین به همراه تصاویر تولید شده را داشته باشد.

نکته

مهلت ارسال این تمرین را می‌توانید از طریق سامانه‌ی L.M.S پیگیری نمایید. مهلت ارسال تمرین تمدید نخواهد شد.

- a. plot the signal below

$$x(t) = e^{j4\pi t} + e^{-j4\pi t}, \tag{1}$$

$$y(t) = \left(e^{j4\pi t} - e^{-j4\pi t}\right)/j. \tag{2}$$

Note: This exercise is to let you know the relationship between cosine/sine signal and e^{jwt} signals.

Requirement: 1) the length of the signal in your plot has to be longer than two periods. 2) put x(t) and y(t) in the same figure but using different colors to mark them. 3) your figures should look like this
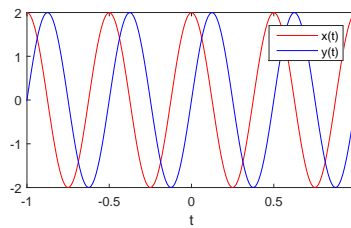

Figure 1: 1 a)

- b. Plot the signal $z(t) = 8cos(2\pi t + \Theta)$, where Θ is the phase of the signal. Try Θ with the following three different values $[-\frac{\pi}{2}, -\pi, -\frac{3\pi}{2}]$.

Requirement: 1) the length of the signal in your plot has to be longer than two periods. 2) put the three plots in one figure but using different colors to mark signals with different phase. 3) *Mark the exact function in the legend* and your figures should look like this
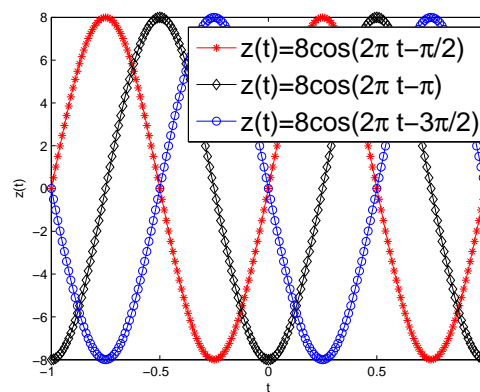

Figure 2: 1 b)

- c. Repeat part (b) for the signal $w(t) = 3cos(8\pi t + \Theta)$.

- d. The signal $w(t) = Acos(wt + \Theta)$ can also be expressed as $w(t) = Acos(w(t - t_1))$, where t_1 is the time delay. In your lab report please answer the question: what is the time delay for each of the signals in part b) and c)?

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- An even function signal (f(t)=f(-t)) can be expressed as the sum of Cosine Fourier Series ($b_n = 0$). If the even function has no DC component, i.e. $a_0 = 0$, the even function can be expressed as

$$f(t) = \sum_{n=1}^{\infty} a_n \cos(nw_0 t) = \sum_{n=1}^{\infty} f_n(t). \tag{3}$$

Listed below are the first three terms of the Cosine Fourier Series representations of three different even function signals (x(t), y(t) and z(t)). Each complete Fourier Series representation requires an infinite number of terms. For each signal, the remaining terms of the Fourier Series representation follow the pattern that is present in the first three terms. For each signal, use this pattern to write a general expression for the n-th term of the Fourier Series representation and put this result in your report.

$$x_1(t) = \frac{4}{\pi} \bullet \cos\left(1 \bullet \omega_0 t - \frac{\pi}{2}\right)$$

$$x_2(t) = \frac{4}{\pi} \bullet \frac{1}{3}\cos\left(3 \bullet \omega_0 t - \frac{\pi}{2}\right)$$

$$x_3(t) = \frac{4}{\pi} \bullet \frac{1}{5}\cos\left(5 \bullet \omega_0 t - \frac{\pi}{2}\right)$$

$$y_1(t) = \cos\left(1 \bullet \omega_0 t\right)$$

$$y_2(t) = \cos\left(2 \bullet \omega_0 t\right)$$

$$y_3(t) = \cos\left(3 \bullet \omega_0 t\right)$$

$$z_1(t) = \cos\left(1 \bullet \omega_0 t\right)$$

$$z_2(t) = (1/3)^2 \cos\left(3 \bullet \omega_0 t\right)$$

$$z_3(t) = (1/5)^2 \cos\left(5 \bullet \omega_0 t\right)$$

Figure 3: 2 a)

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Complete the following experiments for each of the three F.S. described above.

- Create a figure with 6 subplots (w_0 is called the fundamental frequency, it can be any number, for example 1, 2
  .... But after you choose w_0, please make sure that each plot should contain at least 2 periods)

  - Subplot 1: Plot the first term of the F.S., i.e. $f_1(t)$.

  - Subplot 2: Plot the first term, the second term, and the sum of the first two terms.

  - Subplot 3: Plot the first term, the second term, the third term, and the sum of the first three terms.

  - Subplot 4: Plot the sum of the first 10 terms of the F.S.

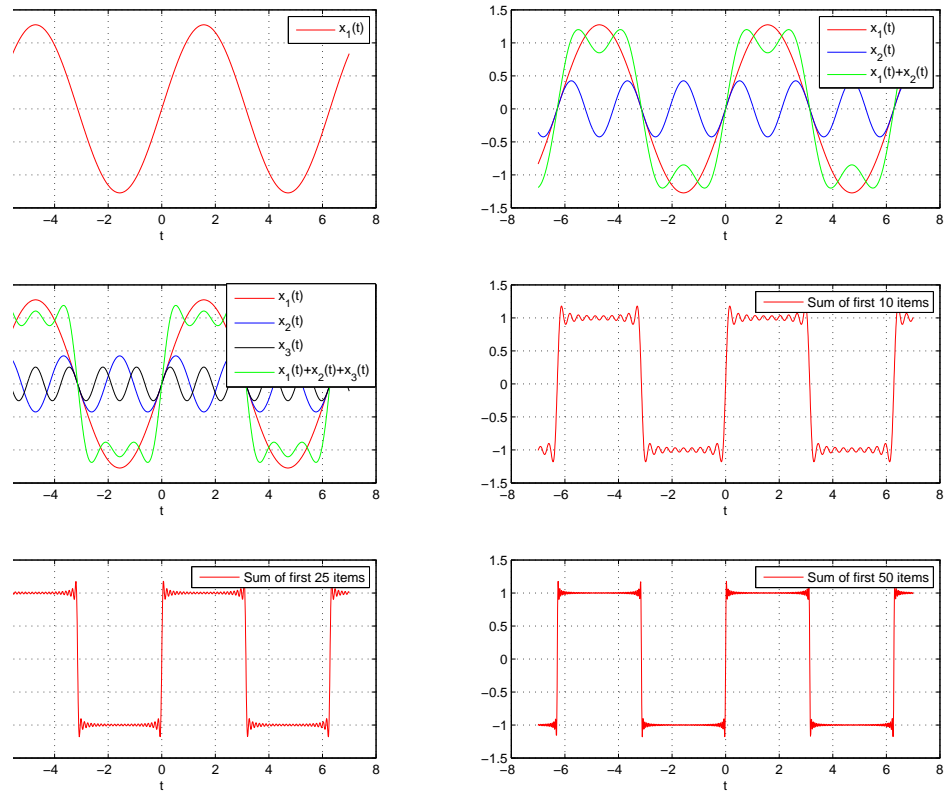 - Subplot 5: Plot the sum of the first 25 terms of the F.S.

Figure 4: 3

– Subplot 6: Plot the sum of the first 50 terms of the F.S. Your figure should look like this