

**Topic of this homework:** Introduction to MATLAB (see the *Matlab tutorial* for help).

Deliverable: Print outs of plots and answers to questions.

## 1 Plotting complex quantities in Matlab

Plot real, imaginary, magnitude and phase quantities.

1. Consider the functions  $f(s) = s^2 + 6s + 25$  and  $g(s) = s^2 + 6s + 5$ .
  - (a) Find the zeros of functions  $f(s)$  and  $g(s)$  using the command `roots`.
  - (b) On a single plot, show the roots of  $f(s)$  as red circles, and the roots of  $g(s)$  as blue plus signs. The x-axis should display the real part of each root, and the y-axis should display the imaginary part. Use `hold on` to plot both sets of roots.
  - (c) Give your figure the title ‘Complex Roots of f(s) and g(s)’ using the command `title`. Label the x-axis ‘Real Part’ and the y-axis ‘Imaginary Part’ using `xlabel` and `ylabel`. Type `ylim([-10 10])` and `xlim([-10 10])` to expand the axes.
2. Consider the function  $h(t) = e^{j2\pi ft}$  for  $f = 5$  and  $t=[0:0.01:2]$ 
  - (a) Use `subplot` to show the real and imaginary parts of  $h(t)$  as two graphs in one figure. Label the x-axes ‘Time (s)’ and the y-axes ‘Real Part’ and ‘Imaginary Part’.
  - (b) Use `subplot` to plot the magnitude and phase parts of  $h(t)$ . Use the command `phase` or `unwrap(angle())` to plot the phase. Label the x-axes ‘Time (s)’ and the y-axes ‘Magnitude’ and ‘Phase (radians)’.

## 2 Prime numbers, infinity, etc. in Matlab

1. Prime numbers in Matlab
  - (a) Use the Matlab function `factor` to find the prime factors of 123, 248, 1767, and 999,999.
  - (b) Use the Matlab function `isprime` to check if 2, 3 and 4 are prime numbers. What does the function `isprime` return when a number is prime, or not prime? Why?
  - (c) Use the Matlab function `primes` to generate prime numbers between 1 and  $10^6$  and save them in a vector `x`. Plot this result using the command `hist(x)`.
  - (d) Now try `[n,bin_centers] = hist(x)`. Use `length(n)` to find the number of bins.
  - (e) Set the number of bins to 100 by using an extra input argument to the function `hist`. Show the resulting figure and give it a title and axes labels.
2. Inf, NaN and logarithms in Matlab
  - (a) Try `1/0` and `0/0` in the command window. What are the results? What do these ‘numbers’ mean in Matlab?
  - (b) In Matlab, the natural logarithm ‘ln’ is computed using the function `log` (`log10` and `log2` are computed using `log10` and `log2`). Try `log(0)` in the command window.
  - (c) Try `log(-1)` in the command window. Do you get what you expect for  $\ln(-1)$ ? Show how Matlab arrives at the answer by considering  $-1 = e^{i\pi}$ .
  - (d) (*not graded*) What is a decibel? Look up decibels on the internet.