UNIVERSITY OF UTAH
ELECTRICAL AND COMPUTER ENGINEERING DEPARTMENT

ECE1020 **COMPUTING ASSIGNMENT 10**
N. E. COTTER **MATLAB® PLOTS: ROVER PERFORMANCE**

READING
Matlab® Student Version: learning Matlab 6, Ch 5
Mastering Matlab® 7, Ch 26 and 27

TOPICS
2-D and 3-D plots

OVERVIEW
In this final assignment, you will prepare your communication system code for testing, and you will map where your rover goes on a distant planet. Figure 1 shows an aerial view of our landing site on the planet. Figure 2 illustrates the basic geographical features of the landing site as viewed from above, with a dashed line indicating the path we want the rover to follow in order to avoid hazards. Figure 3 shows the same information as Figure 2 on a more detailed contour plot (or topographic map).

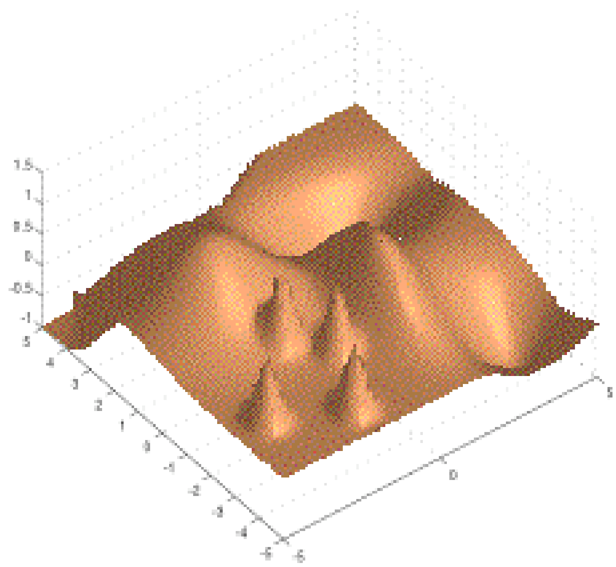

Figure 1: Aerial view of planet

In this assignment, you will create the plots in Figures 1 and 3, but you will show the route actually followed by your rover. After you hand in your code, we will also test it and plot where your rover goes. You may now improve your coding scheme in any way you wish to make your transmitted data immune to the noise we will add to it.

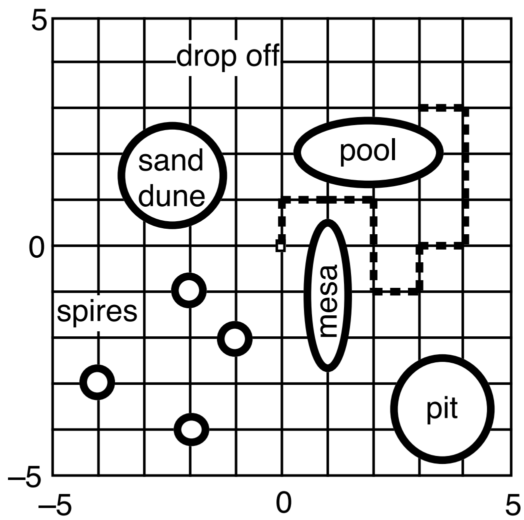

Figure 2: Landing site and desired path.

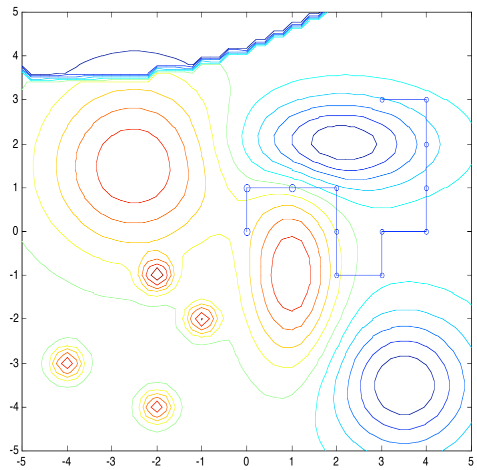

Figure 3: Contour map and desired path.

Rather than changing bits at random, we will add random numbers to the bits you transmit. At the receiving end you must decide how to handle signal values such as 0.341 instead of only 0's and 1's. You might find a way to use these raw values, as is done in Viterbi decoding. Best of luck!

PROCEDURE

In this assignment you will split your previous communication system code into two pieces representing the transmitter and receiver, and you will write a new command file to plot the movements of your rover on a contour map of the distant world.

+30 pts Split previous communication system into two pieces

Using a text editor program on your PC, create two command (i.e., function) files called **transmit.m** and **receive.m**. **transmit.m** will contain commands from your solution to Computational Assignment 9 up to the point where you save the transmitted bits:

```
%%%%%% Write transmitted codewords out to file using save command.
%  Info is save in file called xmit_code_bits.mat
```

You must also use a save command to save your codewords array so it can be read in by the receiver program from a file called codebook.mat

receive.m will first load codebook.mat into its codewords array. It will also contain commands starting after the noisy transmitted data is read in (using dlmread) from a file called noisy_xmit_data.txt. Note that steps for adding noise to the received bits are missing. Use the program ECE1020_addnoise.m from the class web page to create the noisy bits stored in noisy_xmit_data.txt. Because the noise will create bit values that are real numbers, not just zero or one, you must adapt your receiver code to deal with these numbers. You may use a logical operator to quantize the bits to zero or one, if desired, but you may wish to attempt to design a more sophisticated decoder that uses the raw bit values.

+5 pts **Do** use semicolons at the ends of commands in your **transmit.m** and **receive.m** files, but do not use semicolons at the ends of commands in your **rover_map.m** file.

+5 pts Write a command file called **rover_map.m** to plot the planet and your rover movements as described in the steps that follow.

+5 pts
```
% Call function to generate pts on surface of planet.
[x,y,z] = planet_map(51);
```

+10 pts Make a surface plot of the planet.
Using the figure command, set the figure number to 1. Then create a <u>lit</u> surface plot (see p. 437 of *Mastering Matlab 7*) of x, y, and z. Use interpolated shading (p. 435) and the copper color map (p. 462). Also set the viewpoint to azimuth –37.5 degrees and elevation 60 degrees (p. 442). The result will be the plot in Figure 1.

+5 pts Make a contour plot of the planet.
Using the figure command, set the figure number to 2. Then create a contour plot (see p. 441 of *Mastering Matlab 7*), with 11 contours, of x, y, and z. The result will be the contour plot in Figure 3 (without the path of the rover).

+5 pts Process commands in out_comm_str.m
Using the first part of the code from transmit.m, read in command strings from out_comm_str.txt (created by receive.m above) and process them into an array called command_num. Note that this code is identical to the code in transmit.m except for the file name change from in_comm_str.txt to out_comm_str.txt.

+5 pts Insert the following code in rover_map.m after creating command_num. This code calculates the position of the rover from the command numbers in command_num.
```
% Start with rover at [0, 0]
rover_pos = [0, 0]
% Start out heading toward [1, 0]
rover_dir = [1, 0]

% Call function to convert command numbers into rover movement
coordinates.
[rover_lat,rover_long] = rover_move(command_num,rover_pos,rover_dir)
```

Note that the file rover_move.m is available on the class web page as a raw text file. You may copy it from the web page and paste it into a file or save it to a file. The values rover_move returns are the rover's latitude and longitude after each move. You will plot these later on.

+5 pts From the values of rover_lat and rover_long, compute the following quantity: one divided by the distance squared from the base station (located at –0.5, –0.5) to the rover. Save the results in an array called sig_strength. These values will serve as a crude measure of signal strength received by the rover.

+5 pts Insert the following code after the above:
```
% Insert initial rover position and signal strength at start of list.
```

```
rover_lat = [0, rover_lat]
rover_long = [0, rover_long]
sig_strength = [2, sig_strength]
```
These steps give the rover positions and signal strength during its journey.

+5 pts Make a scatter plot of the rover's path.
Using the hold command, superimpose a scatter plot (see p. 419 of *Mastering Matlab 7*) of the rover position and signal strength on the contour plot in Figure number 2. The result will be a set of circles marking the rover's path. The size of the circles indicates signal strength. To give the circles a meaningful size, use 4+sig_strength*2 (or similar) as the third argument when calling the scatter plot function.

+5 pts Make a line plot of the rover's path.
Superimpose an x-y line plot, (for information about basic two-dimensional plotting, type help plot in the Matlab command window), of the rover position on the contour and scatter plots. Use a blue line.

+5 pts Run Programs
Run your communication system programs to verify that they work:
\>> transmit
\>> ECE1020_addnoise
\>> receive
\>> rover_map
If you make any changes in your files, be sure to run the following Matlab command to insure that Matlab reads your file again the next time you run it:
\>> clear all

E-mail your files (transmit.m, receive.m, and rover_map.m) to your TA, (as three separate e-mails). In the Subject line of your e-mail, be sure to put Your Name, "ECE1020 Comp10," and the file name, (e.g. transmit.m). Also, print out the files and hand them in to the TA or to the ECE1020 locker.