ASSIGNMENT #2: PROGRAMING AND VISUALIZATION USING MATLAB

DATE: Wednesday, November 26th, 2014

DATE DUE: Monday December 8nd, 2014 at 4:00 pm **(both hard copy and by email)**

Introduction:

In this assignment, you will process a point cloud (a set of 3d points) that represents a Digital Elevation model (DEM); a digital representation of ground surface topography or terrain (Figure 1). These points can been acquired through airborne LiDAR technology.

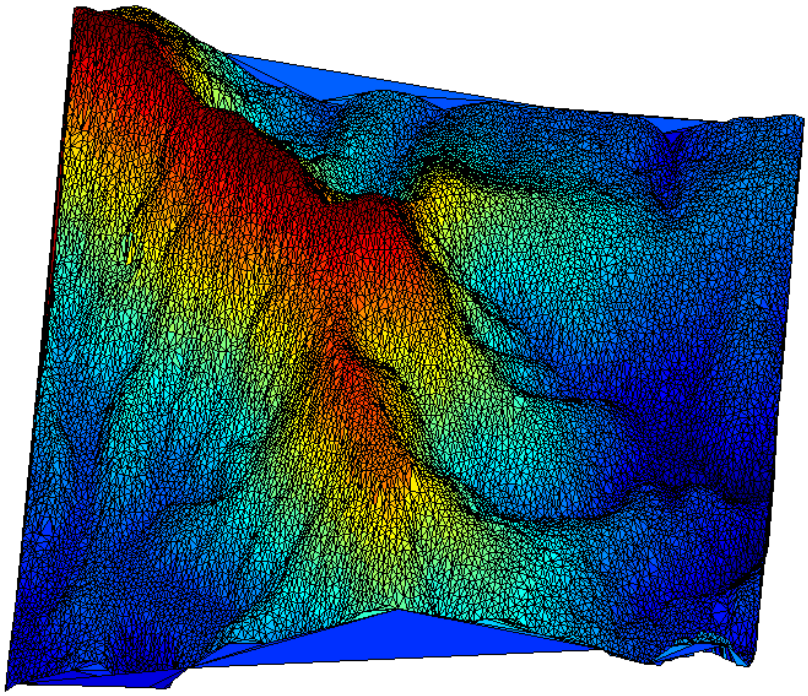

Figure 1) Digital Elevation Model

Based on the elevation (Z coordinate), the contour lines can be extracted, and also the earth surface can be divided into slices, where each slice includes the points of height between two values.

2D triangulation (using x, and y coordinates) of such points offers a more adequate representation of the surface as it is described using triangles that approximate the surface instead of the sparse points. The orientation of these triangles can help to identify important surface features. For example, the flat terrain areas and the high rise areas can be identified using the slope of these triangles.

Tasks:

Please download the file DEM.txt from Desire2Learn. The file contains a point cloud where each row represents the coordinates of a single point.

Use Matlab to accomplish the following tasks and use vectorization and pre-initialization when needed/possible.

a) Plot the individual points (dots)
b) Find the slice of points with elevation higher than 1600m and less than 1700m.
c) Plot the slice points over the figure in task (a) in different color. (Figure 2).
d) Calculate the Delaunay triangulation of the given point cloud using the Matlab built-in function ***delaunay***.
e) Plot the triangulation surface in a new figure.
f) For each triangle in the triangulation calculate the mean point of its three points, and save all mean points into a new matrix.
g) Calculate the slope of each triangle of the Delaunay triangulation.
h) Plot the mean points (in red color) of the triangles of slope >= 15^o in a new figure. (Figure 3)
i) Plot the mean points (in green color) of the triangles of slope < 15^o over the previous figure. (Figure 3)

Hint:

- The output of the ***delaunay*** function is an nx3 matrix where each row represents a triangle, each row includes the three indices of the triangle points.
- The slope of a 3D triangle = 90^o - the slope of the normal to the triangle.
- You may use cross product between two vectors (sides) of a triangle to calculate the normal to that triangle.
- The slope of the normal vector is the angle between this vector and the xy plane.

Please submit the code and your figures in your report. Make sure your name and section are written on your report.

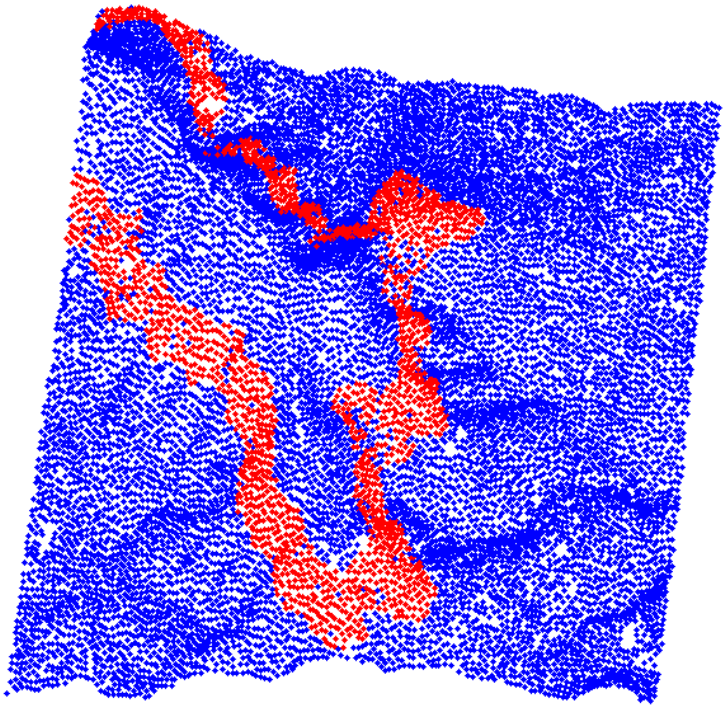

Figure 2) the sample point cloud with a slice highlighted in red color.

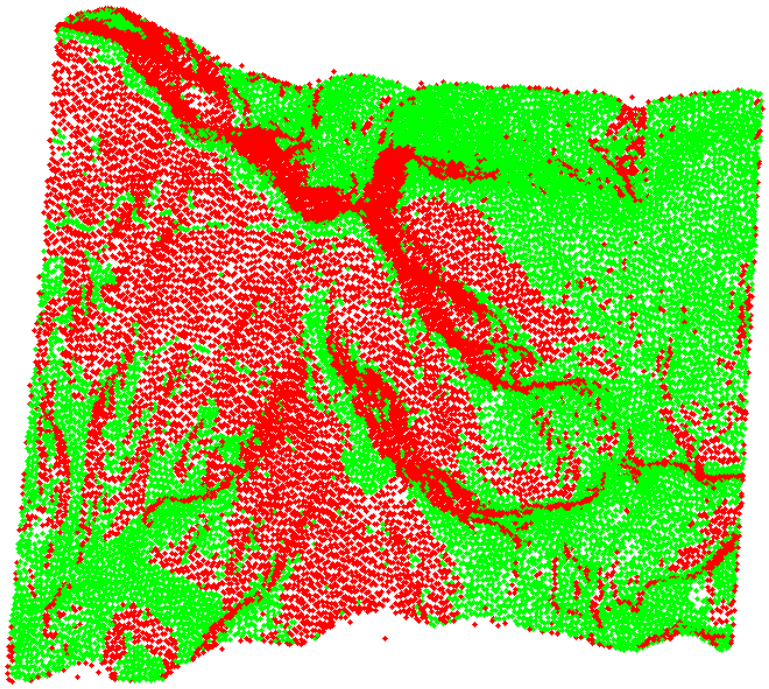

Figure 3) the sample point cloud with areas of slope <15^{o} in green and areas of slope >=15^{o} in red