MTE 203 Project 1

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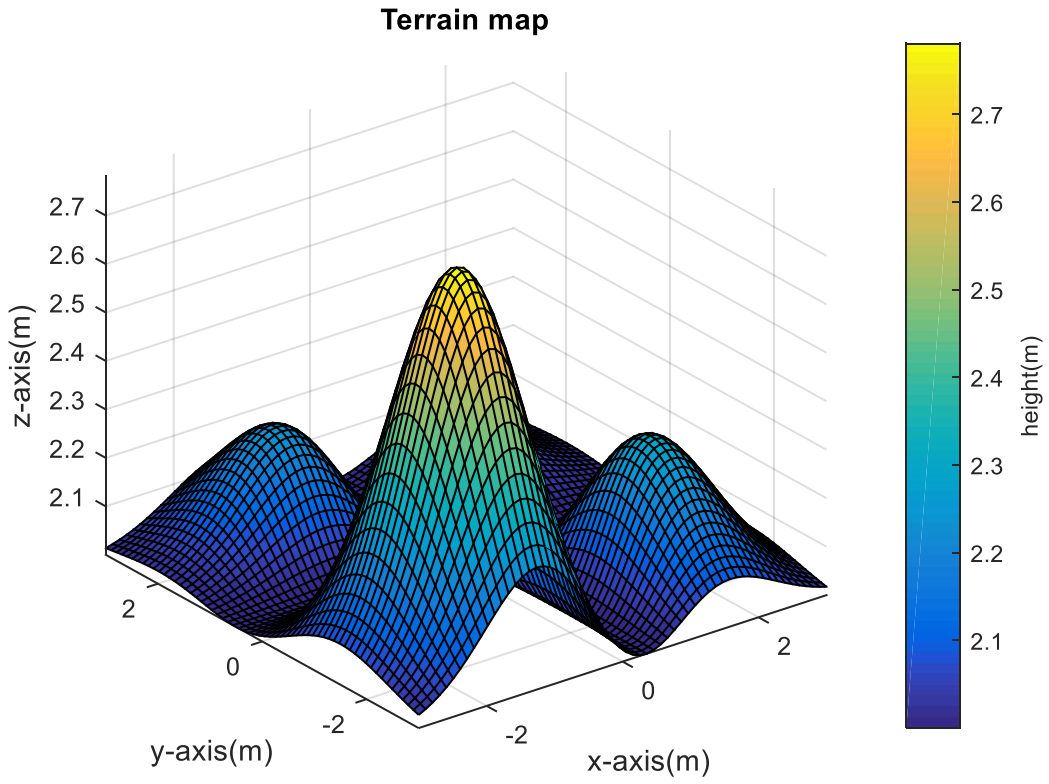
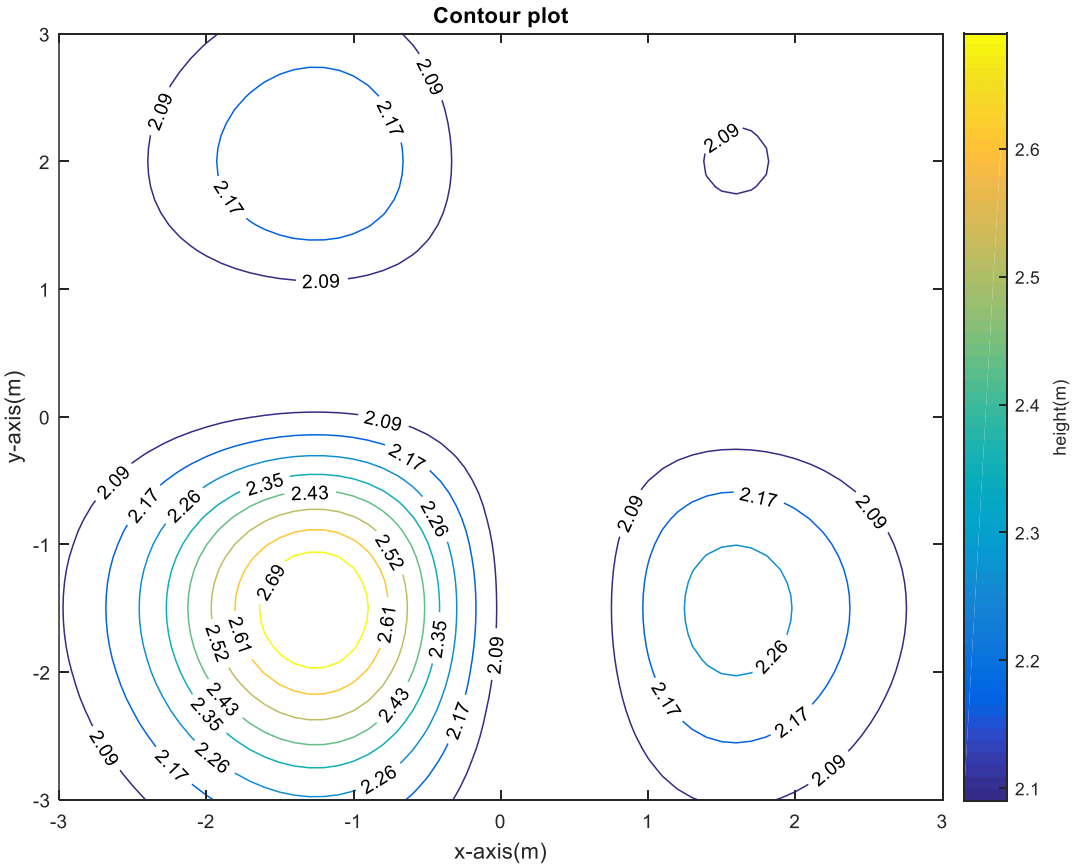
Part 1

1.



2.



3. The slope is the steepest at around (-2<x<-1, -1<y<0) or (-1<x<0,-2<y<-1). The contours lines are the closest together, meaning it takes the smallest change in x and y values to raise or drop a unit elevation.

4.

Point number	x	y	f(x,y)	A	B	C	D = B^2 - AC	Conclusion
1	-1.25733	2	2.245075	-0.43879	0	-0.38123	-0.16728	relative maximum
2	1.590667	2	2.095257	-0.21577	0	-0.14818	-0.03197	relative maximum
3	-1.25733	-1.5	**2.780755**	-1.3979	0	-0.91088	-1.27332	**highest point**
4	1.590667	-1.5	2.303467	-0.68739	0	-0.35405	-0.24337	relative maximum
5	0	0.5	2	0	0	0.073604	0	inconclusive
6	0.333333	0	2	0.170273	0	0	0	inconclusive

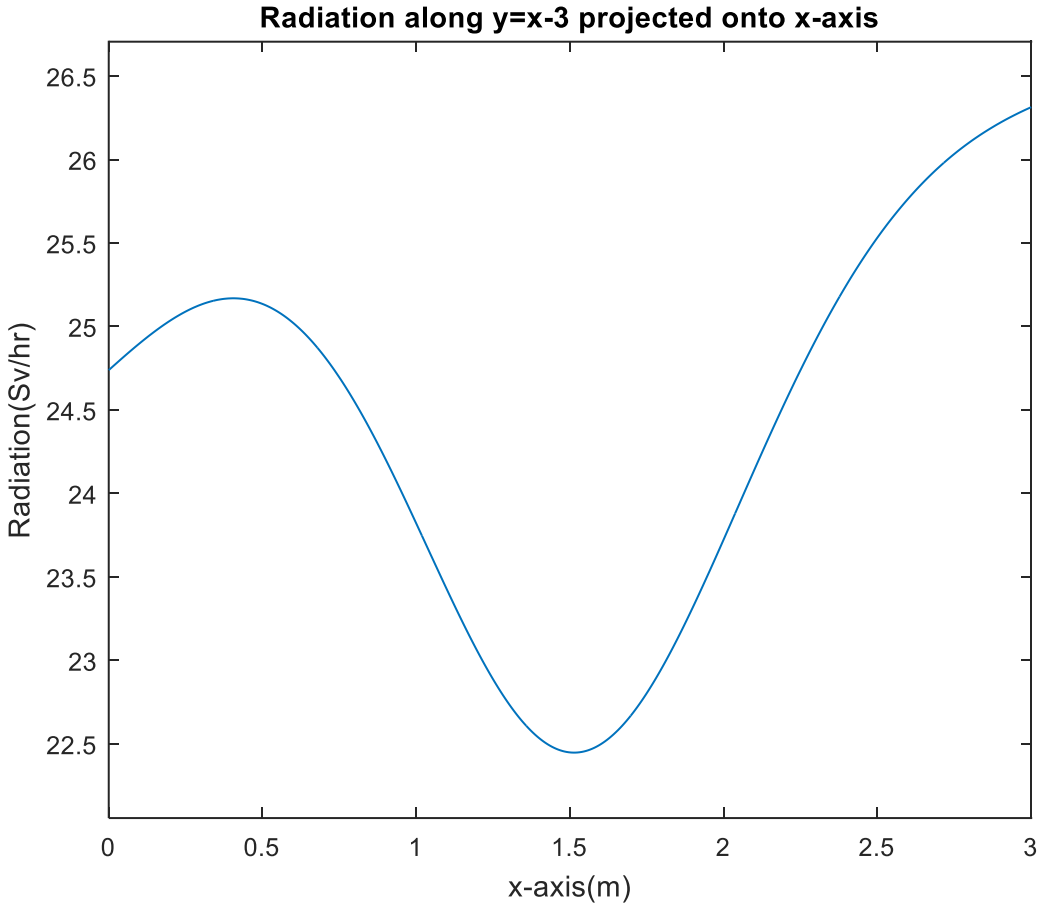
The highest elevation in the terrain is at (x,y)=(-1.257m,-1.5m), with an elevation of 2.781m.

Part 2

1. The radiation at the highest point in the terrain, (x,y)=(-1.257m,-1.5m), is 17.323Sv/hr.

2. The radiation at (x,y)=(2m,-1m) is 23.725Sv/hr.

3.

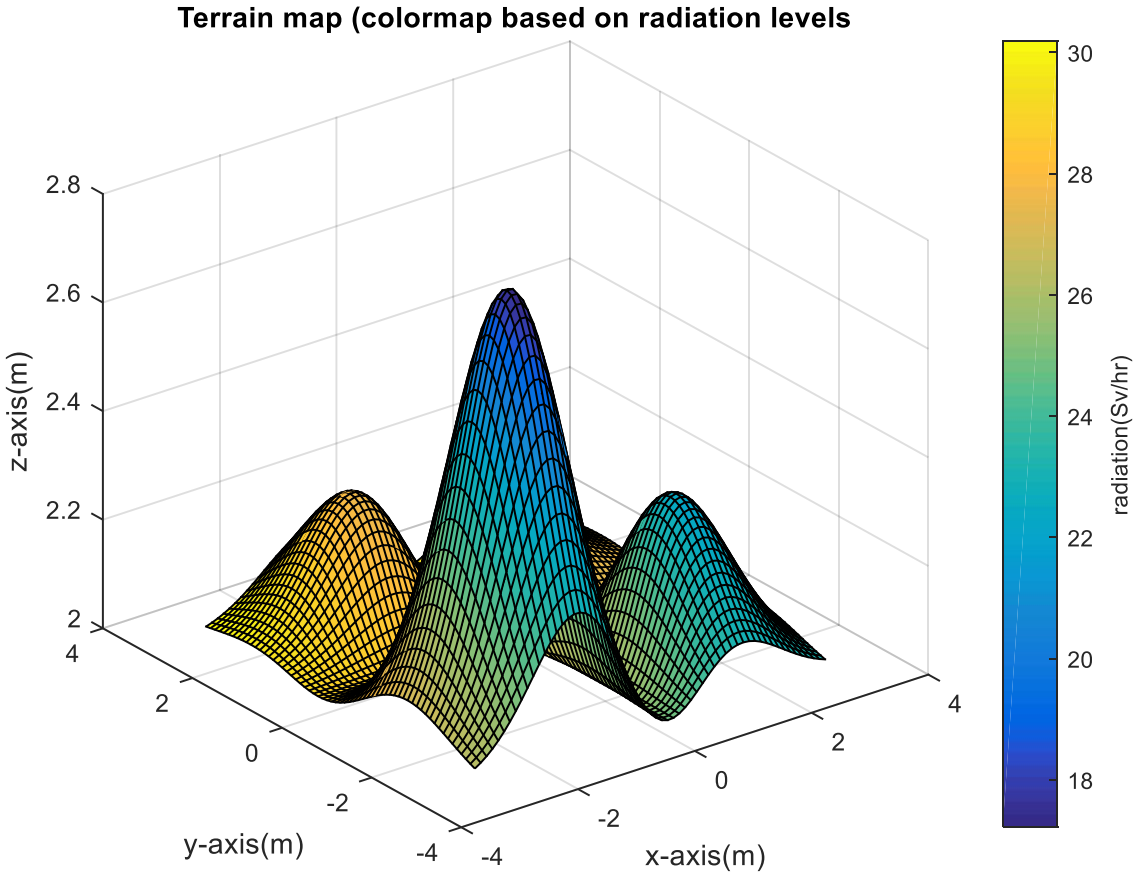


The robot is travelling along a path whose projection in the xy plane is parallel to y = x, and it is passing (x,y)=(2m,-1m), meaning the projection of the path is y = x – 3. Plot the height along y = x – 3 projected onto x-axis.

At x = 2m, the derivative is positive, meaning the robot is experiencing an increasing radiation dose when x and y are both increasing; or decreasing radiation dose as x and y are both decreasing.

The rate of chane of radiation that the robot is experiencing as it moves in the direction at the time when it is exactly at (2m,-1m) is 4.167Sv/hr/m.

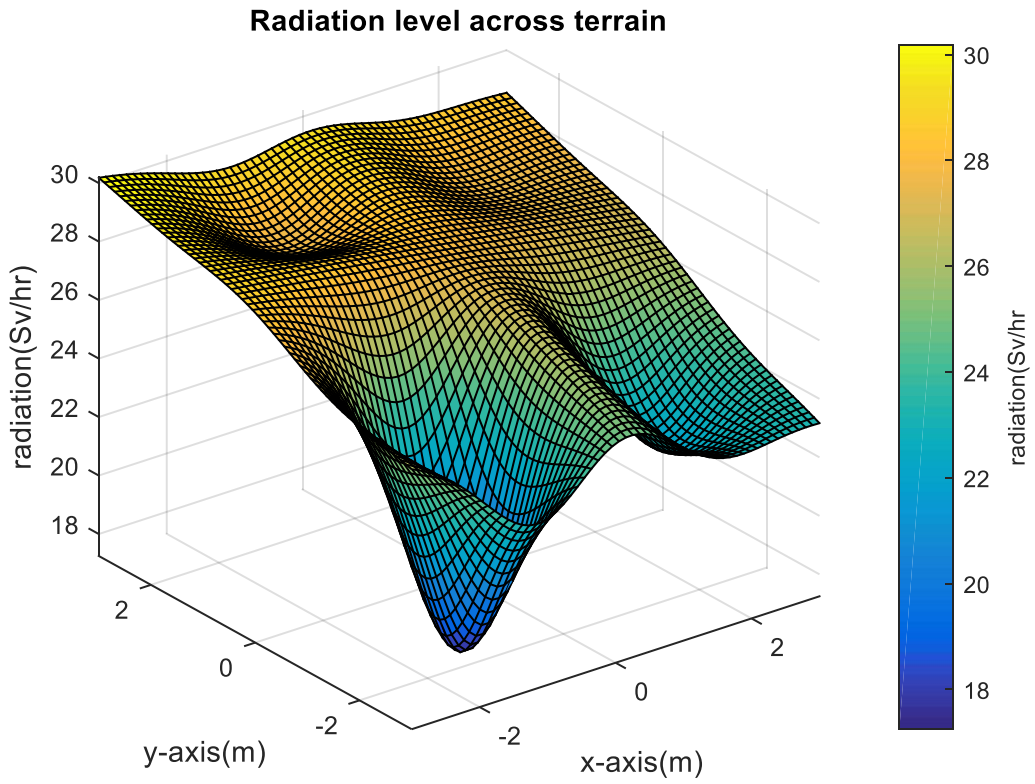
4.



This plot is useful because it contains the information on both the terrain and the radiation levels at the same time. It is clearly shown that the radiation level is low at the peak of the highest terrain peak that is the closest to us. It can also help the engineers to determine where the robot should be placed at, and how it can be directed inside the room, such as the optimal path.

5.

G(x,y) = 35 - ((exp(- x^2/2 - y^2/3)*(3*x - 1)^2*(2*y - 1)^2)/1000 + 1/5)^2 - exp(x/20 - y/10 + (exp(- x^2/2 - y^2/3)*(3*x - 1)^2*(2*y - 1)^2)/100 + 2)



This plot is useful to engineers who are determining where to send robots because it is clearly showing the point where the radiation level is the lowest, and the radiation value associated with it. It also shows how the radiation level is increasing from the lowest point, such as the direction and rate.

From the plot the maximum radiation point is around (x,y)=(-3m,3m), at around 30Sv/hr.

The lowest is around (x,y)=(-1.2m,-1.6m), at around 17.5Sv/hr.

6.

The location of the lowest radiation on the surface describing the terrain is (x,y,z)=(-1.222m,-1.613m,2.774m), with a value of 17.207Sv/hr.

The math from Lagrange Multipliers agrees with the visual observation.