ExtraCredit3

April 8, 2022

1 ExtraCredit3 - Pedestrian simulation

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Due: Tuesday, April 8th

Repeat the previous experiment but this time use two particles. In this case, you want to visua

[3]:
```
import numpy as np
import matplotlib.pyplot as plt
import math
from sympy import symbols
from sympy.plotting import plot3d
```

1.1 Setup the map from the previous part

[4]:
```
x = np.arange(0, 100, 1)
y = np.arange(0, 100, 1)
X,Y = np.meshgrid(x,y)
```

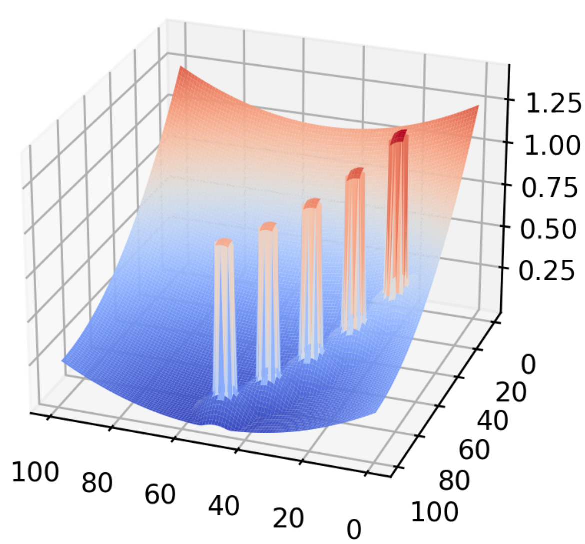
[10]:
```
#Must return (xSize * ySize) size of array
def normMatrix(endX, endY, xSize, ySize):
    coordinateList = []
    norm_vector_X = []
    norm_vector_Y = []
    for y in range(ySize):
        for x in range(xSize):
            distance = [(endX - x), (endY - y)]
            norm = math.sqrt(distance[0] ** 2 + distance[1] ** 2)
            direction = [distance[0] / norm, distance[1] / norm]
            norm_vector_X.append(direction[0] * math.sqrt(2))
            norm_vector_Y.append(direction[1] * math.sqrt(2))
    return norm_vector_X, norm_vector_Y

#Returns z-based value from near 0 to near 1 ratio to the entire map
def z_gradientMatrix(endX, endY, xSize, ySize):
    norm_vector_Z = []
    for y in range(ySize):
```

```python
        z_list =[]
        for x in range(xSize):
            distance = [(endX - x), (endY - y)]
            measure = distance[0] ** 2 + distance[1] ** 2
            normalized = measure / (xSize * ySize)
            z_list.append(normalized)
        norm_vector_Z.append(z_list)
    return np.array(norm_vector_Z)

def single_cylinder(xPos, yPos, trueRadius, affectedRadius ,xSize, ySize):
    if (trueRadius > affectedRadius):
        print("This will allow particle to go into the obstacles")
    z_matrix = []
    for y in range (ySize):
        row_matrix = []
        for x in range(xSize):
            #Calculate distance
            partial_distance = [(xPos - x), (yPos - y)]
            distance = math.sqrt(partial_distance[0] ** 2 + partial_distance[1]␣
 ↪** 2)
            #Normalized will have value between 0 ~ 1
            normalized = (xSize - distance) / xSize
            if(distance >= affectedRadius):
                row_matrix.append(0)
            elif(distance < affectedRadius and distance > trueRadius):
                gradient_increase = (normalized - 0.9) * 2
                row_matrix.append(gradient_increase)
            else:
                row_matrix.append(normalized)
        z_matrix.append(row_matrix)
    return z_matrix
```

[149]:
```python
#Exit location at x = 100, y = 0, z= 50 -> (100, 50)
endPos = (50, 100)

ux, uy = normMatrix(endPos[0], endPos[1], 100, 100) #Euclidean distance on each␣
 ↪point
uz = z_gradientMatrix(endPos[0], endPos[1], 100, 100)
v = 0 #Vector set 0 to use only norm value(directional value)

#Five cylinder coordinates
cylinder_1 = (50 ,90)
cylinder_2 = (40, 80)
cylinder_3 = (30, 70)
cylinder_4 = (20, 60)
cylinder_5 = (10, 50)
```

```
cylinder_1_cost = single_cylinder(cylinder_1[0], cylinder_1[1], 3, 10, len(X),␣
 ↪len(Y))
cylinder_2_cost = single_cylinder(cylinder_2[0], cylinder_2[1], 3, 10, len(X),␣
 ↪len(Y))
cylinder_3_cost = single_cylinder(cylinder_3[0], cylinder_3[1], 3, 10, len(X),␣
 ↪len(Y))
cylinder_4_cost = single_cylinder(cylinder_4[0], cylinder_4[1], 3, 10, len(X),␣
 ↪len(Y))
cylinder_5_cost = single_cylinder(cylinder_5[0], cylinder_5[1], 3, 10, len(X),␣
 ↪len(Y))

total_cylinder = np.add(cylinder_1_cost, cylinder_2_cost)
total_cylinder = np.add(total_cylinder, cylinder_3_cost)
total_cylinder = np.add(total_cylinder, cylinder_4_cost)
total_cylinder = np.add(total_cylinder, cylinder_5_cost)
total_cost = np.add(total_cylinder, uz)
```

[150]:
```
from matplotlib import cm

fig = plt.figure()
fig.set_dpi(250)
ax = fig.add_subplot(projection='3d')
ax.view_init(25, 110)
ax.plot_surface(X, Y, total_cost, cmap=cm.coolwarm, rstride = 1,  cstride = 1)
plt.show()
```



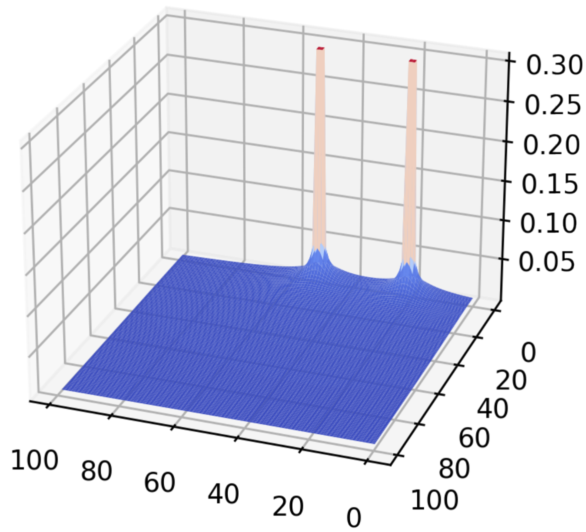
1.2 Represent particle repulsion

The highest cost represents the particle size because any other particles are not allowed to intersect with other particles within its shape.

[151]:
```
particles = [(50, 5), (20, 5)]
```

[266]:
```
def single_particle(xPos, yPos ,xSize, ySize, particleSize):
    #Particle must have certain value of repulsion
    z_matrix = []
    for y in range (ySize):
        row_matrix = []
        for x in range(xSize):
            #Calculate distance
            partial_distance = [(xPos - x), (yPos - y)]
            distance = math.sqrt(partial_distance[0] ** 2 + partial_distance[1]␣
 ↪** 2)
            #distance within the radius value ranged from 0 ~ radius
            if (distance < particleSize):
                row_matrix.append(0.3)
            else:
                normalized = ((1 / distance) * 0.1)
                row_matrix.append(normalized)

        z_matrix.append(row_matrix)
    return np.array(z_matrix)

particle_one = single_particle(particles[0][0], particles[0][1], len(X),␣
 ↪len(Y), 2)
particle_two = single_particle(particles[1][0], particles[1][1], len(X),␣
 ↪len(Y), 2)
totoal_particles = np.add(particle_one, particle_two)
```

[267]:
```
from matplotlib import cm

fig = plt.figure()
fig.set_dpi(250)
ax = fig.add_subplot(projection='3d')
ax.view_init(25, 110)
ax.plot_surface(X, Y, totoal_particles, cmap=cm.coolwarm, rstride = 1,  cstride␣
 ↪= 1)
plt.show()
```

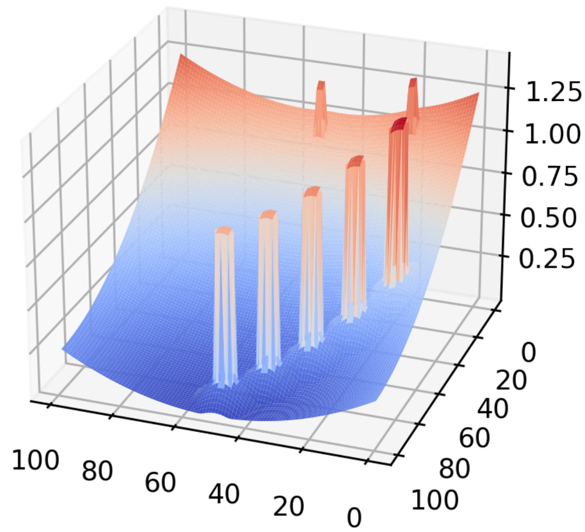


1.3 Particles with repulsive gradient on the entire map

5 stationary obstacles near the exit, 2 dynamic particles near the edge of the map.

[268]:
```
total_map = np.add(total_cost, totoal_particles)
```

[269]:
```
from matplotlib import cm

fig = plt.figure()
fig.set_dpi(250)
ax = fig.add_subplot(projection='3d')
ax.view_init(25, 110)
ax.plot_surface(X, Y, total_map, cmap=cm.coolwarm, rstride = 1,  cstride = 1)
plt.show()
```


1.25
1.00
0.75
0.50
0.25
0
20
40
60
80
100
100
80
60
40
20
0

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[ ]:
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[ ]:
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