运筹学第五次实验

姓名 方晓坤 学号 2018202046 日期 2020-6-20

一、需求分析

在学习了动态规划的思想后，我们设计并完成了这次Track Puzzle问题。这个问题要求我们将相对运动的轨迹拼接，实现对室内道路结构的还原

二、动态规划和详细解答

1、动态规划

阶段 选择下一个轨迹加入

状态 加入的所有轨迹的位置情况

决策 平移旋转

状态转移方程 将加入的轨迹按上面的抉择结果进行平移旋转，加入集合

指标函数 最大化重合或相近的点

2、详细解答

老师在习题课中认为判断两组点重合或相近的时候可以用LCS模型，这是动态规划的过程。但是我在仔细研究之后发现，轨迹的点是有重复的，也就是说轨迹是有回路的。然而LCS模型是不允许回路的存在的，即不允许两个点列中出现一对多或者多对多的情况。我们别无他法，只好求助于暴力搜索，好在数据量不大。

所以说，这次实验解决的并不是一个动态规划问题，主体上是一个贪心问题。下面是贪心的思路

首先我们先解决轨迹整体平移旋转的问题

```
    # 绕(pointx,pointy)顺时针旋转点(valuex, valuey)
    def rotate(angle, valuex, valuey, pointx, pointy):
        valuex = np.array(valuex)
        valuey = np.array(valuey)
        sRotatex = (valuex-pointx)*cos(angle) + (valuey-pointy)*sin(angle) +
    pointx
```

```
        sRotatey = (valuey-pointy)*cos(angle) - (valuex-pointx)*sin(angle) +
    pointy
        return sRotatex, sRotatey

    # 将一个轨迹上所有点绕(pointx, pointy)转动angle角度
    def rotate_list(angle, point_list, pointx, pointy):
        result = []
        for valuex, valuey in point_list:
            x, y = rotate(angle, valuex, valuey, pointx, pointy)
            result.append([x, y])
        return result

    # 将一个轨迹上第j个点与fix_list上第i个点对齐，平移
    def move_list(fix_list, point_list, i, j):
        result = []
        for point in point_list:
            x = (point[0] + (fix_list[i][0] - point_list[j][0]))
            y = (point[1] + (fix_list[i][1] - point_list[j][1]))
            result.append([x, y])
        return result
```

导入轨迹和距离

```
points = [
    [[0, 0], [0.005217503, 1.047483615], [0.953293989, 0.957596736],
[0.955386293, 0.008701917], [2.030506, -0.00861], [1.995147, 0.980914],
[2.989265, 0.976383], [3.028964, 0.025877], [1.986429, 0.049522],
[2.003235, -1.03134], [1.021166, -0.97189], [1.037148, -0.03042],
[-0.01713, 0.049236]],
    [[0, 0], [0.858448, 0.493237], [1.388912, -0.34111], [1.865861,
-1.27813], [2.396924, -2.05344], [1.485651, -2.57171], [0.957324,
-1.72617], [0.509099, -0.89764], [0.041019, -0.00021]],
    [[0, 0], [0.91545, -0.479492], [1.4015106, 0.3718813], [2.2782912,
-0.108312], [2.6159703, -1.450452], [1.7224009, -0.953757], [2.2755487,
-0.130468], [2.7299993, 0.7784378], [1.8392046, 1.1936134]],
    [[0, 0], [-0.019565105, 0.964250932], [1.008019183, 0.997847447],
[0.003096445, 1.975683535], [0.040120809, 2.986909169], [-0.995944957,
3.016176491], [-1.006801939, 1.966960881], [-0.995733301, 0.977878402],
[-0.978758519, -0.030177821], [-0.048332529, -0.030492847]]
]

dists = [
    [[5.016279514, 0.935040718], [4.690532681, 0.114626958], [3.634084718,
1.073260383], [4.761865813, 1.149580336], [3.553570989, 2.305426161],
[2.723679102, 1.996288886], [2.378383212, 2.72126573], [3.16548357,
3.633352892], [3.951924163, 2.242067433], [4.021516298, 3.075044347],
[4.736930384, 2.693413259], [4.592395991, 1.514475708], [5.057769309,
0.590346738]],
    [[3.755262203, 1.772784094], [3.411067053, 2.435701745], [3.387460015,
1.729886079], [3.681604732, 2.546696083], [4.146484056, 3.316866392],
[4.589998815, 2.05700901], [4.483544894, 0.974819929], [4.348793549,
1.056555749], [4.029359902, 1.744195994]],
    [[4.358759034, 1.703242486], [3.940938679, 0.952207454], [3.41450563,
1.609861706], [3.215293644, 2.005951641], [5.024637345, 2.708719054],
[4.68254464, 1.226073508], [3.397008403, 2.586425315], [3.240074549,
3.301553807], [1.991438275, 2.58866584]],
    [[5.723420395, 1.084718619], [4.92024469, 0.975242492], [5.084641303,
2.021176063], [3.933283449, 1.927054418], [2.770957087, 3.055689167],
[2.562641957, 3.176871093], [2.869880695, 1.818104726], [3.756916611,
1.171462889], [5.170010589, -0.330232934], [5.032820584, 0.976079718]]
]
```

离散化旋转的角度

```
angles = [0, 30, 60, 90, 120, 150, 180, 210, 240, 270, 300, 330]
```

判断两个点是否吻合

```
    # 根据点的坐标和dist来判断两个点是否吻合
    def is_matched(point1, point2, dis1, dis2):
        if(sqrt((dis1[0] - dis2[0])**2 + (dis1[1] - dis2[1])**2) < 0.4 and \
            sqrt((point1[0] - point2[0])**2 + (point1[1] - point2[1])**2) <
    0.2):
            return True
        else:
            return False
```

接下来就是贪心的过程

我选择了第一条轨迹作为基准，其他每一条轨迹的旋转平移都为了最大可能地与它重合

```
    best_i = -1
    best_j = -1
    best_angle = 0
    count = 0
    max_count = -1

    index = 2   #   1, 2, 3
    for i in range(len(points[0])):
        for j in range(len(points[index])):
            for angle in angles:

                count = 0

                after_move = move_list(points[0], points[index], i, j)  # 平移
                after_rotate = rotate_list(radians(angle), after_move,
    points[0][i][0], points[0][i][1])   # 旋转

                for k in range(len(points[0])): # 暴力计算匹配点的数量
                    for l in range(len(points[index])):
                        if(is_matched(points[0][k], after_rotate[l], dists[0]
    [k], dists[index][l])):
                            count+=1

                if count > max_count:   # 更新平移和旋转
                    best_i = i
                    best_j = j
                    best_angle = angle
                    max_count = count
```

```
print(best_i, best_j, best_angle, max_count)    # 打印最佳方案
```

打印出最佳的平移旋转方案和吻合的点的个数

由于数据量小，所以这里的多重循环并没有太高的实际复杂度10*10*10*10*10，运行时间大概1s

这样我们就得到了其他所有轨迹的最优方案(将轨迹中的第j个点移动到第一条轨迹中的第i个点的位置，然后整体顺时针旋转angle度数)

```
i j angle
2 7 30
2 1 60
0 0 90
```

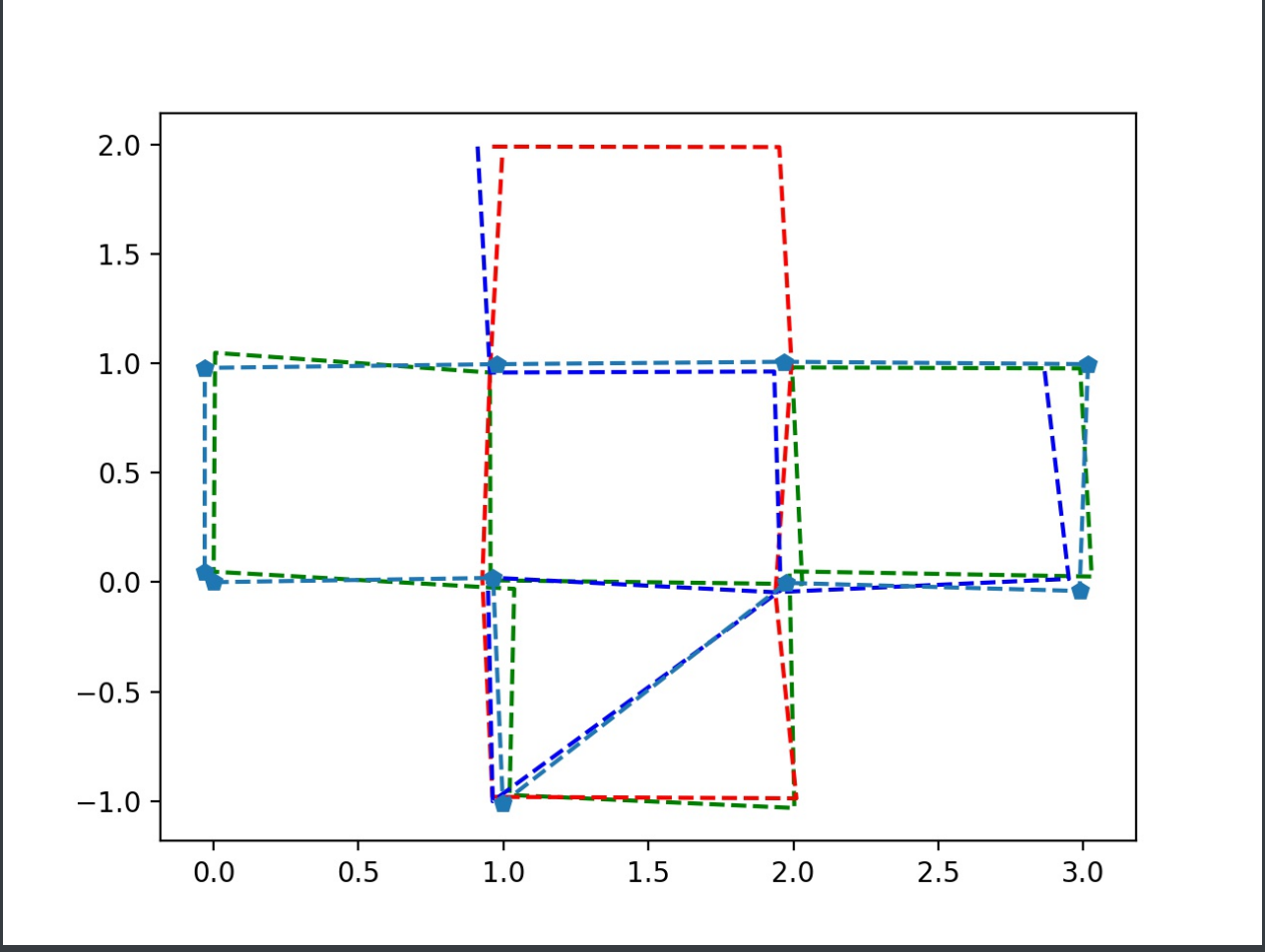
最后我们得到最优的轨迹结果，并将它们绘制到一张图上

```
#最佳平移旋转后的结果
list1 = np.array([[0, 0], [0.005217503, 1.047483615], [0.953293989,
0.957596736], [0.955386293, 0.008701917], [2.030506, -0.00861], [1.995147,
0.980914], [2.989265, 0.976383], [3.028964, 0.025877], [1.986429,
0.049522], [2.003235, -1.03134], [1.021166, -0.97189], [1.037148,
-0.03042], [-0.01713, 0.049236]])
list2 = np.array([[0.961221321958746, 1.9895252794530633],
[1.9512775977866896, 1.9874570515394885], [1.9934993975797983,
0.9996593539681536], [1.9380393478893825, -0.05029826988594088],
[2.010298396899358, -0.9872679256940542], [0.9619778291165012,
-0.9804664117134152], [0.9272032256112801, 0.015956208202479005],
[0.953293989, 0.957596736], [0.9966398179965799, 1.9688339141182687]])
list3 = np.array([[0.9108212419114079, 1.9901456918944642], [0.953293989,
0.957596736], [1.9336351949037902, 0.9623425586212937], [1.956165898376708,
-0.037068364524068476], [0.9626781129414614, -1.0005770434511345],
[0.9460439008741733, 0.021624256993283852], [1.9356069895304597,
-0.04577128985418977], [2.949967801977478, 0.015115845780729664],
[2.8641230686089245, 0.9941544855372677]])
list4 = np.array([[0.0, 0.0], [0.964250932, 0.01956510500000006],
[0.9978474470000002, -1.008019183], [1.975683535, -0.003096444999999879],
[2.986909169, -0.04012080899999982], [3.016176491, 0.9959449570000002],
[1.966960881, 1.0068019390000003], [0.9778784019999999,
0.9957333010000001], [-0.03017782100000006, 0.978758519],
[-0.030492847000000003, 0.048332529]])

#绘制最终轨迹图
```

```
    x1 = list1[:, 0]
    y1 = list1[:, 1]
    x2 = list2[:, 0]
    y2 = list2[:, 1]
    x3 = list3[:, 0]
    y3 = list3[:, 1]
    x4 = list4[:, 0]
    y4 = list4[:, 1]
    fig = plt.figure()
    ax1 = fig.add_subplot(1, 1, 1)
    ax1.plot(x1, y1, 'g--', x2, y2, 'r--', x3, y3, 'b--', x4, y4, 'p--')
    plt.show()
```

结果如下图



由于测量存在一定误差，甚至有的distence的结果出现了负值，所以说做到这个结果，可以说是比较满意的