

Assignment 2

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Question 1

1.

Shutter speed –the speed at which the shutter of the camera closes.

Field of view – the maximum area of a sample that a camera can image.

Digitization bias – refers to the problematic phenomenon that almost empty cells are marked as occupied on grids.

2. The difference between continuous and event-driven replanning is that continuous replanning is essentially imposing a hierarchical sense, plan, act cycle. Event-driven replan when there is some event, exception, or indication that the plan execution is not working.

Question 2

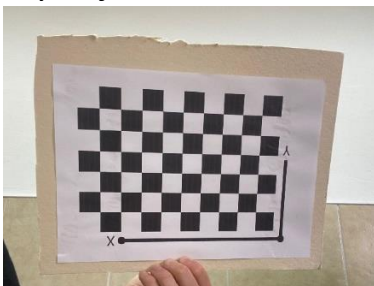
In this question I used MATLAB for generate the matrices and the explanations of the concepts were taken from the lectures and Wiki.

1. I used my own smart phone (iPhone 11) as a camera to take photos of the object. My object was A4 printed paper attached on canvas board. My phone was static and I have moved the canvas board and took photos from 10 different angles.

My camera:



My object:



2.

The camera's extrinsic matrix describes the camera's location in the world, and what direction in what direction it's pointing. The parameters used to describe the transformation between the camera and its external world. It has two components: a rotation matrix- R, and the translation vector T.

cameraParamsNitzan.TranslationVectors			
	1	2	3
1	101.0491	53.8935	478.4337
2	90.0799	40.0441	499.1397
3	134.6387	14.9359	473.9849
4	137.9784	97.7660	518.6930
5	142.5570	-18.0450	586.7359
6	105.5407	74.5112	513.6664
7	78.7635	52.3304	519.5853
8	130.2928	21.1736	451.8351
9	136.1720	-14.6384	501.5655
10	137.0866	34.6913	529.8612
11	118.4059	30.4449	514.4281

cameraParamsNitzan.RotationVectors			
	1	2	3
1	-0.4035	-0.2272	-3.0554
2	0.2858	0.2531	-2.8852
3	0.4573	-0.2727	2.7150
4	-0.2293	-0.2720	-3.1020
5	0.3546	-0.6224	3.0344
6	0.1775	0.7601	3.0115
7	-0.8017	0.0538	2.9616
8	0.7000	-0.1062	3.0392
9	0.3143	-0.6055	3.0055
10	0.1155	0.5401	3.0882
11	-0.4395	0.2142	3.0008

The intrinsic matrix allows you to transform 3D coordinates to 2D coordinates on an image plane using the pinhole camera model.

The intrinsic parameters represent the optical center and the focal length (the distance between the pinhole and the film).

The camera coordinates are mapped into the image plane using intrinsics parameters.

The value at point (1,1) represents f_x and (2,2) f_y .

The point (f_x, f_y) is the pixel distance between the pinhole and the film.

The value at point (3,1) represents x_0 and (3,2) y_0 .

The point (x_0, y_0) is the line perpendicular to the image plane that passes through the pinhole.

The value at point (2,1) represents s .

s is the axis skew which causes shear distortion in the projected image.

cameraParamsNitzan.IntrinsicMatrix			
	1	2	3
1	1.8245e+03	0	0
2	0	1.8240e+03	0
3	763.7008	1.0224e+03	1

3.

cameraParamsNitzan2.TranslationVectors				cameraParamsNitzan2.RotationVectors			
	1	2	3		1	2	3
1	8.8912	17.3425	445.8838	1	-0.4523	0.3786	3.0119
2	40.3846	27.8613	436.5243	2	0.3499	-0.1931	-3.1020
3	42.6116	27.9930	383.2566	3	0.5730	0.2596	3.0454
4	50.5797	-22.9082	470.4266	4	-0.3212	-0.5896	3.0017
5	5.0198	13.5926	491.6910	5	-1.0347	0.1997	2.6418
6	42.3695	52.2060	408.3527	6	0.3400	-0.8821	-2.9352
7	54.9913	60.2529	364.7285	7	-0.3356	-0.6127	-2.8879
8	62.7054	20.8828	453.4635	8	0.2516	0.2809	-3.0945
9	52.1448	-1.9080	495.7186	9	-0.7909	-0.5804	2.9008
10	34.3623	17.0390	407.5206	10	0.3585	-0.2582	3.0105

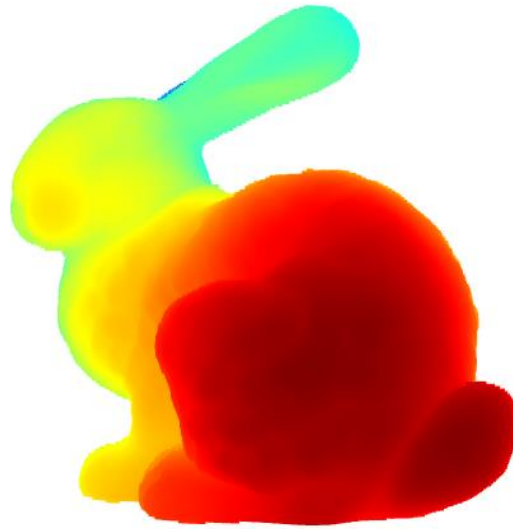
cameraParamsNitzan2.Intrinsics.IntrinsicMatrix			
	1	2	3
1	1.0758e+03	0	0
2	0	1.0744e+03	0
3	795.3765	598.1495	1

The difference in the intrinsics matrices is only on the y_0 because I changed the location of the camera only in the y axis. The focal length and x_0 didn't change significantly.

Each row in the extrinsics matrices represent 1 photo, every photo has its own R and T.

Question 3

1. bunny045



2. The bunny volume is 0.00323.

I calculated this volume by 4 scans. From 0, 90, 180 and 270 angles.

I build dice around the bunny, I found the miny and maxy by bun000 and bun180 points, minx and maxx by bun090 and bun270, and minz and maxz using the four scans.

All this points represents the corners of the dice.

After I found all this parameters I calculated the volume:

$$(\text{maxx}-\text{minx}) * (\text{maxy}-\text{miny}) * (\text{maxz}-\text{minz}) = 0.00323$$

3. I used the height to make the segmentation, meaning the z value, higher z values got closer to the ears and from a certain threshold I colored the points in red.



Question 4

1. The found path by A* search using h3 is SCKBG, this is the optimal path.
2. The 3 heuristic functions h1, h2 and h3 will generate an optimal path when using A*. h2 and h3 are admissible functions so it's guaranteed to get an optimal solution, h1 not admissible but still generate an optimal path.

Question 5

The next node that will be expanded is D, because in A* we chose the next node by the calculation of the minimum value of $f=h$ (heuristic function value) + g (actual value until now) of the neighbors.

The calculation of f for node E is 17, for node F is 20, for node G is 16, for node H is 19, for node D is 15.

So the next node that will be expanded is D.