RGB+D Cameras: Image, 3D point clouds and camera model

3D with Kinect

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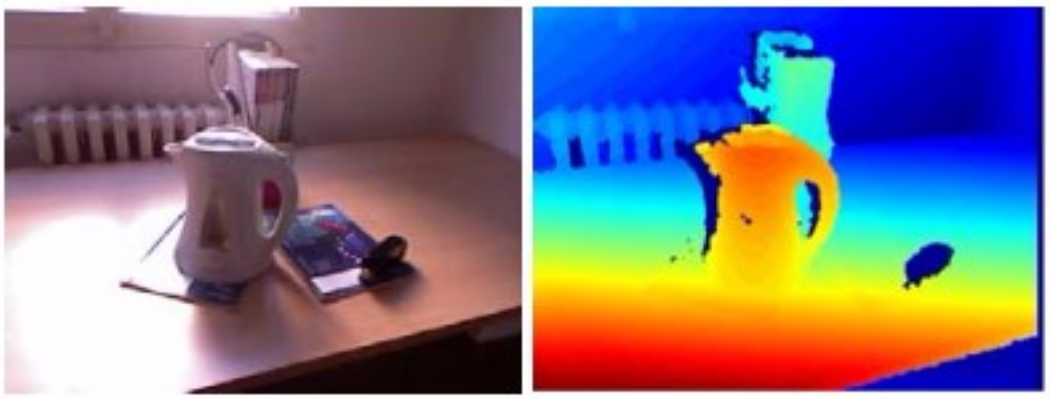
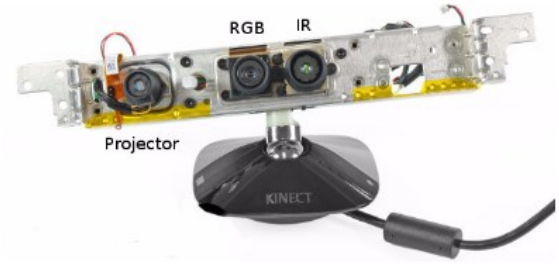
"Kinect" (depth) cameras provide 2 type of images: RGB and DEPTH



(a) RGB image (b) Depth image

Q: What coordinate is the "depth" ? How is it obtained ?



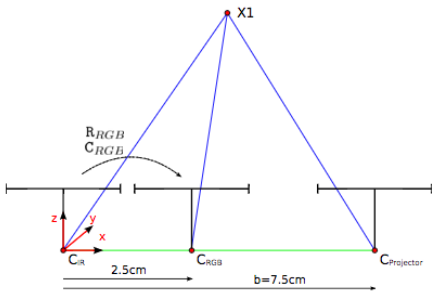


Figure 5. Geometrical model of Kinect.

Tasks:

1. See RGB and Depth images
    a. display and interpret images
    b. display R,G,B in separate figures
2. Display depth
    a. depth as image
    b. depth as a surface
    c. point cloud, mesh

d. depth image vs. point cloud

Question: What is the "best" representation ?
edges
Dataset:
Load depth image from the lab (link)
read image from file (link)
load point cloud (link)
http://printart.isr.ist.utl.pt/piv/lab/pivlab1/

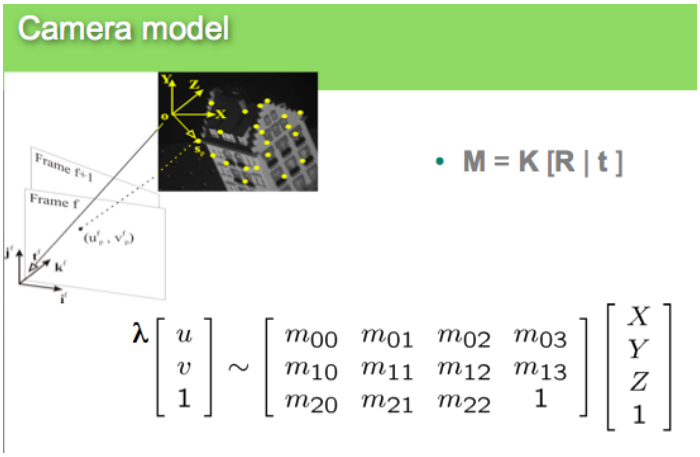
CODE - getting the triangular mesh from ordered points.
Display a triangular surface (top triangles)

```
J=repmat((1:639),479,1);
I=repmat((1:479)',1,639);
I1=[I(:), I(:), I(:)+1];
J1=[J(:), J(:)+1, J(:)+1];
ind1=(J1-1)*480+I1;

%%
zs=xyz(ind1(:,1),3).*xyz(ind1(:,2),3) .* xyz(ind1(:,3),3);
ind1ok=find(zs>0);
trimesh(ind1(ind1ok,:),xyz(:,1),xyz(:,2),xyz(:,3))
```

Camera model -

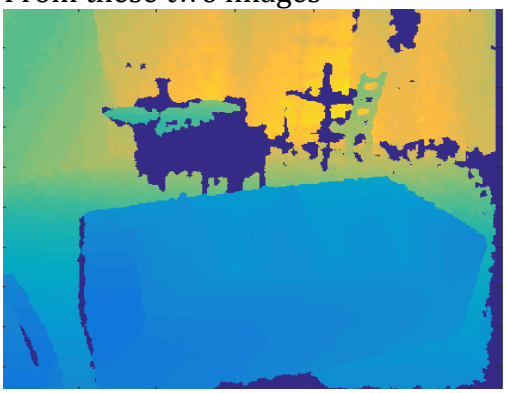
- How to generate an image from 3D points?
- How to compute 3D positions from images/depth



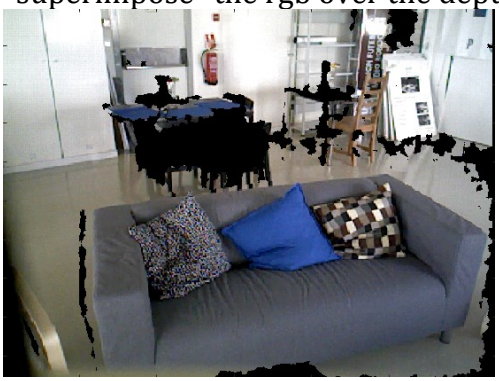
Tasks:

1. given u,v and depth compute XYZ
2. generate image projection from point cloud
3. Rotate and Translate point cloud and do the same
4. Project Point cloud in the RGB image. What about the reverse: click rgb and get the 3D!

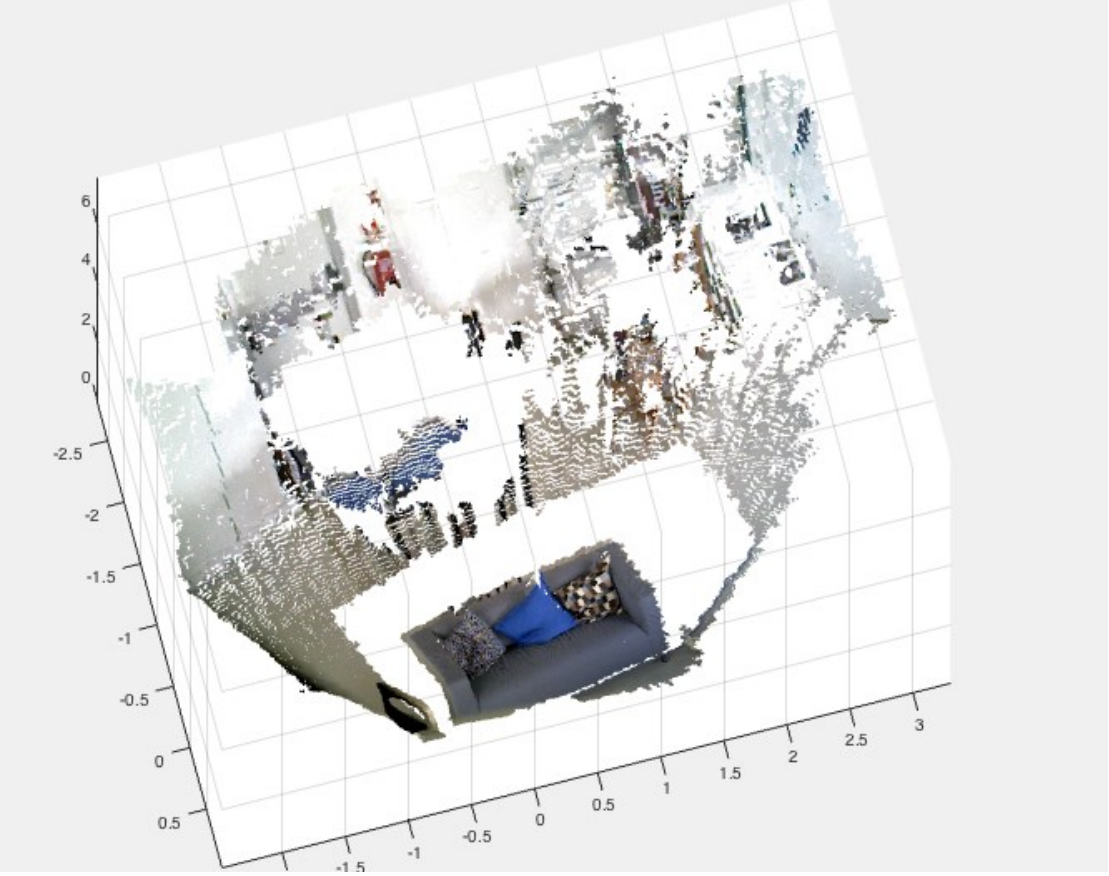
From these two images




and the intrinsic and extrinsic camera parameters you should be able to "superimpose" the rgb over the depth



Note that now each pixel of this image is in line with the depth! So, you can compute XYZ for each pixel and create this point cloud


6
4
2
0
-2.5
-2
-1.5
-1
-0.5
0
0.5
-1.5
-1
-0.5
0
0.5
1
1.5
2
2.5
3