**6.869 PSET 1**
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**1. *A simple Image Formation Model***
*Orthographic Image:*The image shows three views , and can be viewed from the top(plan) and sides(side elevations) in 3d and it is not necessarily diminishing as you move further away from the camera.
*Perspective Image:* The image seems bigger and more prominent when nearer to the camera and diminishes when farther away.
**2. *Orthographic Projection***
Resultant = Resolution in vertical axis + Resolution in horizontal axis
$x = Xcos(\theta) + Xsin(\theta)$
$x = Xcos(0) + Xsin(0)$
$x = X(1) + X(0)$
$= X$
$y = Ycos(\theta) - Zcos(90 - \theta)$
$y = Ycos(\theta) - Z[cos(90)cos(\theta) + sin(90)sin(\theta)]$
$y = Ycos(\theta) - Z[0.cos(\theta) + 1.sin(\theta)]$
$y = Ycos(\theta) - Z(sin(\theta))$
$= Ycos(\theta) - Zsin(\theta)$
**3. *Constraints***
$Z(x, y) = 0$ if $(x, y)$ belongs to a ground pixel
$\frac{\partial Z}{\partial x}$ = undefined
$Zsin(\theta) = Ycos(\theta) + y + y_0$
$Z = Ycot(\theta) + \frac{y}{sin(\theta)} + \frac{y_0}{sin(\theta)}$
$\frac{\partial Z}{\partial y} = \frac{1}{sin(\theta)}(1 - \frac{\partial Y}{\partial y}cos(\theta)) = \frac{1}{sin(\theta)}[1 - \frac{1}{cos(\theta)}cos(\theta)] = 0$
$\frac{\partial Z}{\partial t} = 0$
$\frac{\partial^2 Z}{\partial x^2} = 0$
$\frac{\partial^2 Z}{\partial y^2} = \frac{\partial}{\partial y}(\frac{\partial Z}{\partial y})$
$= \frac{\partial}{\partial y}(0) = 0$
$\frac{\partial^2 Z}{\partial x \partial y} = \frac{\partial}{\partial x}(\frac{\partial Z}{\partial y})$
$= \frac{\partial}{\partial x}[\frac{1}{sin(\theta)}] = 0$
**4. *Approximation of derivatives***
***Line 166***
$\frac{\partial Y}{\partial t} = \frac{-n_y}{8}\frac{\partial Y}{\partial x} + \frac{n_x}{8}\frac{\partial Y}{\partial y}$

$$= \frac{-n_y}{8}\begin{pmatrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{pmatrix} + \frac{n_x}{8}\begin{pmatrix} -1 & -2 & -1 \\ 0 & 0 & 0 \\ 1 & 2 & 1 \end{pmatrix}$$

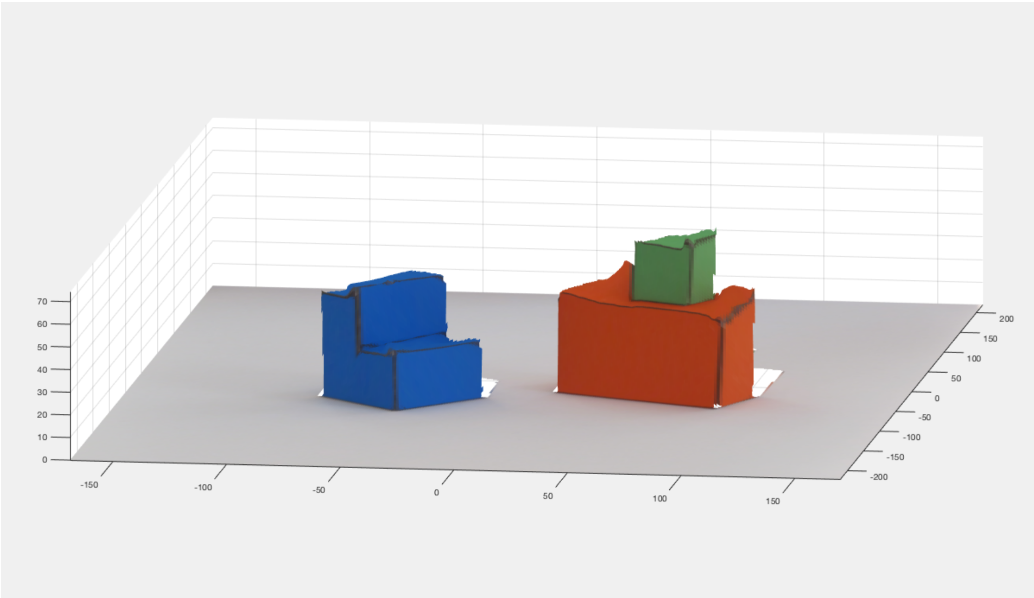


Figure 1: Image viewpoint , problem 5

$$= \frac{1}{8} \begin{bmatrix} n_y - n_x & -2n_x & -(n_x + n_y) \\ 2n_y & 0 & -2n_y \\ n_x + n_y & 2n_x & n_x - n_y \end{bmatrix}$$

***Line 180***

After increment , kernel $= A^T_{i,j} = 0.1 \begin{bmatrix} 0 & -1 & 0 \\ 0 & 2 & 0 \\ 0 & -1 & 0 \end{bmatrix}^T = 0.1 \begin{bmatrix} 0 & 0 & 0 \\ -1 & 2 & -1 \\ 0 & 0 & 0 \end{bmatrix}$

**5. *Run the Code***

Image Viewpoints

**6. *Violating simple world assumptions***

Image 3 fails

Reason : You might miss an edge due to space not being enough between the red cube and the blue L shaped object , edge and the ground ,so not enough contrast, hence when taking a gradient you smooth over or ignore some edges and miss them

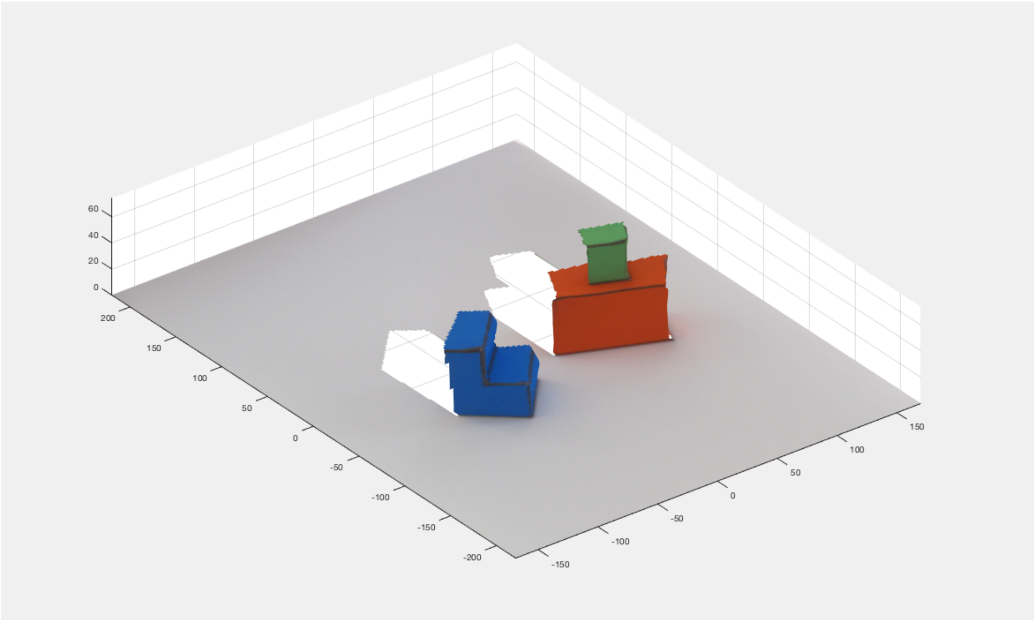


Figure 2: Image viewpoint, problem 5

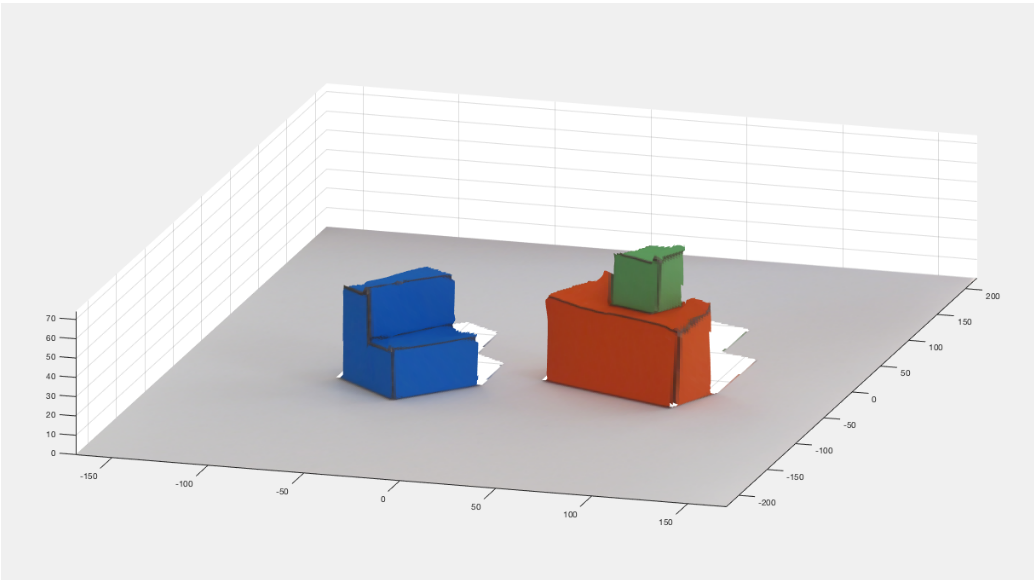


Figure 3: Image viewpoint,problem 5


Figure 4: Orthographic Image , problem 1.


Figure 5: perspective Image , problem 1

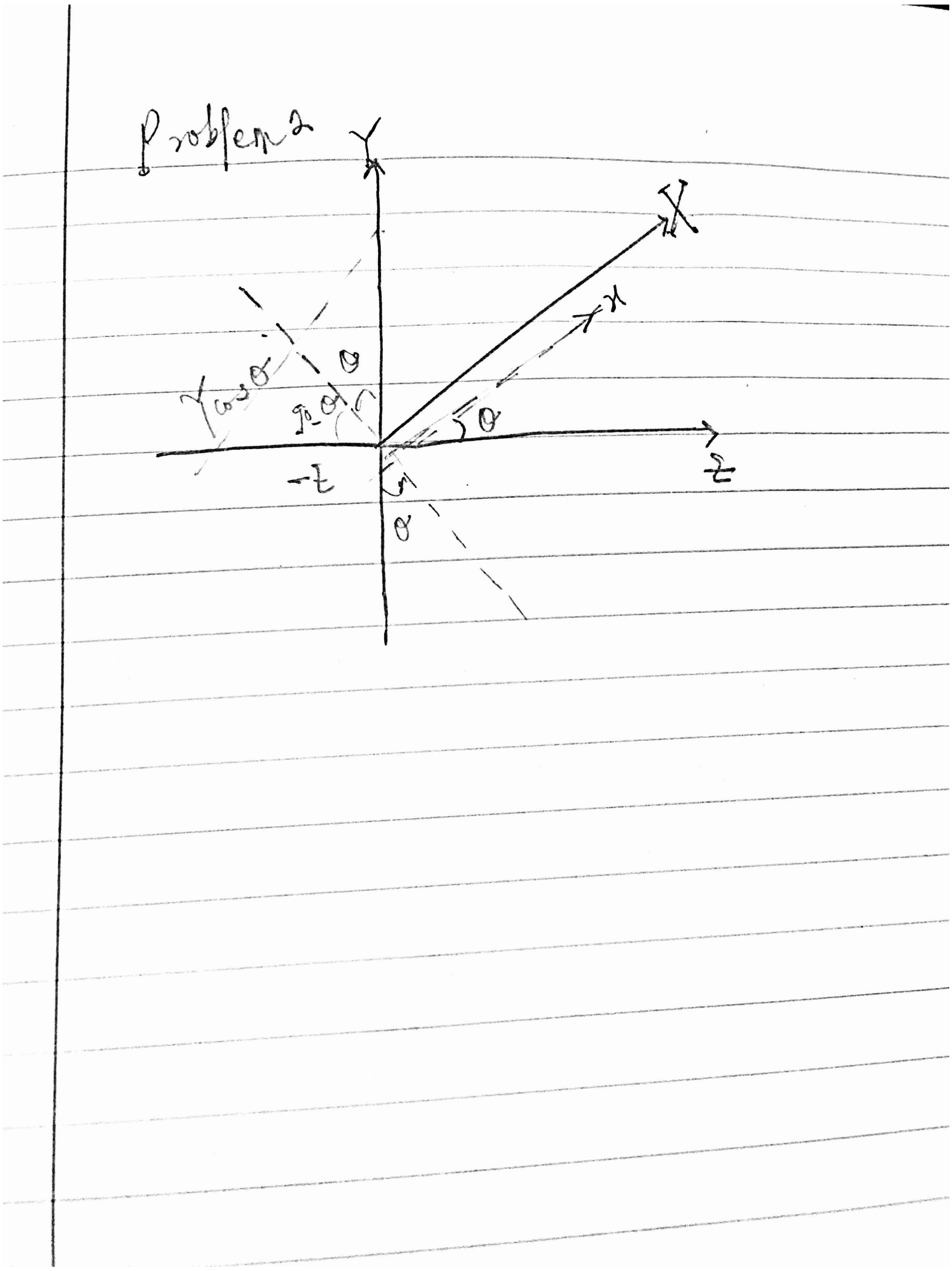


Figure 6: Resolution of vectors , problem 2