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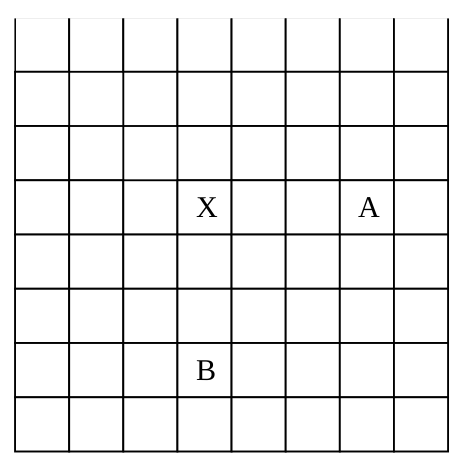
Course: ECE 4310

Lab #8

Range Image Segmentation

In this project the student was to segment a range image based upon surface normals. The student was to use a PPM image called “chair-range.ppm” and C code regarding conversion of pixels into 3D coordinates and Region Grow. The segmentation process used the image grid for grouping of pixels, but used the 3D coordinates for calculating the surface normals for region predicates. The laboratory was successfully completed by completing the following steps:

1. Threshold Image
   1. The image “chair-range.ppm” was thresholded at a value of **137 (value of THRESHOLD on C Code)** with the purpose of removing the background and only leaving the floor and chair in the image.
2. Obtain 3D Coordinates
   1. The C-code provided by Dr. Hoover was modified and implemented in order to obtain the 3D coordinates from pixels from the “chair-range.ppm” image. It should be noted that the slant type was assumed to be of scan-direction downward.
3. Calculate Surface Normals
   1. Surface normals were obtained by using the “chair-range.ppm” image and calculating it by taking the cross product of (B – X) x (A – X), where A and B are both 3D coordinates of those pixels (reference image below). The distance chosen between pixels for cross products were of value **3** **(value of PIXEL\_WIDTH on C code).**

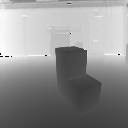


1. Region Growing
   1. The C-code provided by Dr. Hoover regarding queue-based region growing was modified and used to segment regions of the thresholded PPM image. The region predicate was able to join each region if its orientation was within a threshold of the average orientation of pixels already in the region. The angular difference was calculated using the dot product. The threshold chosen was of **0.8 (value of ANGULAR\_THRESHOLD on C code).**
   2. The seed pixels for the region growing were identified by using a 5x5 window for unlabeled of still-unlabeled region of the thresholded image. It should be noted that if any pixel within the 5x5 window was masked out or already labeled, the pixel could not be a seed of the new region. The region growing algorithm ended when there were no more possible seed pixels.

All C Code can be seen at the end of the report.

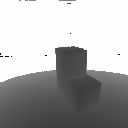
**RESULTS**

*Original “chair-range.ppm” Image:*

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*Thresholded “chair-range.ppm” Image:*

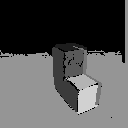
***Threshold value: 137***

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*Segmented & Thresholded “chair-range.ppm” Image:*

***Threshold value: 137***

***Cross Product Distance: 3***

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|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Region** | **Number of Pixels** | **Average Surface Normal (X)** | **Average Surface Normal (Y)** | **Average Surface Normal (Z)** |
| 1 |  |  |  |  |
| 2 |  |  |  |  |
| 3 |  |  |  |  |
| 4 |  |  |  |  |
| 5 |  |  |  |  |
| 6 |  |  |  |  |