

Challenges with feature detection in 3D point clouds. A Machine Vision Project

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1. Feature detection uses

Feature detection is used in:

- Quality inspection
- Quality Assurance
- Conformity control

2. Feature detection

Image

Several methods can be used for feature detection

- Hough Circle
- Shi-Tomasi
- Canny Edge

Point cloud

Unlike image processing, Point clouds does not have similar methods for feature detection. Thus methods has to be programmed from the ground. Existing solutions does exist however.

- Gauss map clustering
- Centroid method

Noise, a common problem.

- Noise removal

3. Solution & Results

Unable to develop any solution capable of performing feature detection, and so attempted solutions will be presented.

- Trogonometric
- Line analysis
- Dot product

Image processing solution featured methods like Canny Edge, Shi-Tomasi, and Hough Circle in order to find features.

Obtained results for image processing:

The Image processing code was used on 2 objects. One object had 2 circular holes, and a square hole, the oter had 1 circular hole and a square hole.

```
In [2]: runfile('C:/Users/shans/OneDrive/Skrivebord/AAU/8 Semester/VT2Project.py', wdir='C:/Users/shans/OneDrive/Skrivebord/AAU/8 Semester')
Circle distances to corners are: [[226.20584264192647, 174.6213969186056], [258.9734124700742, 119.4990130811634]] mm
The diameter of circle 1 is: 13.750159999999998 mm
The diameter of circle 2 is: 13.750159999999998 mm
The area of the square is: 1473.0491499999998 mm
The largest angle is: 162.71571144046537 degrees
Square distance to corner is: 196.16158180706063 and 249.72876342913162 for the first corner. 196.16158180706063 and 249.72876342913162 for the other. All in mm
Program execution time : 0.15434765815734803 seconds
```

Figure 1: The obtained results for object 1

```
In [4]: runfile('C:/Users/shans/OneDrive/Skrivebord/AAU/8 Semester/VT2Project.py', wdir='C:/Users/shans/OneDrive/Skrivebord/AAU/8 Semester')
The diameter of the circle is: 15.34564 mm
Circle distance to corners is: 266.1739234707149 and 268.8946468686359 mm
The area of the square is: 1431.64236 mm
The largest angle is: 3.5005213877888493 degrees
Square distance to corner is: 198.93829843892502 and 255.91123527140812 for the first corner. 198.93829843892502 and 255.91123527140812 for the other. All in mm
Program execution time : 0.140183925288621 seconds
```

Figure 2: The obtained results for object 2

The developed code found all features and computed distances from 2 corners to the features. The code was robust, though poor image quality made the code unreliable.

4. Discussion & Conclusions

Feature detection is a challenging task, and noise is a problem present for both point cloud and image processing.

Future work:

- Point to pixel conversion
- Computation of points within a given distance
- Modified centroid method.

Conclusion:

Feature detection is a challenging task that can provide great benefits for companies if done correctly as it can automate otherwise repetitive work.

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