**Manatec Project - Wheel Alignment**

**Report**

**Introduction**

Based on the stereo images provided, the program calculates the distance of the wheel centre in three dimensions (X, Y, Z) and applies a formula to thus calculate the distance of the wheel centre from the centre of the stereo cameras.

**Procedure**

The two stereo images are taken as inputs to the program, and stored in matrices. The contours in the image are found using OpenCV functions and we isolate the elliptical contours in the neighbourhood of centre of the images. The largest such contour is isolated and taken as the wheel rim contour.

An ellipse is fit to this contour, and the centre of the ellipse is obtained from the image. The centres are (xl, yl) and (xr, yr) from the left and right images respectively.

Using these we calculate ‘d’ the disparity. We assume the baseline width ‘b’ or the distance between the stereo cameras as 5 cm. Based on formulae, the depth is extracted as

Z = f \* b / d

Here ‘f’ is the focal length, and is obtained from the vertical viewing angle (28º) as specified in the camera details, and the image height as

f = img\_ht / ( 2 \* tan( 28º / 2 ) )

Using Z and f, we obtain X and Y - the other two distances in X and Y dimensions as

X = xl \* Z / f

Y = yl \* Z / f

Now we calculate D, the distance of the wheel centre from the centre of the cameras as

D = sqrt ( X^2 + Y^2 + Z^2 )

This value is displayed in metres.

**Other Requirements**

The actual values of the distance are not provided for cross checking, so these are required to test the validity.

The baseline width was assumed as 5 cm, the actual value needs to be provided for proper result.

**Sample Outputs**

| Image Number | X in metres | Y in metres | Z in metres | D in metres |
| --- | --- | --- | --- | --- |
| **0** | 0.2366 | 0.1575 | 0.3207 | 0.4285 |
| **1** | 0.2363 | 0.1574 | 0.3201 | 0.4279 |
| **2** | 0.2368 | 0.1575 | 0.3206 | 0.4286 |
| **3** | 0.2369 | 0.1575 | 0.3207 | 0.4287 |
| **4** | 0.2372 | 0.1575 | 0.3207 | 0.4288 |
| **5** | 0.2379 | 0.1575 | 0.3207 | 0.4293 |
| **6** | 0.2393 | 0.1575 | 0.3207 | 0.4300 |
| **7** | 0.2436 | 0.1576 | 0.3208 | 0.4326 |
| **8** | 0.2512 | 0.1580 | 0.3218 | 0.4377 |
| **9** | 0.2961 | 0.1887 | 0.3804 | 0.5176 |
| **10** | 0.2394 | 0.1585 | 0.3239 | 0.4328 |
| **11** | 0.2389 | 0.1583 | 0.3232 | 0.4320 |
| **12** | 0.2396 | 0.1588 | 0.3240 | 0.4331 |
| **13** | 0.2389 | 0.1584 | 0.3231 | 0.4319 |
| **14** | 0.2386 | 0.1585 | 0.3226 | 0.4315 |
| **15** | 0.2379 | 0.1587 | 0.3216 | 0.4304 |
| **16** | 0.2365 | 0.1589 | 0.3194 | 0.4281 |
| **17** | 0.2322 | 0.1598 | 0.3131 | 0.4213 |
| **18** | 0.2197 | 0.1656 | 0.2942 | 0.4029 |
| **19** | 0.2204 | 0.1665 | 0.2953 | 0.4044 |

**Result**

The distance of the wheel centre has been calculated and so have X, Y, Z based on the location of point in 3D from stereo images.

For validation, the baseline width ‘b’ measurement and the actual distances are required.