Angle Measurements by Camera – Short Report X-Cali

Measurement: Burak SEZGİN, Data extraction: Burak SEZGİN

Before the integration of the angle measurement code and camera on the vehicle, they are tested. A4 Tech PK-900H model of webcam is used for this test to measure the angle of the plank. The test specifications are provided below.

|  |  |
| --- | --- |
| Environment | : Living Room, luminous |
| Driver | : RaspberryPi3 |
| Camera | : A4 Tech PK-900H |
| Temperature | : 24℃  N |

Measurement Tool: IC Measure (On-Screen Measurement Software)

Measurement Method (Angle):

First, some arbitrary angles are adjusted for plank and it is photographed. Then, with the help of *the angle measurement code, plank’s angle on photo is measured. Furthermore, real angle of the plank is measured by a software (IC Measure).*

*Measurement Method (FPS):*

*First, the number of frames of the video is set to specific values such as 100, 200 … up to 1000 frames. Then, for these number of frames, FPS is calculated as follows: a stopwatch code is utilized which measures time difference between the first frame and the last one. And to find FPS value, frame number is divided into that time difference.*

*The following graphs are obtained using MATLAB.*

|  |  |
| --- | --- |
| Real Angle (Degrees) | Measured Angle by Camera (Degrees) |
| -70,5 | -70 |
| -56,5 | -56 |
| -34 | -36 |
| -15,5 | -17 |
| 1 | 0 |
| 16,5 | 18 |
| 35 | 36 |
| 53,5 | 54 |
| 72,5 | 72 |
| 83,5 | 82 |

Table 1: Measurement results of angle by camera (in a range between -90 and 90 degrees)

|  |  |  |
| --- | --- | --- |
|  | When planck is not detected | When planck is detected |
| Number of frames | Measured FPS | Measured FPS |
| 100 | 22,42 | 21,59 |
| 200 | 21,62 | 21,34 |
| 300 | 21,94 | 21,95 |
| 400 | 22,42 | 21,41 |
| 500 | 22,29 | 21,68 |
| 600 | 21,93 | 21,58 |
| 700 | 22,09 | 21,61 |
| 800 | 22,14 | 21,34 |
| 900 | 22,14 | 21,86 |
| 1000 | 22,28 | 21,62 |

Table 2: Measurement results of FPS for all circumstances (For when plank is detected and not detected)

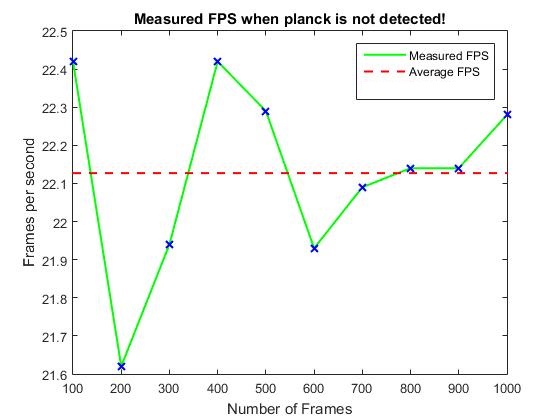


Figure 1: Measured FPS When Planck is not Detected

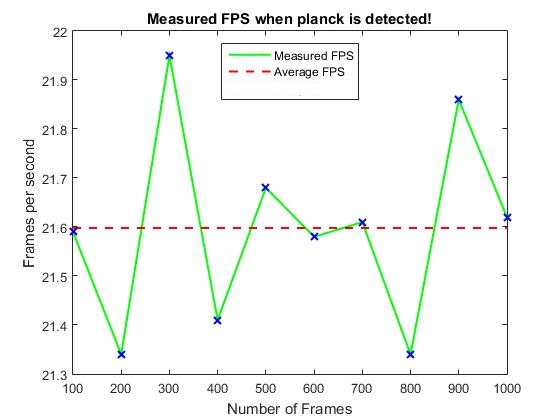


Figure 2: Measured FPS When Planck is Detected

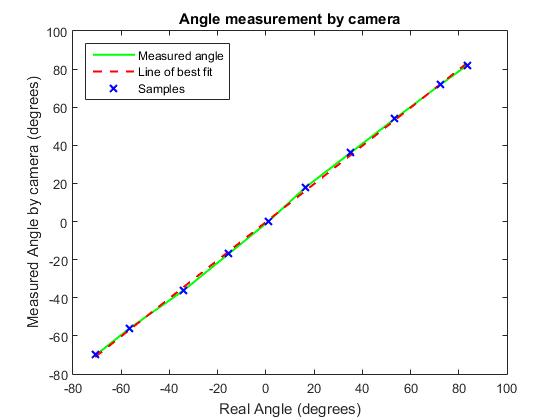


Figure 3: Angle Measurement Results of Camera

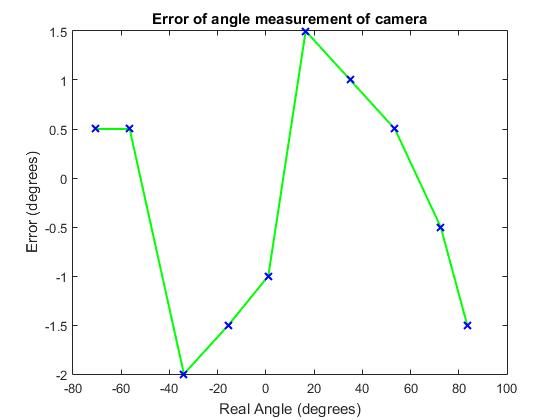


Figure 4: Error of Angle Measurement of Camera