

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°C

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 plank is not detected	When plank 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)

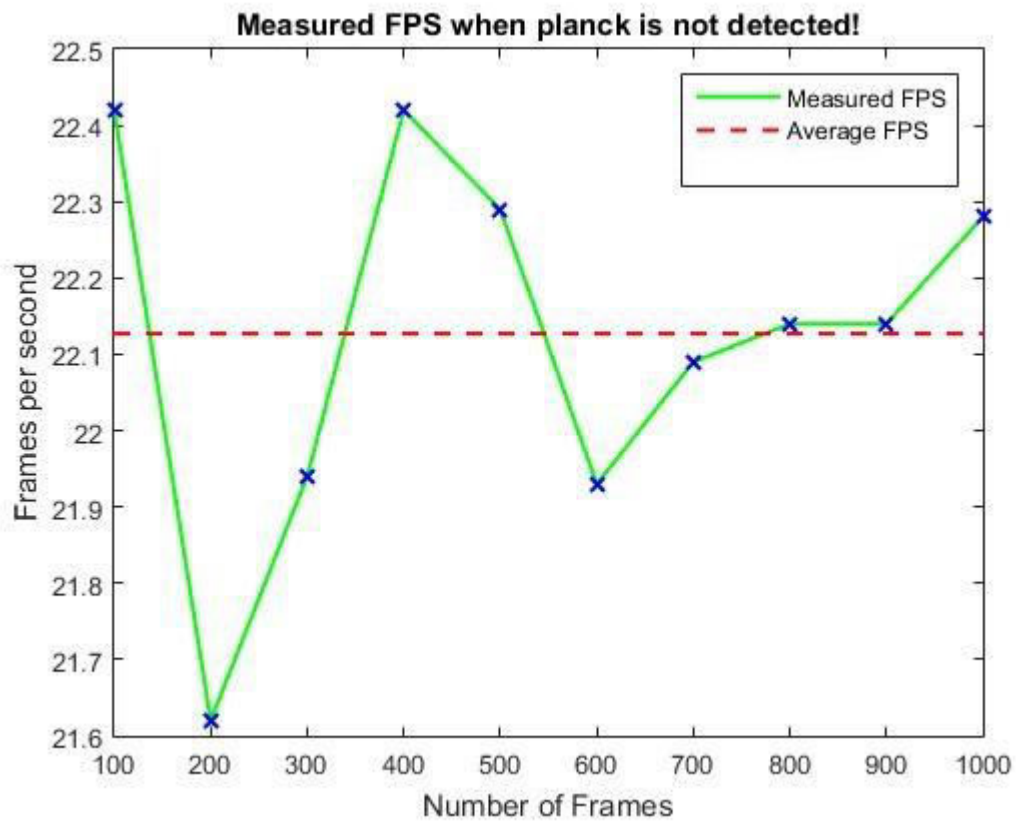


Figure 1: Measured FPS When Planck is not Detected

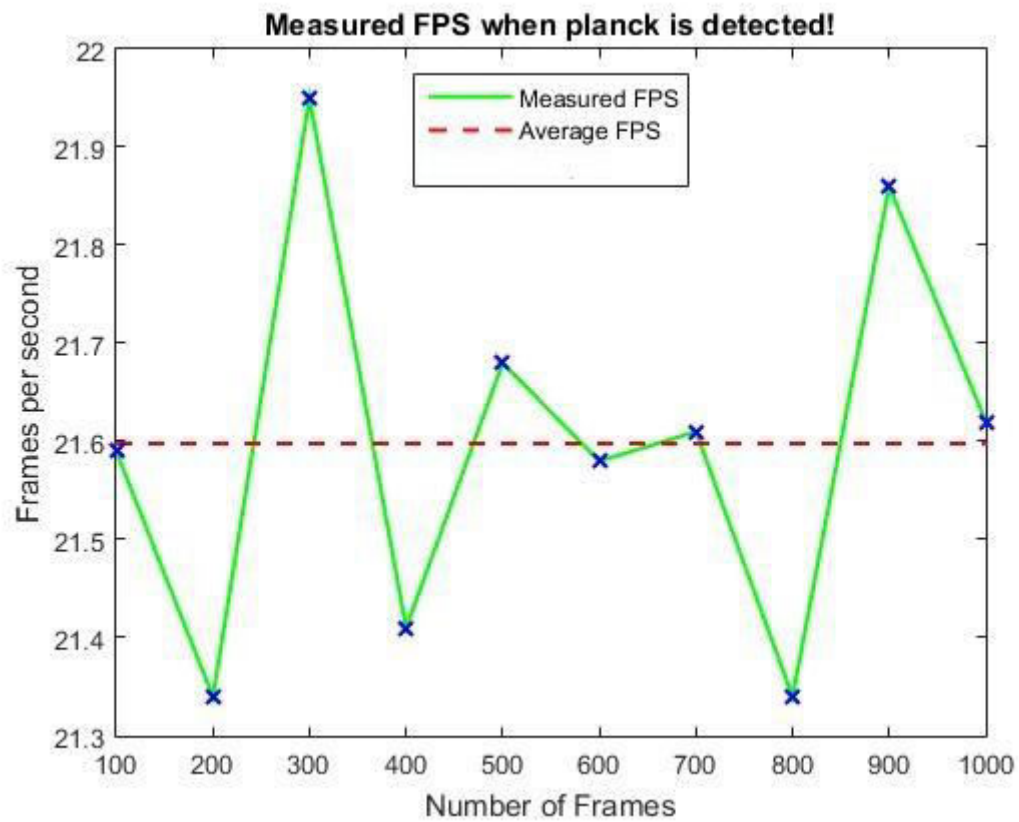


Figure 2: Measured FPS When Planck is Detected

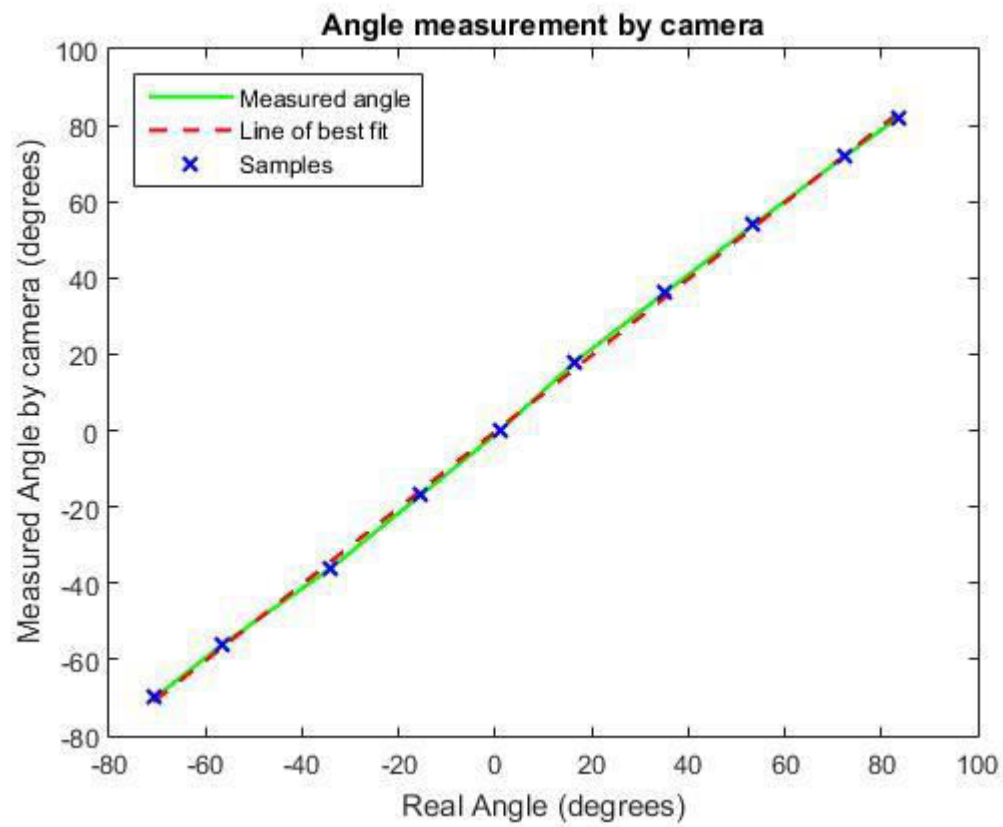


Figure 3: Angle Measurement Results of Camera

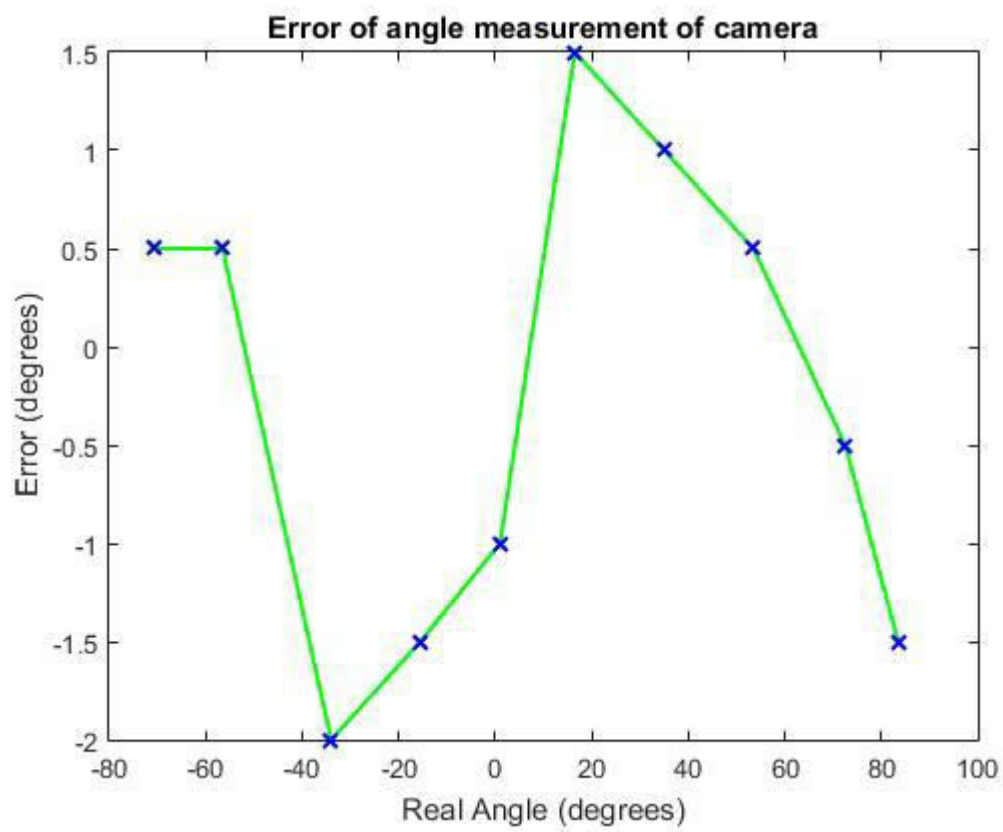


Figure 4: Error of Angle Measurement of Camera