r06946003 湯忠憲

Camera Calibration

Task description:

1. Camera calibration i.e. compute #mm/ pixel object displacement
2. Calculate horizontal field of view in degrees of angle.
3. Calculate theoretical values (FOV) and compare with measured values.

Method:

1. Identifying the position of button on clothing, i.e., green circle in Fig. 1. This can be easily done by 小畫家.

Figure 1

2. Based on the movement on x-axis, we can calculate the displacement.
3. Then we can calculate horizontal field of view in degrees of angle using formula shown below:

- **FOV** theoretical value (f = 135mm, sensor width = 23.4mm):

$$\text{FOV} = 2 \times \arctan\left(\frac{sensor\ width}{2 \times f}\right) \times \frac{180}{\pi}$$

- **FOV** measured value:

$$\text{FOV} = 2 \times \arctan\left(\frac{Image\ width(in\ pixel) \times \text{mm per pixel}}{2 \times object\ distance}\right) \times \frac{180}{\pi}$$

Experiment results:

18mm		實際位移	x	位移 Pixel	mm/pixel	FOV 估計	FOV理論
600mm_0mm	600	0	2255				
600mm_1mm	600	1	2259	4	0.25	88.45156	66.04774
600mm_5mm	600	5	2280	25	0.2	75.81341	66.04774
600mm_10mm	600	10	2307	52	0.192308	73.64571	66.04774
600mm_20mm	600	20	2355	100	0.2	75.81341	66.04774
1200mm_0mm	1200	0	2324				
1200mm_1mm	1200	1	2327	3	0.333333	65.95818	66.04774
1200mm_5mm	1200	5	2341	17	0.294118	59.58651	66.04774
1200mm_10mm	1200	10	2354	30	0.333333	65.95818	66.04774
1200mm_20mm	1200	20	2380	56	0.357143	69.617	66.04774
1800mm_0mm	1800	0	2317				
1800mm_1mm	1800	1	2320	3	0.333333	46.7859	66.04774
1800mm_5mm	1800	5	2327	10	0.5	65.95818	66.04774
1800mm_10mm	1800	10	2336	19	0.526316	68.66935	66.04774
1800mm_20mm	1800	20	2362	45	0.444444	59.95185	66.04774

53mm		實際位移	x	位移 Pixel	mm/pixel	FOV 估計	FOV理論
600mm_0mm	600	0	2221				
600mm_1mm	600	1	2243	22	0.045455	20.07142	24.89732
600mm_5mm	600	5	2284	63	0.079365	34.34174	24.89732
600mm_10mm	600	10	2351	130	0.076923	33.34457	24.89732
600mm_20mm	600	20	2485	264	0.075758	32.86679	24.89732
1200mm_0mm	1200	0	2362				
1200mm_1mm	1200	1	2372	10	0.1	22.03162	24.89732
1200mm_5mm	1200	5	2407	45	0.111111	24.4097	24.89732
1200mm_10mm	1200	10	2442	80	0.125	27.35236	24.89732
1200mm_20mm	1200	20	2526	164	0.121951	26.70941	24.89732
1800mm_0mm	1800	0	2382				
1800mm_1mm	1800	1	2395	13	0.076923	11.40179	24.89732
1800mm_5mm	1800	5	2420	38	0.131579	19.38075	24.89732
1800mm_10mm	1800	10	2441	59	0.169492	24.81072	24.89732
1800mm_20mm	1800	20	2484	102	0.196078	28.55367	24.89732

135mm		實際位移	x	位移 Pixel	mm/pixel	FOV 估計	FOV理論
600mm_0mm	600	0	2119				
600mm_1mm	600	1	2177	58	0.017241	7.680601	9.906515
600mm_5mm	600	5	2277	158	0.031646	14.04766	9.906515
600mm_10mm	600	10	2382	263	0.038023	16.84131	9.906515
600mm_20mm	600	20	2622	503	0.039761	17.59959	9.906515
1200mm_0mm	1200	0	2427				
1200mm_1mm	1200	1	2465	38	0.026316	5.865177	9.906515
1200mm_5mm	1200	5	2490	63	0.079365	17.56521	9.906515
1200mm_10mm	1200	10	2570	143	0.06993	15.50411	9.906515
1200mm_20mm	1200	20	2740	313	0.063898	14.18094	9.906515
1800mm_0mm	1800	0	2270				
1800mm_1mm	1800	1	2274	4	0.25	35.95073	9.906515
1800mm_5mm	1800	5	2304	34	0.147059	21.60989	9.906515
1800mm_10mm	1800	10	2357	87	0.114943	16.96849	9.906515
1800mm_20mm	1800	20	2480	210	0.095238	14.09181	9.906515