

Appendix A

Benchmark results

A.1 Effect of convergence criterion during bundle adjustment

Table A.1: Effect of convergence criterion on Bundle Adjustment speed and performance

Convergence Threshold	Accuracy			Robustness		
	Distance (m)	Angle (rad)	Time (s)	Distance (m)	Angle (rad)	Time (s)
1.000×10^1	0.099	0.041	0.529	0.776	0.219	0.527
5	0.099	0.041	0.533	0.776	0.219	0.560
1	0.099	0.041	0.537	0.776	0.219	0.529
5×10^{-1}	0.099	0.041	0.532	0.284	0.086	0.615
1×10^{-1}	0.116	0.037	0.671	0.244	0.098	1.176
5×10^{-2}	0.068	0.016	0.743	0.291	0.113	2.117
1×10^{-2}	0.090	0.032	1.421	0.823	0.316	2.770
5×10^{-3}	0.091	0.031	1.533	0.142	0.050	4.186
1×10^{-3}	0.085	0.023	3.620	1.035	0.397	4.907
1×10^{-4}	0.084	0.026	5.058	1.362	0.480	10.484
1×10^{-5}	0.090	0.030	12.453	1.483	0.528	13.206
1×10^{-6}	0.090	0.030	15.703	1.374	0.492	13.802
1×10^{-7}	0.088	0.028	15.795	1.559	0.567	12.935

A.2 Effect of outlier threshold after bundle adjustment

A.2.1 Threshold after first bundle adjustment

Table A.2: Effect of removing outliers (convergence tolerance = 0.05)

Outlier Threshold	Accuracy			Robustness		
	Distance (m)	Angle (rad)	Time (s)	Distance (m)	Angle (rad)	Time (s)
3	0.083	0.025	1.039	0.214	0.061	1.705
4	0.074	0.021	1.018	0.168	0.061	1.792
5	0.075	0.021	0.941	0.127	0.046	1.849
6	0.079	0.023	0.967	0.135	0.048	2.034
7	0.079	0.022	1.006	0.134	0.048	1.979
8	0.079	0.022	0.960	0.137	0.050	2.108
9	0.078	0.023	0.975	0.187	0.070	1.747

Table A.3: Effect of removing outliers (convergence tolerance = 0.005)

Outlier Threshold	Accuracy			Robustness		
	Distance (m)	Angle (rad)	Time (s)	Distance (m)	Angle (rad)	Time (s)
3	0.085	0.026	2.232	0.370	0.137	3.597
4	0.084	0.026	2.158	0.347	0.122	3.494
5	0.086	0.026	2.048	0.319	0.113	4.200
6	0.086	0.027	2.087	0.309	0.109	3.295
7	0.086	0.026	2.076	0.202	0.072	3.390
8	0.086	0.026	2.147	0.185	0.065	4.522
9	0.085	0.028	2.066	0.213	0.076	3.578

A.2.2 Threshold after second bundle adjustment

Table A.4: Effect of removing outliers (convergence tolerance = 0.005)

Outlier Threshold		Accuracy			Robustness		
1 st b. a.	2 nd b. a.	Distance (m)	Angle (rad)	Time (s)	Distance (m)	Angle (rad)	Time (s)
5	4	0.074	0.025	1.059	0.133	0.049	1.892
5	5	0.078	0.026	1.046	0.122	0.044	1.866
5	7	0.072	0.023	1.068	0.128	0.046	1.928
5	1.000×10^1	0.074	0.023	1.063	0.136	0.049	1.822
5	1.500×10^1	0.071	0.023	1.095	0.136	0.048	1.900
6	4	0.078	0.025	1.090	0.124	0.046	1.955
6	5	0.072	0.023	1.098	0.127	0.047	1.960
6	7	0.072	0.022	1.067	0.123	0.045	1.930
6	1.000×10^1	0.073	0.022	1.082	0.121	0.045	1.944
6	1.500×10^1	0.073	0.023	1.094	0.121	0.045	1.933
7	4	0.076	0.024	1.090	0.123	0.045	1.915
7	5	0.074	0.023	1.071	0.129	0.048	1.913
7	7	0.073	0.022	1.111	0.124	0.046	1.950
7	1.000×10^1	0.071	0.021	1.114	0.121	0.045	1.923
7	1.500×10^1	0.073	0.022	1.073	0.121	0.045	1.959