

The Random Cluster Model for Robust Geometric Fitting

Supplementary Material

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1 Two view motion segmentation results.

Table 1 reports the full qualitative result on the motion segmentation datasets.

2 Multi-homography detection results.

Table 2 summaries the comparison results on the multi-homography estimation datasets.

Table 1: Summary statistics (median) and two sample t-tests (RCMSA versus others) over 50 repetitions on fundamental matrices detection. For each run, we record the lowest SE achieved within 1000 iterations/hypotheses and the time when the lowest SE was achieved (SE in percent, time in seconds). On each dataset, the lowest median SE and time among all methods are bolded; p-values smaller than 0.01 (significance level) are in bold and italic. Note that we test either our method is significantly better or worse than another. S = number of structures; I = number of inliers; and O = number of outliers.

Datasets		PEARL	QP-MF	FLOSS	AJCMC	RCMSA	
Biscuitbookbox S=3, I=162, O=97	Segmentation error	Median	8.11	7.72	11.58	11.58	7.72
		p-value (ours is better)	1.88e-01	8.50e-01	<i>1.07e-11</i>	<i>3.45e-12</i>	x
		p-value (ours is worse)	8.12e-01	1.50e-01	1.00e+00	1.00e+00	x
	Running time	Median	2.51	5.59	3.76	0.4	0.16
		p-value (ours is better)	<i>2.42e-19</i>	<i>1.58e-28</i>	<i>1.73e-36</i>	<i>3.45e-04</i>	x
		p-value (ours is worse)	1.00e+00	1.00e+00	1.00e+00	1.00e+00	x
Boardgame S=3, I=166, O=113	Segmentation error	Median	16.85	17.2	17.92	19.35	12.9
		p-value (ours is better)	<i>2.70e-21</i>	<i>9.31e-18</i>	<i>3.31e-22</i>	<i>8.92e-29</i>	x
		p-value (ours is worse)	1.00e+00	1.00e+00	1.00e+00	1.00e+00	x
	Running time	Median	3.16	5.74	5.91	1	0.23
		p-value (ours is better)	<i>2.27e-11</i>	<i>1.50e-19</i>	<i>2.35e-21</i>	<i>5.54e-05</i>	x
		p-value (ours is worse)	1.00e+00	1.00e+00	1.00e+00	1.00e+00	x
Breadcartoychips S=4, I=155, O=82	Segmentation error	Median	12.24	10.97	15.82	13.92	9.92
		p-value (ours is better)	<i>5.13e-06</i>	1.28e-01	<i>4.61e-18</i>	<i>1.03e-12</i>	x
		p-value (ours is worse)	1.00e+00	8.72e-01	1.00e+00	1.00e+00	x
	Running time	Median	2.84	6.51	5.29	1.35	0.35
		p-value (ours is better)	<i>1.98e-19</i>	<i>1.01e-23</i>	<i>7.07e-33</i>	<i>1.41e-09</i>	x
		p-value (ours is worse)	1.00e+00	1.00e+00	1.00e+00	1.00e+00	x
Breadcubechips S=3, I=149, O=81	Segmentation error	Median	9.57	6.96	11.74	10.43	9.78
		p-value (ours is better)	9.81e-01	1.00e+00	1.19e-02	2.13e-01	x
		p-value (ours is worse)	1.89e-02	<i>1.16e-06</i>	9.88e-01	7.87e-01	x
	Running time	Median	2.76	4.37	4.16	0.55	0.18
		p-value (ours is better)	<i>1.01e-28</i>	<i>1.71e-26</i>	<i>5.67e-37</i>	<i>2.01e-03</i>	x
		p-value (ours is worse)	1.00e+00	1.00e+00	1.00e+00	9.98e-01	x
Breadtoycar S=3, I=110, O=56	Segmentation error	Median	10.24	8.73	11.75	10.84	8.73
		p-value (ours is better)	<i>1.00e-06</i>	7.63e-01	<i>2.09e-10</i>	<i>1.93e-06</i>	x
		p-value (ours is worse)	1.00e+00	2.37e-01	1.00e+00	1.00e+00	x
	Running time	Median	1.94	4.93	3.54	0.85	0.12
		p-value (ours is better)	<i>1.40e-26</i>	<i>2.17e-21</i>	<i>1.04e-33</i>	<i>4.36e-10</i>	x
		p-value (ours is worse)	1.00e+00	1.00e+00	1.00e+00	1.00e+00	x
Carchipscube S=3, I=105, O=60	Segmentation error	Median	10.3	9.09	16.97	15.76	4.85
		p-value (ours is better)	<i>2.57e-35</i>	<i>2.51e-19</i>	<i>5.85e-30</i>	<i>1.55e-30</i>	x
		p-value (ours is worse)	1.00e+00	1.00e+00	1.00e+00	1.00e+00	x
	Running time	Median	2.28	3.78	3.66	0.43	0.24
		p-value (ours is better)	<i>1.86e-12</i>	<i>5.45e-22</i>	<i>4.13e-14</i>	<i>7.00e-04</i>	x
		p-value (ours is worse)	1.00e+00	1.00e+00	1.00e+00	9.99e-01	x
Cubebreadtoychips S=4, I=239, O=88	Segmentation error	Median	9.02	7.34	11.31	9.94	8.87
		p-value (ours is better)	3.37e-01	1.00e+00	1.74e-05	1.91e-02	x
		p-value (ours is worse)	6.63e-01	<i>1.75e-04</i>	1.00e+00	9.81e-01	x
	Running time	Median	3.55	6.37	6.15	1.36	0.25
		p-value (ours is better)	<i>2.51e-15</i>	<i>7.54e-24</i>	<i>2.40e-31</i>	<i>9.08e-10</i>	x
		p-value (ours is worse)	1.00e+00	1.00e+00	1.00e+00	1.00e+00	x
Dinabooks S=3, I=205, O=155	Segmentation error	Median	19.17	17.78	20.28	20.56	17.5
		p-value (ours is better)	<i>9.72e-05</i>	1.86e-01	<i>5.71e-09</i>	<i>1.36e-08</i>	x
		p-value (ours is worse)	1.00e+00	8.14e-01	1.00e+00	1.00e+00	x
	Running time	Median	3.77	4.77	7.19	1.32	0.38
		p-value (ours is better)	<i>2.11e-18</i>	<i>3.23e-23</i>	<i>5.11e-17</i>	<i>8.47e-09</i>	x
		p-value (ours is worse)	1.00e+00	1.00e+00	1.00e+00	1.00e+00	x
Toycubecar S=3, I=128, O=72	Segmentation error	Median	12	10.5	13.75	13.5	11
		p-value (ours is better)	2.25e-01	9.63e-01	<i>1.69e-04</i>	<i>2.17e-03</i>	x
		p-value (ours is worse)	7.75e-01	3.75e-02	1.00e+00	9.98e-01	x
	Running time	Median	2.6	4.47	5.04	0.38	0.13
		p-value (ours is better)	<i>5.18e-15</i>	<i>1.33e-17</i>	<i>1.84e-16</i>	<i>2.01e-06</i>	x
		p-value (ours is worse)	1.00e+00	1.00e+00	1.00e+00	1.00e+00	x

Table 2: Summary statistics (median) and two sample t-tests (RCMSA versus others) over 50 repetitions on multi-homography detection. For each run, we record the lowest SE achieved within 1000 iterations/hypotheses and the time when the lowest SE was achieved (SE in percent, time in seconds). On each dataset, the lowest median SE and time among all methods are bolded; p-values smaller than 0.01 (significance level) are in bold and italic. Note that we test either our method is significantly better or worse than another. S = number of structures; I = number of inliers; and O = number of outliers.

Datasets			PEARL	QP-MF	FLOSS	AJCMC	RCMSA
Bonython Hall S=6, I=1002, O=66	Segmentation error	Median	18.63	14.42	15.68	13.34	8.8
		p-value (ours is better)	<i>1.18e-18</i>	<i>4.19e-15</i>	<i>2.83e-19</i>	<i>3.12e-10</i>	x
		p-value (ours is worse)	1.00e+00	1.00e+00	1.00e+00	1.00e+00	x
	Running time	Median	18.3	42.52	31.81	5.6	2
		p-value (ours is better)	<i>2.19e-17</i>	<i>6.58e-16</i>	<i>6.95e-25</i>	<i>4.47e-13</i>	x
		p-value (ours is worse)	1.00e+00	1.00e+00	1.00e+00	1.00e+00	x
Jonhsona S=4, I=295, O=78	Segmentation error	Median	5.63	23.19	6.17	4.02	2.14
		p-value (ours is better)	<i>6.78e-36</i>	<i>5.29e-32</i>	<i>8.19e-31</i>	<i>1.87e-09</i>	x
		p-value (ours is worse)	1.00e+00	1.00e+00	1.00e+00	1.00e+00	x
	Running time	Median	7.61	19.6	13.71	2.38	0.87
		p-value (ours is better)	<i>8.39e-22</i>	<i>2.30e-11</i>	<i>6.82e-22</i>	<i>6.69e-08</i>	x
		p-value (ours is worse)	1.00e+00	1.00e+00	1.00e+00	1.00e+00	x
Johnsonb S=7, I=571, O=78	Segmentation error	Median	18.64	23.73	15.49	15.18	14.79
		p-value (ours is better)	<i>5.73e-05</i>	<i>8.72e-17</i>	1.94e-01	7.09e-01	x
		p-value (ours is worse)	1.00e+00	1.00e+00	8.06e-01	2.91e-01	x
	Running time	Median	9.86	20.76	29.79	2.94	3.37
		p-value (ours is better)	<i>6.98e-10</i>	<i>7.13e-14</i>	<i>8.67e-20</i>	9.37e-01	x
		p-value (ours is worse)	1.00e+00	1.00e+00	1.00e+00	6.33e-02	x
Ladysymon S=3, I=160, O=77	Segmentation error	Median	7.59	18.78	7.59	2.53	3.38
		p-value (ours is better)	<i>7.50e-68</i>	<i>2.63e-34</i>	<i>1.60e-67</i>	9.78e-01	x
		p-value (ours is worse)	1.00e+00	1.00e+00	1.00e+00	2.18e-02	x
	Running time	Median	3.92	19.41	6.55	1.54	0.44
		p-value (ours is better)	<i>3.03e-20</i>	<i>6.65e-12</i>	<i>3.81e-20</i>	<i>7.93e-12</i>	x
		p-value (ours is worse)	1.00e+00	1.00e+00	1.00e+00	1.00e+00	x
Merton Colleges 1 S=5, I=1503, O=437	Segmentation error	Median	8.12	7.09	7.96	5.85	3.35
		p-value (ours is better)	<i>6.90e-37</i>	<i>3.44e-15</i>	<i>1.33e-24</i>	<i>2.59e-17</i>	x
		p-value (ours is worse)	1.00e+00	1.00e+00	1.00e+00	1.00e+00	x
	Running time	Median	32.12	43.48	59.55	7.27	2.75
		p-value (ours is better)	<i>3.62e-17</i>	<i>2.92e-21</i>	<i>3.26e-28</i>	<i>3.25e-09</i>	x
		p-value (ours is worse)	1.00e+00	1.00e+00	1.00e+00	1.00e+00	x
Merton Colleges 3 S=6, I=1707, O=275	Segmentation error	Median	6.53	8.65	5.95	4.39	3.58
		p-value (ours is better)	<i>3.70e-17</i>	<i>1.38e-21</i>	<i>2.57e-11</i>	<i>1.59e-05</i>	x
		p-value (ours is worse)	1.00e+00	1.00e+00	1.00e+00	1.00e+00	x
	Running time	Median	27.59	80.93	72.07	13.63	3.77
		p-value (ours is better)	<i>3.68e-14</i>	<i>3.89e-15</i>	<i>8.56e-38</i>	<i>2.68e-20</i>	x
		p-value (ours is worse)	1.00e+00	1.00e+00	1.00e+00	1.00e+00	x
Neem S=3, I=153, O=88	Segmentation error	Median	13.49	28.01	13.28	1.66	2.07
		p-value (ours is better)	<i>3.44e-68</i>	<i>1.39e-38</i>	<i>3.25e-73</i>	1.00e+00	x
		p-value (ours is worse)	1.00e+00	1.00e+00	1.00e+00	<i>4.85e-08</i>	x
	Running time	Median	4.02	7.89	8.07	2.2	0.88
		p-value (ours is better)	<i>4.77e-20</i>	<i>1.88e-18</i>	<i>9.11e-23</i>	<i>2.90e-14</i>	x
		p-value (ours is worse)	1.00e+00	1.00e+00	1.00e+00	1.00e+00	x
Oldclassicswing S=3, I=256, O=123	Segmentation error	Median	3.96	5.01	3.96	1.32	1.32
		p-value (ours is better)	<i>2.78e-28</i>	<i>1.02e-26</i>	<i>3.67e-49</i>	<i>4.51e-03</i>	x
		p-value (ours is worse)	1.00e+00	1.00e+00	1.00e+00	9.95e-01	x
	Running time	Median	5.06	15.18	6.53	1.2	0.19
		p-value (ours is better)	<i>3.98e-19</i>	<i>1.02e-14</i>	<i>1.11e-21</i>	<i>1.74e-11</i>	x
		p-value (ours is worse)	1.00e+00	1.00e+00	1.00e+00	1.00e+00	x
Raglan Castle S=11, I=2420, O=214	Segmentation error	Median	22.89	29.82	19.17	22.63	1.06
		p-value (ours is better)	<i>2.67e-37</i>	<i>1.04e-27</i>	<i>2.40e-38</i>	<i>2.57e-24</i>	x
		p-value (ours is worse)	1.00e+00	1.00e+00	1.00e+00	1.00e+00	x
	Running time	Median	29.3	49.65	112.19	8.17	8.61
		p-value (ours is better)	<i>8.69e-11</i>	<i>7.50e-15</i>	<i>1.85e-69</i>	7.24e-01	x
		p-value (ours is worse)	1.00e+00	1.00e+00	1.00e+00	2.76e-01	x
Sene S=3, I=132, O=118	Segmentation error	Median	6.8	7.6	6.8	0.4	0.4
		p-value (ours is better)	<i>2.99e-43</i>	<i>2.22e-49</i>	<i>6.49e-42</i>	9.81e-01	x
		p-value (ours is worse)	1.00e+00	1.00e+00	1.00e+00	1.94e-02	x
	Running time	Median	2.43	20.29	4.73	0.41	0.43
		p-value (ours is better)	<i>3.67e-13</i>	<i>1.50e-17</i>	<i>6.86e-16</i>	2.29e-02	x
		p-value (ours is worse)	1.00e+00	1.00e+00	1.00e+00	9.77e-01	x
Unionhouse S=5, I=1739, O=345	Segmentation error	Median	5.18	4.75	4.56	7.2	3.79
		p-value (ours is better)	<i>8.39e-21</i>	<i>1.37e-19</i>	1.99e-02	<i>2.55e-17</i>	x
		p-value (ours is worse)	1.00e+00	1.00e+00	9.80e-01	1.00e+00	x
	Running time	Median	22.47	62.89	83.01	15.73	5.39
		p-value (ours is better)	<i>4.39e-14</i>	<i>9.10e-25</i>	<i>3.44e-37</i>	<i>1.27e-49</i>	x
		p-value (ours is worse)	1.00e+00	1.00e+00	1.00e+00	1.00e+00	x