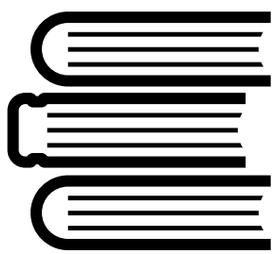
HSfM: Hybrid Structure-from-Motion

Hainan Cui, Xiang Gao, Shuhan Shen, and Zhanyi Hu
2017 IEEE Conference on Computer Vision and Pattern Recognition



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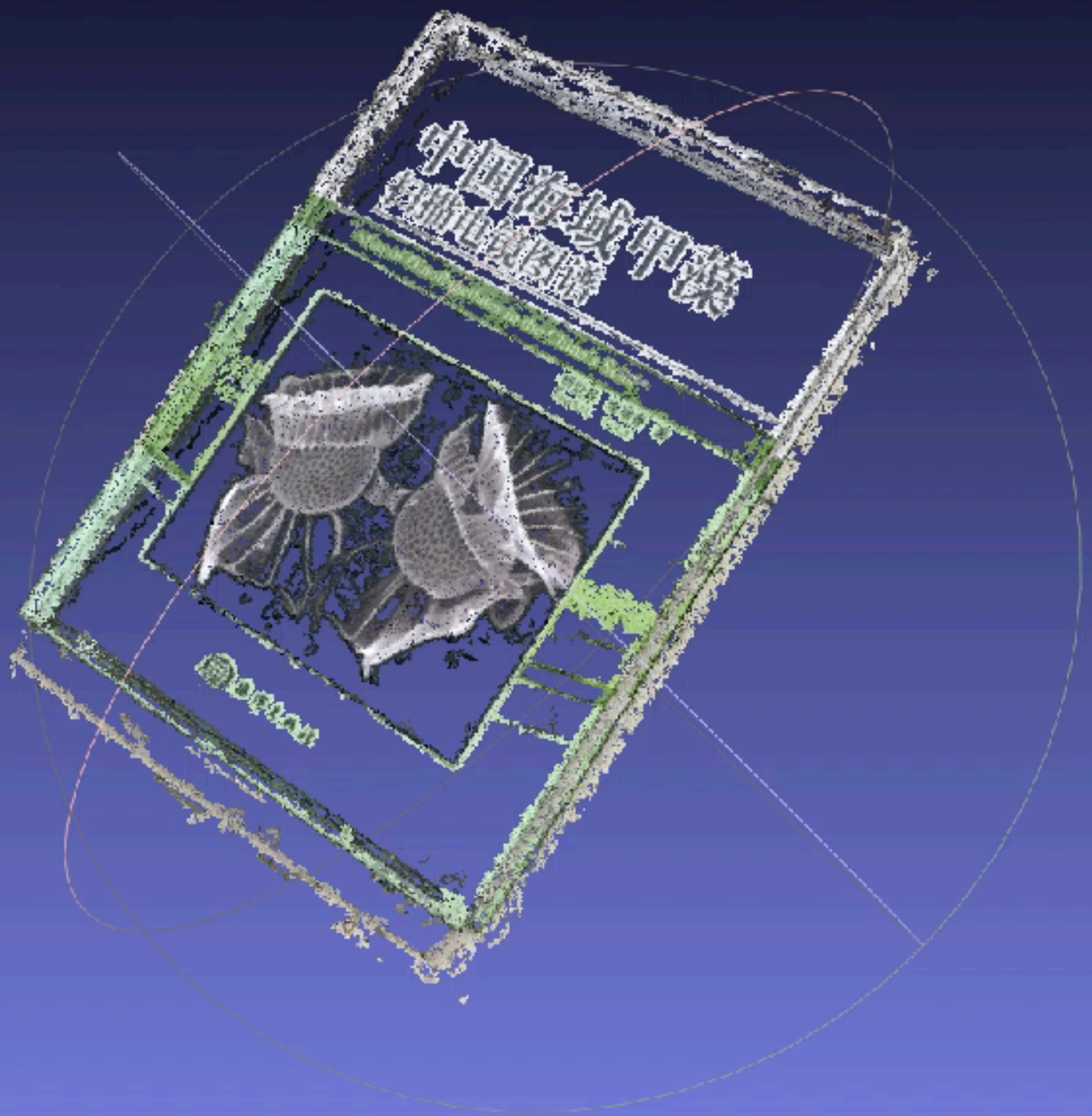

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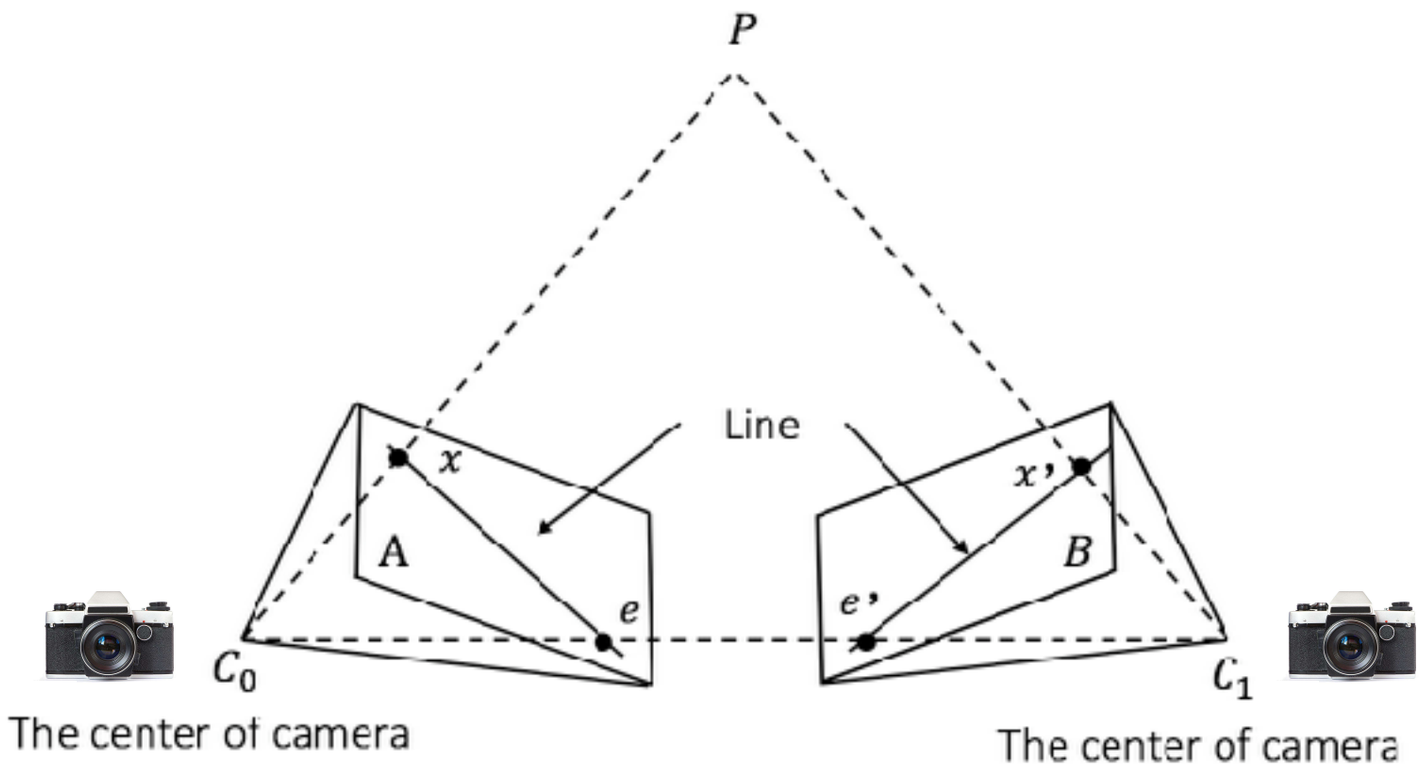

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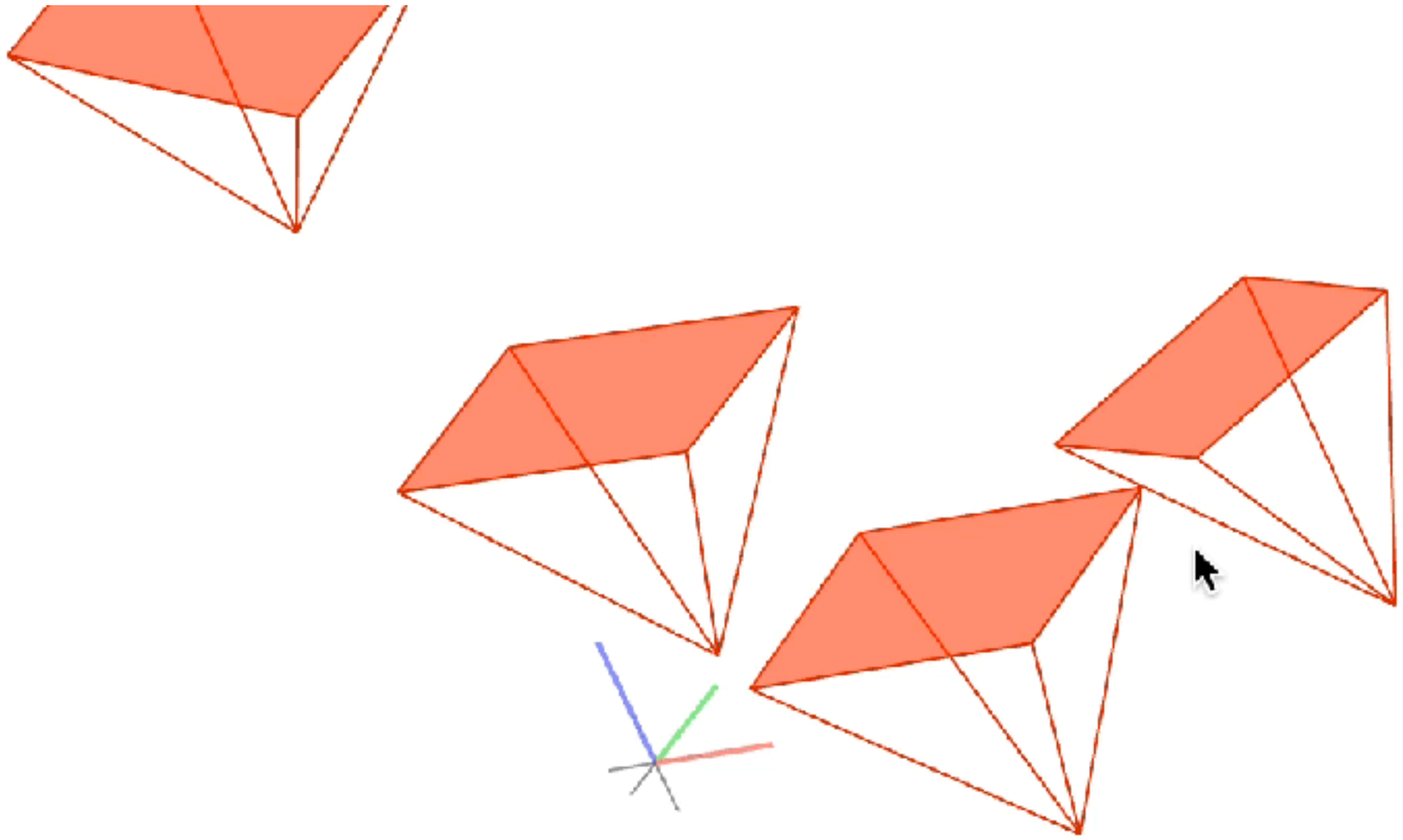

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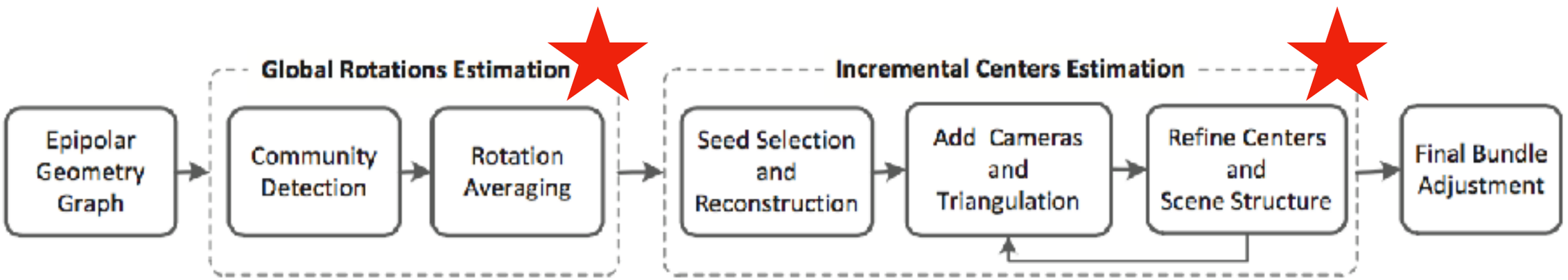
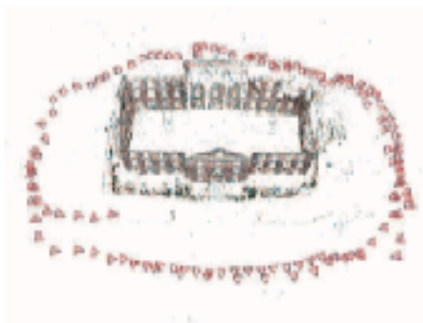
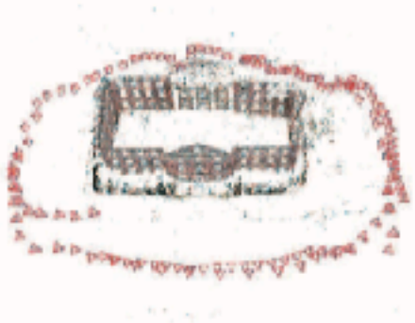
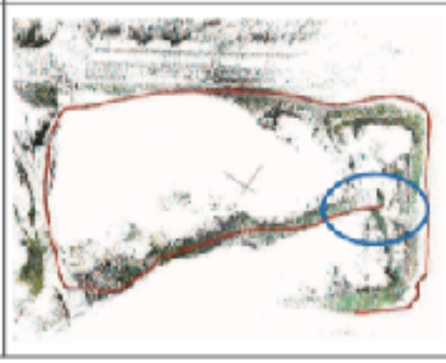
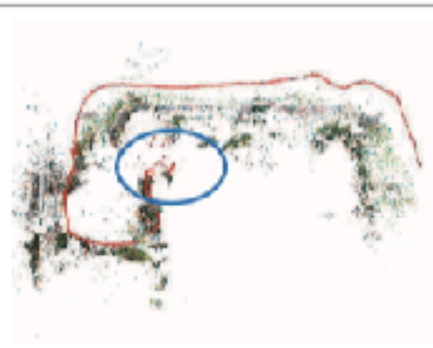
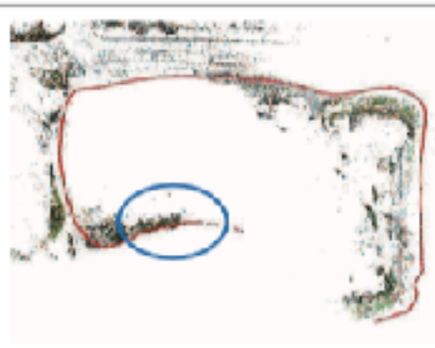
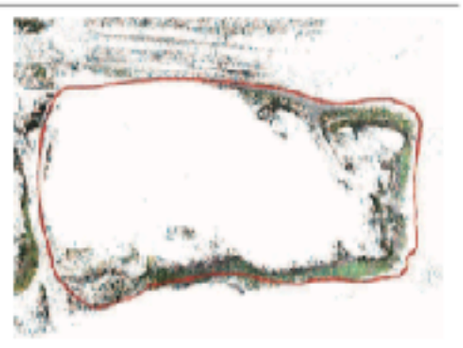
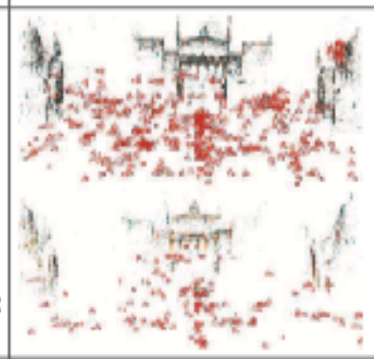
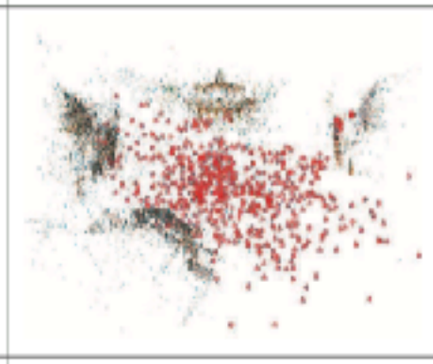
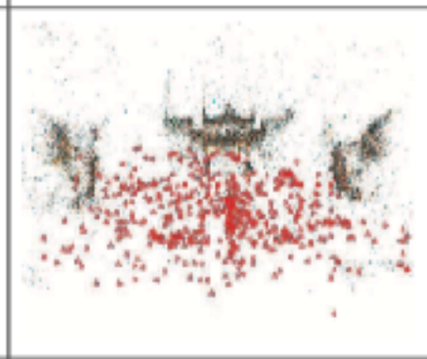
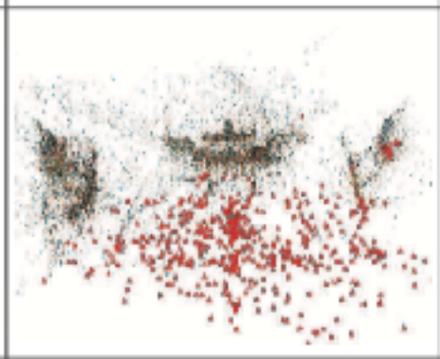
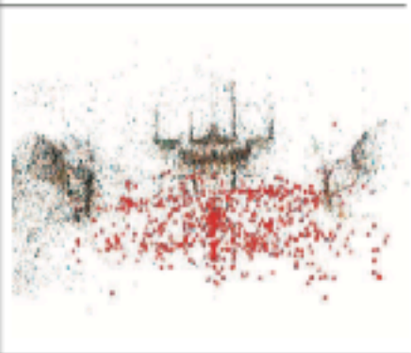
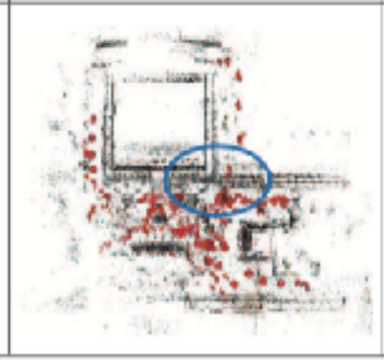
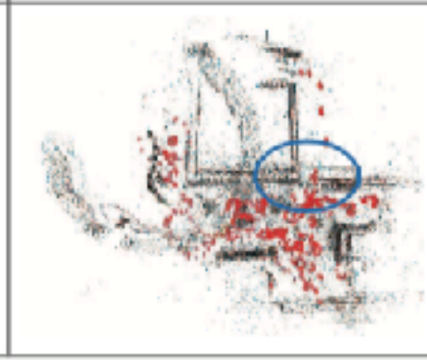
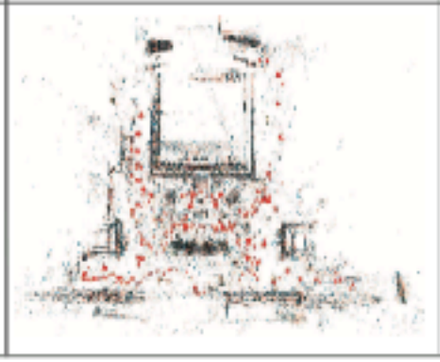
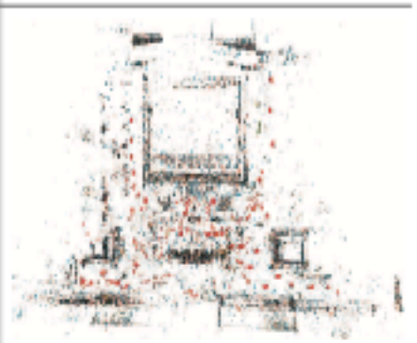


HSfM: Hybrid Structure-from-Motion

	COLMAP	LUD	Theia	Our HSfM
 Building 128				
 Campus 1040				

Evaluation on Sequential Image Data

HSfM: Hybrid Structure-from-Motion

	COLMAP	LUD	Theia	Our HSfM	Bundler
 Gendar-menmarkt					
 Temple					

Evaluation on Unordered Image Data

HSfM: Hybrid Structure-from-Motion

Dataset		1DSfM [44]			LUD [31]			Cui [11]			Sweeney [40]		Theia [39]			Our HSfM		
Name	N_i	N_c	$\tilde{x}$	$\bar{x}$	N_c	$\tilde{x}$	$\bar{x}$	N_c	$\tilde{x}$	$\bar{x}$	N_c	$\tilde{x}$	N_c	$\tilde{x}$	$\bar{x}$	N_c	$\tilde{x}$	$\bar{x}$
Alamo	627	529	**0.3**	2e7	547	**0.3**	2.0	**574**	0.5	3.1	533	0.4	520	0.4	1.8	**566**	**0.3**	**1.5**
Ellis Island	247	214	**0.3**	3.0	–	–	–	223	0.7	4.2	203	0.5	210	1.7	**2.8**	**233**	2.0	4.8
Metropolis	394	291	0.5	7e1	288	1.5	4.0	317	3.1	16.6	272	**0.4**	301	1.0	**2.1**	**344**	1.0	3.4
Montreal N.D.	474	427	0.4	1.0	435	0.4	1.0	452	**0.3**	1.1	416	**0.3**	422	0.4	**0.6**	**461**	**0.3**	**0.6**
Notre Dame	553	507	1.9	7.0	536	**0.2**	0.7	549	**0.2**	1.0	501	1.2	540	**0.2**	**0.5**	**550**	**0.2**	0.7
NYC Library	376	295	0.4	**1.0**	320	1.4	7.0	338	**0.3**	1.6	294	0.4	291	0.4	**1.0**	**344**	**0.3**	1.5
Piazza del Popolo	354	308	2.2	2e2	305	1.0	4.0	340	1.6	2.5	302	1.8	290	**0.8**	**1.5**	**344**	**0.8**	2.9
Piccadilly	2508	1956	0.7	7e2	–	–	–	2276	**0.4**	2.2	1928	1.0	1824	0.6	**1.1**	**2279**	0.7	2.0
Roman Forum	1134	989	**0.2**	3.0	–	–	–	1077	2.5	10.1	966	0.7	942	0.6	**2.6**	**1087**	0.9	8.4
Tower of London	508	414	1.0	4e1	425	3.3	10.0	465	1.0	12.5	409	**0.9**	439	1.0	**1.9**	**481**	**0.9**	6.4
Union Square	930	710	3.4	9e1	–	–	–	570	3.2	11.7	701	2.1	626	**1.9**	3.7	**827**	2.8	**3.4**
Vienna Cathedral	918	770	**0.4**	2e4	750	4.4	10.0	842	1.7	4.9	771	0.6	738	1.8	3.6	**849**	1.4	**3.3**
Yorkminster	458	401	**0.1**	5e2	404	1.3	4.0	417	0.6	14.2	409	0.3	370	1.2	1.8	**421**	1.2	**1.7**
Trafalgar	5433	4957	–	–	–	–	–	4945	3.6	8.6	–	–	3873	**2.6**	**4.0**	**4966**	**2.6**	7.2
Gendarmenmarkt	742	–	–	–	–	–	–	609	4.2	27.3	–	–	597	2.9	28.0	**611**	**2.8**	**26.3**

Accuracy Comparison

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Dataset		Our HSfM					1DSfM [44]	LUD [31]	Cui [11]	Sweeney [40]	Theia [39]	Bundler [38]
Name	Q_{max}	T_D	T_R	T_C	T_{BA}	T_Σ	T_Σ	T_Σ	T_Σ	T_Σ	T_Σ	T_Σ
Alamo	0.12	1	27	332	20	380	910	750	578	198	1271	1654
Ellis Island	0.08	1	6	120	10	137	171	–	208	33	213	1191
Metropolis	0.31	1	12	108	13	134	244	142	60	161	294	1315
Montreal N.D.	0.10	1	11	472	25	509	1249	553	684	266	1110	2710
Notre Dame	0.08	1	25	298	93	417	1599	1047	552	247	2726	6154
NYC Library	0.19	1	6	173	13	193	468	200	213	154	453	3807
Piazza del Popolo	0.08	1	8	73	17	99	249	162	194	101	292	1287
Piccadilly	0.27	23	277	2405	588	3293	3483	–	1480	1246	3698	44369
Roman Forum	0.59	5	4	501	72	582	1457	–	491	1234	2004	4533
Tower of London	0.41	1	2	312	51	366	648	228	563	391	975	1900
Union Square	0.47	2	3	201	27	233	452	–	92	243	698	1244
Vienna Cathedral	0.12	2	110	270	40	422	3139	1467	582	607	3183	10276
Yorkminster	0.32	1	13	242	38	294	899	297	663	102	858	3225
Trafalgar	0.53	49	318	3850	631	4848	12240	–	2901	–	10210	29160
Gendarmenmarkt	0.41	2	3	161	30	196	–	–	214	–	799	–

Running Times Comparison

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