

進捗報告

1 SSIM と PSNR による Attention の評価

表 1: 実験で用いたパラメータ

train data	826
eval data	551
test data	25
batch size	25
max epoch	600
snapshot_interval	50
optimizer	Adam
learning rate	0.0002
max_words_num	20
embedding_dim	300
captions_per_image	10
γ_1	4.0
γ_2	5.0
γ_3	10.0
attention image size	272×272

表 1 に示した実験条件で、鳥画像での AttnGAN による Attention の観察を行った。図 1, 2 にテスト用に選抜した鳥画像データと CUB 公式のセグメンテーションデータとを、それぞれ正方形にクロップ加工したものを示す。

図 3 にセグメンテーションデータを 17×17 にリサイズし、`skimage.transform.pyramid_expand` を用いて 16 倍に拡大したものを示す。これはもともとのサイズが 17×17 である Attention を可視化する際の処理と同一の処理であり、'bird' という単語に対する Attention の理論上の最適解と同等であると考えられる。これを Attention との比較検証用データとする。

図 4～図 13 に各手法によって得られた epoch600 時点での Attention を可視化処理したものを示す。この処理の際に輝度を Attention として $\text{attention} = (\text{attention} - \text{attention.min}()) / (\text{attention.max}() - \text{attention.min}())$ の式により、最小輝度を 0，最大輝度を 255 となるように調整している。

実験により得られた Attention と、CUB 公式のセグメンテーションデータおよび比較検証用データとの比較検証を SSIM と PSNR の値を用いて行った。図 14～図 21 に青いほど高い数値、赤いほど低い数値となるように Excel のカラスケールを用いて結果を示す。この時、epoch600 までに 50epoch ごとに snapshot したものの平均値とその中での最大値とを比較した。最大値を比較対象としたのは過学習を考慮したためである。

SSIM は構造的・部分的な類似度、PSNR は MSE を基にした再現度を示す値であり、数値が高いほど、得られた Attention が CUB 公式のセグメンテーションデータおよび比較検証用データに近いことを示すと考えられる。

あと、研究室サーバの `kanonserv` との `ssh` ができないのですが、様子を見ていただけますでしょうか？

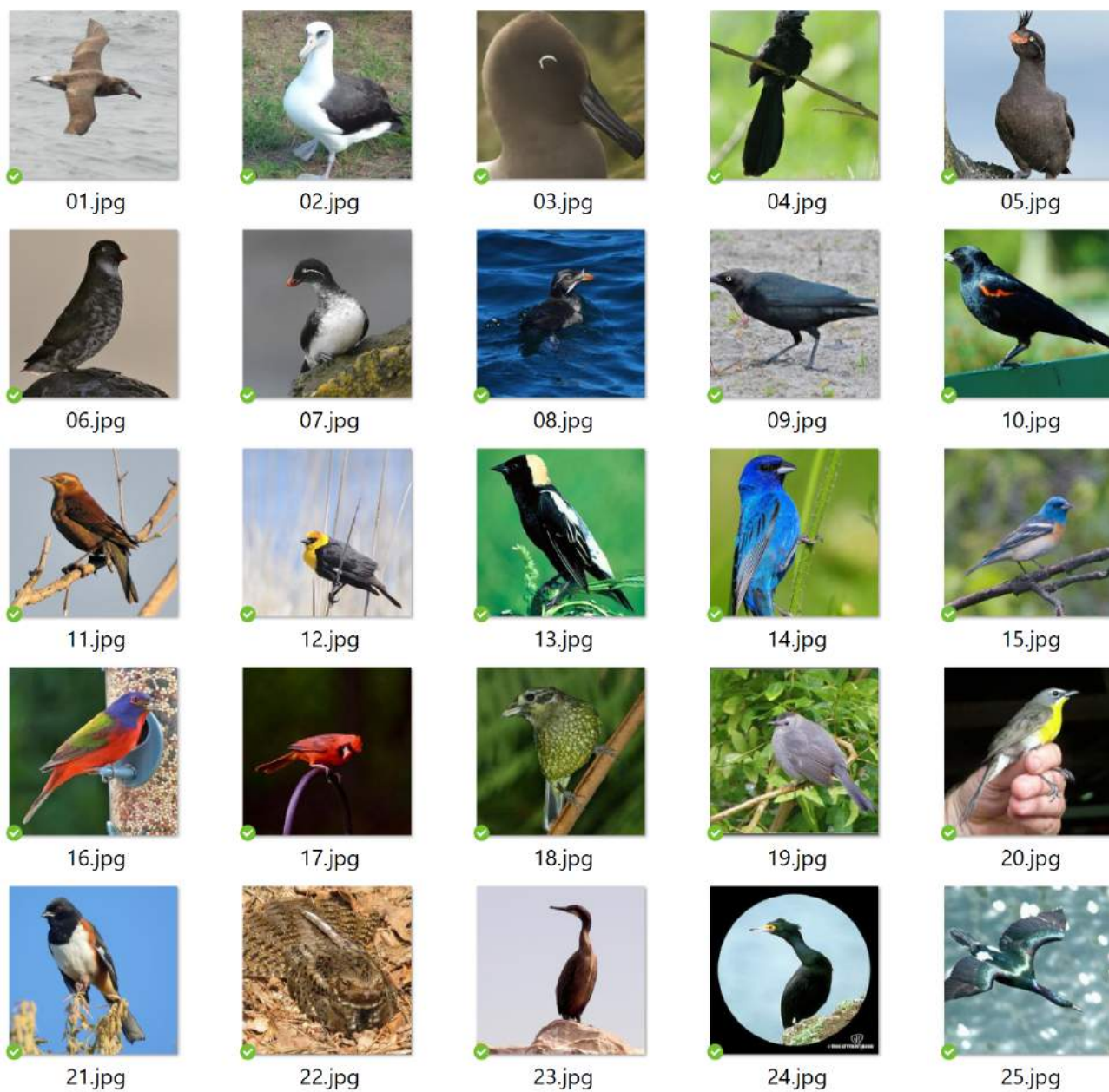


図 1: テスト用の鳥画像データ (正方形にクロップ済み)

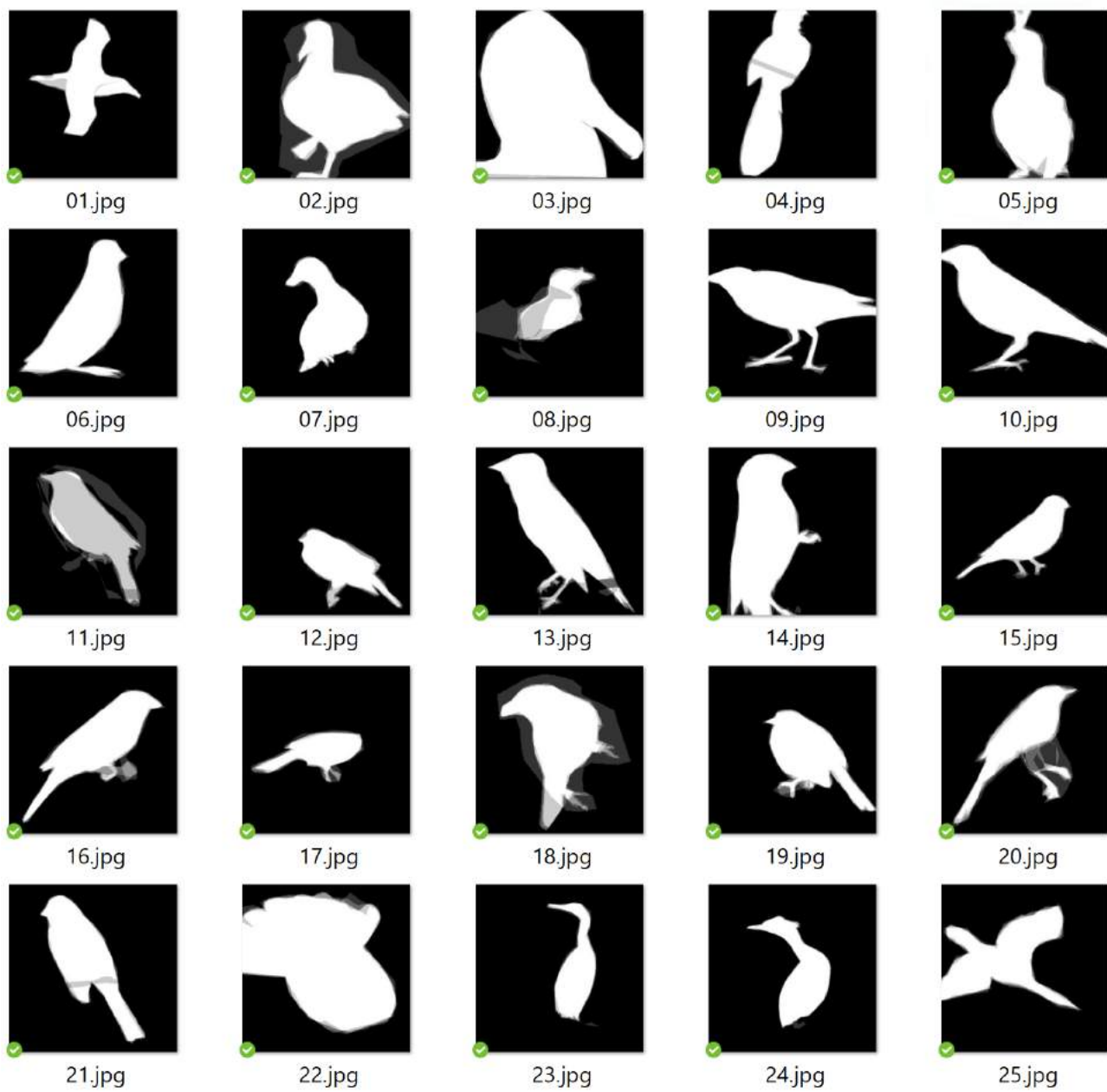


図 2: CUB 公式のセグメンテーションデータ (正方形にクロップ済み)

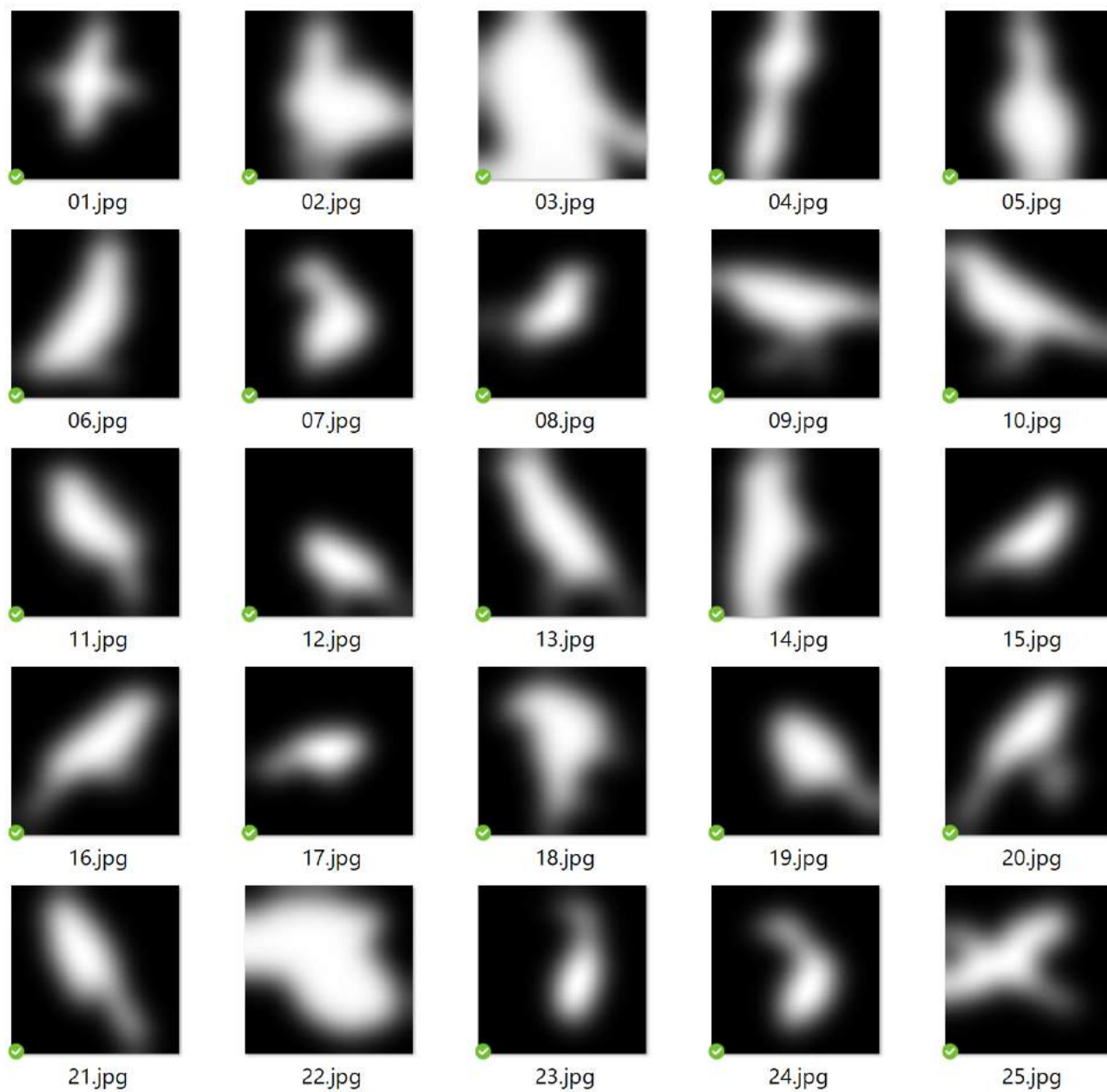


図 3: Attention との比較検証用データ

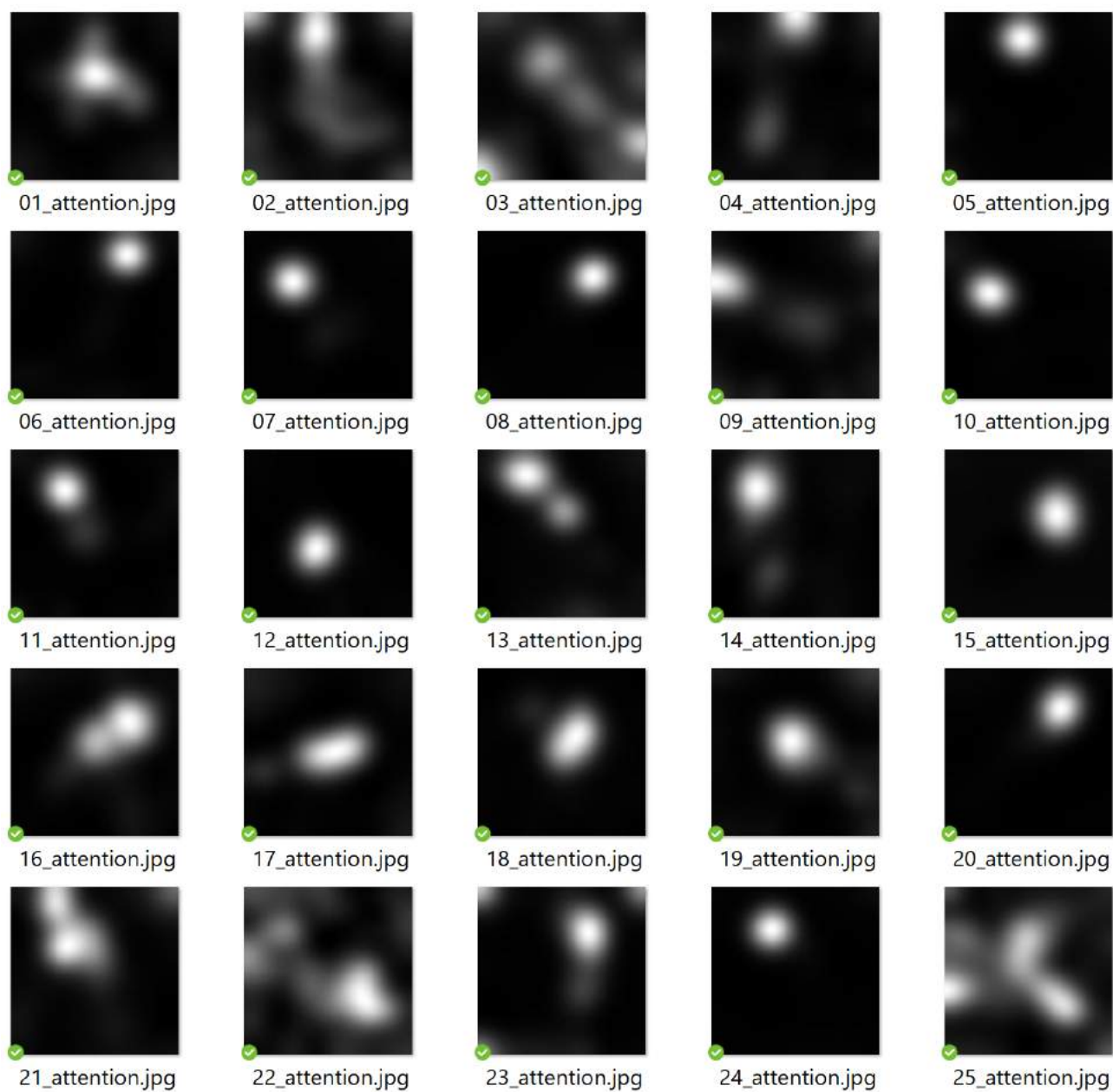


图 4: 從來手法 (LSTM):epoch600

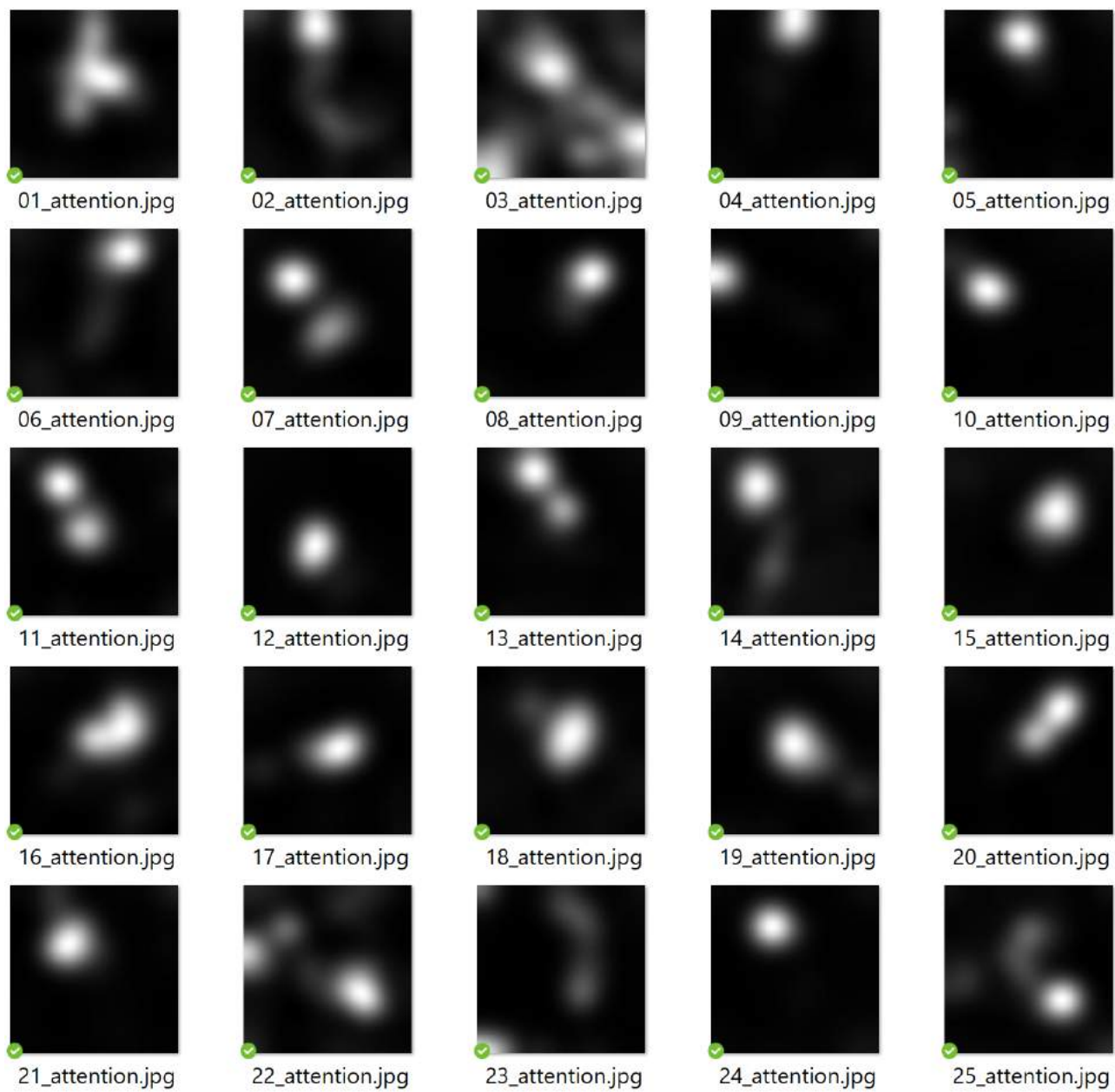


图 5: 従来手法 (GRU):epoch600

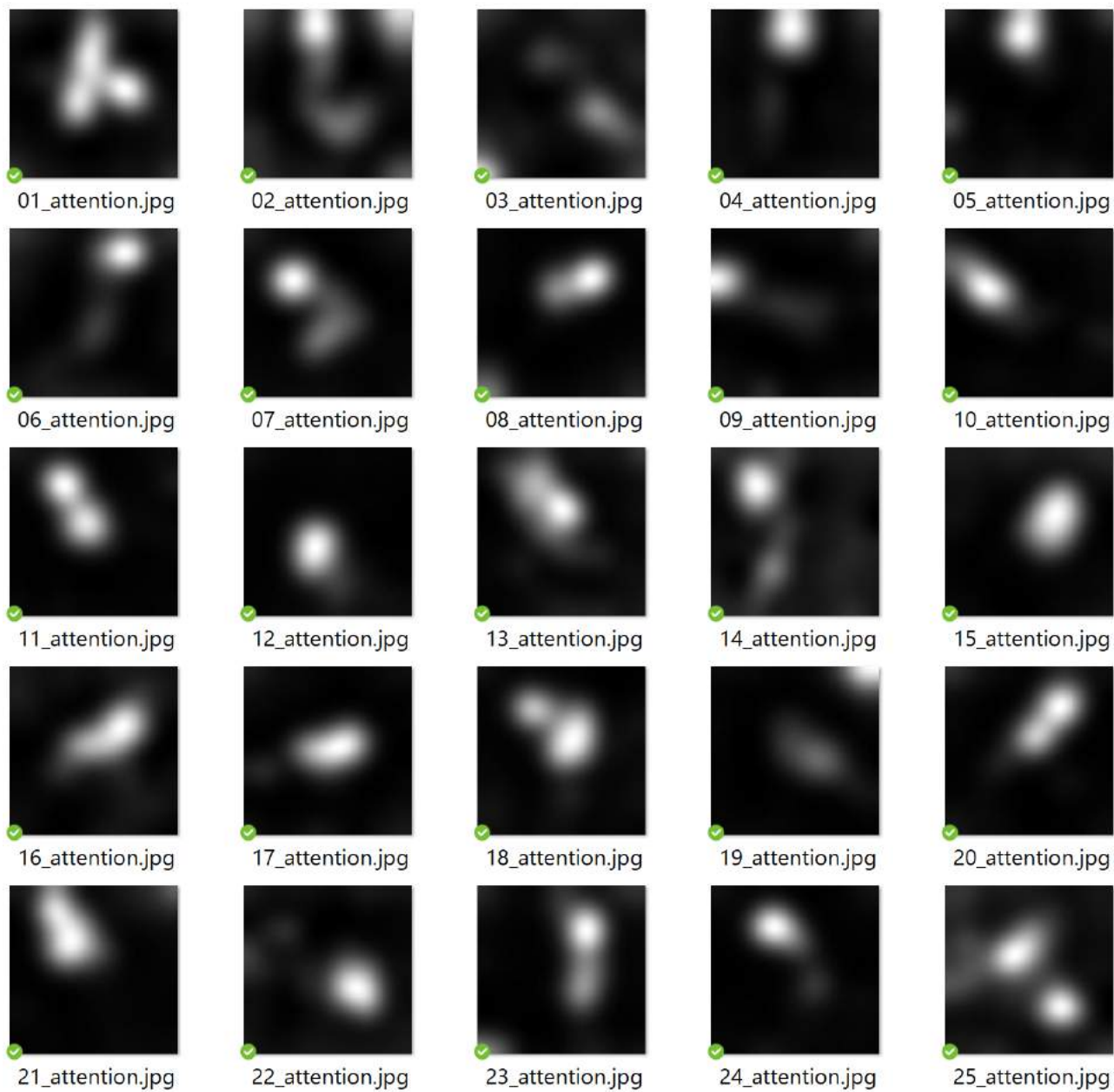


图 6: Word2Vec(LSTM):epoch600

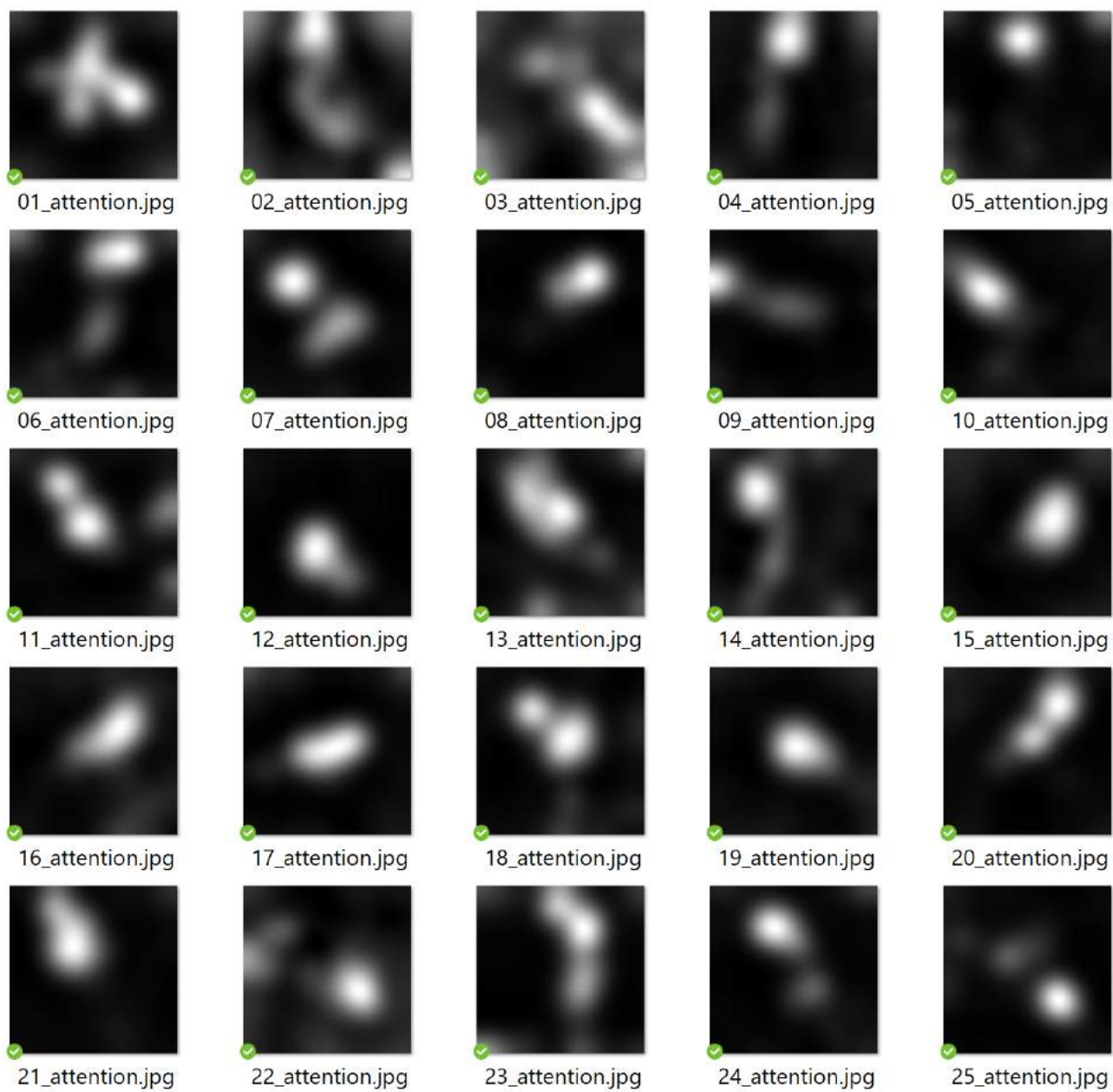


图 7: Word2Vec(GRU):epoch600

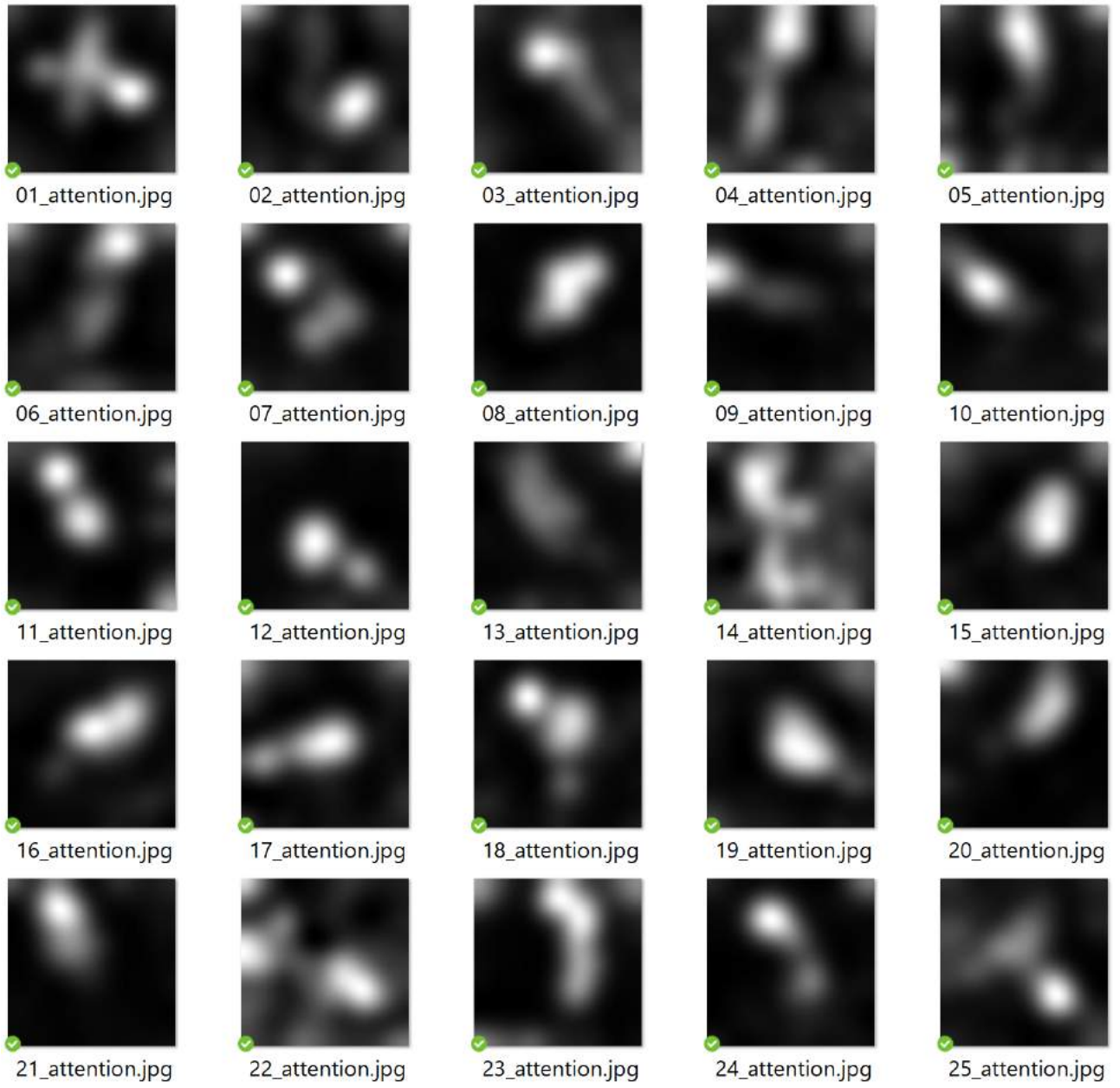


图 8: GloVe(LSTM):epoch600

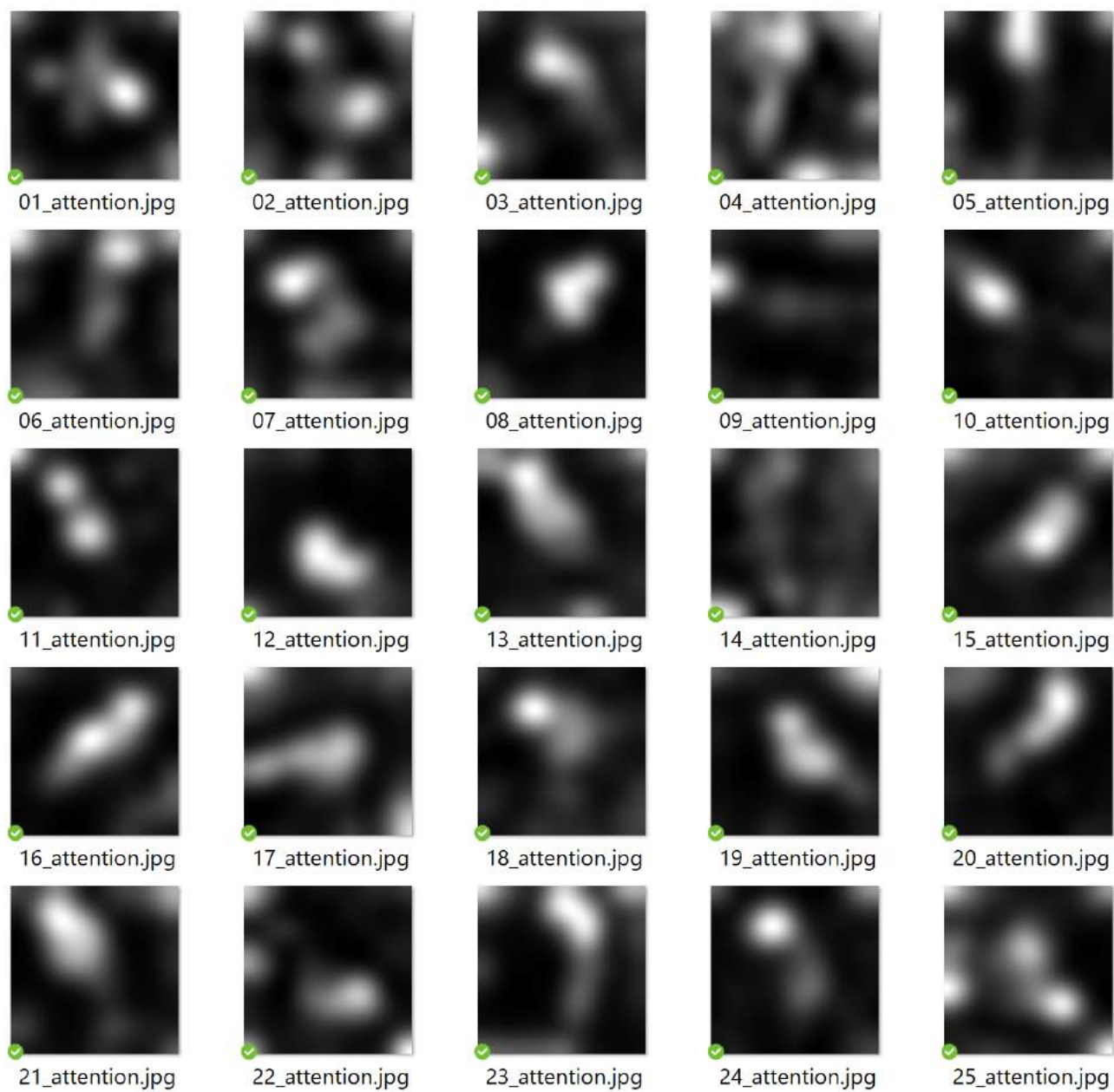


图 9: GloVe(GRU):epoch600



☒ 10: fastText(LSTM):epoch600

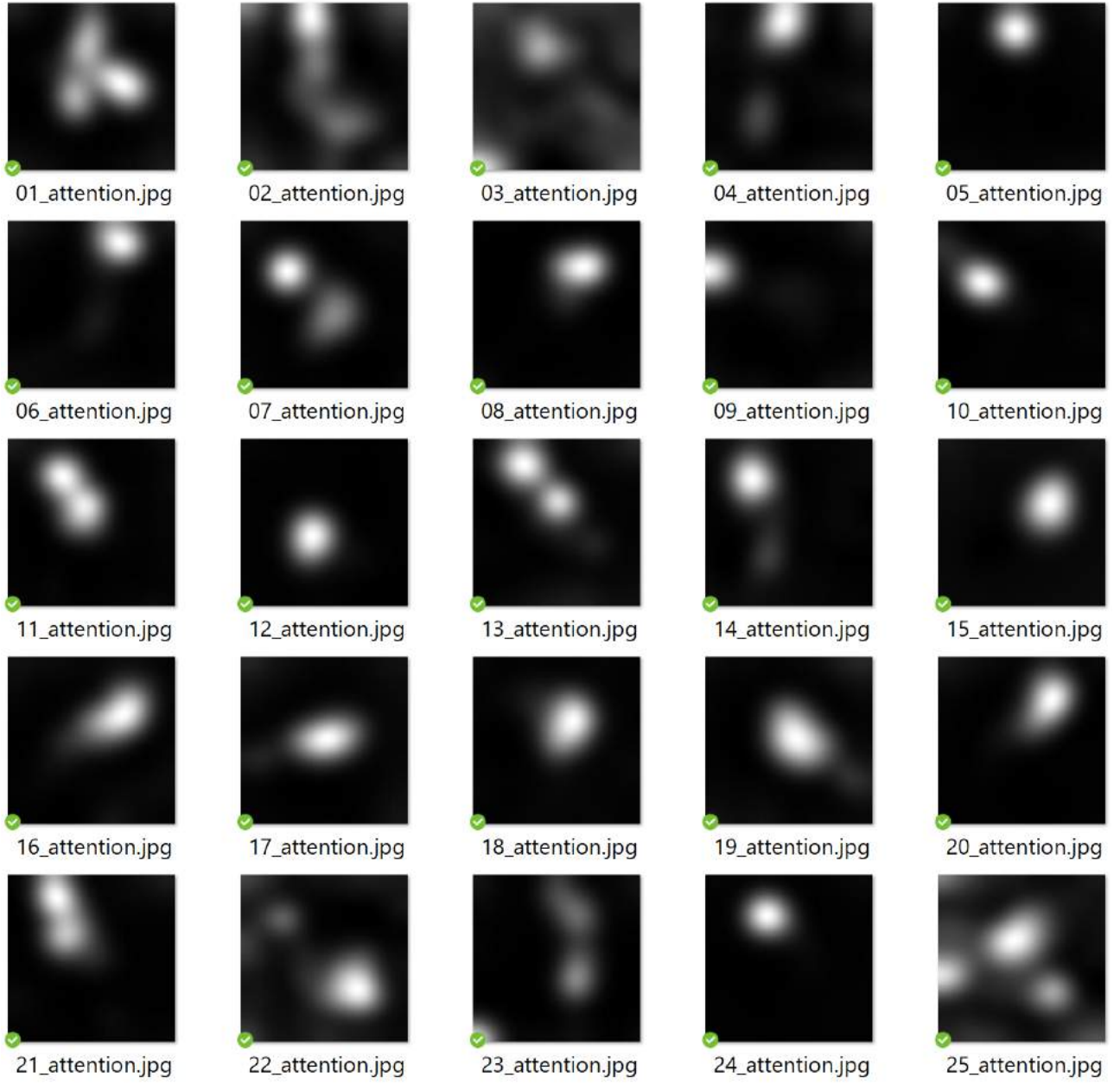


图 11: fastText(GRU):epoch600



☒ 12: ConceptNet(LSTM):epoch600

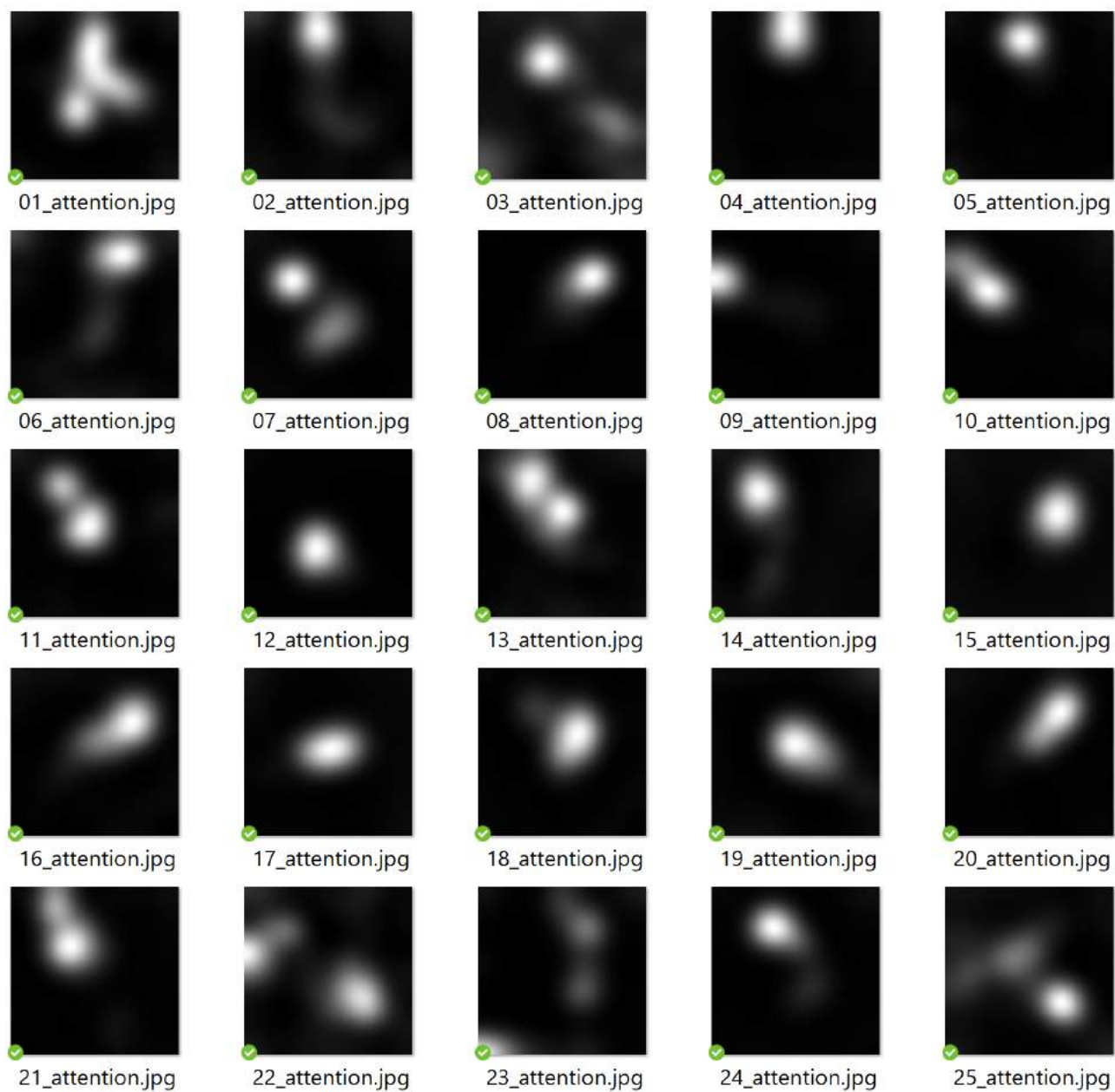


图 13: ConceptNet(GRU):epoch600

SSIM	従来手法(LSTM)	従来手法(GRU)	Word2Vec(LSTM)	Word2Vec(GRU)	GloVe(LSTM)	GloVe(GRU)	fastText(LSTM)	fastText(GRU)	ConceptNet(LSTM)	ConceptNet(GRU)
1	0.16869795	0.24713504	0.20187298	0.15143724	0.15692737	0.11621913	0.19234088	0.22086978	0.16296792	0.26595865
2	0.20718455	0.19954328	0.16496334	0.18814197	0.18427426	0.18794622	0.23024967	0.20646228	0.16867448	0.21049640
3	0.17240963	0.20666623	0.09439985	0.17898537	0.14767637	0.16003766	0.16858728	0.17076852	0.12627800	0.14493486
4	0.23723782	0.36443406	0.20259256	0.13607867	0.11129867	0.09953797	0.37865241	0.17356934	0.54097301	0.28112528
5	0.38340528	0.31805679	0.14984761	0.14536001	0.11933937	0.11181828	0.22926790	0.24223071	0.47868539	0.27770095
6	0.36968488	0.23321885	0.21970161	0.20711699	0.17591826	0.12923175	0.34416883	0.34386303	0.28222985	0.22990281
7	0.53967045	0.34371548	0.28867469	0.20341179	0.13620615	0.12931068	0.52149543	0.36766759	0.53401008	0.35884878
8	0.53880898	0.44320049	0.27393732	0.34027154	0.17956066	0.18628293	0.59070969	0.50951897	0.57674955	0.54291112
9	0.13333792	0.30243932	0.20014929	0.17065064	0.17246766	0.11782244	0.36221427	0.29921754	0.41676728	0.46829983
10	0.51943703	0.47566548	0.31883573	0.17099061	0.14584451	0.11021115	0.56782641	0.37158486	0.48351567	0.36506833
11	0.38560315	0.38825379	0.30349290	0.20079188	0.20780879	0.16595090	0.30792453	0.32411508	0.33713649	0.31024097
12	0.61023066	0.49407032	0.39509737	0.28997637	0.19645997	0.18277240	0.64211088	0.55889874	0.64070152	0.61597663
13	0.24422208	0.32685706	0.19249491	0.16242321	0.16078235	0.13099246	0.20908610	0.27189912	0.26940247	0.28061448
14	0.22300517	0.13416783	0.12557067	0.11405965	0.12546320	0.11087816	0.26946694	0.25227922	0.28309084	0.14791848
15	0.14105913	0.16453017	0.20609627	0.13244775	0.12747836	0.07790500	0.21947599	0.11860435	0.19007051	0.11261385
16	0.27120892	0.26722639	0.15669778	0.15364062	0.14943476	0.15795019	0.21221004	0.24593610	0.24612304	0.26270334
17	0.30786363	0.40759365	0.29713275	0.18741584	0.11436452	0.08866354	0.37461868	0.22374668	0.53156620	0.31860846
18	0.36056398	0.21612319	0.26044096	0.23539509	0.21942280	0.19574152	0.31903408	0.30392681	0.31775343	0.38358378
19	0.26074351	0.28588230	0.34179343	0.16063991	0.13862321	0.13441950	0.40656119	0.27129256	0.36667487	0.34486221
20	0.51605654	0.44467545	0.35382345	0.21345625	0.23009069	0.14410956	0.44616046	0.42323449	0.46899419	0.36629498
21	0.19633004	0.44011430	0.23200272	0.19339367	0.21656027	0.13626564	0.49607343	0.33822986	0.38629371	0.38187834
22	0.20480281	0.19215959	0.12659895	0.16223715	0.20515090	0.13354524	0.15566129	0.13839032	0.13833027	0.18445117
23	0.31883977	0.43728085	0.28980604	0.20752406	0.18074135	0.12180339	0.31999574	0.42535474	0.28066481	0.43295724
24	0.54030151	0.39979211	0.31792381	0.16774240	0.16975802	0.08754709	0.58379739	0.46763467	0.58636660	0.42243953
25	0.12995949	0.19750572	0.11594530	0.17523273	0.14125691	0.12168700	0.18590571	0.10717331	0.16873385	0.17290629
MEAN	0.3192302033	0.3172123098	0.2331956918	0.1859528539	0.1645163751	0.1331579930	0.3485358058	0.2950587460	0.3593157599	0.3153570711

図 14: 公式セグメンテーションデータと各手法における Attention との SSIM（各手法の 600epoch までの平均値）

SSIM	従来手法(LSTM)	従来手法(GRU)	Word2Vec(LSTM)	Word2Vec(GRU)	GloVe(LSTM)	GloVe(GRU)	fastText(LSTM)	fastText(GRU)	ConceptNet(LSTM)	ConceptNet(GRU)
1	0.21518923	0.26996727	0.31342433	0.18045254	0.17959471	0.13514772	0.23805494	0.24588751	0.18478131	0.29059038
2	0.22979015	0.22518179	0.17540514	0.20535326	0.20284081	0.19192039	0.24448016	0.21843485	0.17393067	0.23669417
3	0.18404177	0.23362705	0.11601732	0.21553557	0.16672140	0.17060082	0.17756848	0.22927873	0.14520668	0.16949907
4	0.28632234	0.38441646	0.35237316	0.14499386	0.12139094	0.10499620	0.41608113	0.19446292	0.56418944	0.33964568
5	0.48576192	0.38544705	0.16745258	0.17513885	0.12210560	0.12085423	0.32779102	0.26352109	0.51379611	0.29830742
6	0.39467222	0.25835415	0.25004582	0.21812532	0.19963874	0.13489894	0.38444818	0.36649272	0.31657603	0.24242817
7	0.58286423	0.39168084	0.36885536	0.23256548	0.14804209	0.12980054	0.54348692	0.39883150	0.57310268	0.37720861
8	0.55529414	0.46799641	0.33775798	0.35884647	0.19682494	0.21549943	0.62327096	0.53328122	0.59228137	0.57805919
9	0.16510309	0.41948127	0.24405973	0.23754869	0.18458363	0.13298410	0.38748369	0.33327706	0.46635639	0.48233911
10	0.53768636	0.54148086	0.41649611	0.21427035	0.18421729	0.13001180	0.58232519	0.40877216	0.50891794	0.40472251
11	0.41163460	0.42557782	0.36467616	0.26041048	0.22331598	0.17281546	0.34170321	0.37561116	0.36312510	0.33389292
12	0.65326259	0.52614558	0.43190485	0.31930117	0.22046035	0.19599759	0.69176042	0.63473273	0.65425531	0.66854803
13	0.26262562	0.39176452	0.25553559	0.18515238	0.19353396	0.14113863	0.22926333	0.32061510	0.32499342	0.38594947
14	0.23326000	0.17200988	0.15302923	0.13071088	0.13180719	0.11881170	0.28250880	0.29392777	0.35971634	0.16818292
15	0.18553427	0.19967801	0.23651539	0.13818744	0.15478357	0.09308215	0.39334710	0.14057557	0.27990473	0.13470640
16	0.30393356	0.30612190	0.18665709	0.18686159	0.17705046	0.18620503	0.23871666	0.26022361	0.32899456	0.29180394
17	0.35848448	0.48442738	0.34885578	0.20690872	0.13647518	0.10772980	0.42435350	0.24696309	0.54255598	0.38058435
18	0.38351041	0.22911364	0.28123733	0.24467466	0.23410501	0.19973647	0.38531056	0.32758387	0.36306338	0.41647071
19	0.30570377	0.30610129	0.39233072	0.18522261	0.16492216	0.15363643	0.44149976	0.32716276	0.38652841	0.40399399
20	0.53369199	0.45337467	0.45455673	0.24090449	0.26481458	0.14759530	0.47879583	0.43682016	0.49516125	0.44601823
21	0.23040898	0.50139960	0.25729006	0.22271136	0.25207637	0.15056324	0.52477590	0.40273734	0.42277289	0.40658418
22	0.21522834	0.20070788	0.13512416	0.17096856	0.23115882	0.14136944	0.16426032	0.14665772	0.15112418	0.20467128
23	0.33371749	0.52609371	0.35216740	0.25920208	0.22522556	0.14095667	0.34083505	0.49848815	0.30783999	0.45725227
24	0.55094101	0.43620838	0.34426596	0.18525554	0.20278541	0.10948022	0.63295904	0.50922700	0.61683895	0.48220573
25	0.13909464	0.21536989	0.14447736	0.19386703	0.14780442	0.13489917	0.19487780	0.11062110	0.18033665	0.19368383
MEAN	0.34951029	0.35806909	0.28322045	0.21252678	0.18665917	0.14642926	0.38759072	0.32896748	0.39265399	0.35176170

図 15: 公式セグメンテーションデータと各手法における Attention との SSIM（各手法の 600epoch までの最大値）

PSNR	従来手法(LSTM)	従来手法(GRU)	Word2Vec(LSTM)	Word2Vec(GRU)	GloVe(LSTM)	GloVe(GRU)	fastText(LSTM)	fastText(GRU)	ConceptNet(LSTM)	ConceptNet(GRU)
1	11.82662306	12.55463859	13.09511987	12.12135930	10.99151162	10.21828021	10.85760804	12.23330190	11.56221401	13.35348945
2	7.15523543	6.17216045	6.25697004	6.81145494	7.22204928	6.73948217	7.39356326	7.71330332	6.41986602	6.21989389
3	3.66407873	4.29731310	2.76280704	3.64746675	3.59444390	3.64271586	3.92805328	3.58989157	3.30424633	3.65113511
4	8.38875781	7.92813730	8.29784108	9.40074846	10.26331506	8.02537894	7.93727791	8.78162885	7.99376441	8.1343019
5	6.16913278	6.21185582	6.27640048	6.55791570	7.11426275	6.55602294	6.19232473	6.21639862	6.16758397	6.26848364
6	6.56800906	7.19209897	7.18220862	7.47752779	7.79134549	7.17638371	6.63871277	6.69379831	7.37633459	7.49208502
7	8.05108262	9.55580564	9.80905457	10.30244181	9.56481383	9.80266449	8.23399306	9.2301649	8.49551262	9.47998616
8	10.68671440	11.04160538	11.33101363	11.68029797	13.91918285	13.00232273	10.99628992	11.38228715	10.97201016	11.42359116
9	7.58738882	6.70643985	7.70640528	8.91630371	7.54381909	7.48269735	6.69263627	6.85121921	6.67098832	6.84073838
10	7.33284200	7.46700981	8.13007025	8.34825389	8.51812100	8.1079425	7.34386693	7.61896982	7.44560631	7.89870933
11	11.09325445	12.46318982	13.3939736	13.3585756	12.38793756	12.67062911	11.91868308	13.27446028	11.49166302	13.25204334
12	11.18746067	11.29929904	11.73085902	12.58109377	13.29396540	13.83175854	11.16619417	11.25005787	11.09926109	11.47036465
13	7.94340124	7.87931288	8.97935664	9.49389930	8.72885875	8.95546221	7.85089965	8.26856517	8.05095561	8.90181502
14	7.15760463	7.17745796	7.56618804	7.69304962	7.73291443	6.47609883	6.98285026	6.96830590	6.85459079	6.97610120
15	11.12179757	11.33836513	11.85298251	12.08192786	12.01938662	12.12454244	11.10416575	11.23396633	11.18659654	11.27590018
16	10.77600456	10.73434903	10.56310524	10.61867321	11.35252093	11.90787770	10.49579089	10.16889078	9.86884116	9.82708762
17	16.03347453	14.71404470	15.90627044	15.66704765	14.13406893	12.01687185	15.86568667	15.90058793	15.44194573	15.62428893
18	9.03918881	9.60669952	10.11894649	10.79960538	11.06873526	10.25749832	9.68587414	9.53113951	9.55876106	9.22621506
19	10.81813901	11.74027678	9.27847873	11.66272382	12.88913071	11.55966772	11.44466806	12.25626167	11.67654322	11.46596775
20	8.98513293	9.97258526	10.48885490	10.83330696	9.81843463	10.44939394	9.56244066	9.58405074	9.72411369	9.76388725
21	10.07201447	9.54816424	10.15297870	10.67255809	10.08112570	10.12795518	8.58192110	9.56879236	9.89677084	9.97630927
22	5.67120343	4.98512035	4.41266909	5.10090234	5.71911976	4.27569797	4.49330654	4.54891901	4.75757579	5.60691554
23	11.03403467	10.91229469	12.23956767	11.95930101	10.80985079	10.13841910	11.01873828	11.55053462	10.87393521	10.91473577
24	9.47829674	9.53107943	10.16119648	10.58994156	11.33963880	10.63465570	9.44613464	9.54661153	9.56636319	10.07962137
25	10.14986410	8.29324995	9.83163972	7.94085232	8.90265019	8.53070267	10.87122497	10.03727715	10.43551596	8.55075782
MEAN	9.1196474613	9.1769022282	9.5009992752	9.8525804306	9.8541283330	9.3966531724	9.0681154815	9.3600894074	9.0755823866	9.3243021240

図 16: 公式セグメンテーションデータと各手法における Attention との PSNR（各手法の 600epoch までの平均値）

PSNR	従来手法(LSTM)	従来手法(GRU)	Word2Vec(LSTM)	Word2Vec(GRU)	GloVe(LSTM)	GloVe(GRU)	fastText(LSTM)	fastText(GRU)	ConceptNet(LSTM)	ConceptNet(GRU)
1	11.93736748	13.07462255	13.41022382	12.39004741	11.28657201	10.42197299	11.32137661	12.42734119	11.78063296	13.67395204
2	7.88563168	6.25839364	6.35945042	7.07857185	7.38359681	7.10586878	7.99254004	8.16742128	6.80395421	7.24720257
3	3.83226832	4.73200827	3.01444966	4.04277372	3.86050375	3.78286812	4.09746655	4.16054195	3.56033089	3.93539281
4	8.56480318	7.98796298	8.56920315	9.64089203	10.53107366	8.21073472	8.11754832	8.97063016	8.03909838	8.20083146
5	6.17332952	6.23062909	6.30540476	6.59651263	7.20170591	6.77692947	6.19665695	6.22444558	6.17603600	6.28413378
6	6.94493047	8.04473422	7.24070907	7.55903338	7.88511186	7.35895194	6.93925279	6.70789393	7.99514576	7.94275483
7	8.16987606	9.84442901	9.94996569	10.41987927	9.89202700	9.97494044	8.45641794	9.79068285	8.81163699	9.74977435
8	10.81061198	11.21199930	11.59287429	11.81293305	14.18524678	13.26033807	11.38190868	11.47167072	11.20104631	11.49536415
9	7.76872363	6.99984072	8.11314974	10.00908694	7.62942178	7.69984434	6.72788025	7.01847056	6.74309705	6.93980997
10	7.36978056	7.49751454	8.21164343	8.40449006	8.55979070	8.45414633	7.45263362	7.72346109	7.64262122	8.00327700
11	11.36150346	12.93828504	13.53124492	13.49684958	12.54675544	12.88538407	12.05383503	13.37491967	11.81974278	13.53704422
12	11.20408454	11.34665895	11.88934647	12.95310911	13.54028492	14.17016708	11.19529742	11.30090681	11.15981930	11.64005525
13	8.21746323	7.99190038	9.15421734	9.59103052	9.05263670	9.33794657	7.96029154	8.69520398	8.30689549	9.11931028
14	7.24011719	7.29655294	7.78840002	7.81797376	7.98549593	6.59055524	7.08062795	7.04719336	6.93462228	7.01175979
15	11.14582741	11.44648340	12.01269080	12.20626250	12.25248120	12.32605256	11.12413779	11.33685871	11.23527833	11.29906178
16	11.02250733	10.89823926	11.25787091	10.94399428	11.48637929	12.00994090	10.68460837	10.25655727	10.11449421	10.18144905
17	16.18943003	15.05951968	15.98400238	15.85607067	14.98839660	12.71962316	16.02740730	16.03111566	15.53865279	15.65944681
18	9.08426603	9.74067593	10.72415144	10.96687944	11.33674809	10.50650455	11.29230950	11.46896150	11.30395158	9.48702184
19	10.94072887	12.80701599	9.69599659	11.75945653	13.08018159	11.87988958	11.61585612	12.42660192	11.72849821	11.62382144
20	9.06597315	10.17940119	10.72285331	10.94789428	10.34563083	10.77378333	9.72367535	9.70916146	9.94172852	10.02996642
21	10.42211251	9.60143032	10.49576032	10.76039430	10.36320188	10.65917637	8.81946752	9.77926118	9.94349834	10.01046099
22	5.76407266	5.19778370	4.54990697	5.18232041	6.18991976	4.34272256	4.79360756	4.69647450	4.92264115	5.15634475
23	11.20878892	11.24641550	12.48032851	12.82035583	11.44005032	10.53605095	11.45547703	12.21979543	11.16299108	11.36333402
24	9.52883733	9.54425903	10.29519454	10.80554965	11.48768108	10.75624389	9.46237615	9.59872780	9.58379656	10.19668682
25	10.31541736	8.67344178	10.16685496	8.52816578	9.21933128	8.79060712	11.39388934	10.33044724	10.59536622	8.93038455
MEAN	9.2867381141	9.4300078970	9.7406285397	10.1036210801	10.1492272072	9.6508537252	9.3347418293	9.6373933918	9.3218230634	9.5487464383

図 17: 公式セグメンテーションデータと各手法における Attention との PSNR（各手法の 600epoch までの最大値）

SSIM	従来手法(LSTM)	従来手法(GRU)	Word2Vec(LSTM)	Word2Vec(GRU)	GloVe(LSTM)	GloVe(GRU)	fastText(LSTM)	fastText(GRU)	ConceptNet(LSTM)	ConceptNet(GRU)
1	0.48700661	0.59060659	0.53696371	0.51044025	0.46212827	0.36739452	0.4200502	0.48844037	0.41982354	0.58397016
2	0.39030194	0.30432386	0.30749592	0.34948597	0.37049354	0.35740002	0.40716644	0.42464568	0.32507758	0.30274755
3	0.31209889	0.35258637	0.21202663	0.30820053	0.30226749	0.26672623	0.33573548	0.31816605	0.25802268	0.30191
4	0.37673167	0.35371653	0.31588672	0.36388381	0.42321119	0.27970039	0.35268597	0.34772681	0.41108581	0.35353278
5	0.34709603	0.30510107	0.29424906	0.30934025	0.3422871	0.29262476	0.3310604	0.32681273	0.40443733	0.31666388
6	0.26299935	0.30997335	0.28152888	0.33039356	0.35922369	0.31450395	0.24011187	0.26610967	0.27818695	0.31996954
7	0.36662768	0.42477626	0.41311584	0.4195829	0.38501391	0.38783187	0.3703066	0.37722649	0.38956049	0.40712949
8	0.42829634	0.39905394	0.34476632	0.39987013	0.41045787	0.39993836	0.48779006	0.47423735	0.47313758	0.49185747
9	0.37266223	0.25614979	0.34702433	0.40790851	0.32977954	0.32240696	0.25997271	0.25646231	0.25878953	0.27730018
10	0.29767499	0.29216071	0.37476346	0.41107726	0.40630362	0.42459447	0.32610144	0.31639729	0.31124809	0.36988533
11	0.3931508	0.43708746	0.47389437	0.45610262	0.40624925	0.45250375	0.42215433	0.48209594	0.38763787	0.45853517
12	0.65909658	0.5930638	0.54601532	0.4608051	0.43436109	0.4957254	0.68019189	0.61597395	0.66085916	0.65970203
13	0.46578899	0.42010838	0.49293445	0.55158943	0.49097739	0.48787254	0.42565015	0.43646968	0.41755717	0.510133
14	0.38396059	0.34237109	0.35023728	0.36937645	0.365518	0.25680151	0.39305351	0.37495898	0.37008058	0.31851294
15	0.35857726	0.36369325	0.35641195	0.34917179	0.39170696	0.43806539	0.39419143	0.3325829	0.37368975	0.34161928
16	0.49988343	0.49498252	0.45581232	0.45941581	0.51042406	0.56814646	0.51201945	0.43618632	0.43372554	0.44000456
17	0.56982204	0.56268183	0.56343879	0.48208312	0.48098087	0.41500443	0.6037056	0.51425304	0.61494955	0.54447508
18	0.42547654	0.46399175	0.48202844	0.57592432	0.59670193	0.54765766	0.43582619	0.45299092	0.41016675	0.4070487
19	0.47638283	0.54736529	0.39910592	0.44069694	0.51728125	0.49644697	0.58538395	0.54480804	0.50868999	0.46720012
20	0.34479759	0.3965555	0.43035419	0.45946568	0.46007165	0.46534391	0.38089389	0.37169261	0.38425448	0.38087295
21	0.48416946	0.47070445	0.46637167	0.53043602	0.44485657	0.49747596	0.43472327	0.43923451	0.50721483	0.53664877
22	0.45066839	0.35377433	0.31580681	0.38617978	0.42862278	0.31484638	0.32736983	0.34447713	0.37153365	0.38488725
23	0.51119366	0.53370317	0.5459941	0.48424078	0.43190454	0.32349167	0.47527905	0.56848567	0.45758856	0.53784429
24	0.47878192	0.44151488	0.45455388	0.38560744	0.4649433	0.36875083	0.49603115	0.45222626	0.5060899	0.46054816
25	0.5201345	0.43296539	0.49579184	0.40808495	0.46525061	0.41573739	0.62232201	0.49261135	0.52821054	0.43194714
MEAN	0.42653321	0.41772046	0.41026289	0.42437435	0.42724066	0.39828129	0.42879107	0.41821097	0.41846472	0.42419383

図 18: 比較検証用データと各手法における Attention との SSIM (各手法の 600epoch までの平均値)

SSIM	従来手法(LSTM)	従来手法(GRU)	Word2Vec(LSTM)	Word2Vec(GRU)	GloVe(LSTM)	GloVe(GRU)	fastText(LSTM)	fastText(GRU)	ConceptNet(LSTM)	ConceptNet(GRU)
1	0.49292100	0.60910313	0.60870073	0.53521333	0.48935220	0.40067006	0.46995544	0.50486404	0.44733568	0.60842207
2	0.44000979	0.31312902	0.32056404	0.36891277	0.40216966	0.37621449	0.42920882	0.44990067	0.35701105	0.38484468
3	0.33418459	0.40003558	0.25386303	0.33289712	0.31374469	0.28246058	0.35639551	0.39475862	0.28653235	0.33501933
4	0.39186518	0.36457380	0.34728068	0.38068599	0.43900287	0.31757795	0.35881723	0.35271958	0.42027462	0.37005292
5	0.38636120	0.32652763	0.29932575	0.31509880	0.34807766	0.30653416	0.37281052	0.34014597	0.40972503	0.32992724
6	0.27861964	0.38025347	0.29300703	0.33710493	0.38448592	0.33594264	0.26107701	0.27038337	0.32746133	0.36048879
7	0.38087280	0.44010182	0.43206594	0.42834604	0.42056842	0.40307375	0.37889675	0.40625525	0.39777487	0.42329586
8	0.44097283	0.41069718	0.35819186	0.41432421	0.43055092	0.43825046	0.49893862	0.49580919	0.48498148	0.51533069
9	0.39311928	0.27476322	0.38936190	0.47778111	0.33475555	0.34583809	0.27098011	0.28974312	0.26096438	0.28119689
10	0.30401228	0.29828498	0.38231321	0.41494207	0.42508575	0.44013482	0.33518386	0.32739904	0.34283753	0.39452137
11	0.39835807	0.45151499	0.49021225	0.47871830	0.41151040	0.46773171	0.43035808	0.48658678	0.40448934	0.46857672
12	0.67169060	0.61819499	0.57405017	0.49153296	0.45099604	0.52070384	0.69823421	0.66510404	0.67306020	0.70005846
13	0.47957115	0.46231794	0.49818148	0.57372463	0.57359558	0.51083178	0.43414978	0.45756767	0.42535170	0.52213547
14	0.39224324	0.34497626	0.36750704	0.37249064	0.38228507	0.27099702	0.40207526	0.38245917	0.40808190	0.32308366
15	0.38468060	0.38552826	0.36358197	0.35781606	0.40425538	0.45186439	0.48984599	0.34260659	0.42269332	0.35780177
16	0.51092016	0.50392647	0.48313311	0.48281874	0.51769373	0.57800071	0.53762785	0.44453894	0.44042791	0.45076103
17	0.59681481	0.58477871	0.58213246	0.49300591	0.49282791	0.43521607	0.63383188	0.52737722	0.62265123	0.59975017
18	0.42981492	0.47882286	0.51226344	0.59143460	0.61326089	0.55986804	0.57106632	0.55523513	0.51679540	0.48830388
19	0.48536681	0.58150842	0.43072698	0.46101081	0.53552017	0.52460476	0.62061625	0.56996274	0.53248893	0.47927446
20	0.34909366	0.40819783	0.44405184	0.47030225	0.50093639	0.49391296	0.38480419	0.37526758	0.39258769	0.38828034
21	0.49712364	0.51042274	0.47555282	0.55049654	0.46522884	0.51434906	0.44725359	0.47160572	0.51592953	0.54773036
22	0.46468884	0.37202567	0.33736509	0.39592111	0.47994844	0.32697269	0.36832863	0.35707261	0.38873433	0.39475693
23	0.52094591	0.55146386	0.60136895	0.57741405	0.46425991	0.34423221	0.50459577	0.58523785	0.48617388	0.56138691
24	0.48746326	0.45005341	0.46266487	0.40507858	0.49598226	0.39042420	0.52731733	0.47521228	0.52268262	0.46843199
25	0.54805704	0.46352575	0.57286507	0.46598847	0.48660120	0.43183528	0.65264639	0.51198368	0.53897984	0.45793453
MEAN	0.44239085	0.43938912	0.43521327	0.44692240	0.45050783	0.41872607	0.45740069	0.44159187	0.44104105	0.44685506

図 19: 比較検証用データと各手法における Attention との SSIM (各手法の 600epoch までの最大値)

PSNR	従来手法(LSTM)	従来手法(GRU)	Word2Vec(LSTM)	Word2Vec(GRU)	GloVe(LSTM)	GloVe(GRU)	fastText(LSTM)	fastText(GRU)	ConceptNet(LSTM)	ConceptNet(GRU)
1	16.2424677	18.4499583	18.59503452	16.81127793	14.38524388	13.00382401	13.92106416	16.52331723	15.26885975	19.53397175
2	8.84291826	7.62675116	7.71178877	8.40930851	9.05667062	8.38647961	9.12945255	9.59020691	7.88780998	7.64580372
3	4.64885961	5.41715078	3.56672479	4.66184223	4.56948416	4.72678742	4.95437268	4.58527104	4.20559846	4.61544675
4	10.29149684	9.61868553	10.11197975	11.69335534	13.24922194	9.8635402	9.5922326	10.78140635	9.63293409	9.81951536
5	7.6010335	7.65498484	7.74903493	8.09637531	8.74566315	8.13065151	7.63516045	7.66515763	7.59401435	7.71849684
6	8.33647306	9.19624848	9.12752028	9.54748915	10.04618826	9.14349888	8.4045718	8.47666895	9.31291821	9.48574186
7	10.07991484	12.6176529	12.68157367	13.50541095	12.28675954	12.6848228	10.35746962	11.80861238	10.70887972	12.17550419
8	11.51642247	11.9769033	12.41967555	12.81709428	16.1727887	14.73107602	11.83850473	12.29924475	11.82232119	12.39780983
9	9.95210768	8.52631374	10.06825184	12.0752805	9.83585019	9.79283298	8.59827495	8.81327813	8.57642421	8.79261737
10	9.53825227	9.72071798	10.71002604	11.11698357	11.40709975	11.10700721	9.55216542	9.9705662	9.7034393	10.33759274
11	10.76701921	12.37630446	13.64775981	13.94182493	12.79067475	13.03347533	11.76008989	13.62025008	11.21734356	13.51201129
12	13.04169013	13.29401493	14.13989455	15.47199422	17.03073887	18.28832221	13.01900539	13.17624049	12.92510408	13.4766529
13	10.04966421	9.97130393	11.73568402	12.76575816	10.69068411	11.81353834	9.95594664	10.51328362	10.19129785	11.45235839
14	8.96687723	9.02032794	9.59395035	9.79309299	10.02092152	8.39296395	8.72570878	8.71265569	8.54778326	8.73682501
15	13.19643224	13.6104901	14.39727453	14.75341708	14.92572849	15.09773222	13.11105184	13.39248772	13.24039738	13.45575693
16	14.31606065	14.29843622	14.00659272	14.05722333	15.62664513	16.40102405	13.64350302	13.13799063	12.62506737	12.56055463
17	21.81579632	18.05344979	21.59523314	21.3286973	17.70437233	14.16217658	21.11694284	21.70868631	19.60629176	20.54017315
18	11.33633667	12.23926397	12.93452048	14.13244919	14.38307857	13.11392181	12.29241645	12.09227644	12.06578922	11.57867303
19	13.96490195	15.82504236	11.64761883	15.6802606	17.71608319	14.78213772	15.02248344	16.91776344	15.56409206	15.08942292
20	10.99425774	12.57199217	13.4336383	14.09614307	12.40312234	13.41596788	11.88918872	11.89214809	12.09522524	12.25640558
21	13.44122699	12.61626407	13.47052218	14.71017366	13.36084653	13.5331414	10.88962791	12.4493321	13.06428664	13.26355564
22	7.21275314	6.36642736	5.6579854	6.55294644	7.43329319	5.59167918	5.71459465	5.77366486	6.1539392	6.39629627
23	13.26551907	12.79085577	15.41004314	15.00742705	12.94371356	11.92597657	13.19434091	13.86183822	12.98216276	12.86168896
24	11.26827326	11.3582816	12.25468414	13.0160298	14.27854387	13.13501044	11.20824424	11.36069461	11.36560566	12.10886338
25	13.72405505	10.26574442	13.06231479	9.82188132	11.47639178	11.04845174	15.62277622	13.83707762	14.04189696	10.77373146
MEAN	11.37643160	11.40633292	11.98917306	12.55319944	12.50159234	11.81233529	11.24599260	11.71840478	11.21597929	11.62342280

図 20: 比較検証用データと各手法における Attention との PSNR (各手法の 600epoch までの平均値)

PSNR	従来手法(LSTM)	従来手法(GRU)	Word2Vec(LSTM)	Word2Vec(GRU)	GloVe(LSTM)	GloVe(GRU)	fastText(LSTM)	fastText(GRU)	ConceptNet(LSTM)	ConceptNet(GRU)
1	16.44615714	19.80618904	19.82059002	17.47264092	15.00890595	13.37850535	14.73390484	16.92078211	15.69687191	20.47466151
2	9.82298145	7.73744006	7.84121139	8.73645413	9.2293789	8.85268224	9.92725262	10.18583128	8.36551626	8.92133293
3	4.84435884	5.89407161	3.8629266	5.15188932	4.90028646	4.88814542	5.15902183	5.29731537	4.50662339	4.97073646
4	10.53972365	9.7209676	10.48266604	12.03338632	13.68689643	10.16791093	9.85511472	11.03633031	9.70448058	9.94160712
5	7.60928571	7.67878821	7.79154809	8.14152113	8.85376053	8.39672091	7.64212763	7.67764039	7.60514462	7.73918641
6	8.83000211	10.39960275	9.20022301	9.64224225	10.20602953	9.40792574	8.75879708	8.50326744	10.05036529	10.05538749
7	10.24894869	12.70844458	12.91631884	13.7186679	12.78144978	12.90731244	10.67464277	12.65390313	11.15515811	12.56994071
8	11.66383653	12.20154109	12.79588011	13.01333031	16.59790231	15.01634352	12.29829576	12.38995021	12.08430856	12.45939344
9	10.24704821	8.90784529	10.68185219	13.91136978	9.95660264	10.09333889	8.64604852	8.99704715	8.68666292	8.93285179
10	9.59322403	9.76947948	10.85442709	11.21782535	11.50384975	11.31436898	9.72770138	10.14387297	10.02173625	10.48573824
11	11.0707235	12.97052273	13.86332148	14.00997263	12.98159652	13.34589571	11.97763713	13.76983154	11.58460841	13.92039979
12	13.08141595	13.38237751	14.43140124	16.11012524	17.51053653	19.56880078	13.05076697	13.26905536	12.98227148	13.72947422
13	10.51045531	10.13708938	12.037214	12.97502359	11.79109055	12.51646095	10.10943582	11.15921822	10.57513434	11.82951172
14	9.08277479	9.19353373	9.95553514	9.97127754	10.41322851	8.58475701	8.85664403	8.82387991	8.66092411	8.78806206
15	13.2407386	13.71809475	14.69475433	14.98726143	15.23056442	15.54791907	13.16897481	13.57801109	13.33489432	13.50393053
16	14.84102768	14.63071901	15.38160914	14.7680804	15.89050358	16.61648371	14.01815434	13.29548437	13.12345778	13.1369834
17	22.34762128	18.80192464	21.89074415	21.74938808	19.56100345	15.26069113	21.69676075	22.50184227	19.94087115	20.64770798
18	11.40050089	12.4436818	13.81804344	14.36312889	15.0384483	13.3719892	14.80742043	15.11902637	14.53963236	11.95845537
19	14.19192423	18.24888061	12.2587147	15.93251968	18.03987575	15.1391004	15.35497787	17.28188313	15.66867763	15.4304594
20	11.11315348	12.92682944	13.83741708	14.29378771	13.15290545	13.97206433	12.1328604	12.10071851	12.44544293	12.69951679
21	14.11535665	12.69041799	14.18014941	14.83664542	13.88062687	14.42947234	11.23342007	12.78360707	13.15441287	13.3532685
22	7.35732377	6.4462128	5.83194885	6.68533119	8.06741764	5.71454002	6.1054623	5.97759063	6.36508383	6.52092952
23	13.5373383	13.29505419	15.88621064	16.48364526	13.89329884	12.47620307	13.84045506	14.99546354	13.38988283	13.55568768
24	11.32987296	11.37839071	12.44427043	13.3239539	14.52645492	13.38035869	11.23078123	11.44122091	11.3915231	12.27676427
25	14.19108415	10.85192153	13.68135168	10.56785583	12.03675181	11.34827808	16.89305435	14.38620108	14.49639126	11.39398915
MEAN	11.65027512	11.84553718	12.41761316	12.96319705	12.98957466	12.22785076	11.67598851	12.17155897	11.58120302	11.97185859

図 21: 比較検証用データと各手法における Attention との PSNR (各手法の 600epoch までの最大値)