Progressive Light Transport Simulation on the GPU: Survey and Improvements – Supplemental Material

TOMÁŠ DAVIDOVIČ
Saarland University, Intel VCI
and
JAROSLAV KŘIVÁNEK
Charles University in Prague, Faculty of Mathematics and Physics
and
MILOŠ HAŠAN
Autodesk, Inc.
and
PHILIPP SLUSALLEK
Saarland University, DFKI

In this document, we provide additional experimental data we generated during the preparation of our paper. We also provide extended discussion of these results, where necessary.

1. PATH TRACING

Figure 1 shows the performance, in rays per second, of our Path Tracing algorithms for each tested scene and both GPUs. The results for GTX 580 show that StreamingPTmk outperforms all algorithms irrespective of the scene. The only scene with behavior not matching the average is CoronaWatch. There our NaivePTsk and RegenerationPTsk clearly outperform RegenerationPTmk at all measured paths per frame, and outperform even StreamingPTmk up until 10^6 paths per frame. This is due to the fact that many paths have length of only one segment (directly hit the area light, or miss all geometry) or two (reflect off the bezel), which greatly increases coherence of the traced rays. On the GTX 680 we, again, see results matching our previous assessments, with the only outlier being, again, the CoronaWatch scene, for the very same reasons as on the GTX 580.

2. BIDIRECTIONAL PATH TRACING

Table I shows performance of our Bidirectional Path Tracing (BPT) algorithms not only at 10^6 samples per frame, as in the paper, but also adds 10^7 samples per frame. As in Path Tracing, we can see the increase in performance with more paths per frame. The single-kernel algorithms, i.e., NaiveBPT and LVC-BPTsk, exhibit very little performance gain when given more samples per frame, while the multi-kernel ones gain a boost of up to 39%. Overall we can see that on GTX 580, at 10^7 samples per frame, our LVC-BPTmk has the highest performance on all tested scenes, while on GTX 680, LVC-BPTsk and LVC-BPTmk have a roughly similar performance.

3. ALGORITHM COMPARISON

Figure 2 shows the RMSE-vs-time convergence on both tested GPUs. On GTX 580 (top) we used different algorithms for Path Tracing (StreamingPTmk instead of our RegenerationPTsk) and Bidirectional Path Tracing (LVC-BPTmk instead of LVC-BPTsk), but the convergence curves still closely match GTX 680 curves reported in the paper. Figures 3-8 show the final images (after 15 minutes) rendered by each of the methods on both GPUs.

davidovic@cs.uni-saarland.de; jaroslav.krivanek@mff.cuni.cz
milos.hasan@gmail.com; slusallek@cs.uni-saarland.de

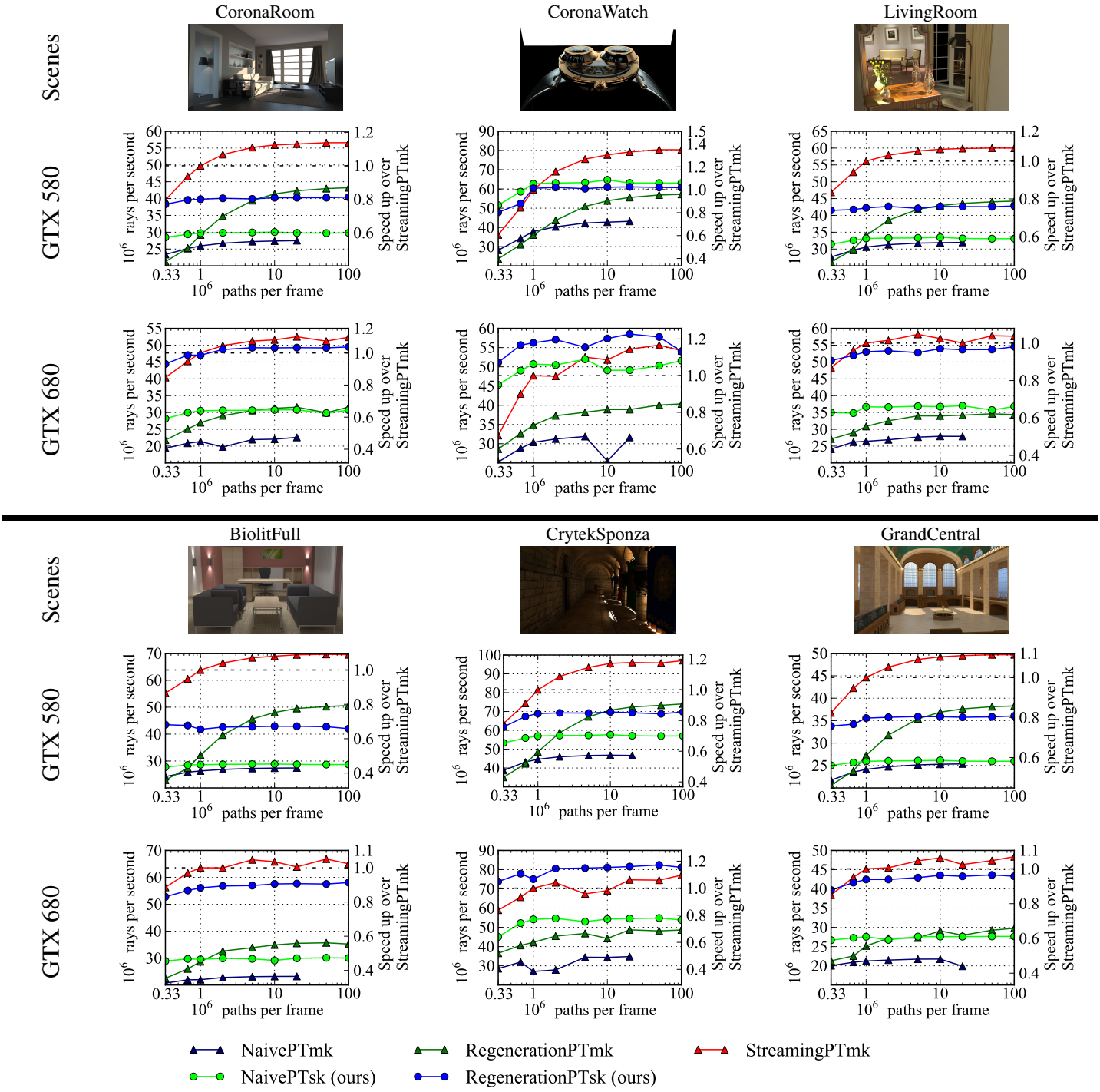


Fig. 1: *Path tracing performance.* Performance in rays per second with increasing number of paths per frame, given for each scene and both GPUs. The right axis shows performance relative to StreamingPTmk at 10^6 paths per frame.

10^6 samples per pass on GeForce GTX 580

	StreamingBPT	NaiveBPT	MultiBPT	**LVC-BPTsk**	**LVC-BPTmk**
CoronaRoom	1.00×	0.91×	0.81×	1.15×	**1.21**×
CoronaWatch	1.00×	**1.41**×	0.93×	**1.41**×	1.15×
BiolitFull	1.00×	0.52×	0.57×	1.53×	**1.81**×
CrytekSponza	1.00×	1.07×	0.93×	**1.35**×	1.29×
GrandCentral	1.00×	0.70×	0.70×	1.29×	**1.34**×
Average	1.00×	0.85×	0.77×	**1.33**×	**1.33**×

10^7 samples per pass on GeForce GTX 580

	StreamingBPT	NaiveBPT	MultiBPT	**LVC-BPTsk**	**LVC-BPTmk**
CoronaRoom	1.18×	0.92×	1.05×	1.18×	**1.55**×
CoronaWatch	1.13×	1.15×	1.00×	1.18×	**1.42**×
BiolitFull	1.02×	0.52×	0.95×	1.53×	**2.07**×
CrytekSponza	1.07×	1.00×	1.05×	1.29×	**1.44**×
GrandCentral	1.10×	0.71×	0.96×	1.28×	**1.50**×
Average	1.17×	0.86×	1.07×	1.36×	**1.66**×

10^6 samples per pass on GeForce GTX 680

	StreamingBPT	NaiveBPT	MultiBPT	**LVC-BPTsk**	**LVC-BPTmk**
CoronaRoom	0.86×	0.72×	0.69×	**1.24**×	1.19×
CoronaWatch	0.74×	1.17×	0.80×	**1.32**×	1.07×
BiolitFull	0.89×	0.42×	0.58×	1.73×	**1.92**×
CrytekSponza	0.84×	0.92×	0.92×	**1.55**×	1.12×
GrandCentral	0.97×	0.55×	0.68×	1.39×	**1.49**×
Average	0.85×	0.68×	0.71×	**1.38**×	1.27×

10^7 samples per pass on GeForce GTX 680

	StreamingBPT	NaiveBPT	MultiBPT	**LVC-BPTsk**	**LVC-BPTmk**
CoronaRoom	0.99×	0.73×	0.87×	1.26×	**1.37**×
CoronaWatch	0.93×	1.18×	1.01×	**1.40**×	1.21×
BiolitFull	0.94×	0.42×	0.96×	1.76×	**2.13**×
CrytekSponza	0.92×	0.92×	1.11×	**1.57**×	1.22×
GrandCentral	1.03×	0.55×	0.91×	1.41×	**1.57**×
Average	0.95×	0.68×	0.96×	**1.42**×	1.41×

Table I. : *Relative BPT speed up*: Speed up, in the terms of time to a given RMSE, of different BPT algorithms, relative to StreamingBPT with 10^6 samples per pass on GTX 580.

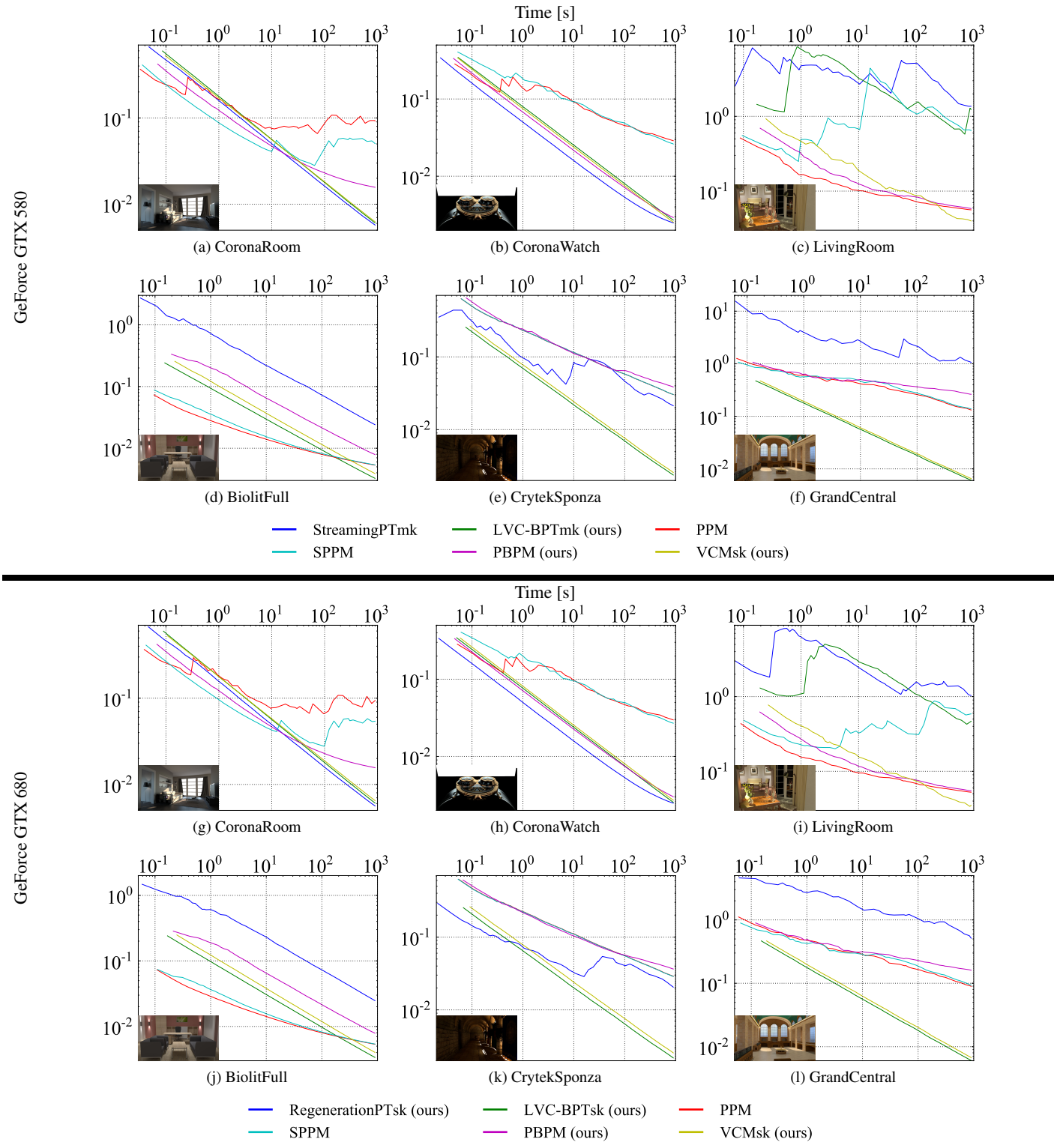
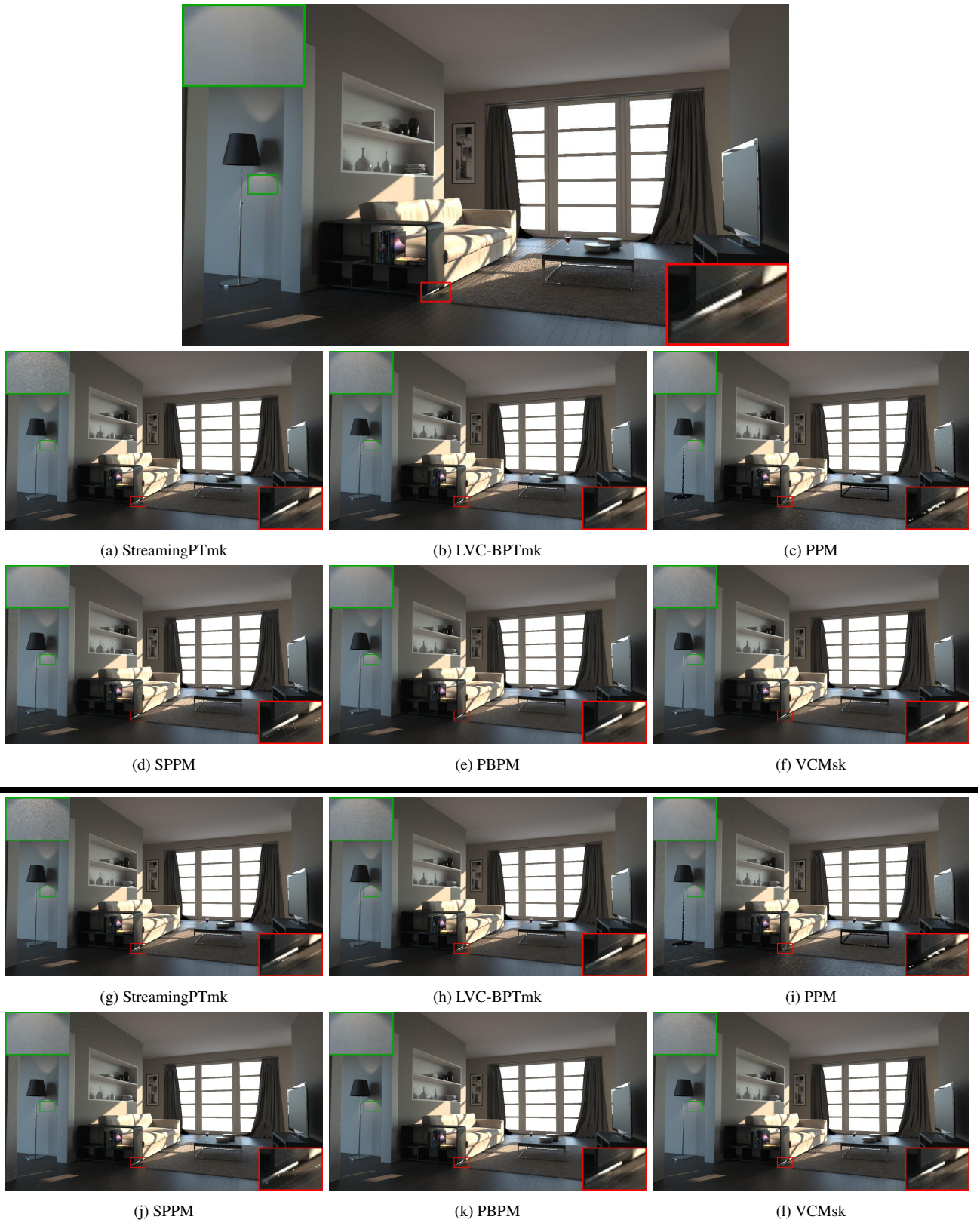


Fig. 2: The log-log plot of the RMSE-vs-time convergence of the six tested methods on each of the test scenes. Top graphs are results from GTX 580, the bottom graphs from GTX 680.



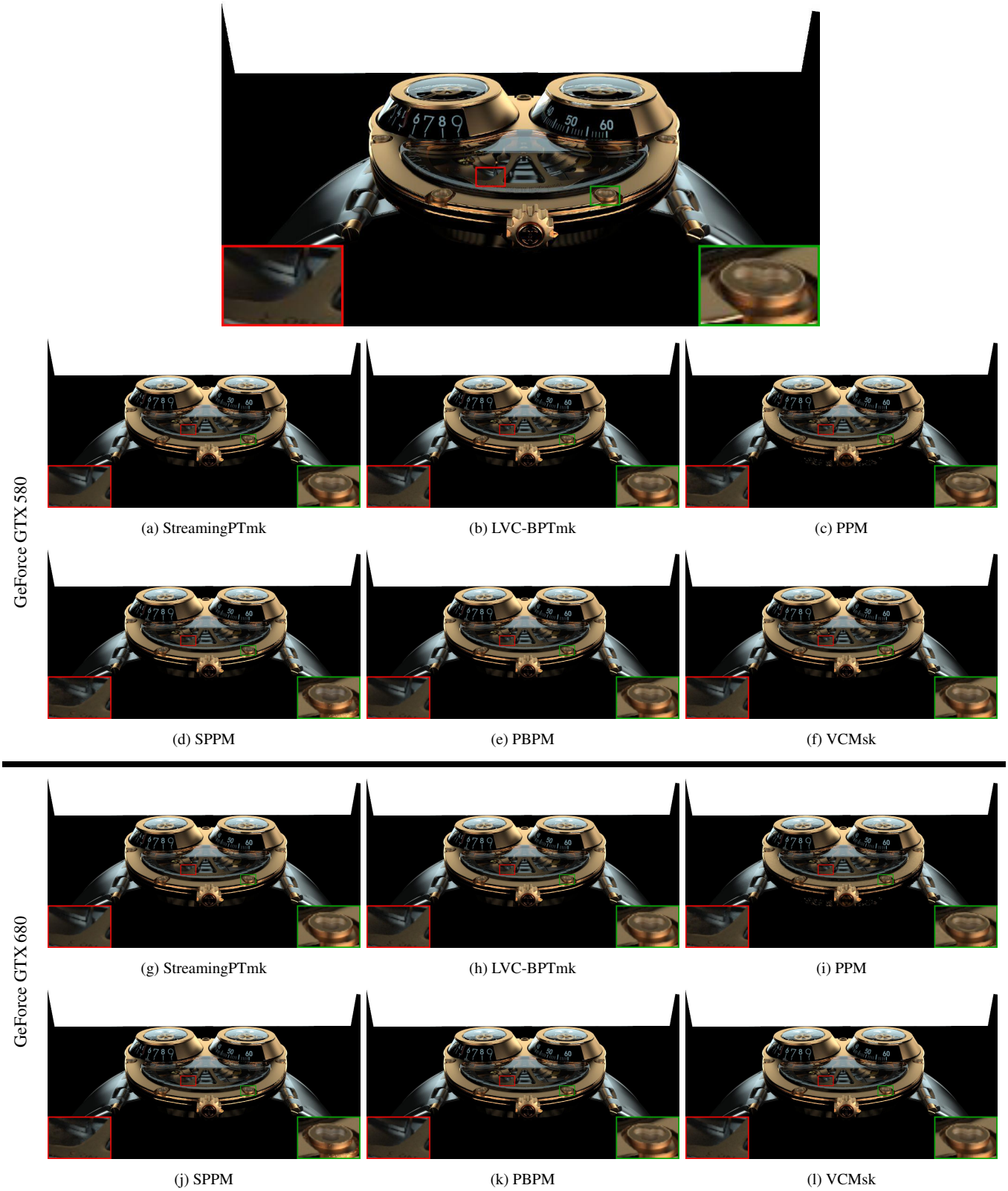
(a) StreamingPTmk (b) LVC-BPTmk (c) PPM

(d) SPPM (e) PBPM (f) VCMsk

(g) StreamingPTmk (h) LVC-BPTmk (i) PPM

(j) SPPM (k) PBPM (l) VCMsk

Fig. 3: *CoronaRoom*. All image results of Algorithm Comparison.



(a) StreamingPTmk (b) LVC-BPTmk (c) PPM

(d) SPPM (e) PBPM (f) VCMsk

(g) StreamingPTmk (h) LVC-BPTmk (i) PPM

(j) SPPM (k) PBPM (l) VCMsk

Fig. 4: *CoronaWatch*. All image results of Algorithm Comparison.

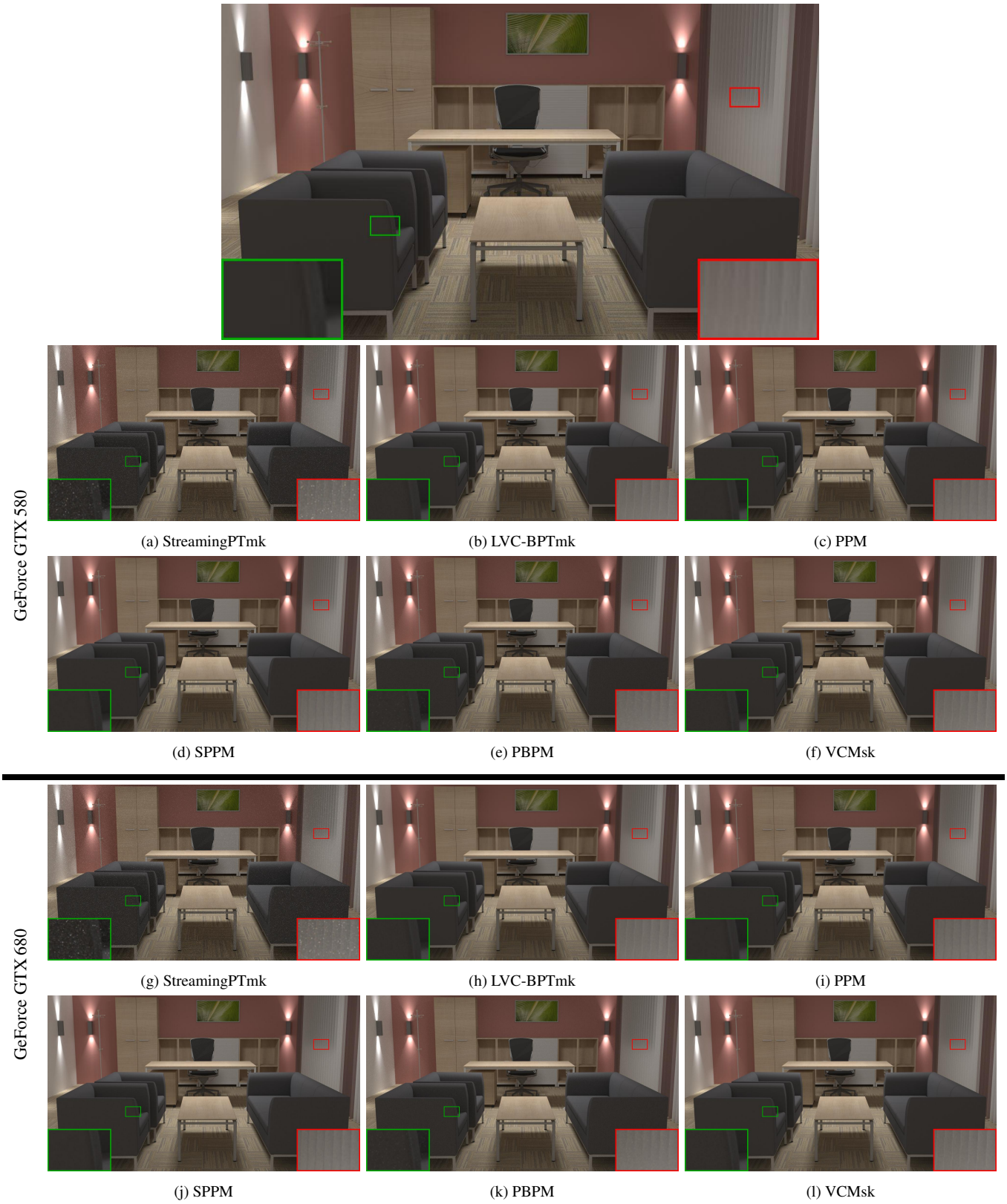
(a) StreamingPTmk (b) LVC-BPTmk (c) PPM

(d) SPPM (e) PBPM (f) VCMsk

(g) StreamingPTmk (h) LVC-BPTmk (i) PPM

(j) SPPM (k) PBPM (l) VCMsk

Fig. 5: *LivingRoom*. All image results of Algorithm Comparison.



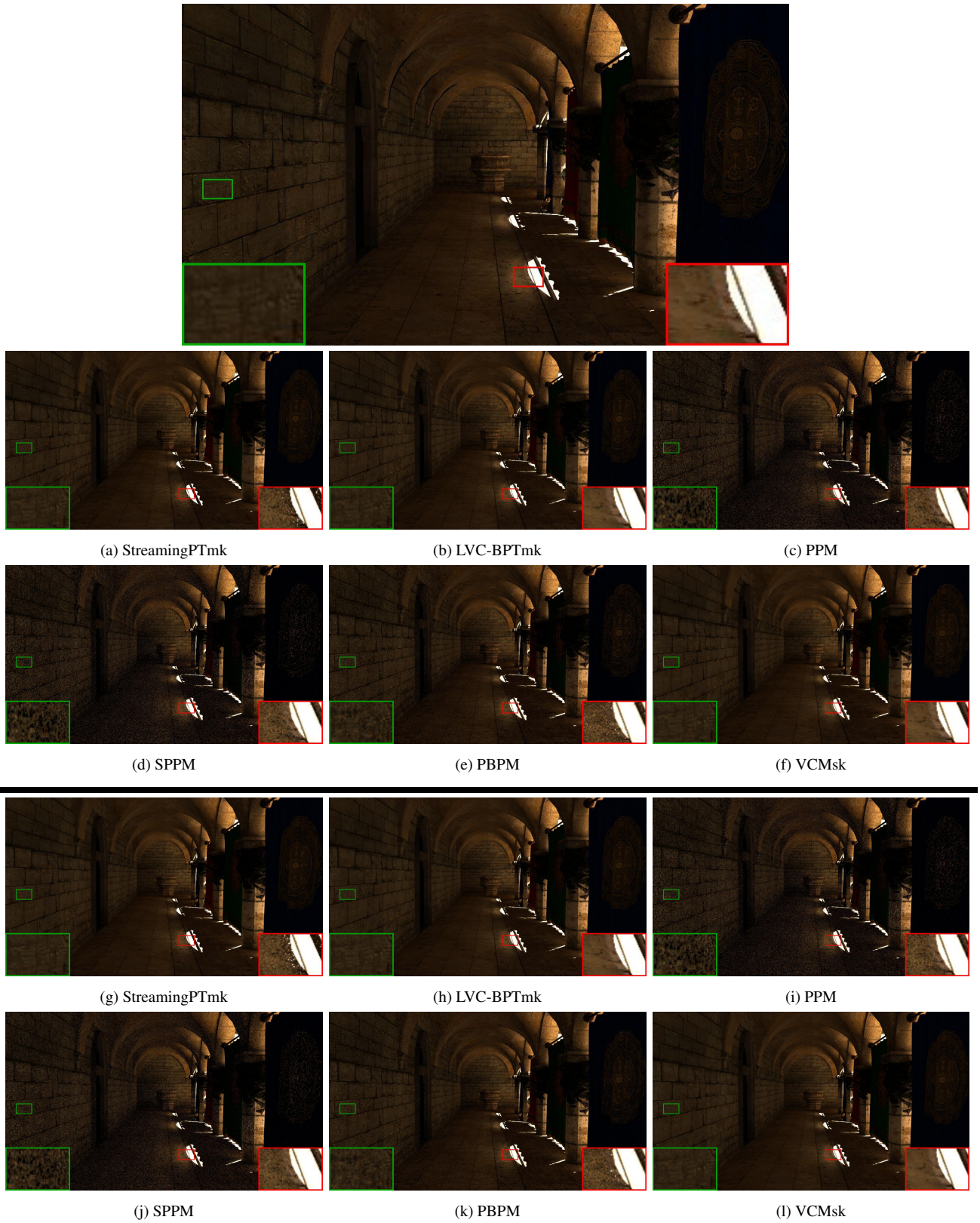
(a) StreamingPTmk (b) LVC-BPTmk (c) PPM

(d) SPPM (e) PBPM (f) VCMsk

(g) StreamingPTmk (h) LVC-BPTmk (i) PPM

(j) SPPM (k) PBPM (l) VCMsk

Fig. 6: *BiolitFull*. All image results of Algorithm Comparison.



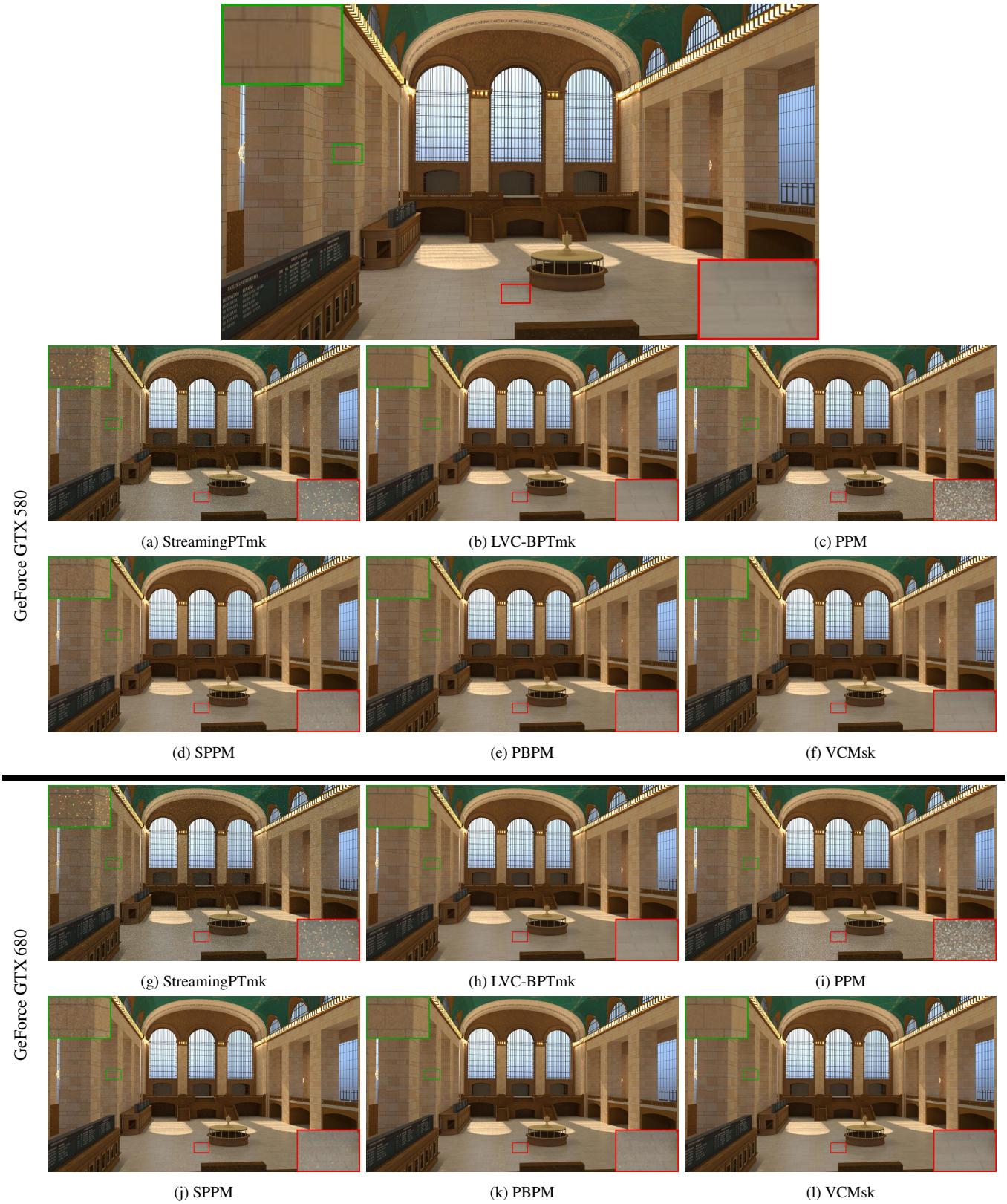
(a) StreamingPTmk (b) LVC-BPTmk (c) PPM

(d) SPPM (e) PBPM (f) VCMsk

(g) StreamingPTmk (h) LVC-BPTmk (i) PPM

(j) SPPM (k) PBPM (l) VCMsk

Fig. 7: *CrytekSponza*. All image results of Algorithm Comparison.



(a) StreamingPTmk (b) LVC-BPTmk (c) PPM

(d) SPPM (e) PBPM (f) VCMsk

(g) StreamingPTmk (h) LVC-BPTmk (i) PPM

(j) SPPM (k) PBPM (l) VCMsk

Fig. 8: *GrandCentral*. All image results of Algorithm Comparison.