I-Cloth: Incremental Collision Handling for GPU-Based Interactive Cloth Simulation
Supplemetary Material

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1 PERFORMANCE COMPARISON

1.1 Benchmark Funnel

Figure 1 is a performance comparison for Benchmark Funnel between PSCC and I-Cloth. Figure 2 shows the running time ratios of different computing stages of PSCC: time integration, broad phase testing (high-level culling), narrow phase testing (low-level culling and exact elementary tests), and penetration handling. Figure 3 shows the running time ratios of different computing stages of I-Cloth.

1.2 Benchmark Sphere

Figure 4 is a performance comparison for Benchmark Sphere between PSCC and I-Cloth. Figure 5 shows the running time ratios of different computing stages of PSCC: time integration, broad phase testing, narrow phase testing, and penetration handling. Figure 6 shows the running time ratios of different computing stages of I-Cloth.

1.3 Benchmark Dress

Figure 7 is a performance comparison for Benchmark Dress between PSCC and I-Cloth. Figure 8 shows the running time ratios of different computing stages of PSCC: time integration, broad phase testing, narrow phase testing, and penetration handling. Figure 9 shows the running time ratios of different computing stages of I-Cloth.

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1.4 Benchmark Tiered

Figure 10 is a performance comparison for Benchmark Tiered between PSCC and I-Cloth. Figure 11 shows the running time ratios of different computing stages of PSCC: time integration, broad phase testing, narrow phase testing, and penetration handling. Figure 12 shows the running time ratios of different computing stages of I-Cloth.

1.5 Benchmark Andy

Figure 13 is a performance comparison for Benchmark Andy between PSCC and I-Cloth. As compared to PSCC [Tang et al. 2018], I-Cloth achieves 3.25X speedup on overall performance, the peak speedup for a frame is 6.6X. Figure 14 shows the running time ratios of different computing stages of PSCC: time integration, broad phase testing, narrow phase testing, and penetration handling. As shown in this figure, collision handling (broad phase testing, narrow phase testing, and penetration handling) is the major efficiency bottleneck. Figure 15 shows the running time ratios of different computing stages of PSCC with Incremental CCD. With incremental CCD algorithm, the costs of broad phase and narrow phase drop down significantly. Figure 16 shows the running time ratios of different computing stages of I-Cloth. With the GPU-based impact zone solver, penetration handling is not the major efficiency bottleneck anymore.

REFERENCES

Min Tang, Zhongyuan Liu, Ruofeng Tong, and Dinesh Manocha. 2018. PSCC: Parallel Self-Collision Culling with Spatial Hashing on GPUs. *Proceedings of the ACM on Computer Graphics and Interactive Techniques* 1, 1 (2018), 18:1–18.

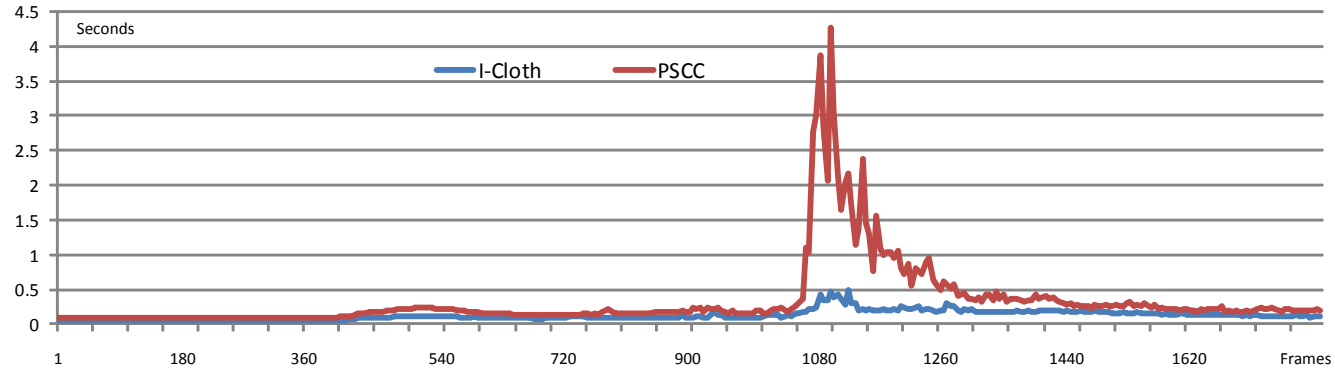

Fig. 1. **Performance Comparison for Benchmark Funnel:** Compared to PSCC, I-Cloth achieves $3.6X$ speedup on overall performance.

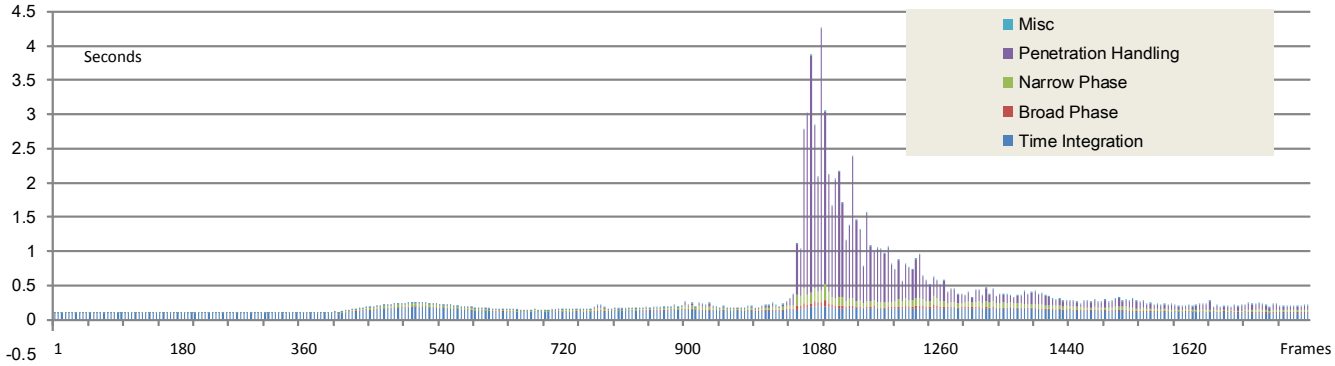

Fig. 2. **Running Time Ratios of Benchmark Funnel with PSCC:** This figure shows the running time ratios of different computing stages of PSCC on Benchmark Funnel: time integration, broad phase testing, narrow phase testing, and penetration handling, respectively.

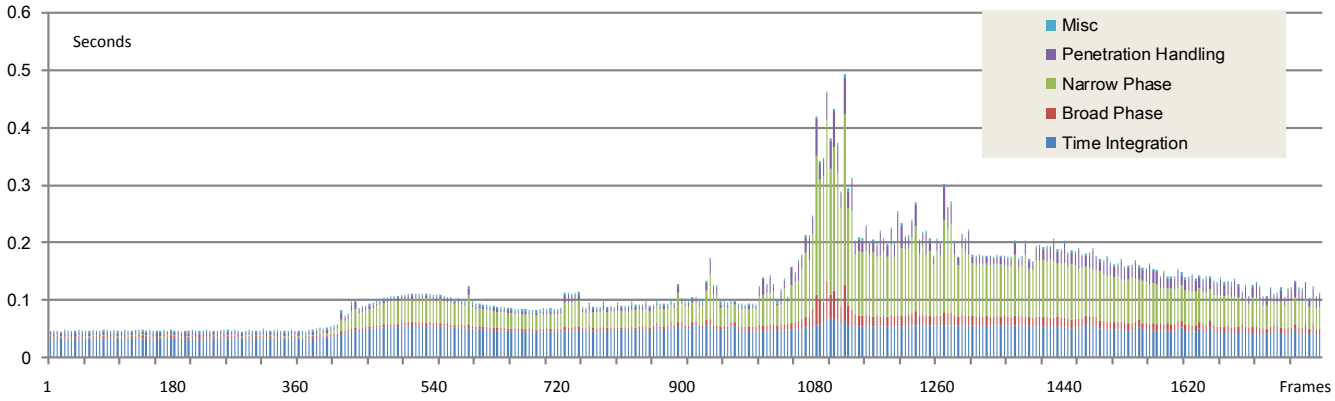

Fig. 3. **Running Time Ratios of Benchmark Funnel with I-Cloth:** This figure shows the running time ratios of different computing stages of I-Cloth on Benchmark Funnel: time integration, broad phase testing, narrow phase testing, and penetration handling, respectively.

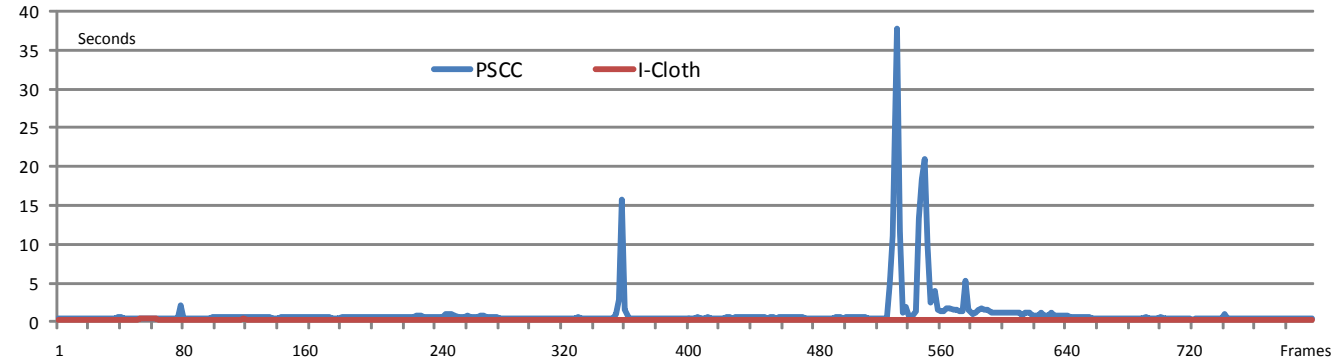

Fig. 4. **Performance Comparison for Benchmark Sphere:** Compared to PSCC, I-Cloth achieves about $2X$ speedups on overall performance.

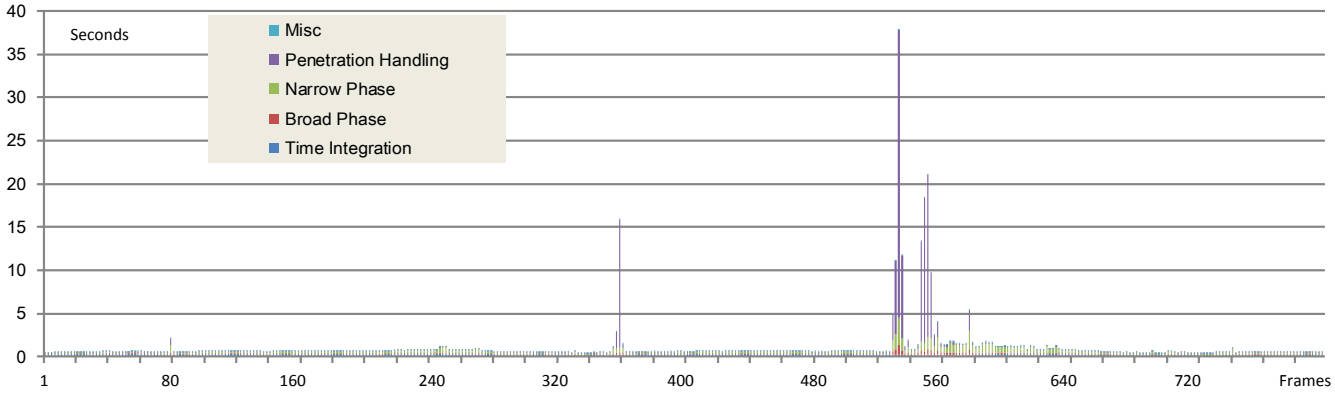

Fig. 5. **Running Time Ratios of Benchmark Sphere with PSCC:** This figure shows the running time ratios of different computing stages of PSCC on Benchmark Sphere: time integration, broad phase testing, narrow phase testing, and penetration handling, respectively.

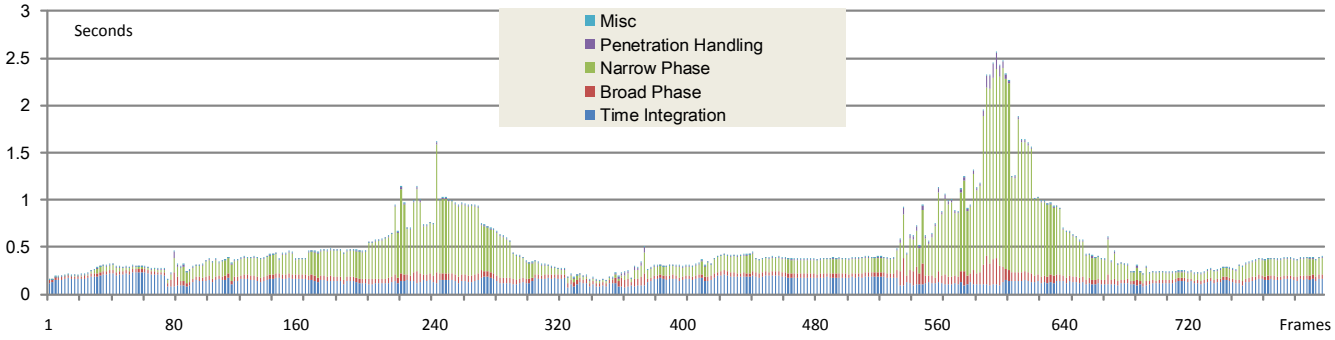

Fig. 6. **Running Time Ratios of Benchmark Sphere with I-Cloth:** This figure shows the running time ratios of different computing stages of I-Cloth on Benchmark Sphere: time integration, broad phase testing, narrow phase testing, and penetration handling, respectively.

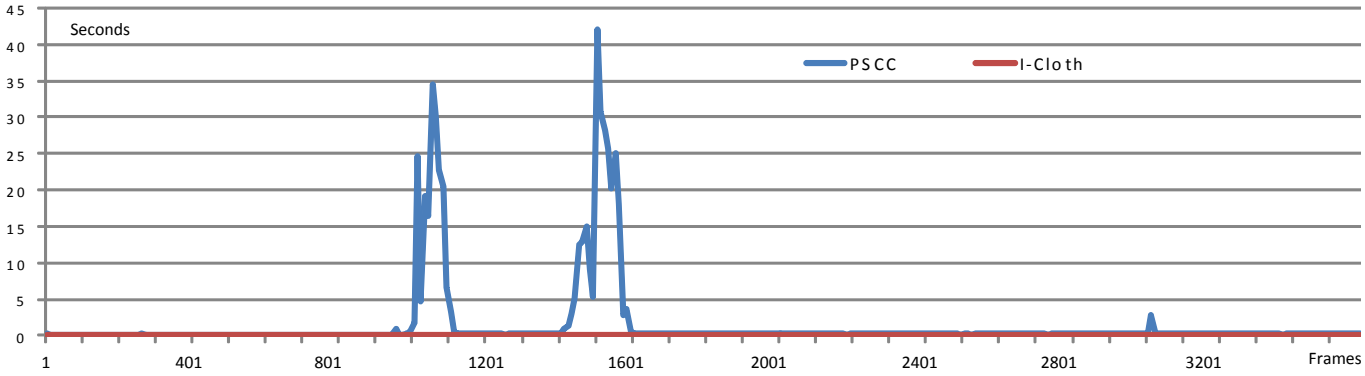

Fig. 7. **Performance Comparison for Benchmark Dress:** Compared to PSCC, I-Cloth achieves $6.6X$ speedup on overall performance.

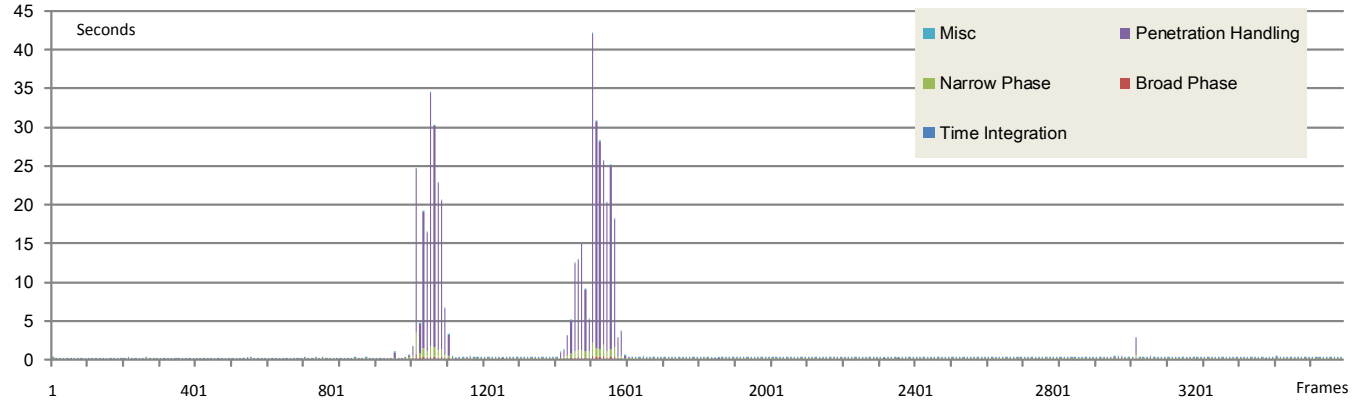

Fig. 8. **Running Time Ratios of Benchmark Dress with PSCC:** This figure shows the running time ratios of different computing stages of PSCC on Benchmark Dress: time integration, broad phase testing, narrow phase testing, and penetration handling, respectively.

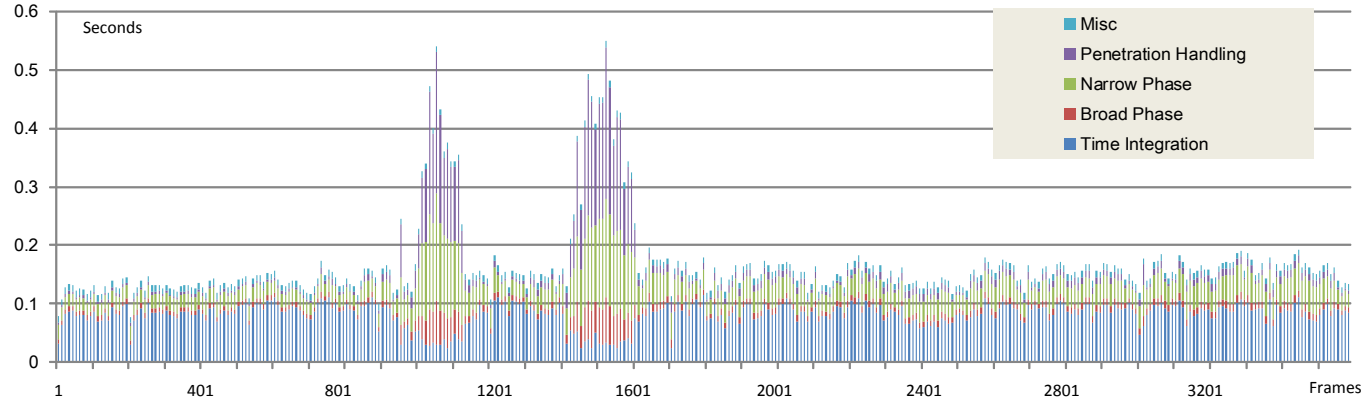

Fig. 9. **Running Time Ratios of Benchmark Dress with I-Cloth:** This figure shows the running time ratios of different computing stages of I-Cloth on Benchmark Dress: time integration, broad phase testing, narrow phase testing, and penetration handling, respectively.

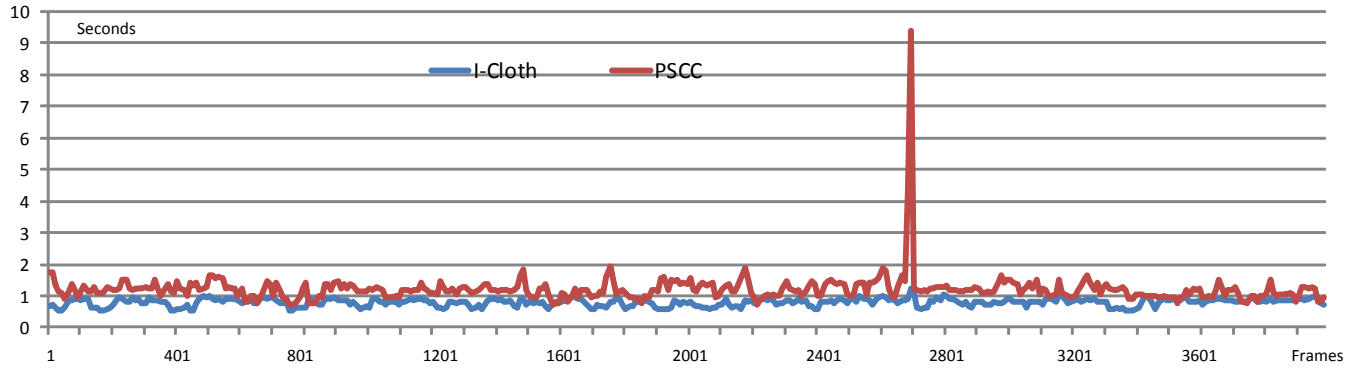

Fig. 10. **Performance Comparison for Benchmark Tiered:** Compared to PSCC, I-Cloth achieve about $2X$ speedup on overall performance.

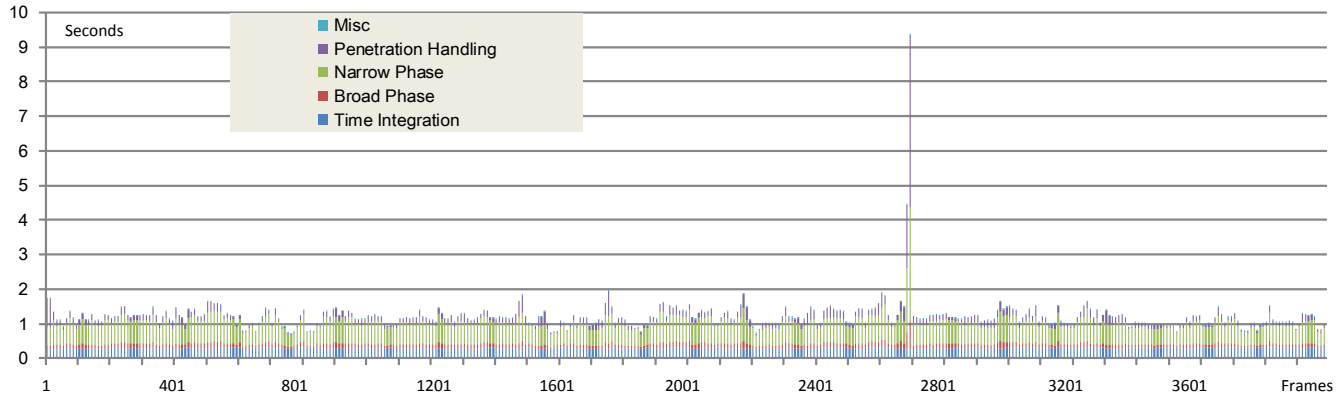

Fig. 11. **Running Time Ratios of Benchmark Tiered with PSCC:** This figure shows the running time ratios of different computing stages of PSCC on Benchmark Tiered: time integration, broad phase testing, narrow phase testing, and penetration handling, respectively.

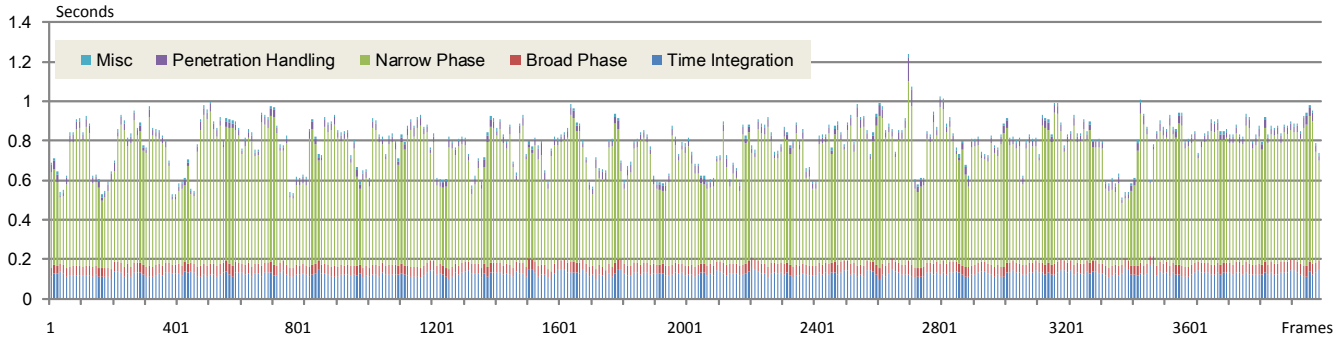

Fig. 12. **Running Time Ratios of Benchmark Tiered with I-Cloth:** This figure shows the running time ratios of different computing stages of I-Cloth on Benchmark Tiered: time integration, broad phase testing, narrow phase testing, and penetration handling, respectively.

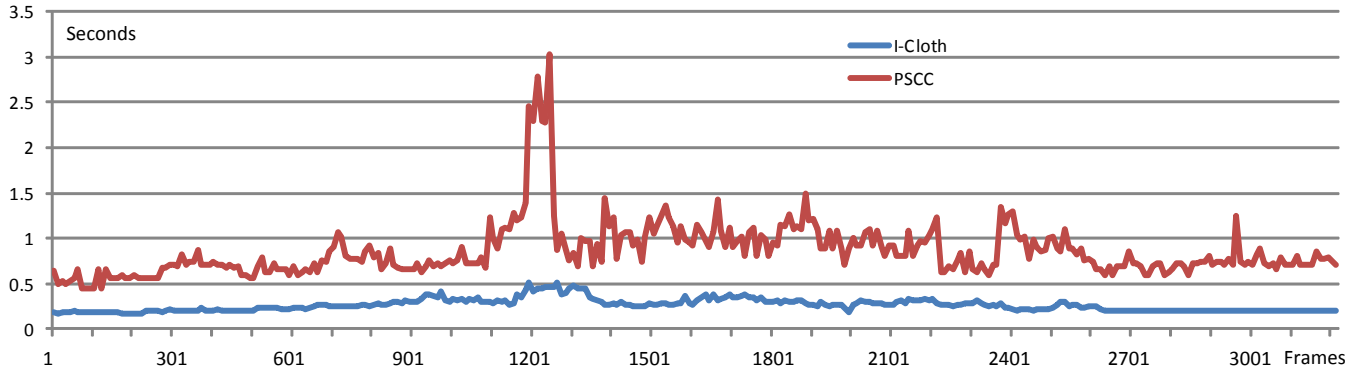

Fig. 13. **Performance Comparison for Benchmark Andy:** Compared to PSCC, I-Cloth achieve up to $3.25X$ speedup on overall performance, the peak speedup for a frame is $6.6X$.

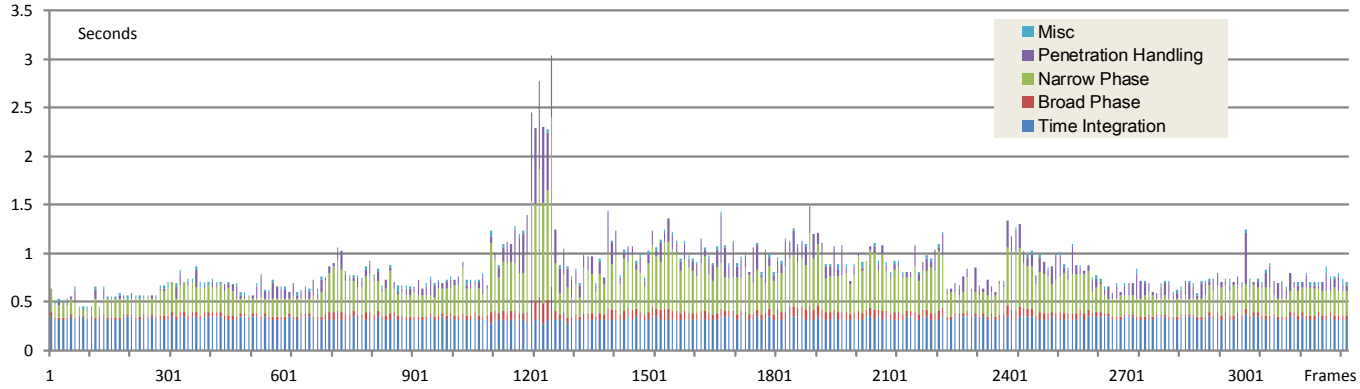

Fig. 14. **Running Time Ratios of PSCC:** This figure shows the running time ratios of different computing stages of PSCC on Benchmark Andy: time integration, broad phase testing, narrow phase testing, and penetration handling, respectively.

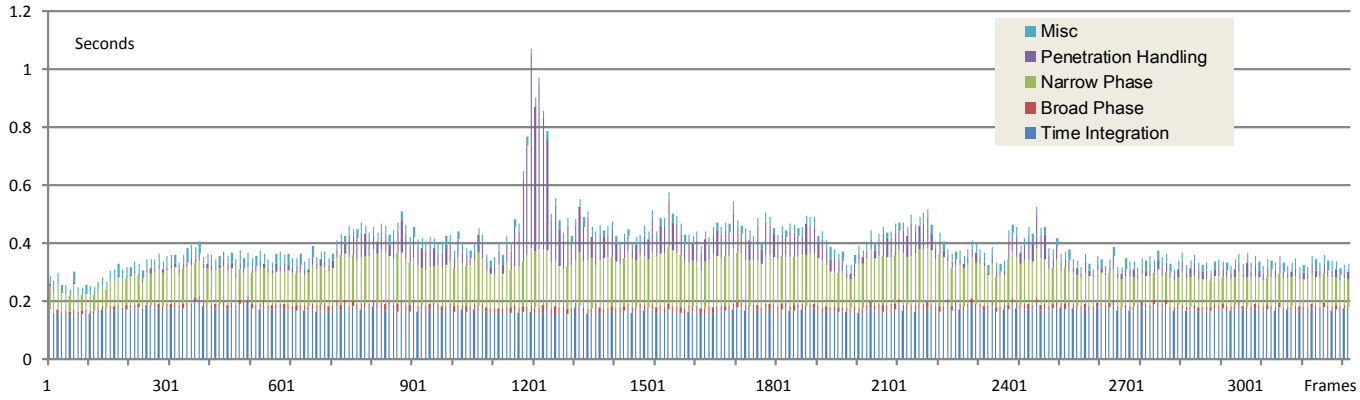

Fig. 15. **Running Time Ratios of PSCC with Incremental CCD:** This figure shows the running time ratios of different computing stages of PSCC with Incremental CCD on Benchmark Andy: time integration, broad phase testing, narrow phase testing, and penetration handling, respectively.

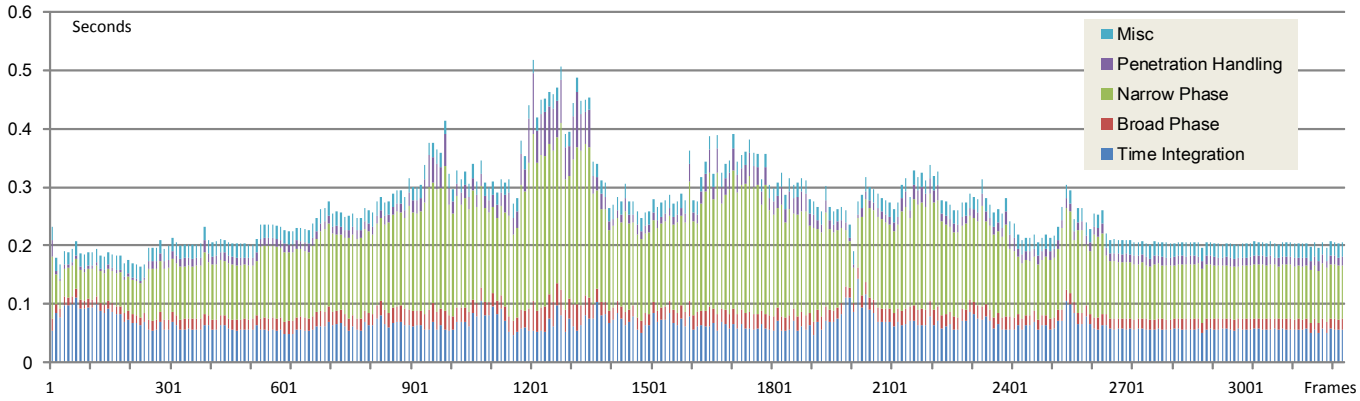

Fig. 16. **Running Time Ratios of I-Cloth:** This figure shows the running time ratios of different computing stages of I-Cloth on Benchmark Andy: time integration, broad phase testing, narrow phase testing, and penetration handling, respectively.