

WEB3D 2020

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OpenCollBench - Benchmarking of Collision Detection & Proximity Queries as a Web-Service

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Korea Computer Graphics









Raytracing

 Benchmarking for collision detection (CD) & proximity query (PQ) algorithms is much more complex

Motivation

CD&PQ Recap

Previous Work

Benchmarks are Important for Scientific Progress



Computer Vision

Open Benchmark

Semantic CD&PQ







Problem Definition



Collision Detection (CD)

Motivation

CD&PQ Recap

Previous Work

Challenges



Proximity Query (PQ)

Open Benchmark

Semantic CD&PQ







CD & PQ: Recap of Approaches

- Approximation methods
 - Based on convex decomposition
- Exact methods
 - For rigid bodies, mostly based on BVH





Challenges

Open Benchmark

Semantic CD&PQ









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CD & PQ: Recap of SIMD Methods

Simultaneous traversal of sequential algorithms



1 vs 1



1 vs many

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SIMD optimized simultaneous traversal using AVX512 [Tan et al., 2019]



many vs many

Open Benchmark

Semantic CD&PQ





CD & PQ: Factors Influencing Performance

- CD & PQ algorithm depends on many factors
 - Object's polygon
 - Object's shape and used BV
 - Obviously, sphere BV will fit better for ball object compared with AABB
 - Object's configuration
 - Slightly change can results in completely different timings

Challenges

Open Benchmark

Semantic CD&PQ

Conclusion



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Previous Proposals for Benchmarking CD & PQ

- Set of pre-defined objects [Woulfe & Manzke, 2009]
- Scenarios with pre-defined motion paths [Bergen, 1998] [Caselli et al., 2002] [Otaduy & Lin, 2003]
- Systematic benchmark:
 - Relative distance between objects [Zachmann, 1998]
 - Combined broad and narrow phases into CD pipeline [Trenkel et al., 2007]
 - Added relative penetration [Diktas & Sahiner, 2008] [Weller et al, 2010]





Challenges for Defining Benchmarks for CD & PQ

- Benchmarking process is often difficult and time-consuming
- Require prior knowledge about algorithms and benchmarking tools
- Hardware availability
- Results are not meaningful enough
 - Usually represented using chart or

histogram



Challenges

Open Benchmark





Our Contribution: Open Benchmark for CD & PQ

- OpenCollBench: Benchmarking CD & PQ as a web-service, accessible at <u>opencollbench.com</u>
 - Intuitive & accessible for both expert & non-expert user
 - Unified & dedicated hardware
 - Results reproduceable
 - New metrics for benchmarking CD & PQ
 - Better understanding of benchmarking results on a sub-object level, e.g.,
 - Identify critical or outlier regions
 - Identify heavily tested configurations



Challenges

Open Benchmark

Semantic CD&PQ



Bremen Ŵ



CD&PQ Recap Previous Work Motivation

Challenges **Open Benchmark** Conclusion Semantic CD&PQ





OpenCollBench – Web Interface

Object File Choose a file bunny.obj	Benchmark Mode Collision	Algo SIMDop	First / All Collision ?
Benchmark Configurations: Use Saved Positions	Position Finding Method : Sphere	Rotate Object By Degree	Move Object By Degree
Relative Distance : 0			
Remove object after benchmark			
	8	tart	



Challenges

Open Benchmark

Semantic CD&PQ







OpenCollBench – Progress Page

OpenCollBench: Benchmarking of Collision Detection & Proximity Queries as a Web-Service



Benchmark is running. You can safely close your browser and come back later to check result.

CD&PQ Recap Motivation

Previous Work

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Open Benchmark

Semantic CD&PQ









OpenCollBench – Result Page

openCollBench: Open Access Benchmarking Server for Collision Detection and Proximity Query		
Result		
hand_63825 Configurations		
Wireframe : OFF		
Filter Outliers : OFF		
Display : Timing - Median	TESH CAREEN	
Closest Points : OFF Back		
	E-JAS BAT	

Motivation

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Challenges





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New Metrics for Benchmarking CD & PQ





Median timings

Average timings



Standard deviation

Motivation

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Previous Work

Challenges





Min timings

Max timings



Configurations density

Open Benchmark

Semantic CD&PQ







Our New Metrics Show Critical or Outlier Regions



CD&PQ Recap

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Our New Metrics Show Heavily Tested Regions





distance of 0.0

distance of 0.2







distance of 0.6

Challenges

Open Benchmark

Semantic CD&PQ







Conclusions

- New metrics for benchmarking CD & PQ
- Sub-object level accuracy for analysis of benchmarking results
- New proposal: open benchmarking of CD & PQ as a web service
- Future work:
 - based algorithms, etc
 - one

• Extend to cover more cases related to CD & PQ, .e.g., deformable objects, GPU-

• Allow user to upload their own CD & PQ algorithms and compare with existing

Challenges

Open Benchmark

Semantic CD&PQ







Thank You!





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Source of images

- 26-DOP & AABB
 - http://www-ljk.imag.fr/Publications/Basilic/com.lmc.publi.PUBLI_

Inproceedings@117681e94b6_1860ffd/bounding_volume_hierarchies.pdf

All website: last visited at 17.09.2020







Source of videos

- BART (Benchmark of Animated Ray Tracing)
- Multi Object Tracking
 - https://arxiv.org/pdf/2003.09003.pdf

http://www.cse.chalmers.se/~uffe/BART/museum/museum400x300 300.mpg

All website: last visited at 17.09.2020



