



Massively-Parallel Proximity Queries for Point Clouds

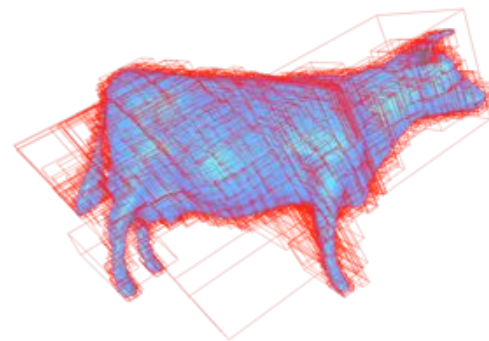
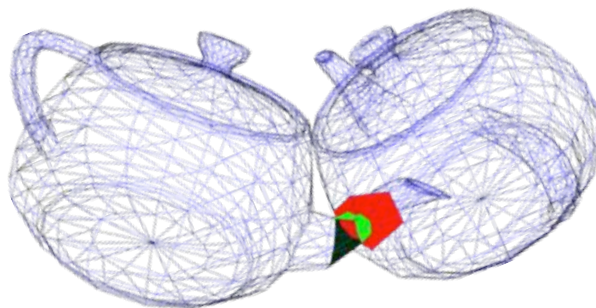


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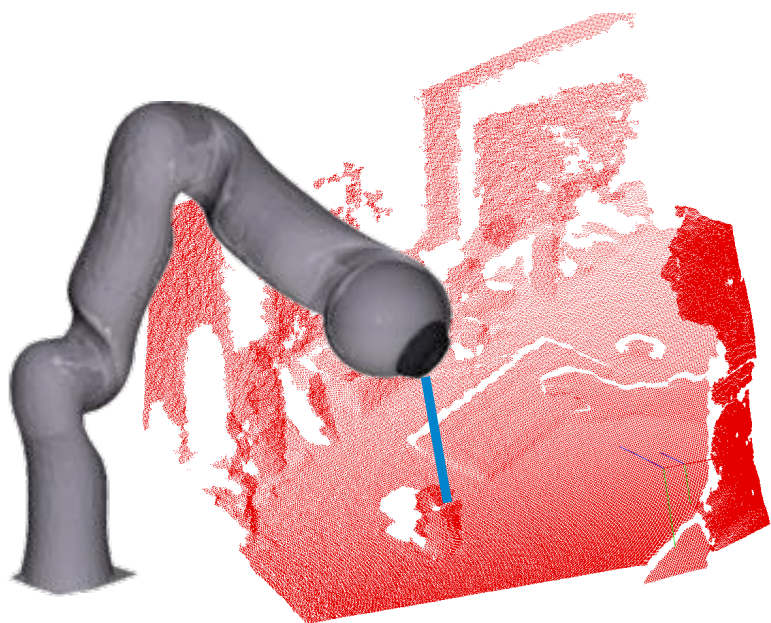
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cgvr.cs.uni-bremen.de

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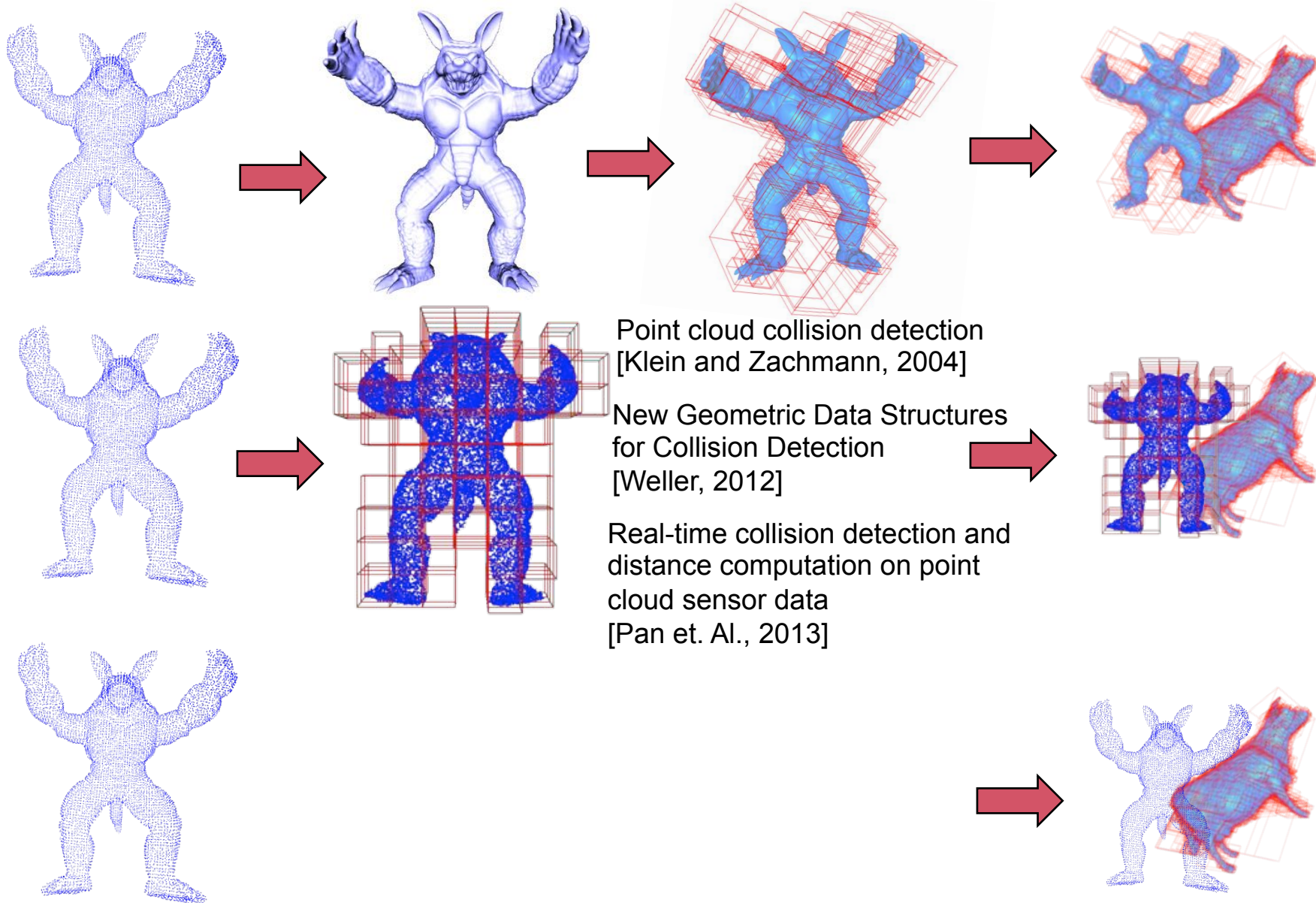
Motivation



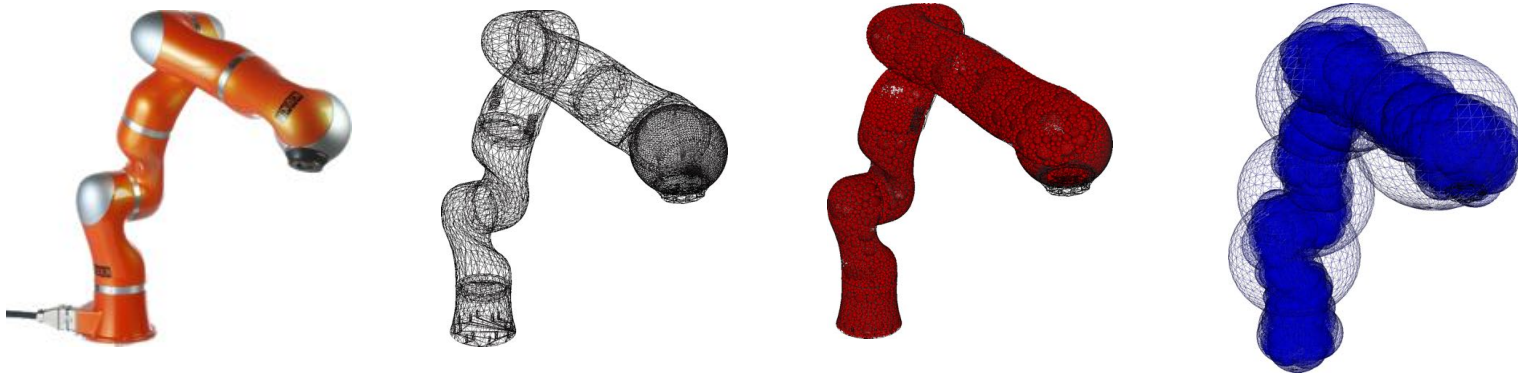
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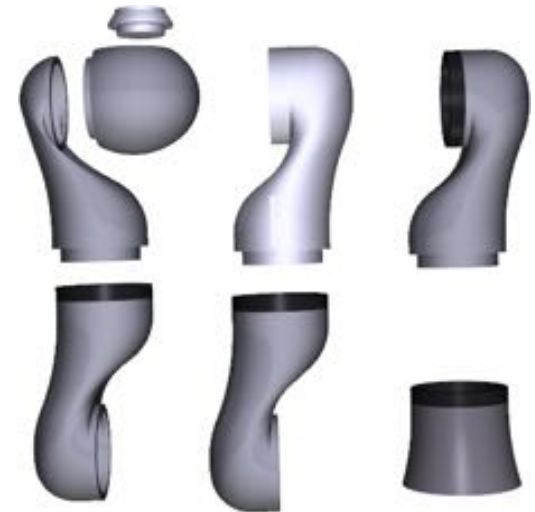
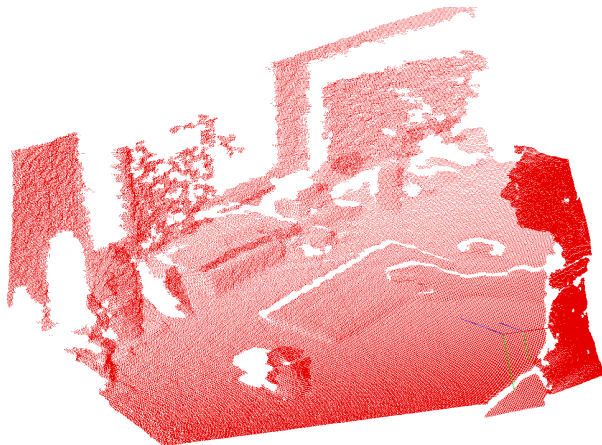
Previous Works



- Polygonal object representation: Inner Sphere Trees (ISTs)



- Point cloud captured in real-time via Kinect



Basic Algorithm

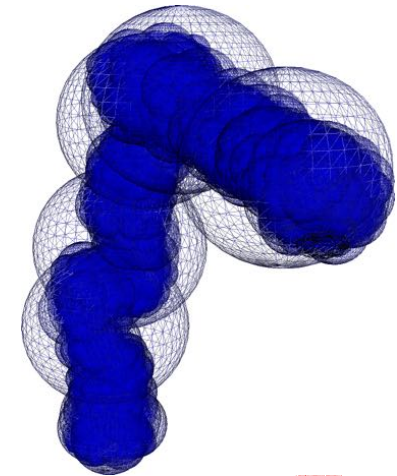


```
minDist = ∞
```

```
For Parallel IST in Robot:
```

```
For Parallel Point p in Point Cloud:
```

```
  getDistance( Root(IST), p, minDist)
```



```
getDistance( Sphere s, Point p,
d )
```

```
  forall the Children sc of s do
```

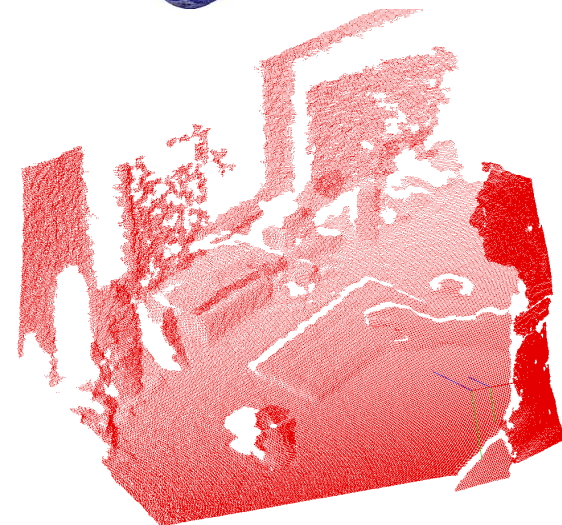
```
    d = distance( sc, p )
```

```
    if d < minDist then
```

```
      getDistance( sc, p, d )
```

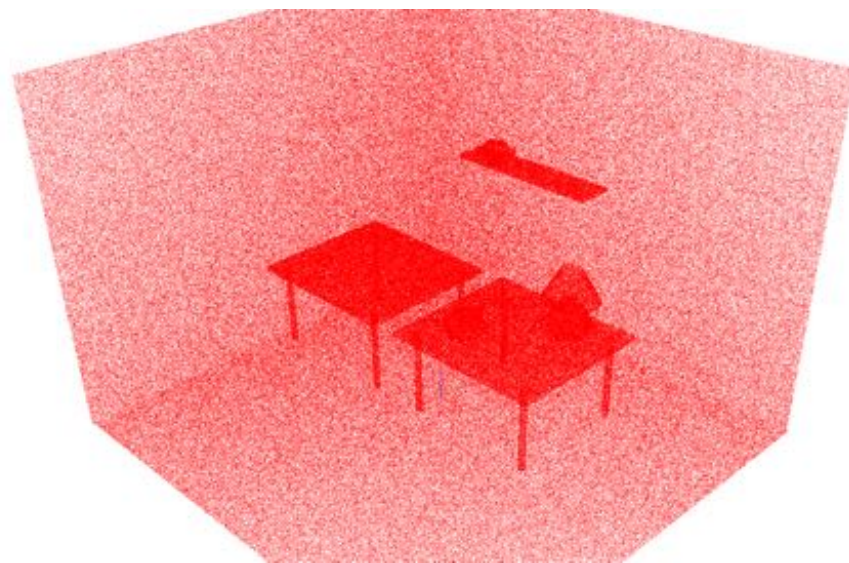
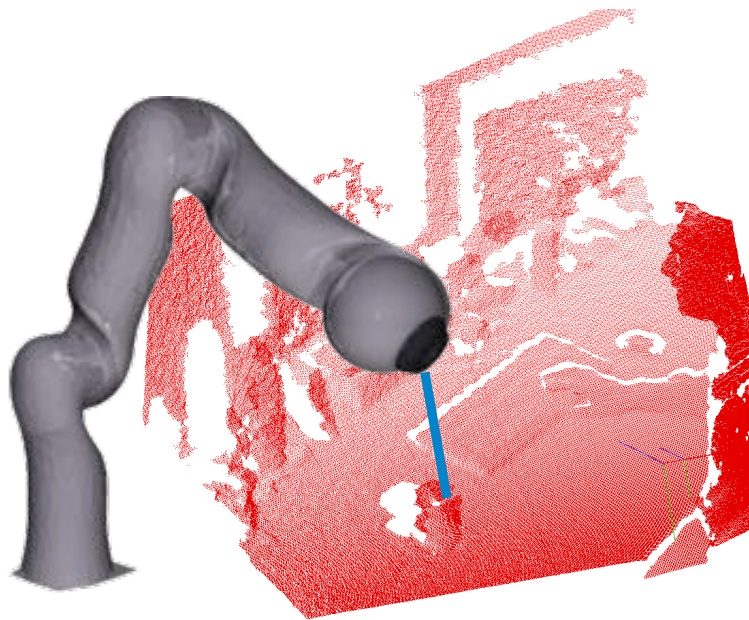
```
  if minDist > d then
```

```
    minDist = d
```

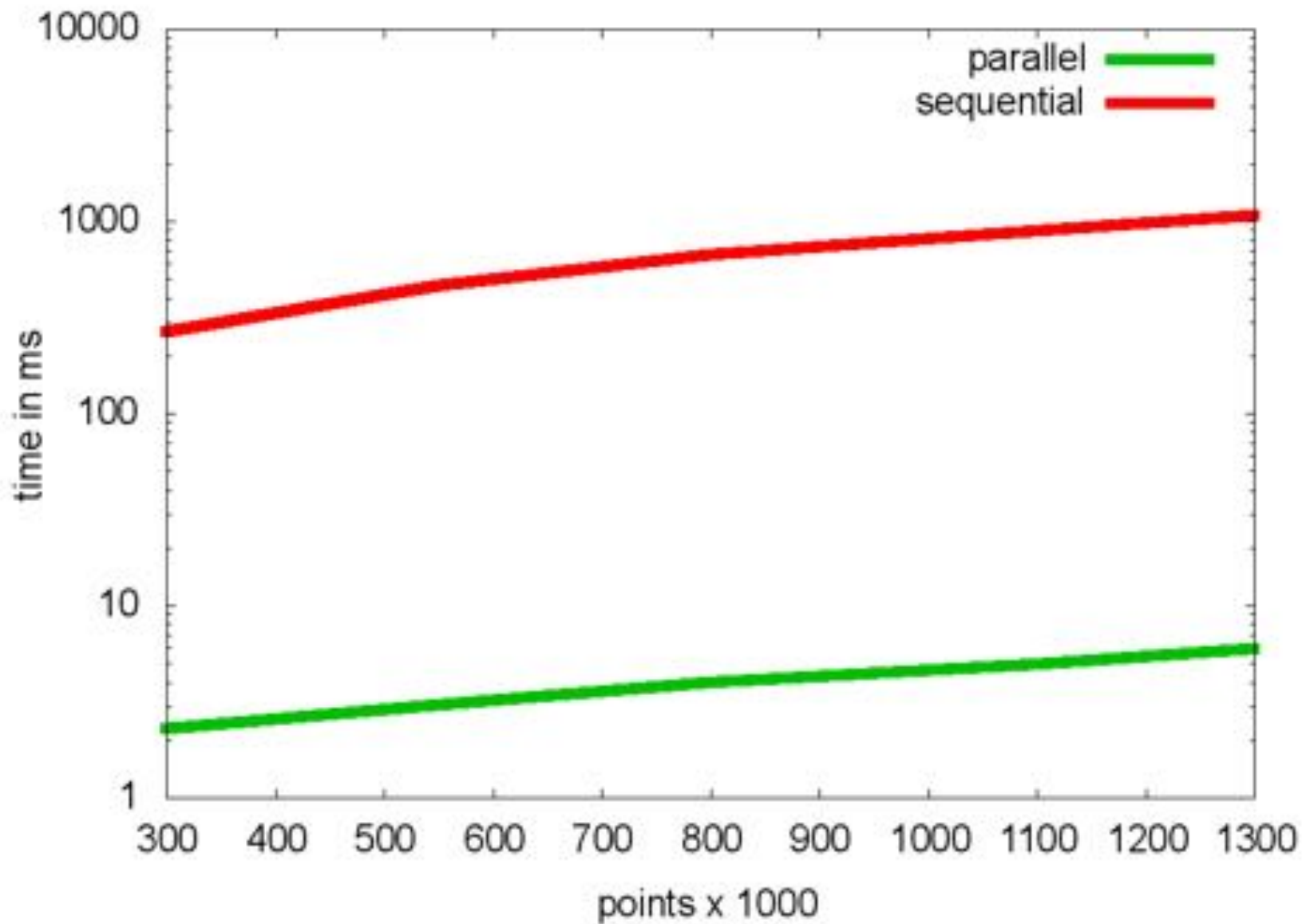


Test Scenarios

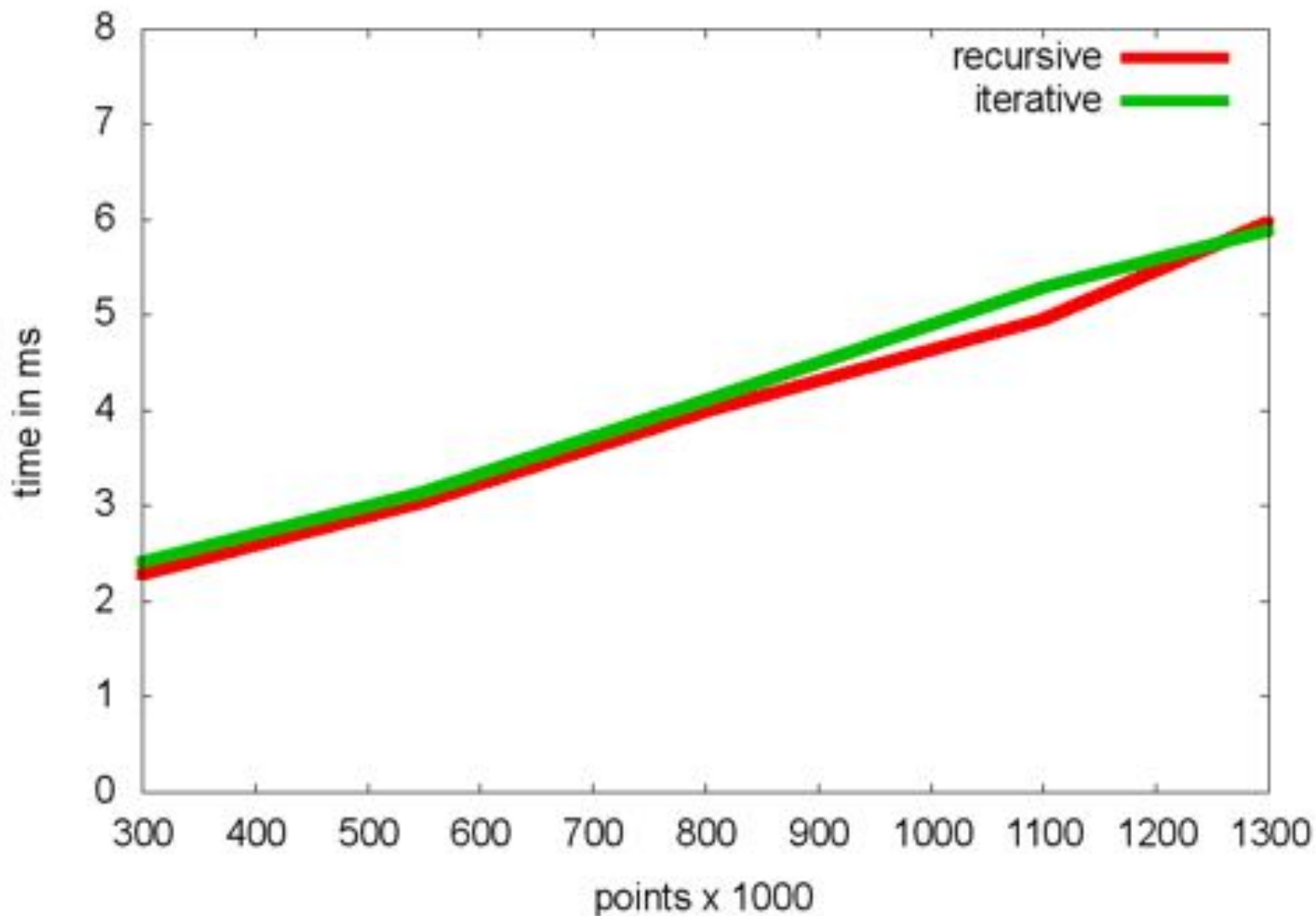
- Implemented in CUDA (5.5 & 6.0)
- Geforce GTX 780, 2GByte Memory
- Pre-recorded and artificial point clouds with up tp 5M points



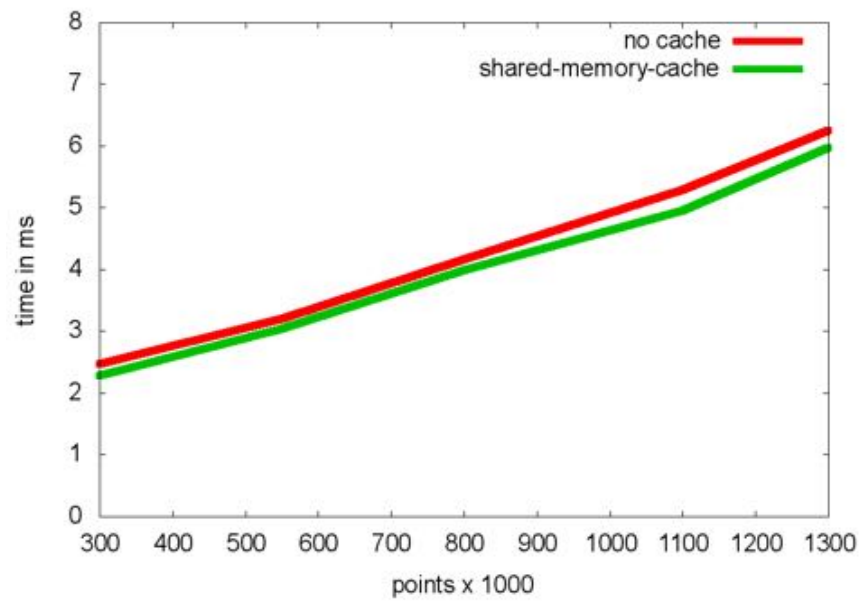
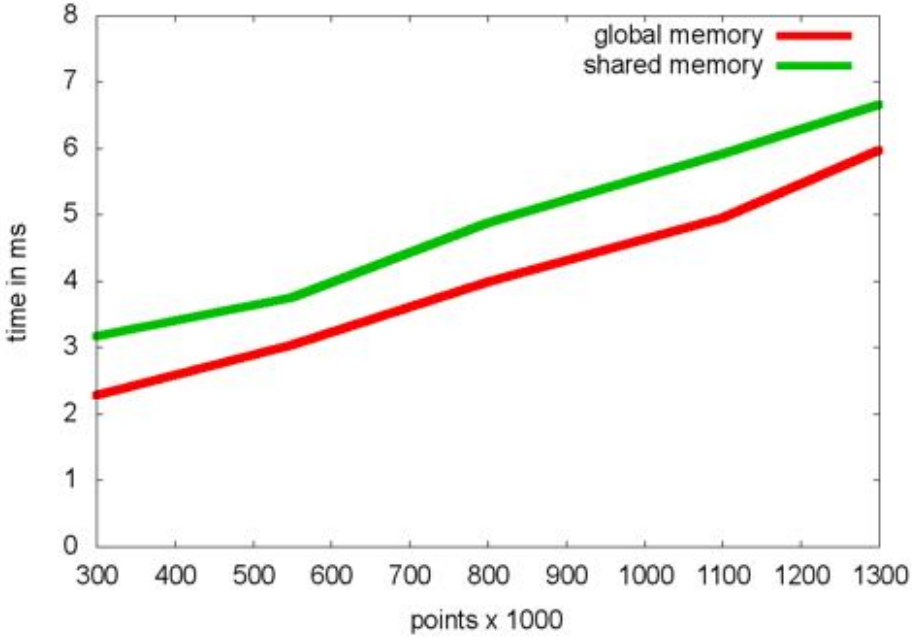
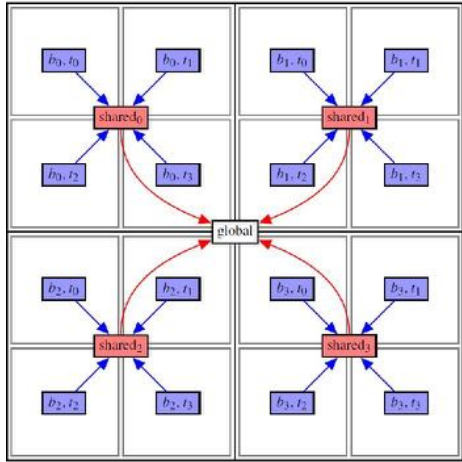
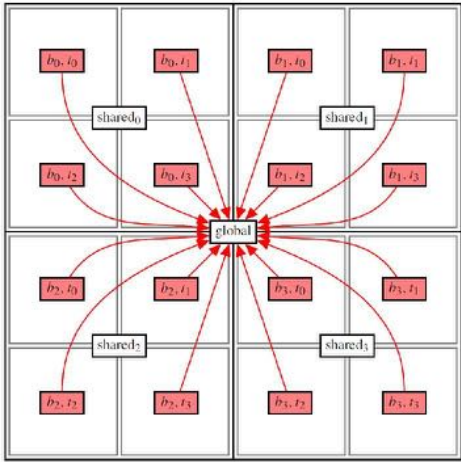
Results: Parallel vs. Sequential



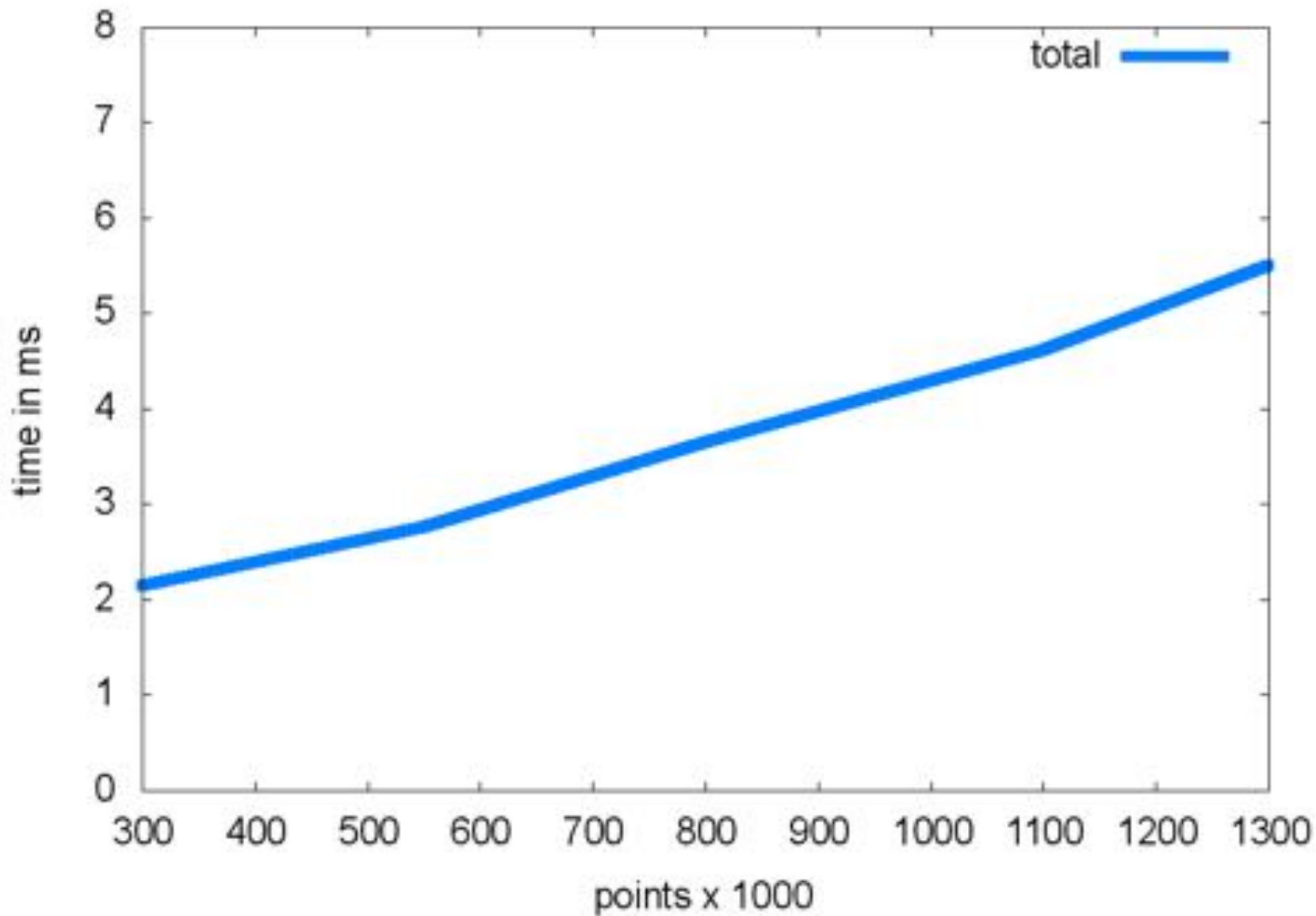
Improvement(?) 1: Recursive vs. Iterative



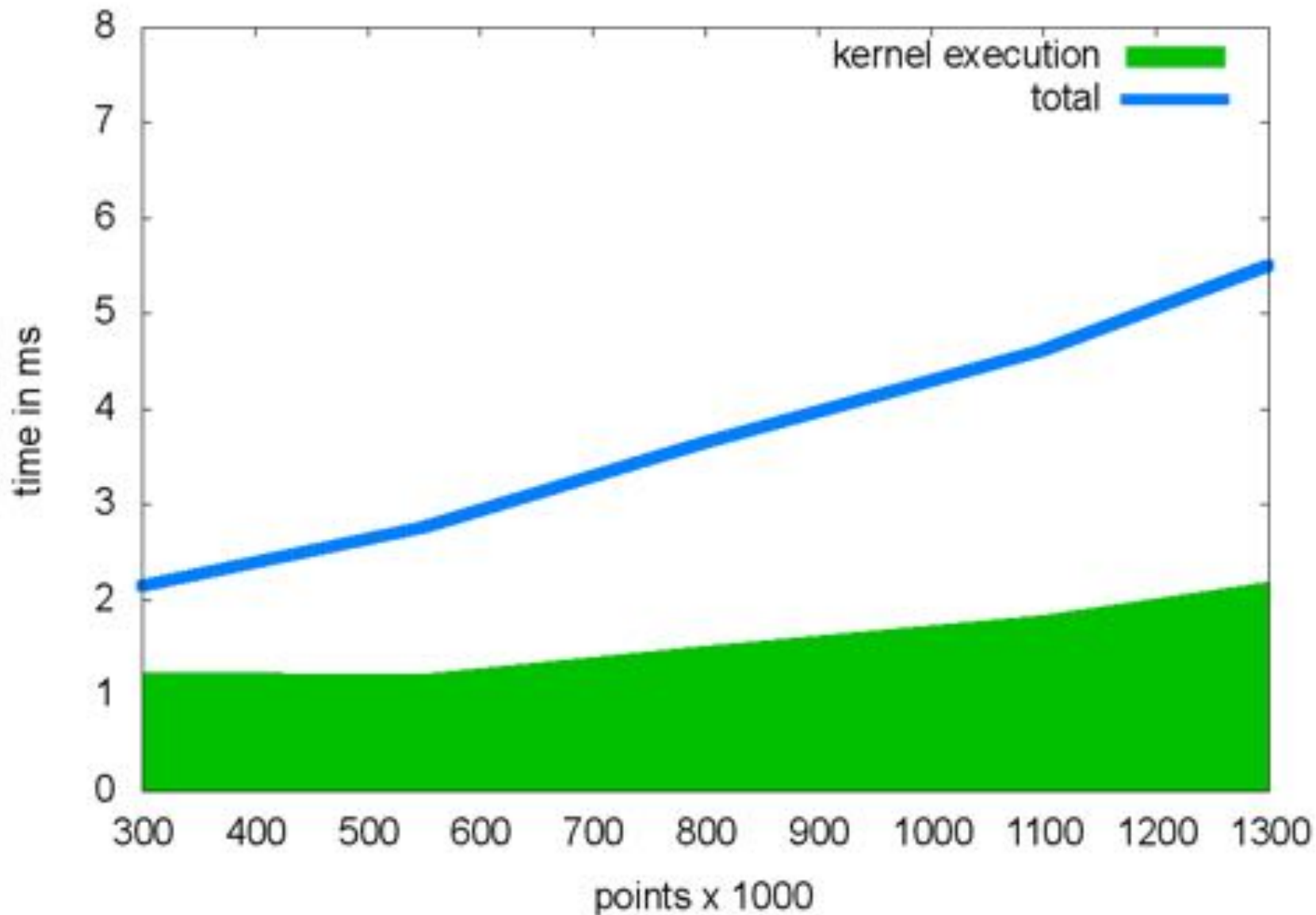
Improvement(?) 2: Global vs. Shared Memory



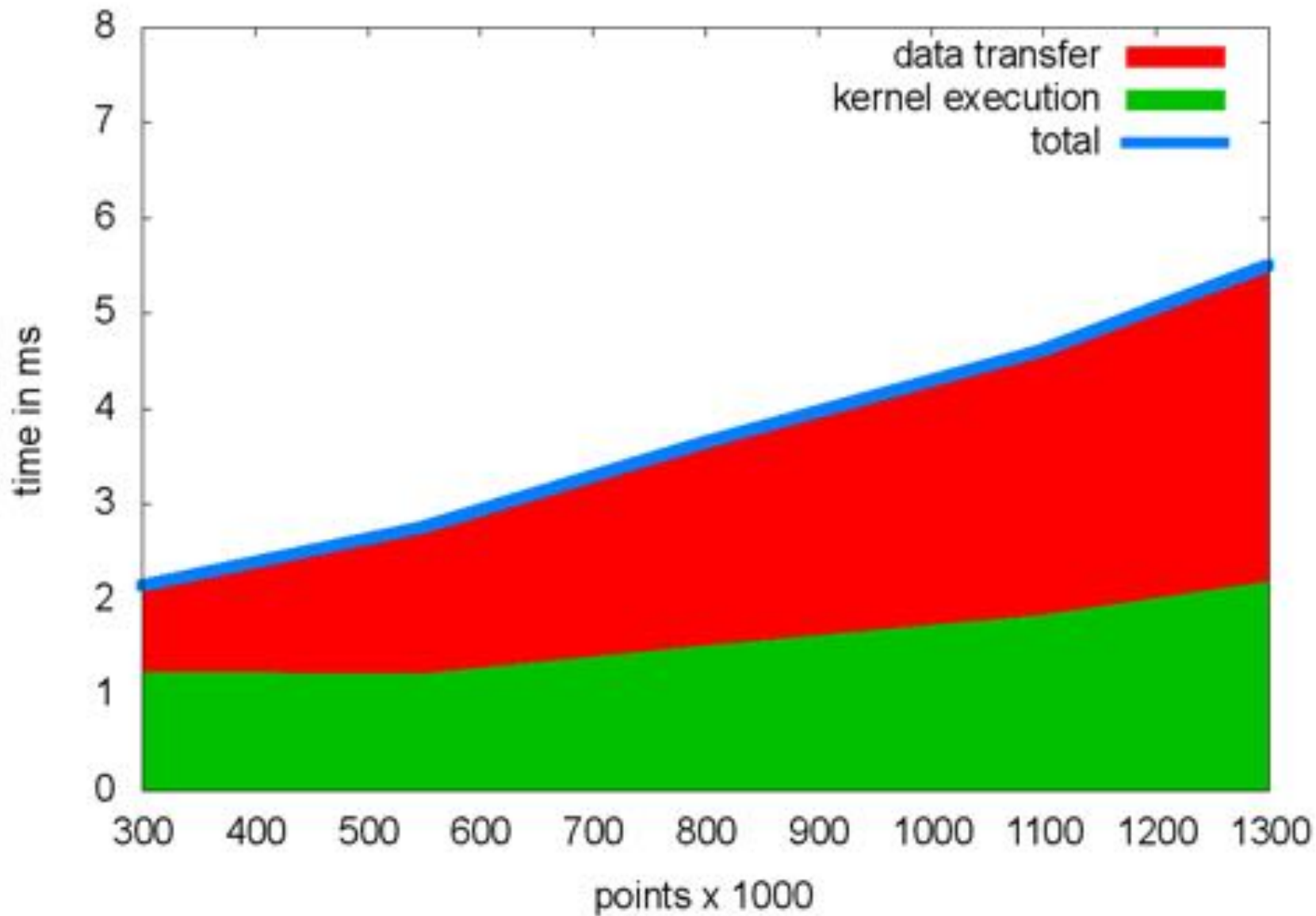
Improvement(?) 3: Pre-Filtering



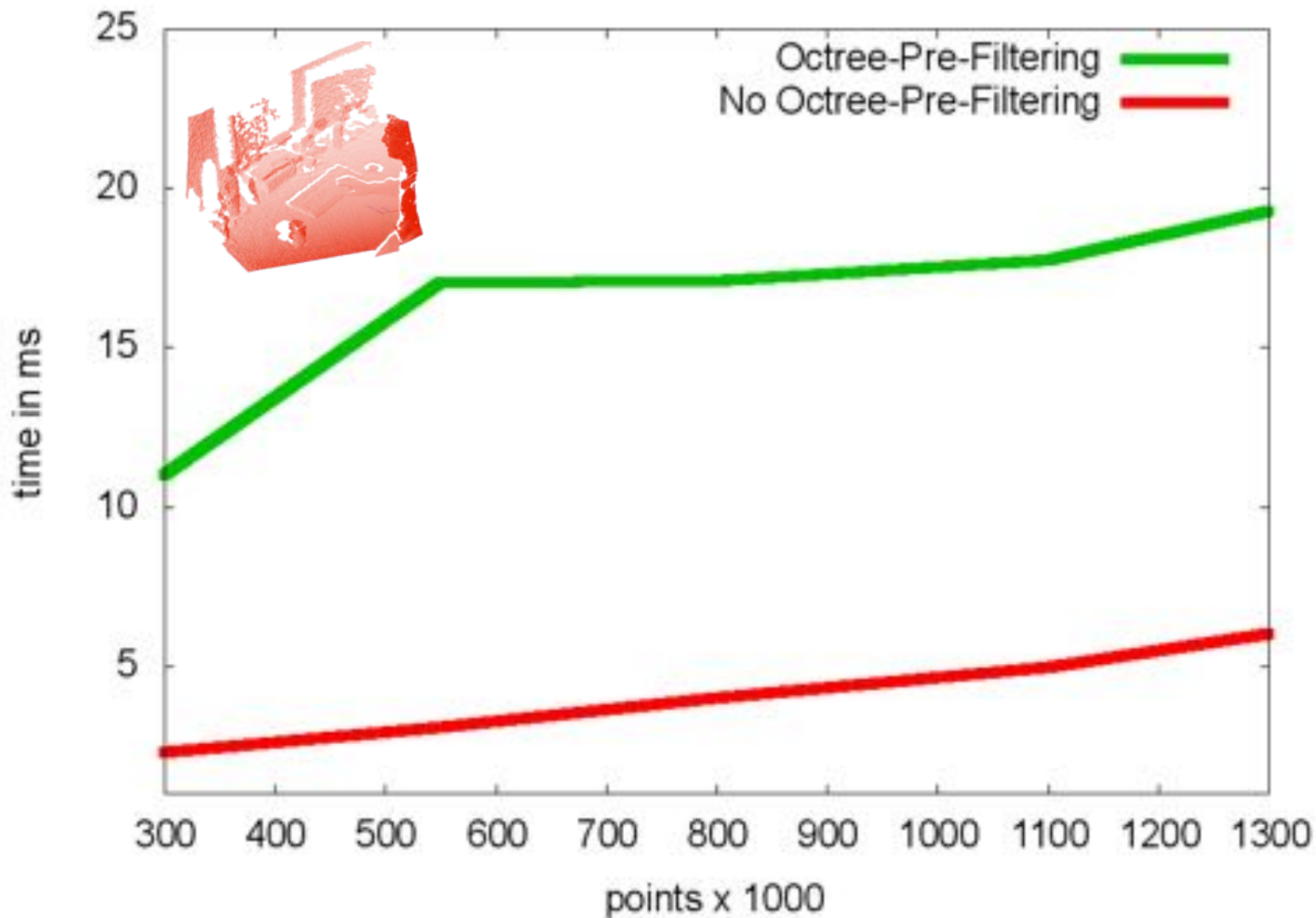
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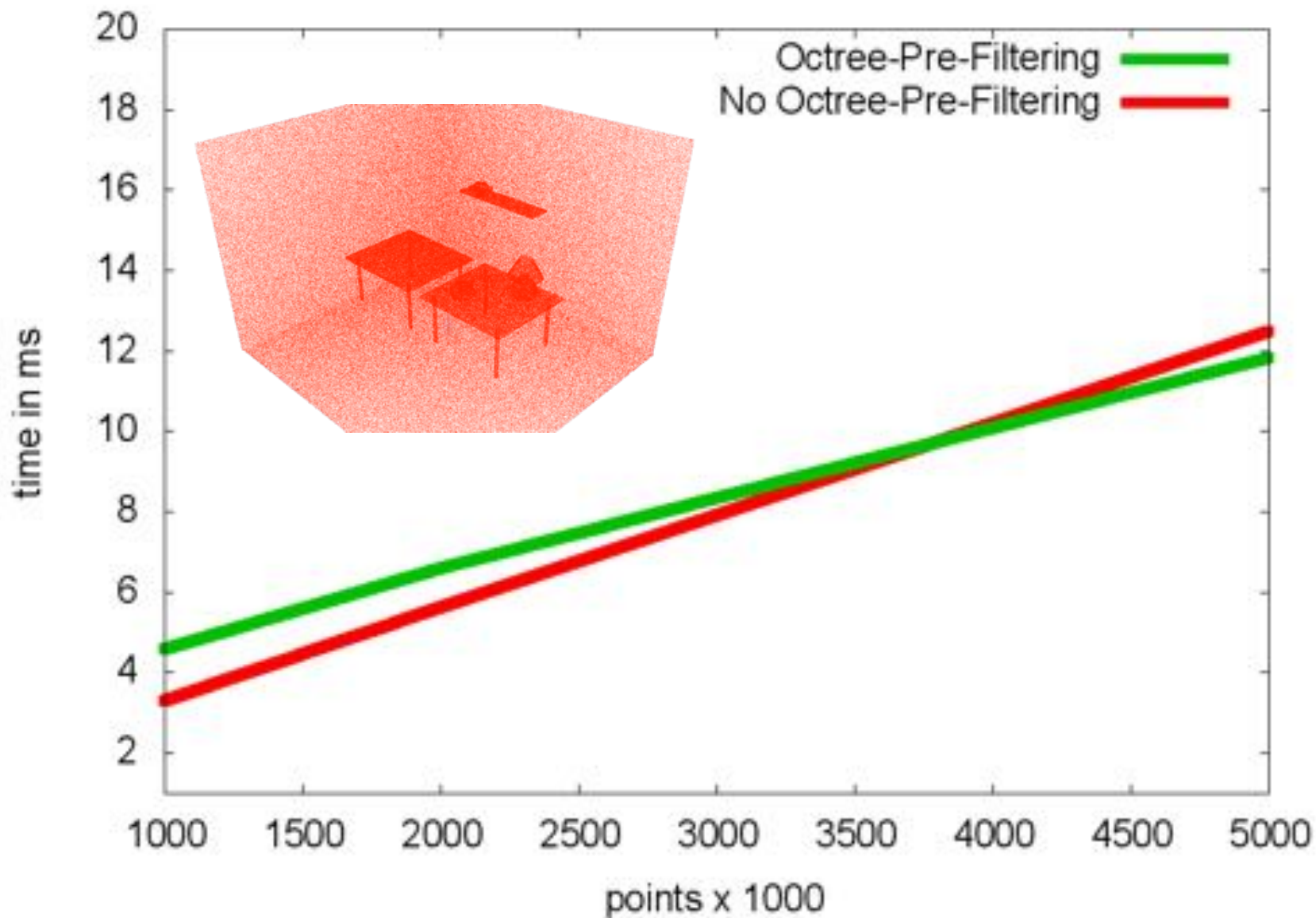
Improvement(?) 3: Pre-Filtering



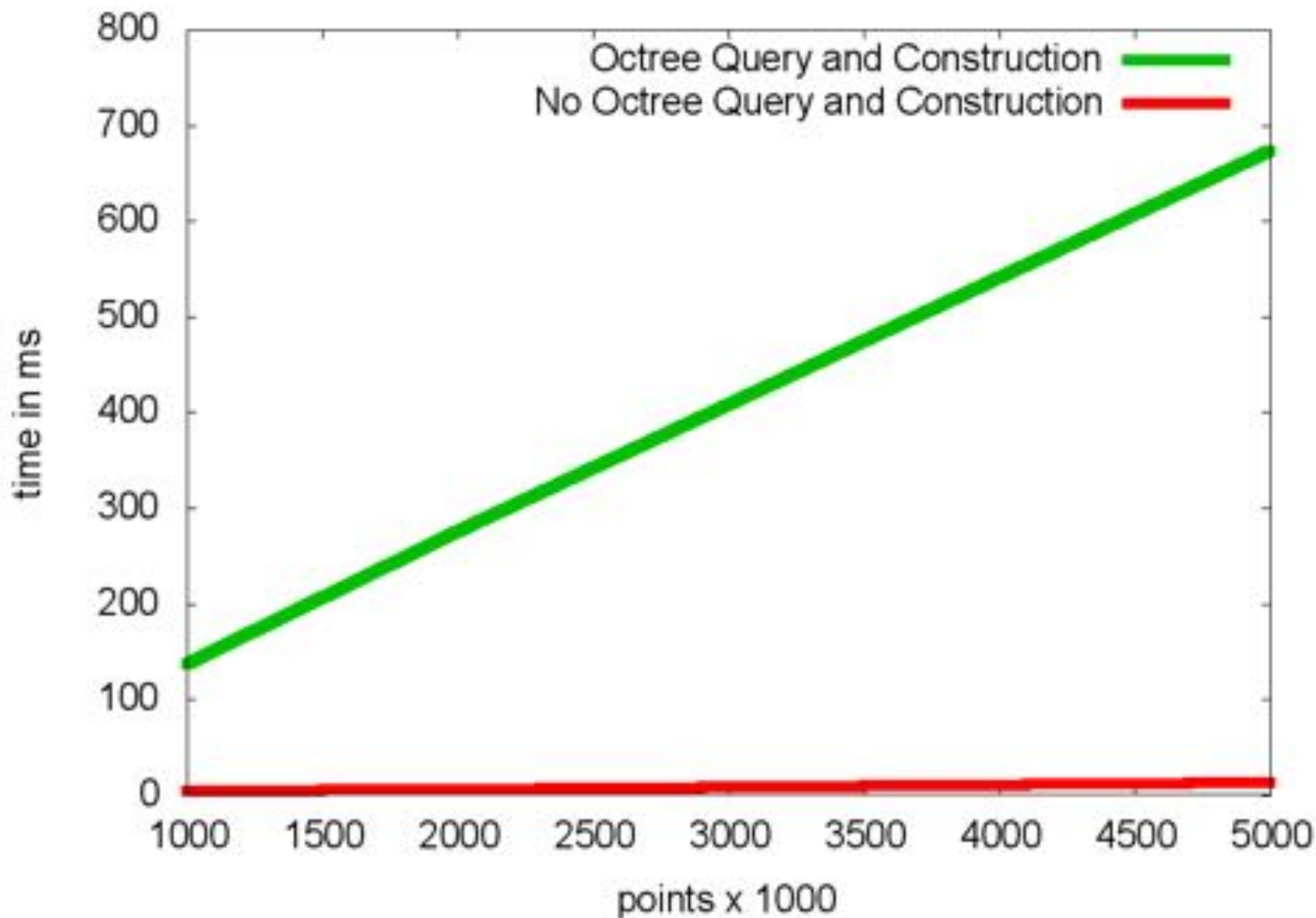
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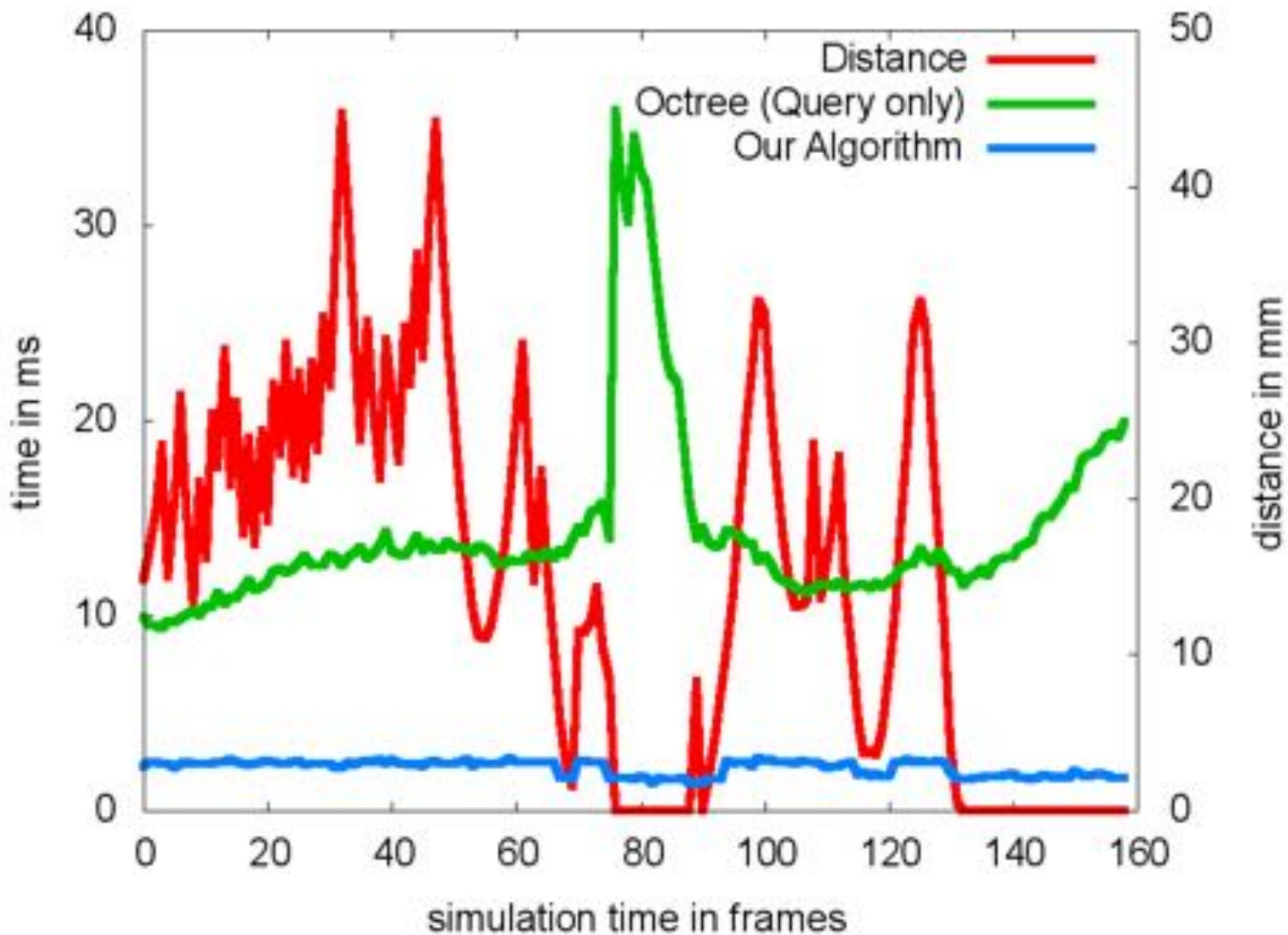
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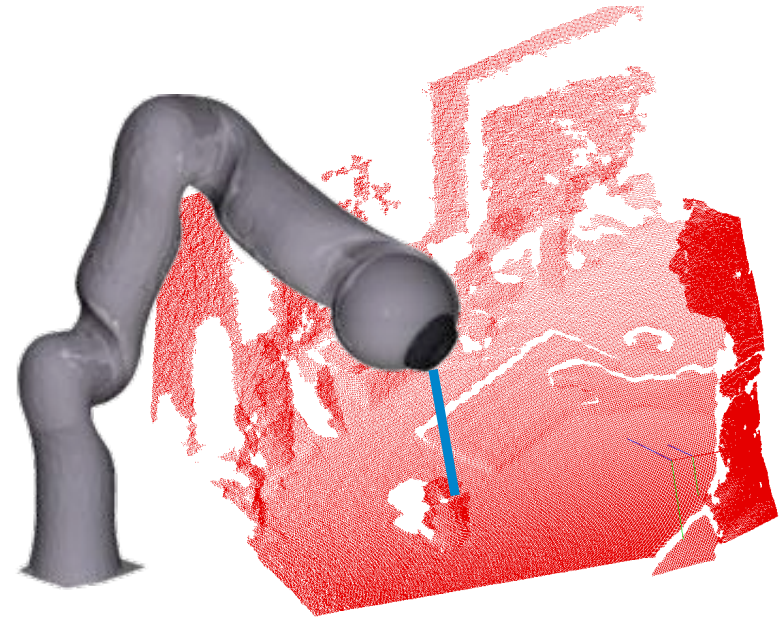
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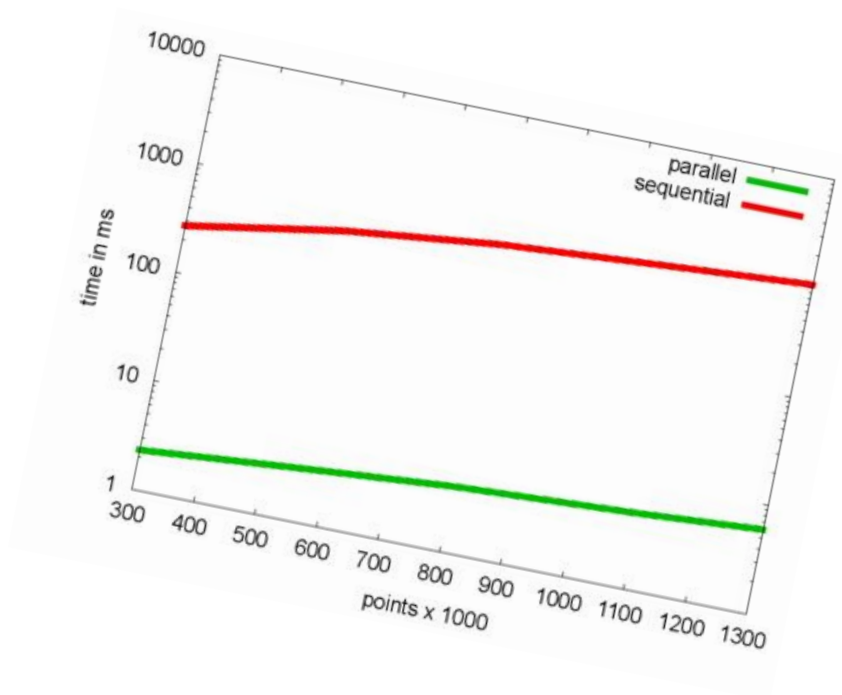
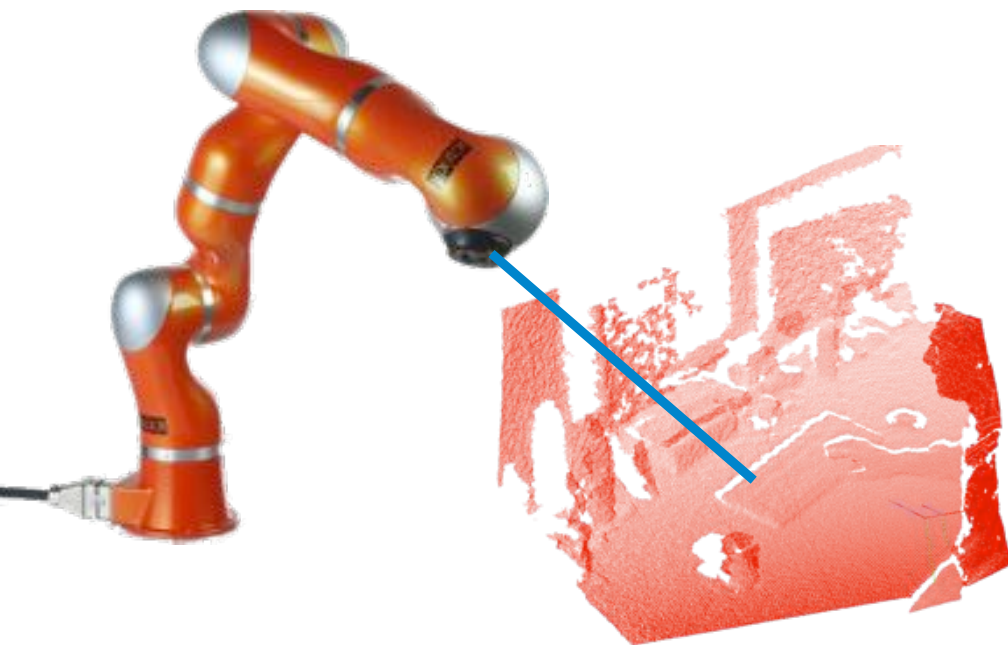


Conclusions and Future Work

- First algorithm to compute distances between CAD objects and point clouds in real-time
 - < 10 msec for 5M points
- Easy to implement, robust
- Sometimes, easier is better

- Faster pre-filtering
- Other applications
 - VR
 - Haptics
 - Path-planning





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