A LOD-Sprite Technique for Accelerated Terrain Rendering

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Outline

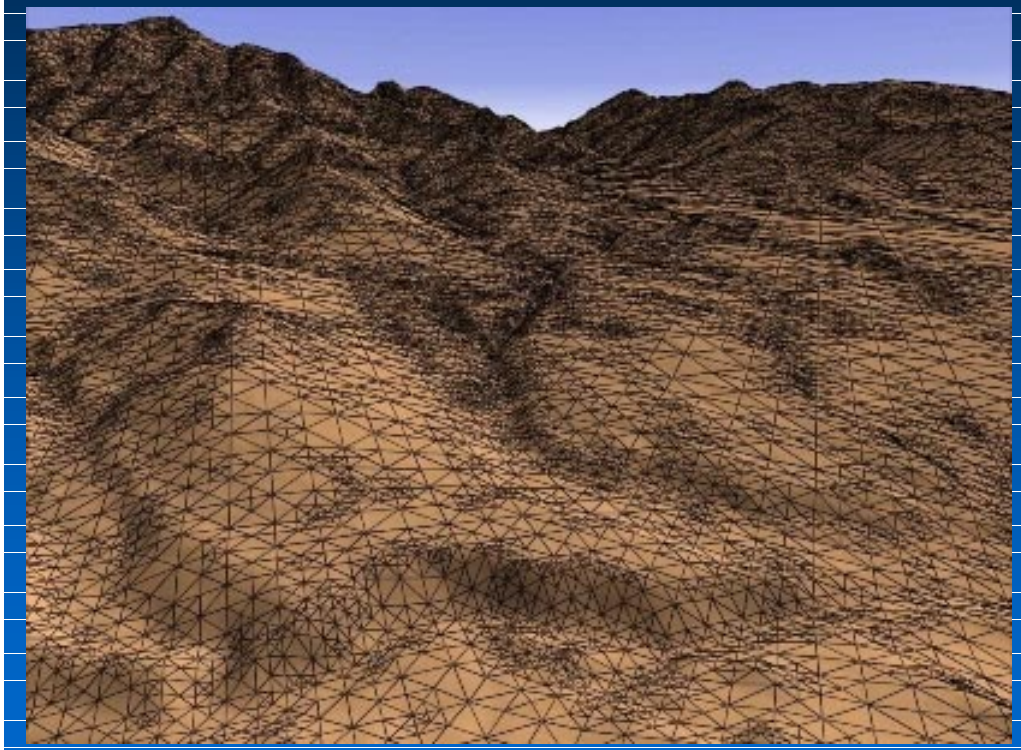
- Introduction
- LOD-Sprite Algorithm
- Error Metrics
- Visibility Detection
- Results
- Continued Work

Introduction

Dragon System

Introduction

Level-Of-Detail
(Lindstrom et al.’96)



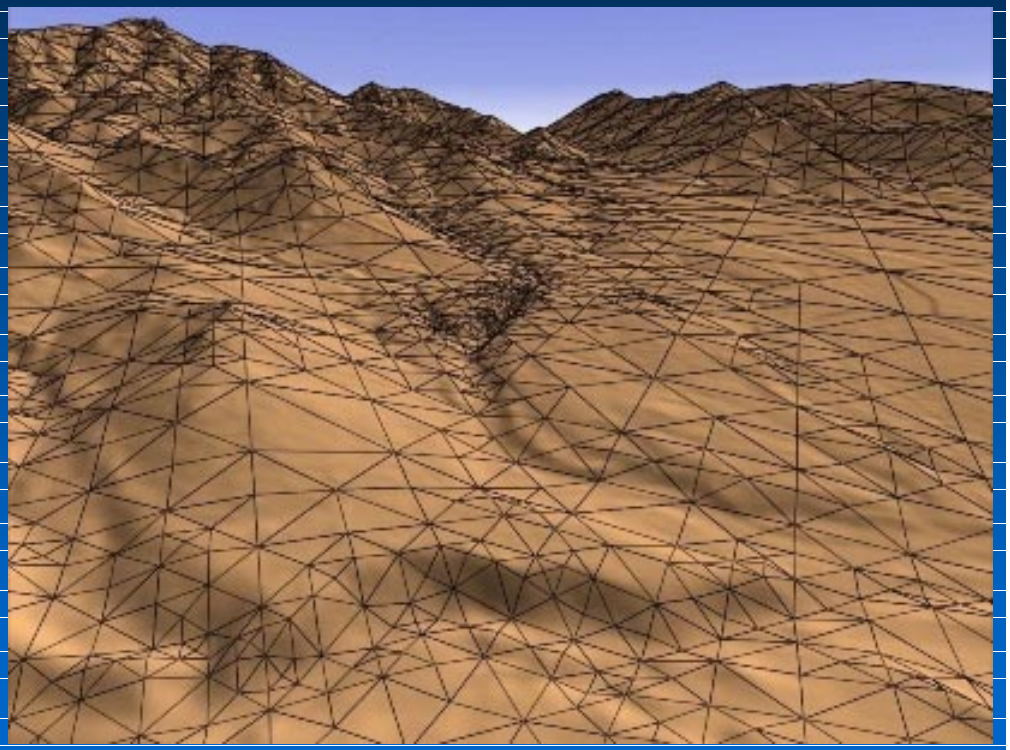
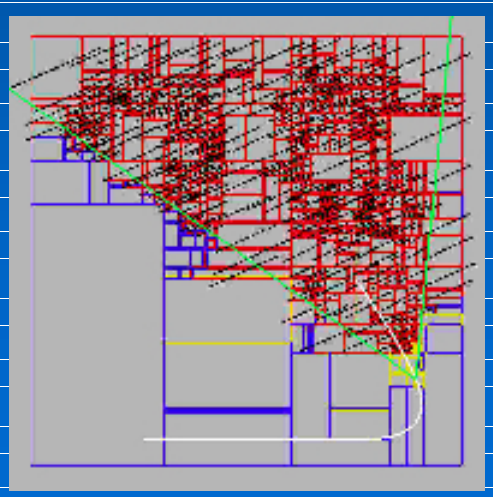
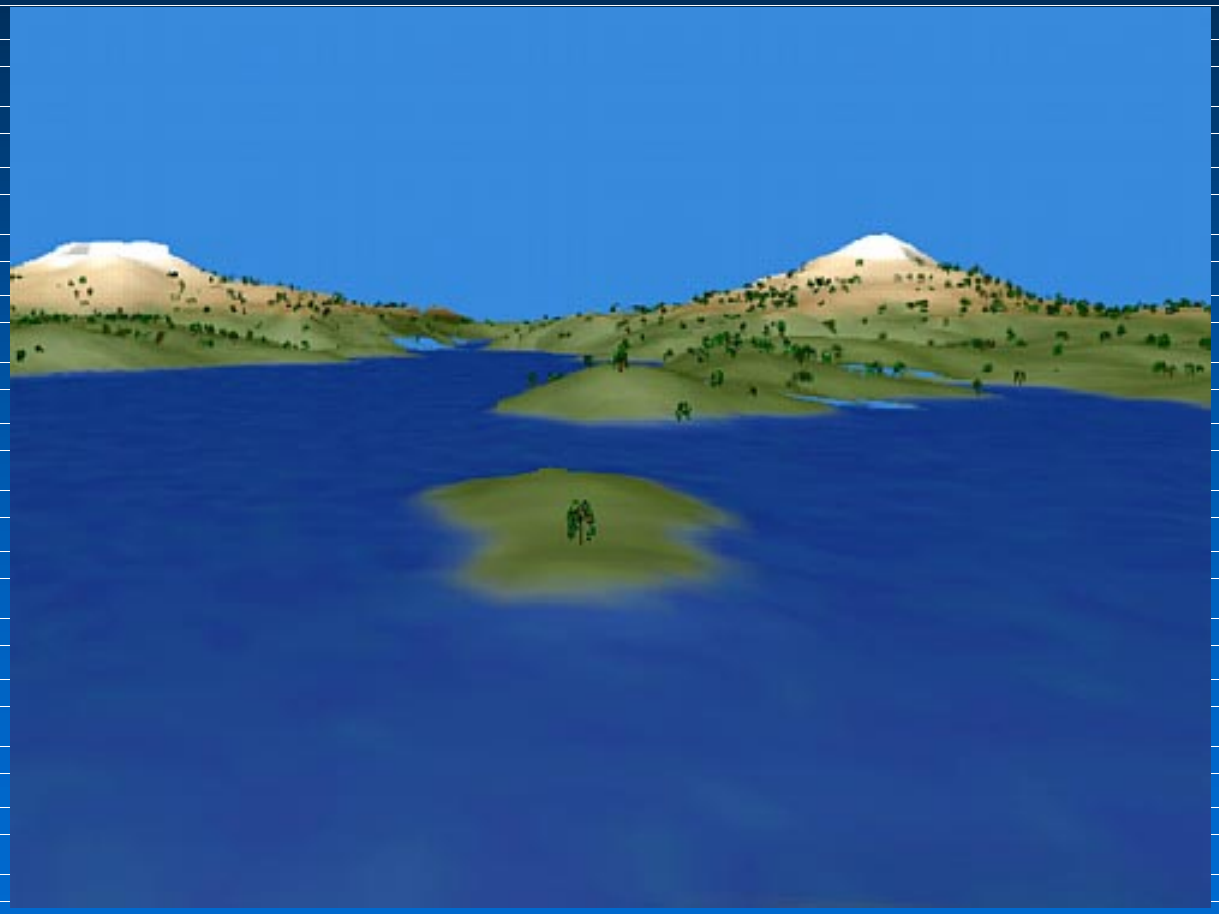
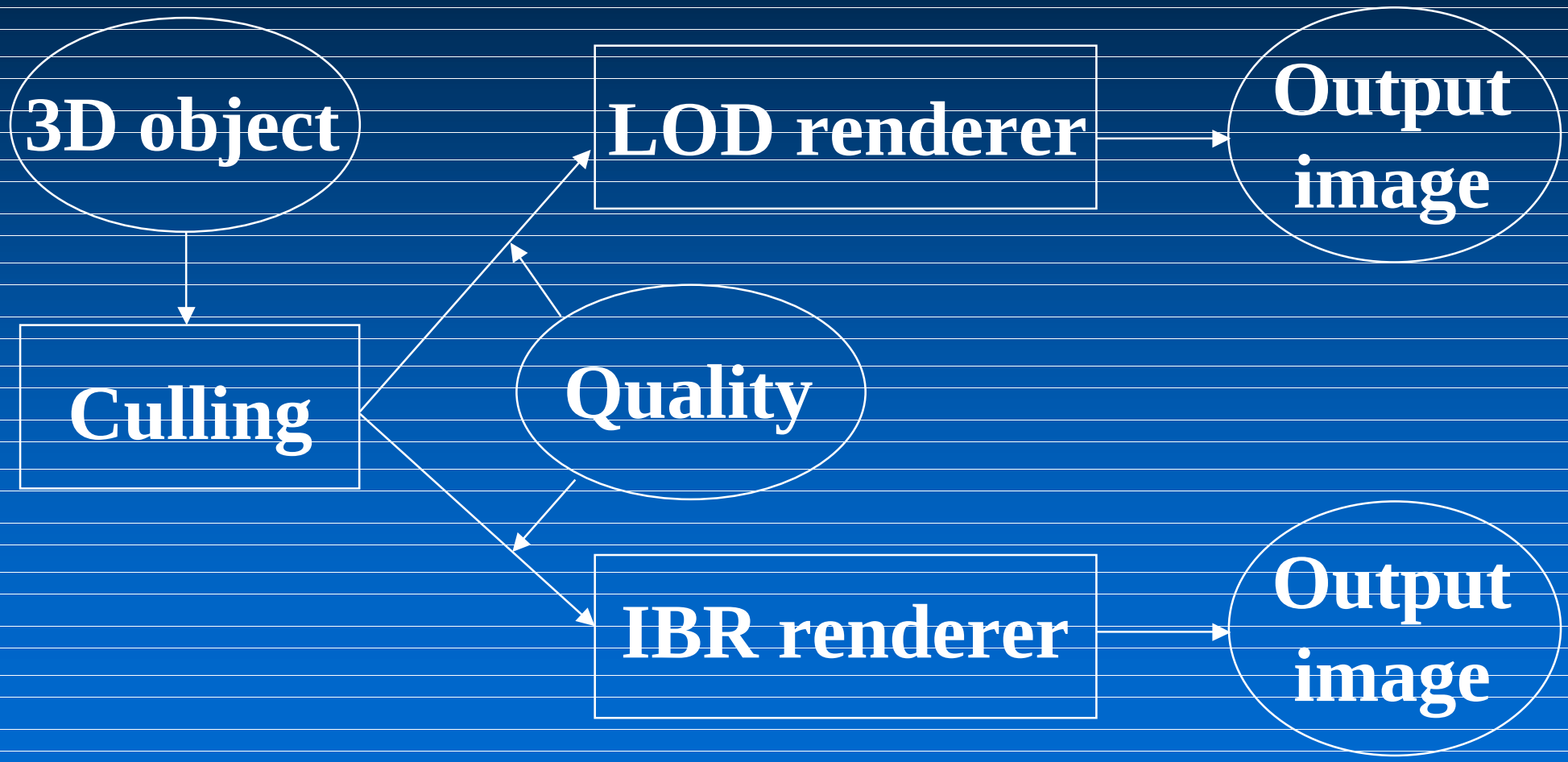


Image-based Rendering
(Shade et al.’96)

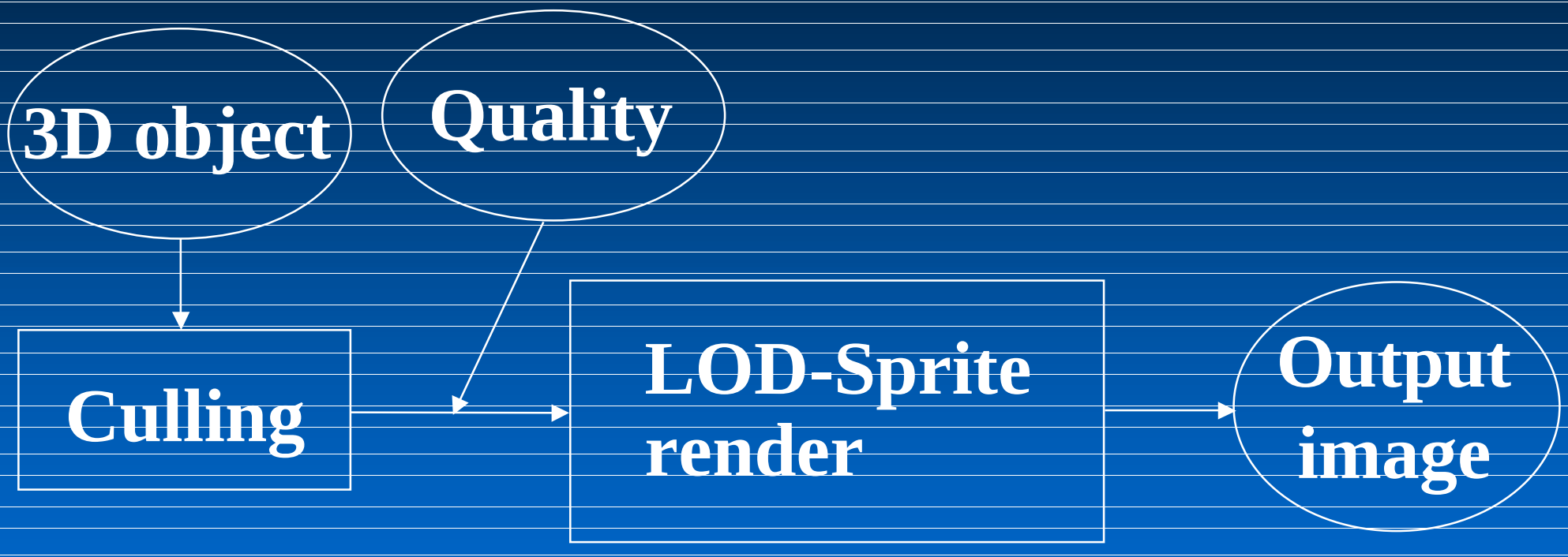




Traditional Approaches



Our Approach



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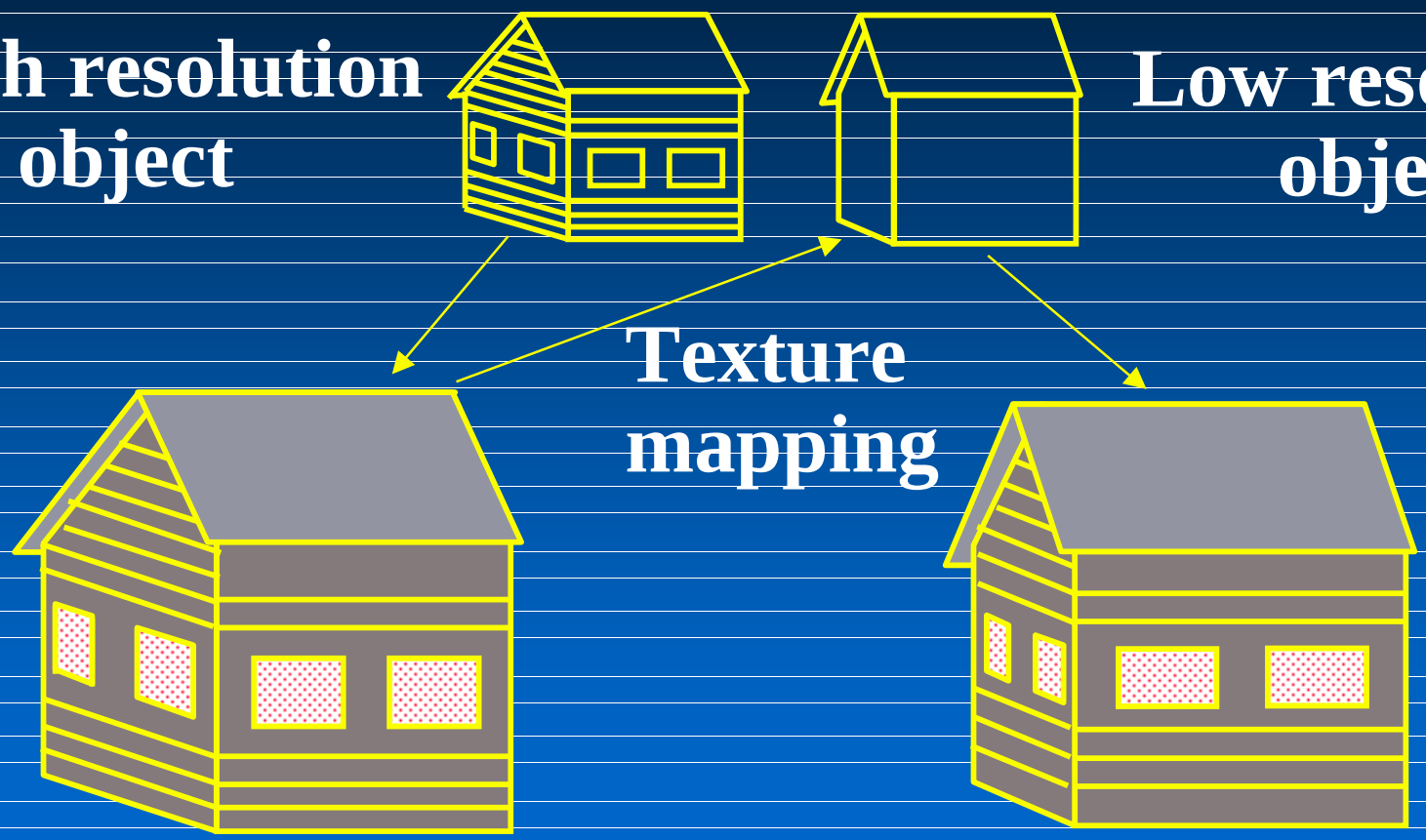
LOD-Sprite Algorithm

Central Idea



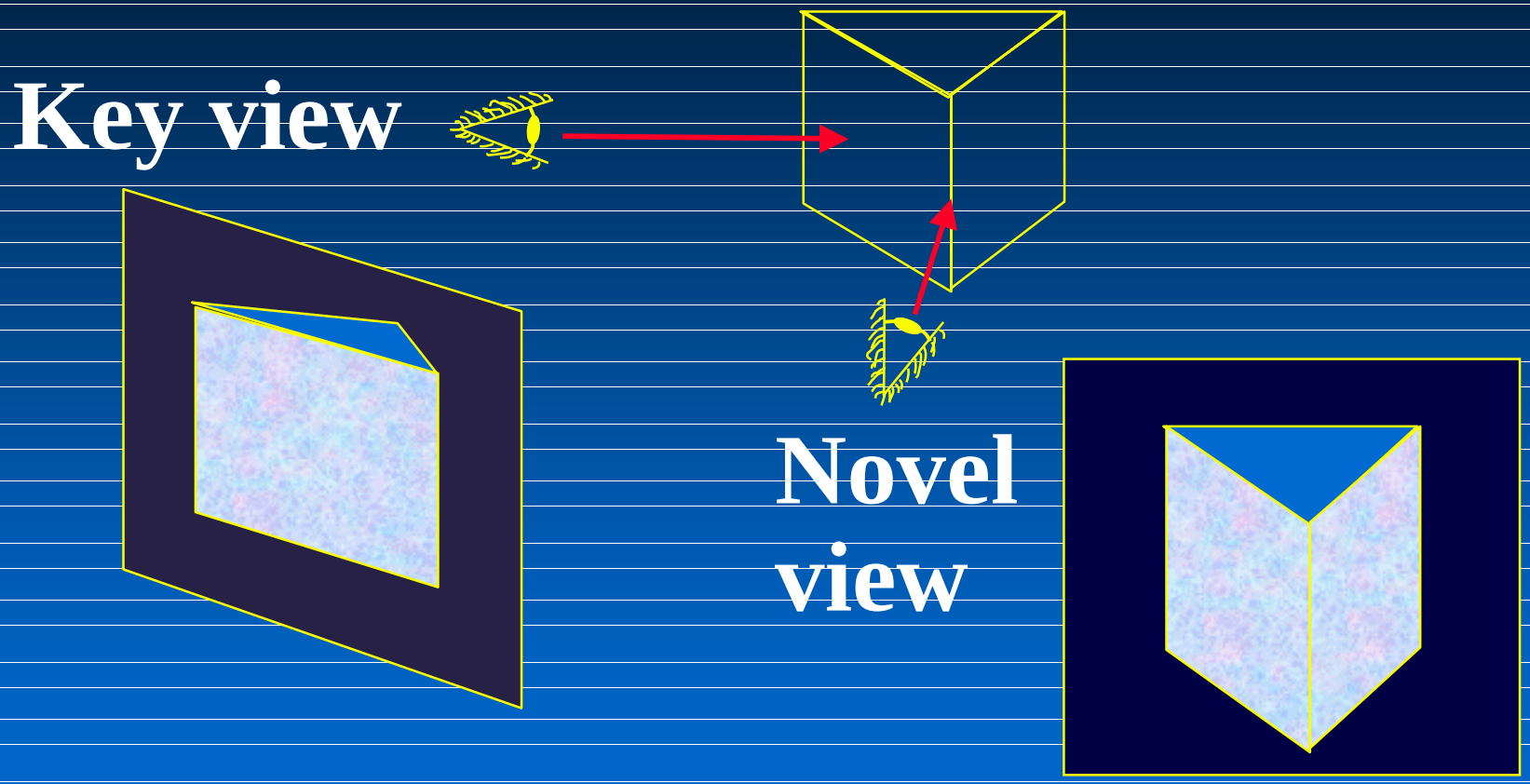
LOD-Sprite Algorithm

Pseudo Code

```
render sprite image ( high-mesh, vp )
for each novel viewpoint vp
    let error = ErrorMetric ( vp, sprite )
    if error > threshold then
        render sprite image ( high-mesh, vp )
    else
        let polys = set of low-mesh polygons
        for each poly
            if WasVisible ( poly, sprite ) then
                render poly, map with sprite
            else
                render poly, map with original texture
```

LOD-Sprite Algorithm

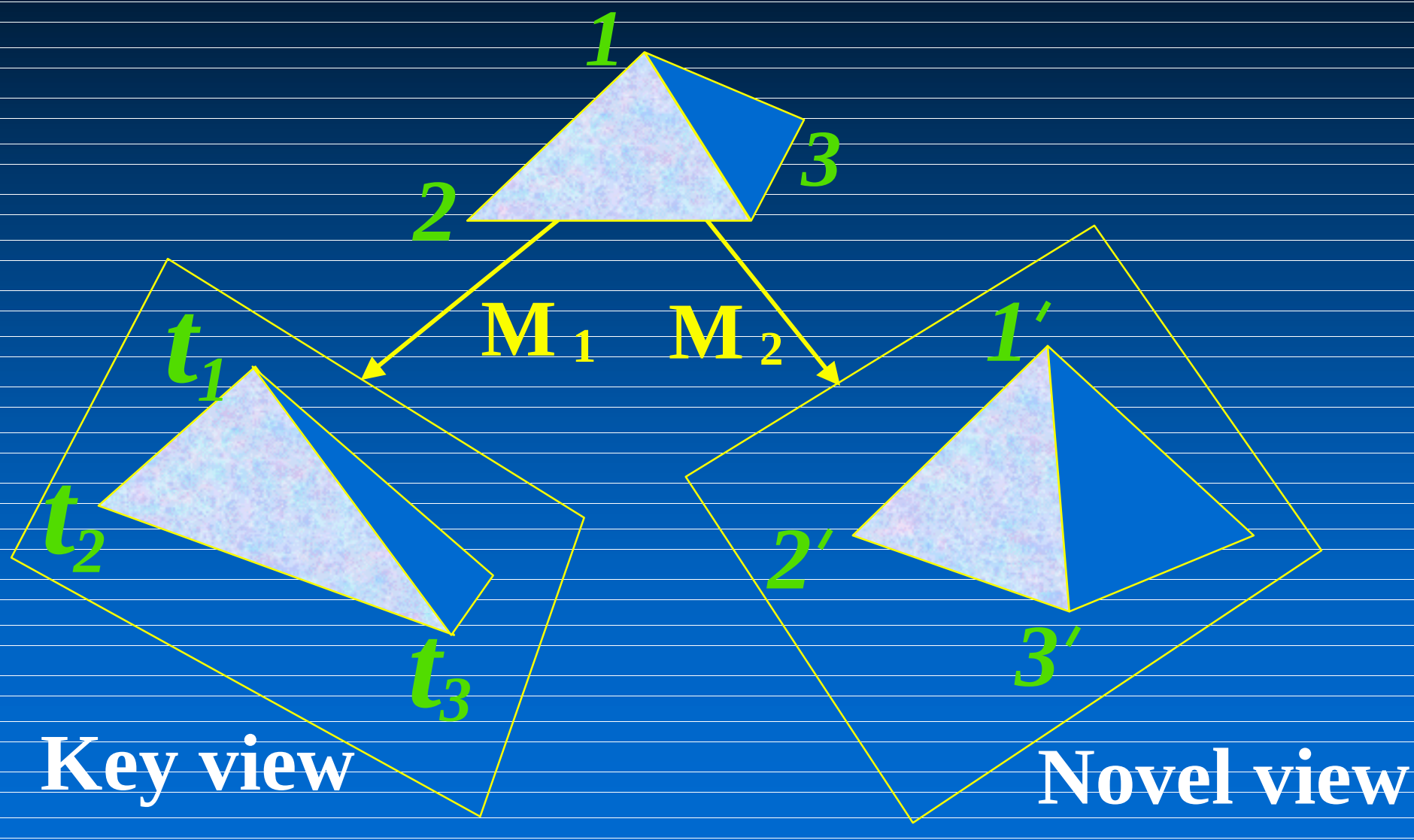
Texture Mapping



Projective texture mapping

LOD-Sprite Algorithm

Texture Mapping



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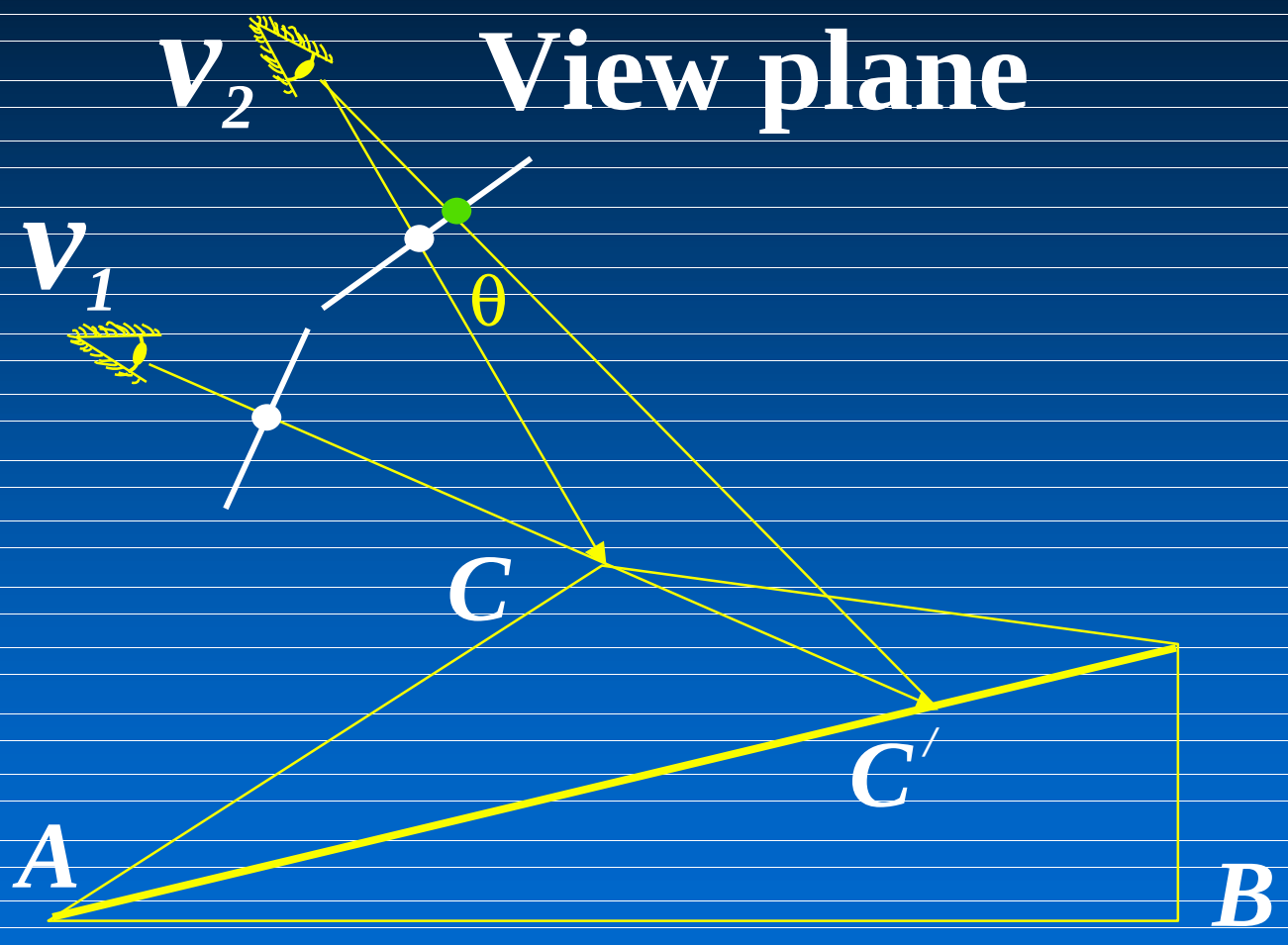
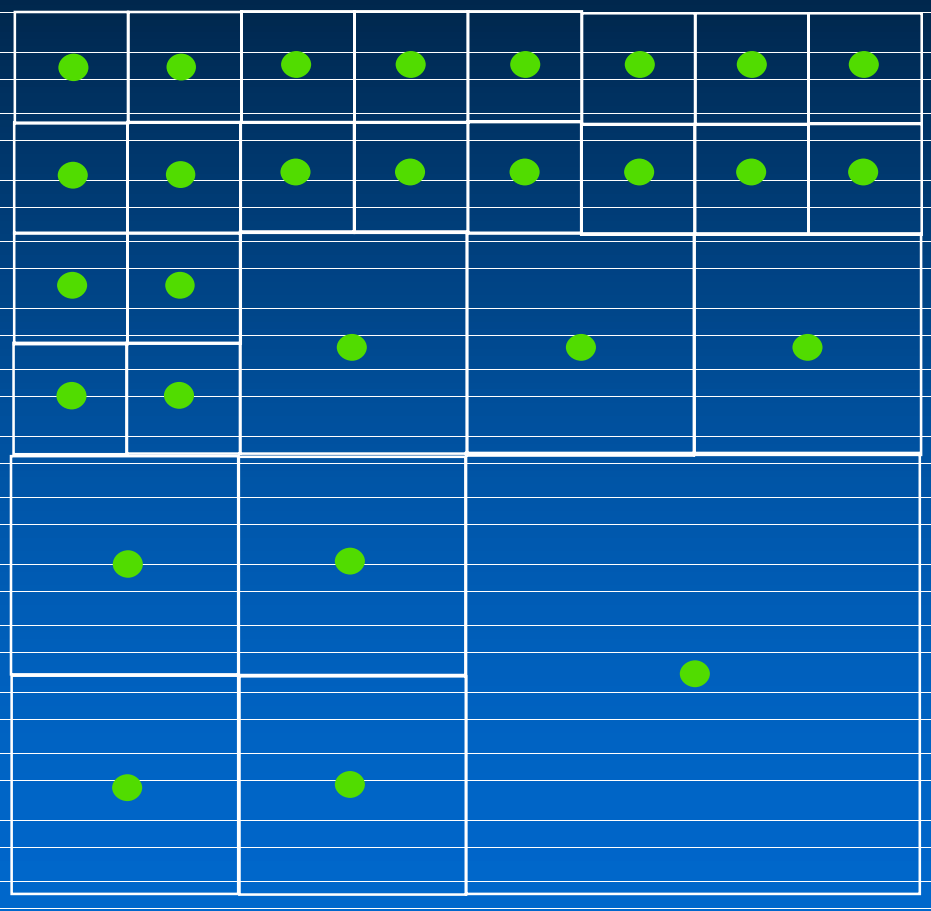
Error Metrics



Criteria:

$$\theta < \beta \cdot \varepsilon$$

Error Metrics



Evaluation:

$$\frac{\sum_{i=1}^{n} \theta_i^2}{n} < (\beta \cdot \varepsilon)^2$$

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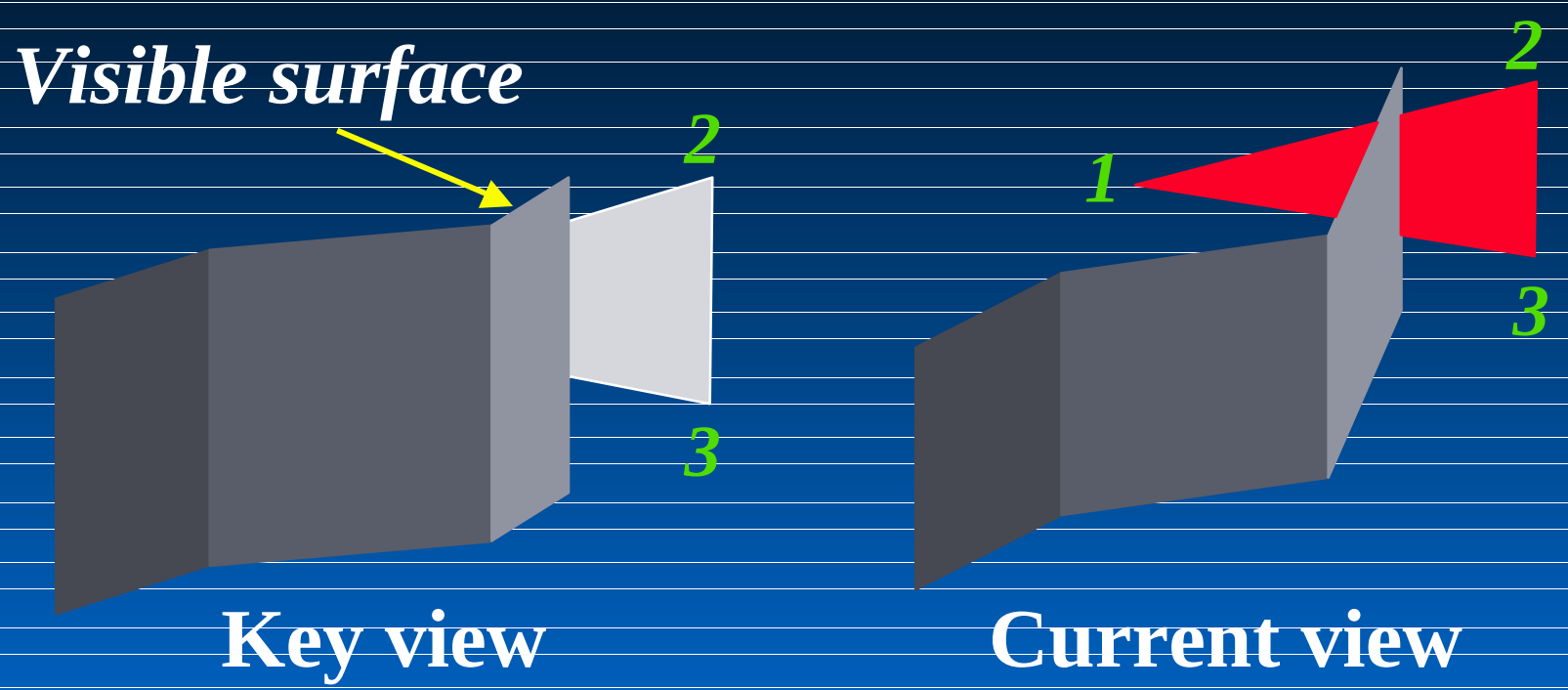
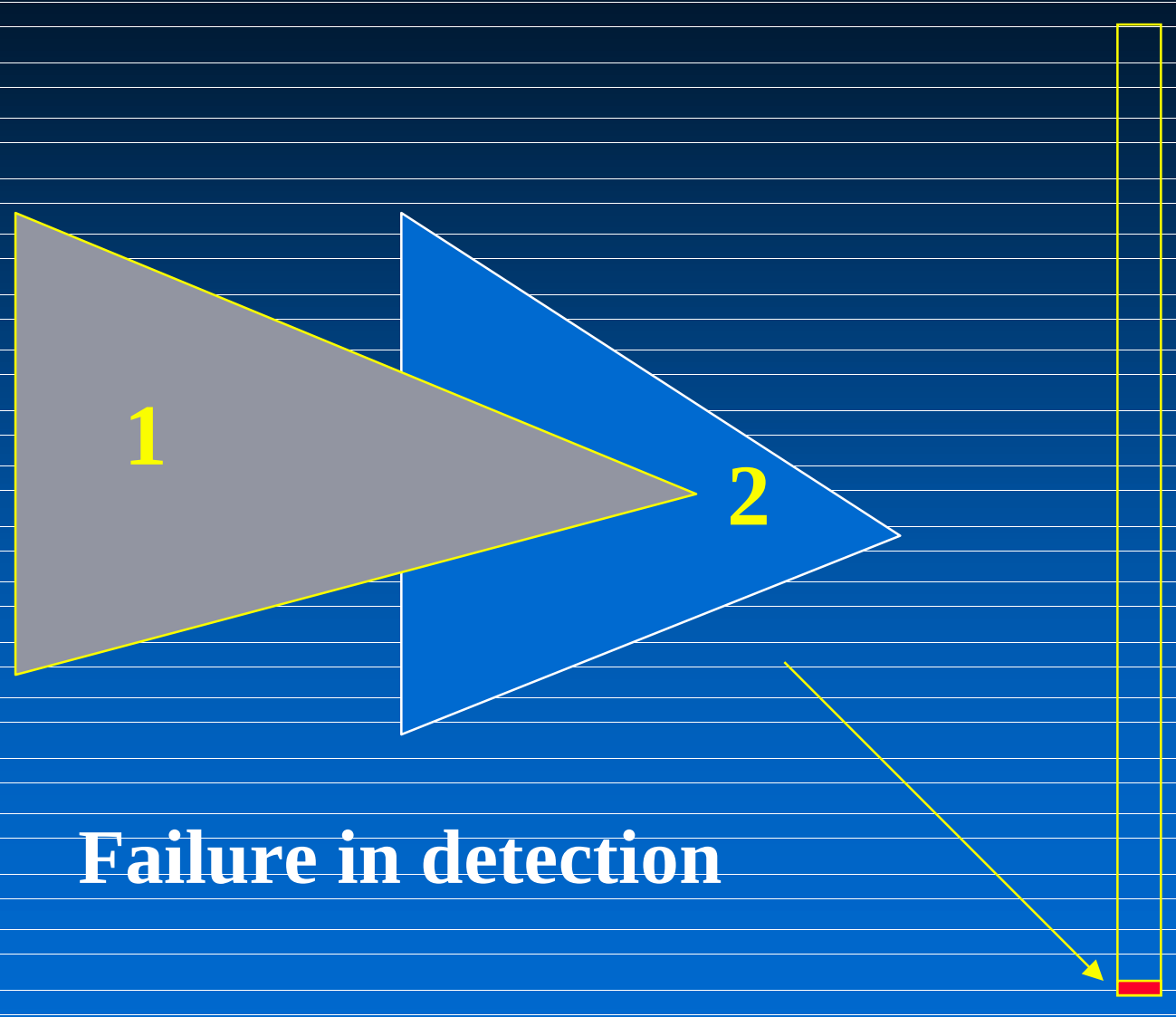
Visibility Detection



Visible ($\triangle_{123}$)

= Visible (*1*) *and* Visible (*2*) *and* Visible (*3*)

Visibility Detection



Failure in detection

Visibility Detection

Z-buffer

$$z_{vertex} - z_{buffer} \mid < \varepsilon$$

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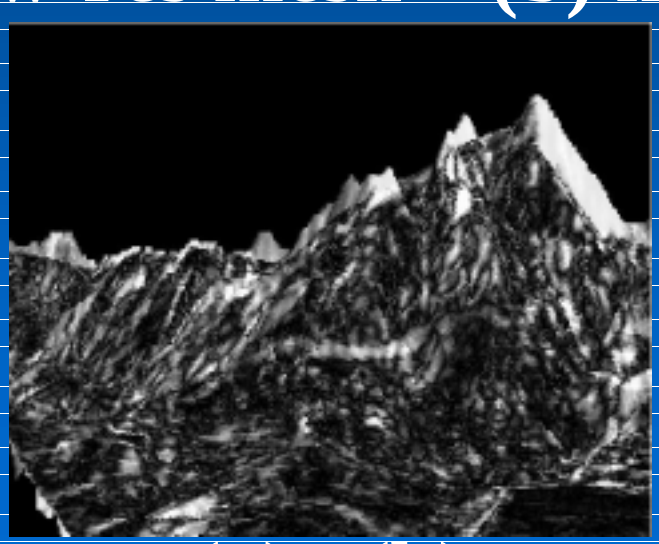
Results

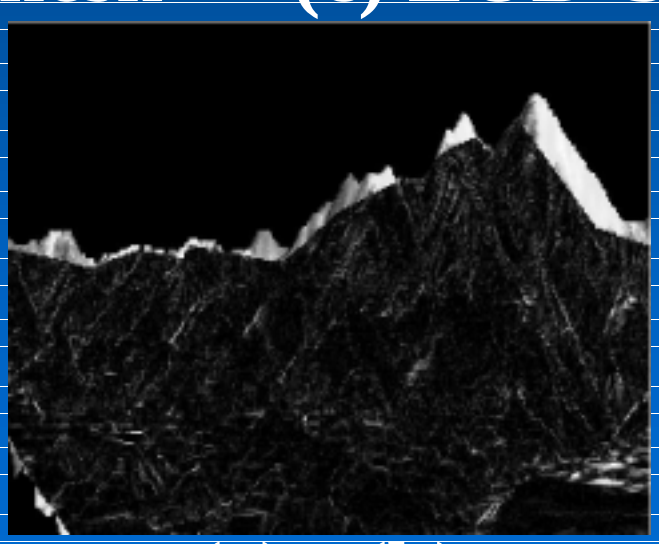
(a) low-res mesh

(b) high-res mesh

(c) LOD-Sprite

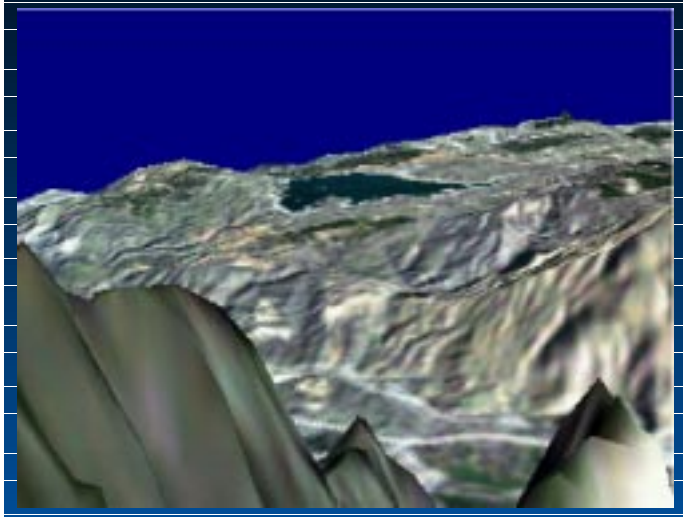


(a) - (b)



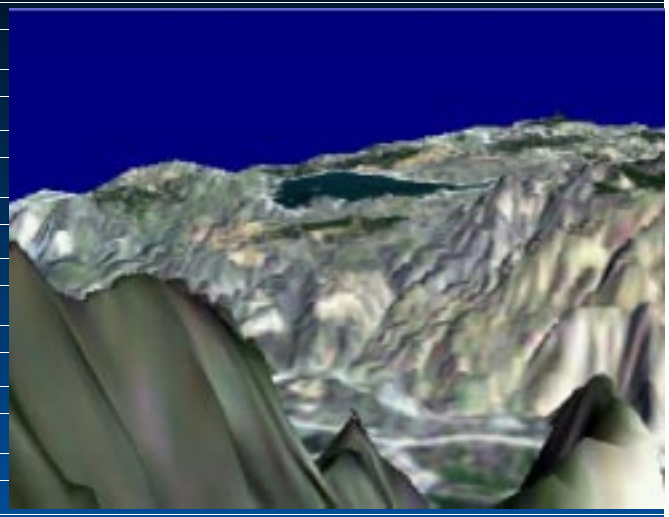
(c) - (b)

Results

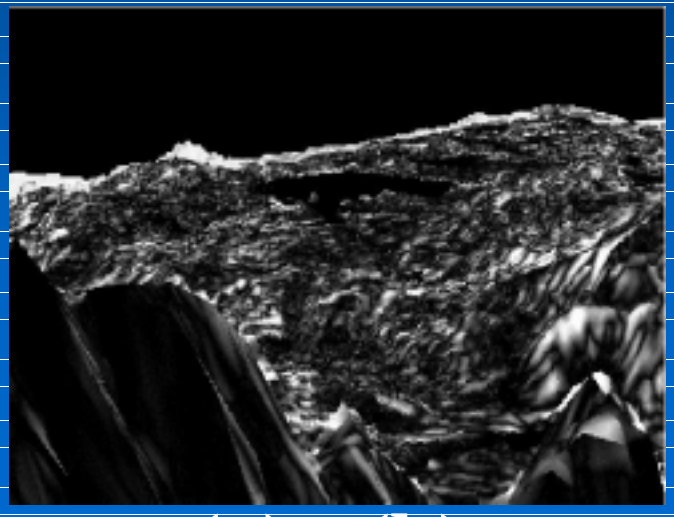


(a) low res

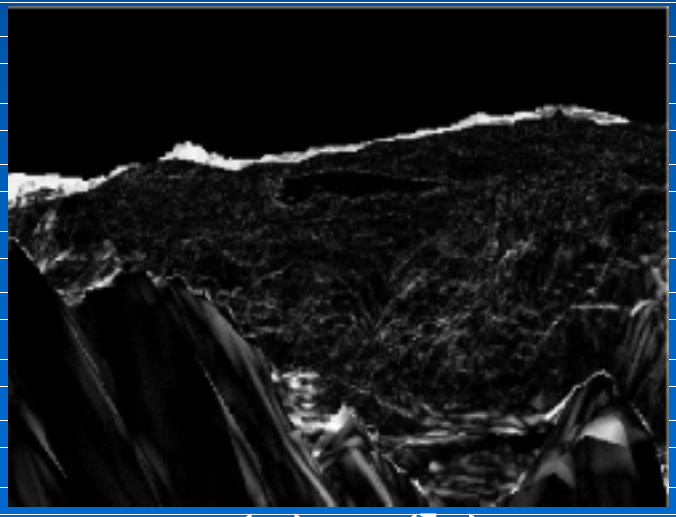
(b) high res



(c) LOD-Sprite



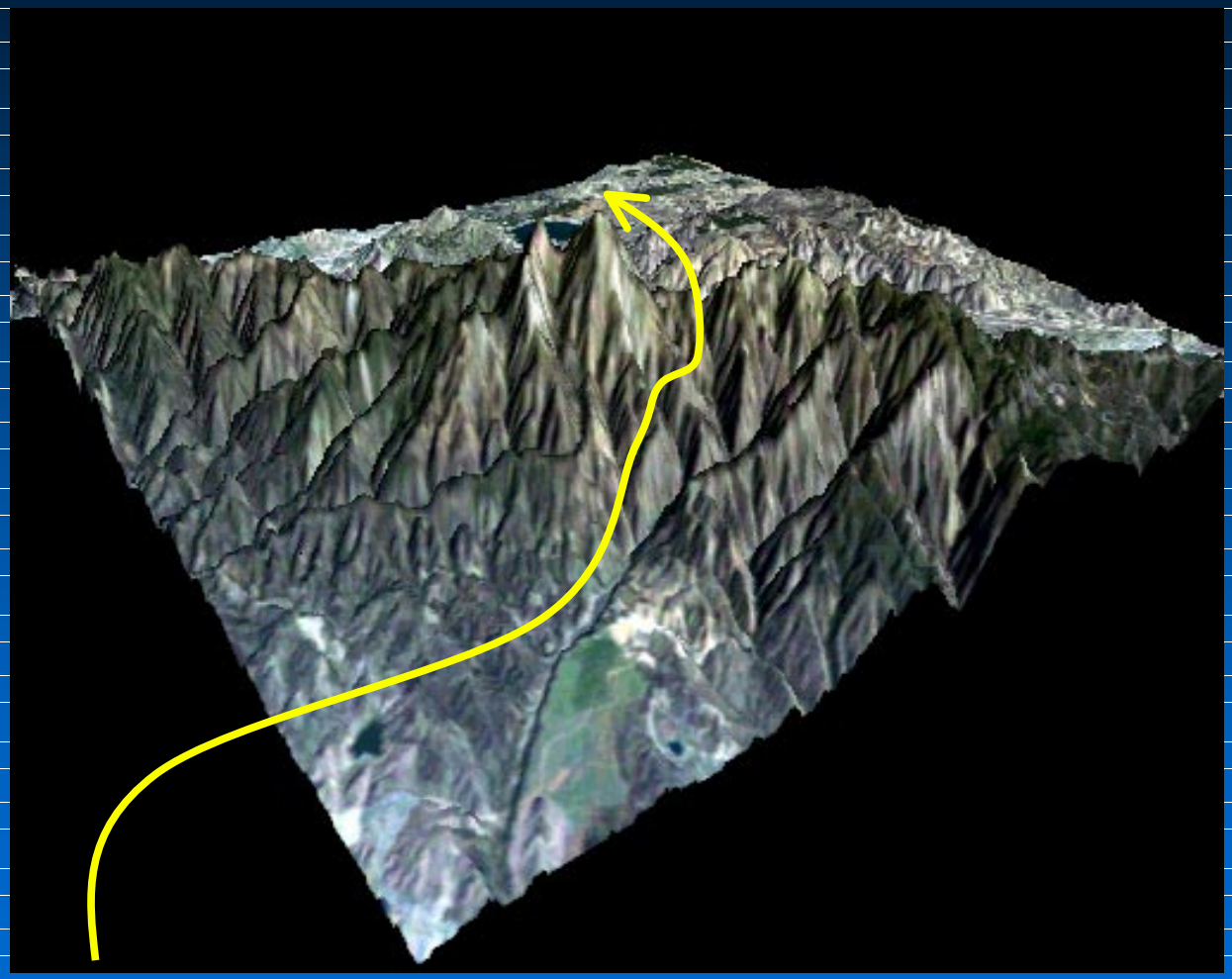
(a) - (b)



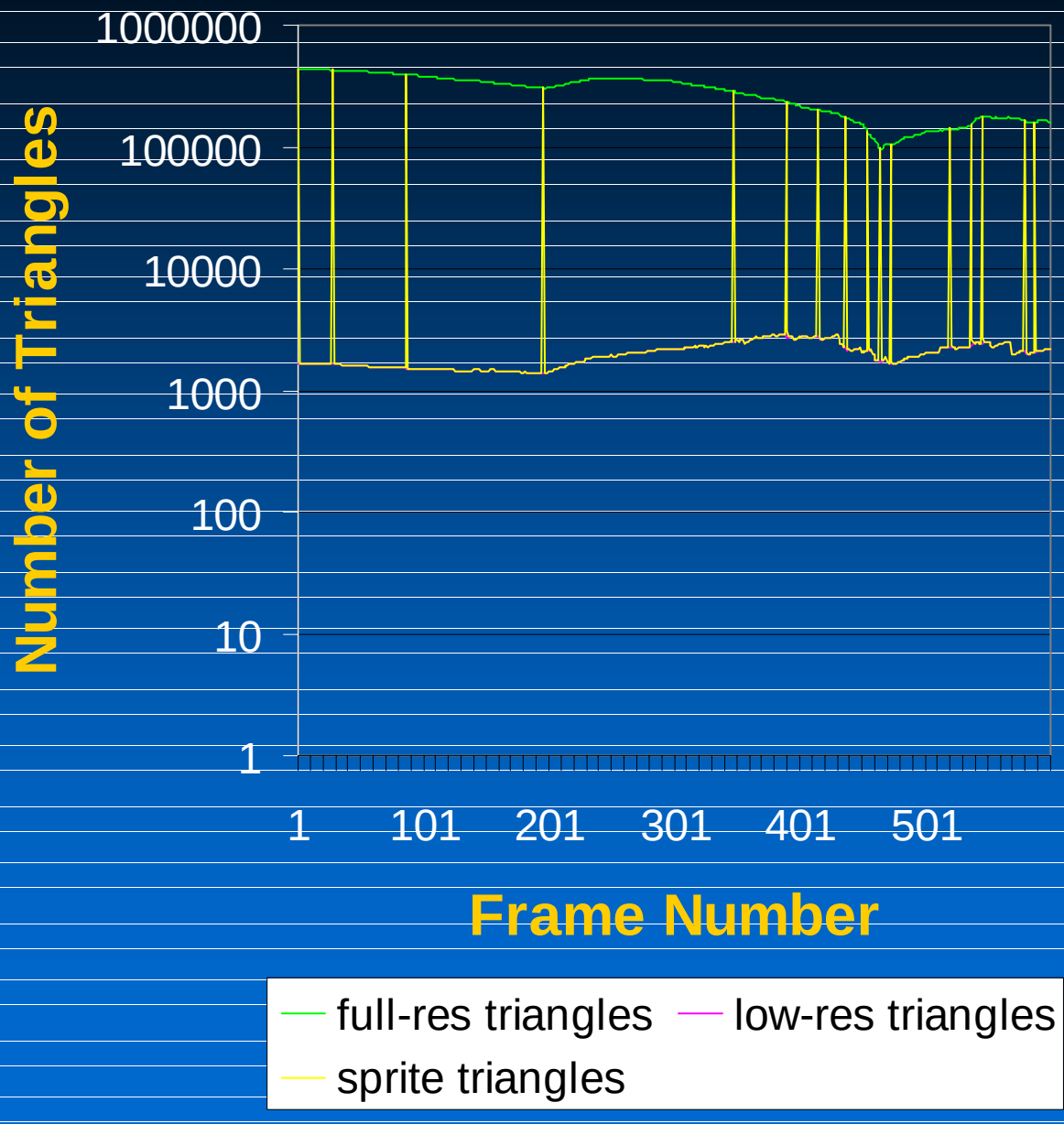
(c) - (b)

Results

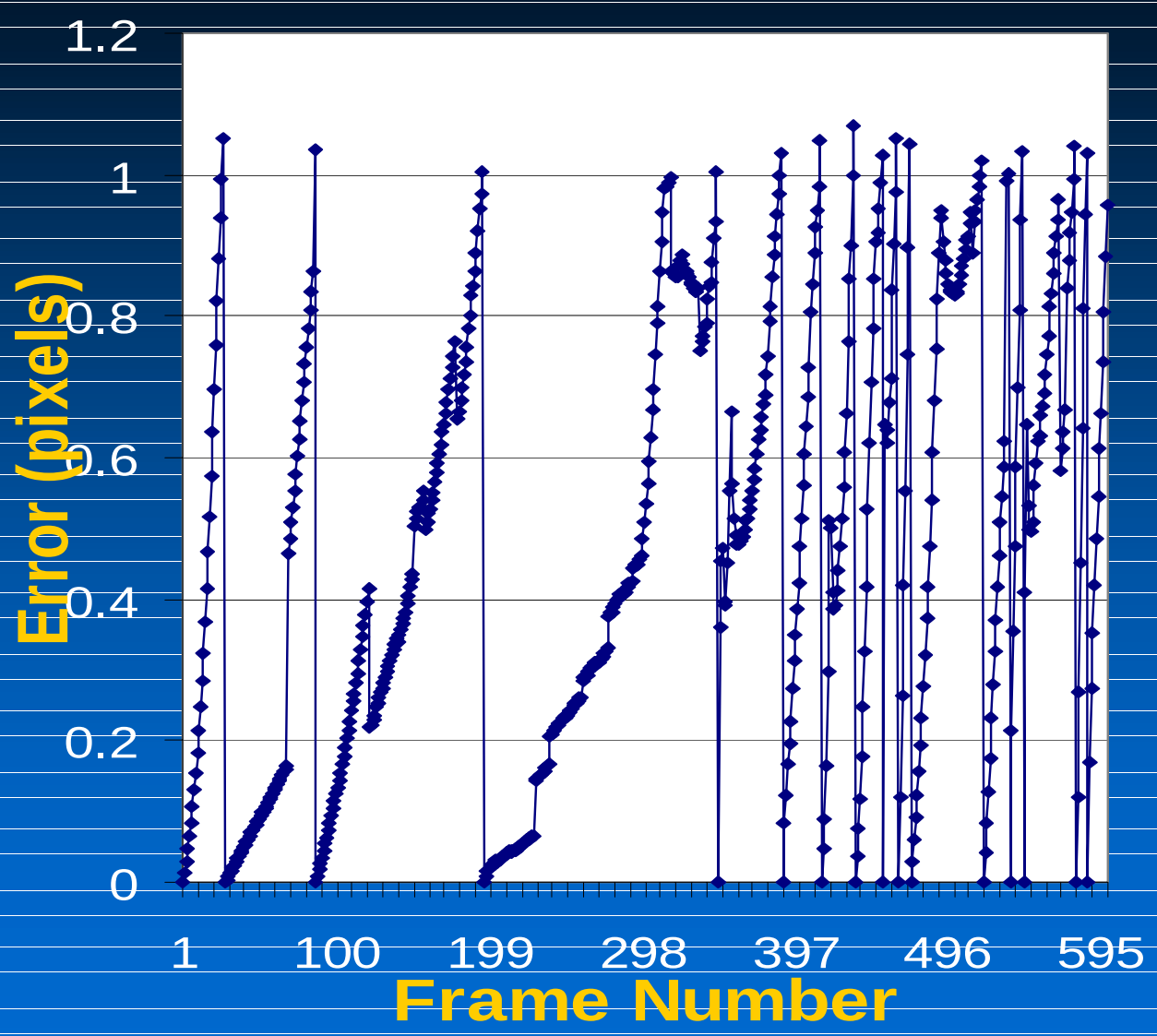
Navigation Path



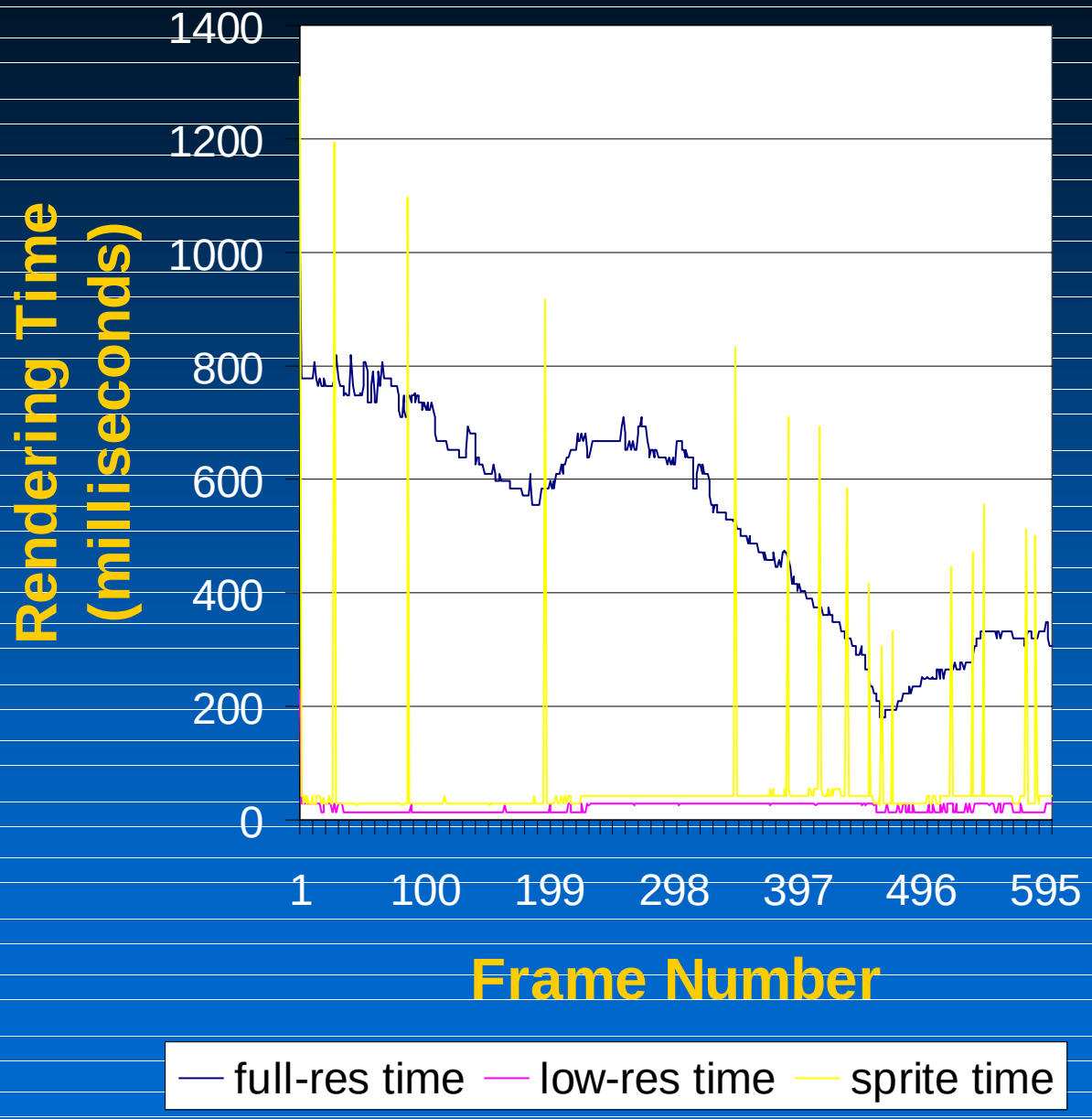
Results


1000000
100000
10000
1000
100
10
1
Number of Triangles
1
101
201
301
401
501
Frame Number
full-res triangles
low-res triangles
sprite triangles

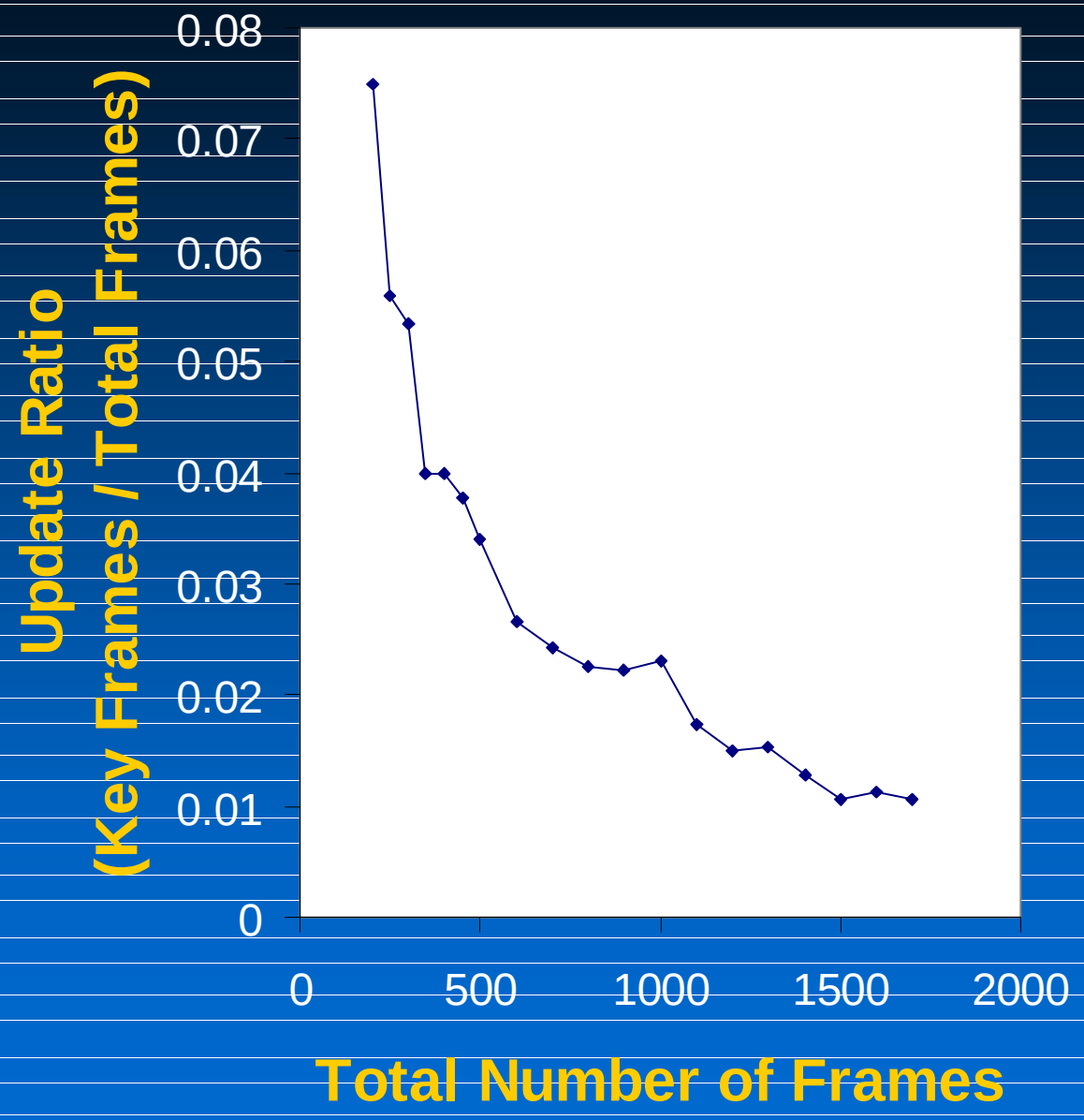
Results


1.2
1
0.8
0.6
0.4
0.2
0
Error (pixels)
1
100
199
298
397
496
595
Frame Number

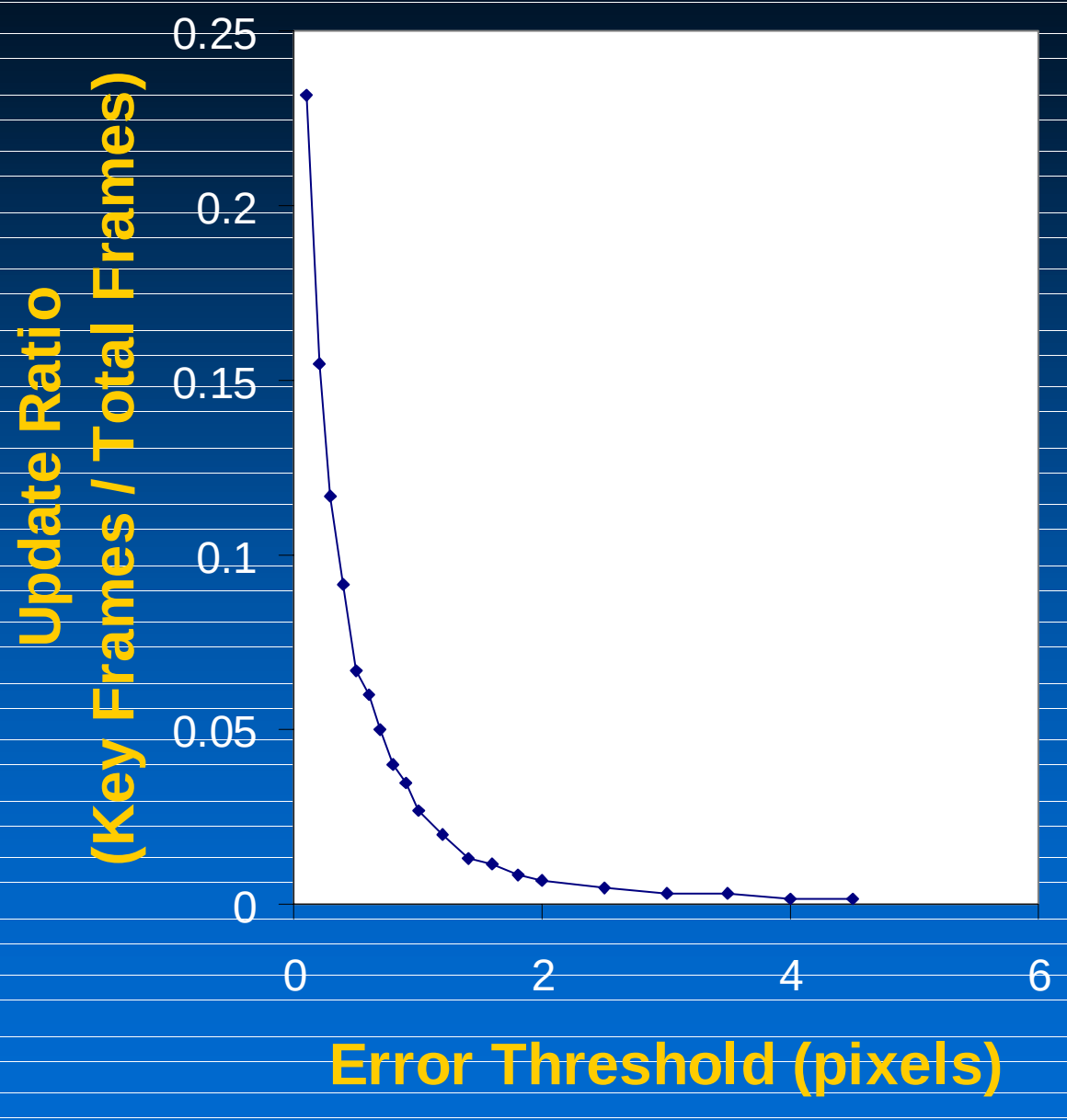
Results


1400
1200
1000
800
600
400
200
0
Rendering Time (milliseconds)
1
100
199
298
397
496
595
Frame Number
full-res time
low-res time
sprite time

Results


Update Ratio
(Key Frames / Total Frames)
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
0
500
1000
1500
2000
Total Number of Frames

Results


Update Ratio
(Key Frames / Total Frames)
0.25
0.2
0.15
0.1
0.05
0
0
2
4
6
Error Threshold (pixels)

Results

Results

Video

Latest Work

1. Better visibility detection method
2. Better silhouette preserving LOD method
3. Path prediction

Acknowledgements

Sponsors:

National Science Foundation

Office of Naval Research

Naval Research Laboratory

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Hewlett-Packard

Intel Co.

Thank You !

ELEVATION SCALE = X2 (ENHANCED)
LOCAL TIME: Tue Nov 4 15:07:06 1997
ZULU TIME: Tue Nov 4 20:07:06 1997
LAST INTERSECTED UNIT
LAV25 (enemy)
Unit Number = 10351
POSITION
LL: 34:30:07N 116:08:14W
UTM: 3818151N 579205E
Elev: 3650 ft (3650 ft)
UNIT STATUS
HUNTER/WARRIOR - NRL
JMCIS FEED
Line 1.
Line 2.
Line 3.
Line 4.
Line 5.
Line 6.
GROUND COORDINATES
LL: 34:30:10N 116:08:12W
UTM: 3818231N 579244E
Elevation:
Elev: 3228 ft (0 ft)
TAI
NOBLE