The Comparison of Illumination Maps Technique in Computer Graphics Software

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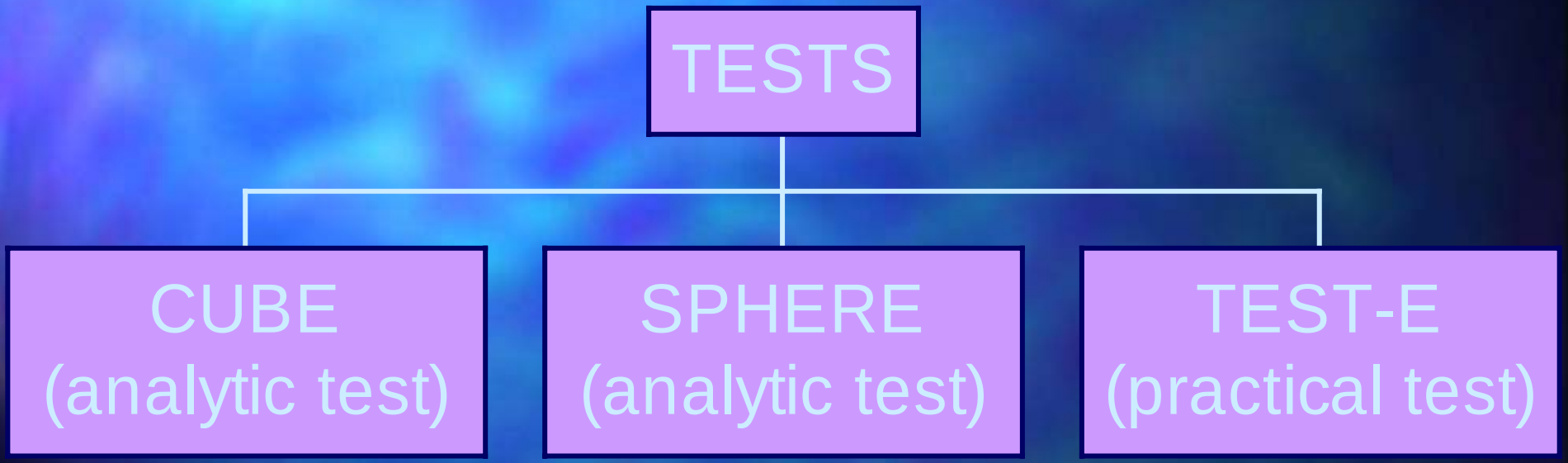
International Conference Graphicon 1998,
Moscow, Russia, http://www.graphicon.ru/

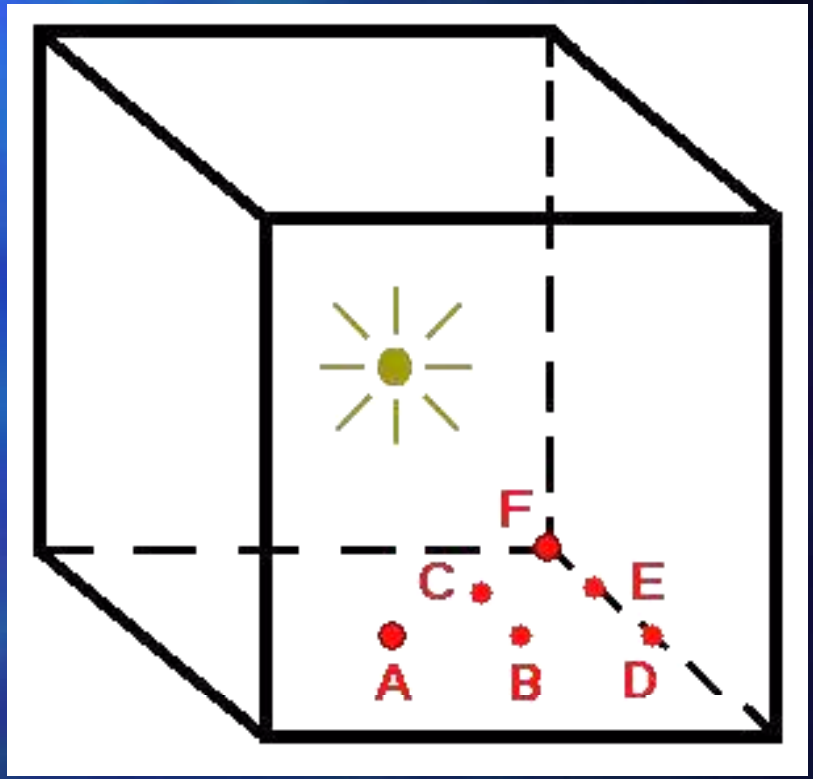
Illumination Maps: VRML

International Conference Graphicon 1998,
Moscow, Russia, http://www.graphicon.ru/


TESTS
CUBE
(analytic test)
SPHERE
(analytic test)
TEST-E
(practical test)

CUBE

- 10×10×10 m
- 50000 cd
- illumination = 2000 lux
- white color
- diffuse reflectivity = 2/3

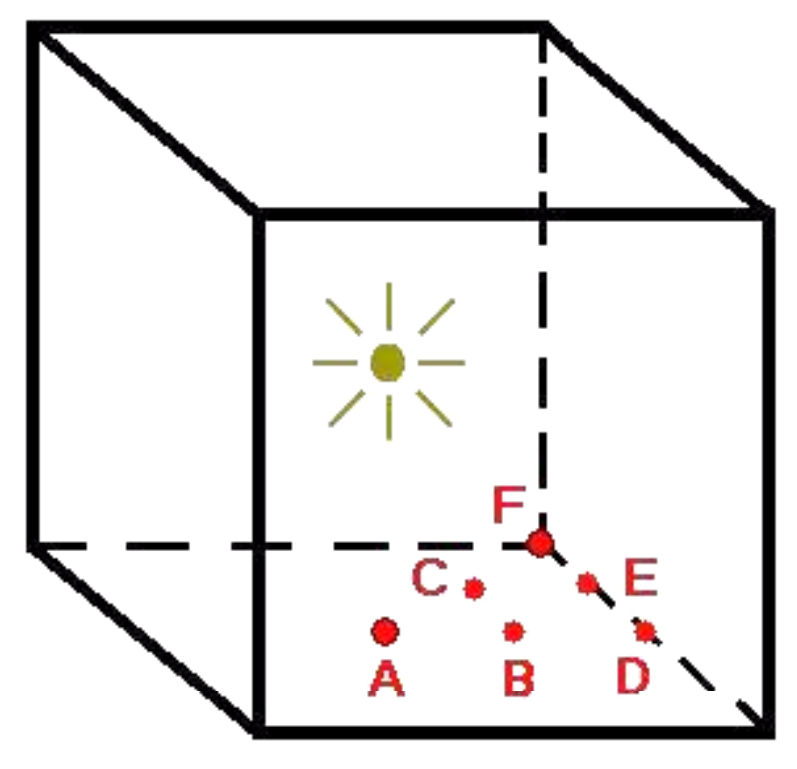


CUBE: energy transfer equation

$$Illum(p) = \int_{\Omega} \frac{Lum(q) \cdot \cos(\alpha) \cdot \cos(\beta)}{r^2(p,q)} dA(q)$$

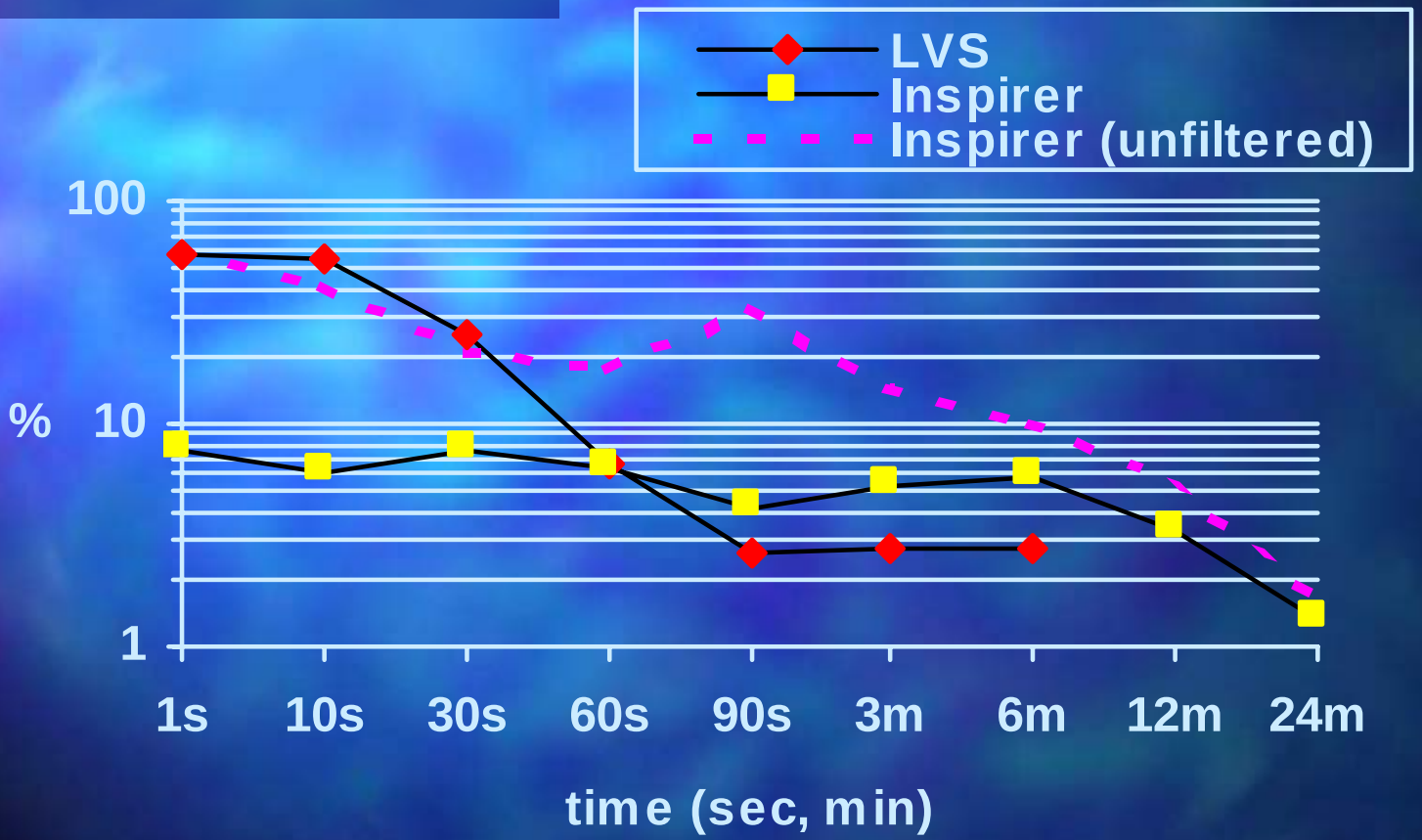
- $Illum(p)$ - is unknown luminance in some point P
- $lum(q)$ - is luminance at point Q
- Ω - integral spans over all surfaces in a scene
- a, B - are angles between normals in P, Q and
- PQ segment
- $r(p,q)$ - is Euclidean distance between P and Q
- $d\,A(q)$ - is differential area element at point Q

Theoretical luminance values for cube

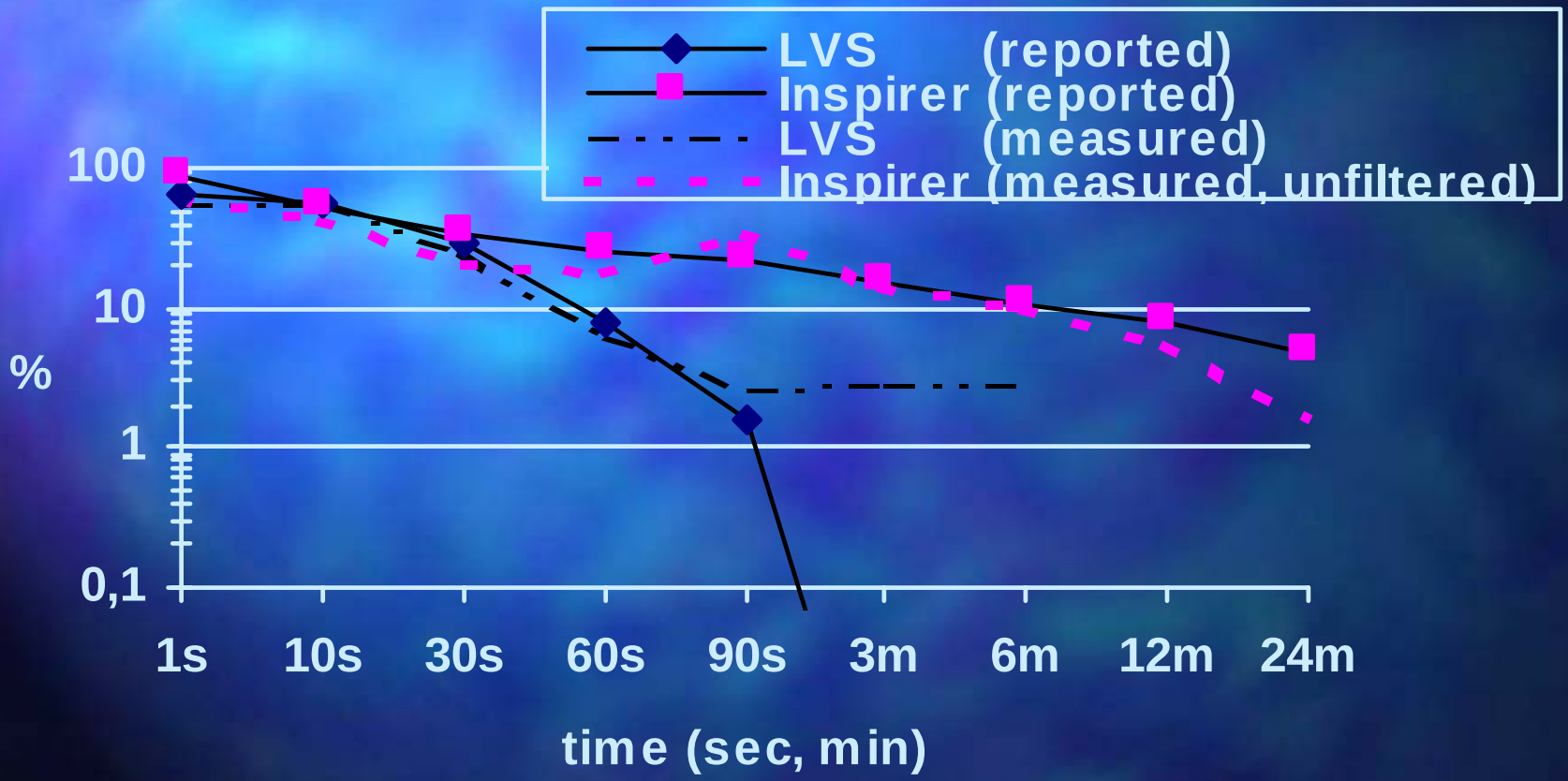


- A = 892.8 (cd/m^2)
- B = 768.7 (cd/m^2)
- C = 686.6 (cd/m^2)
- D = 565.1 (cd/m^2)
- E = 522.4 (cd/m^2)
- F = 388.4 (cd/m^2)
- A - 1/25
- B,C,D,F - 4/25
- E - 8/25

CUBE: Measured error vs. time

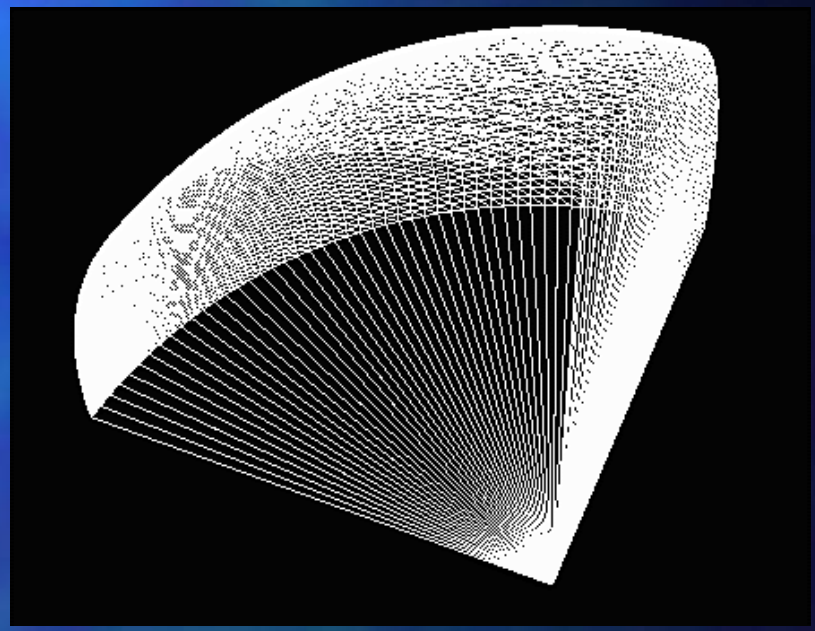


CUBE: Reported error vs. time



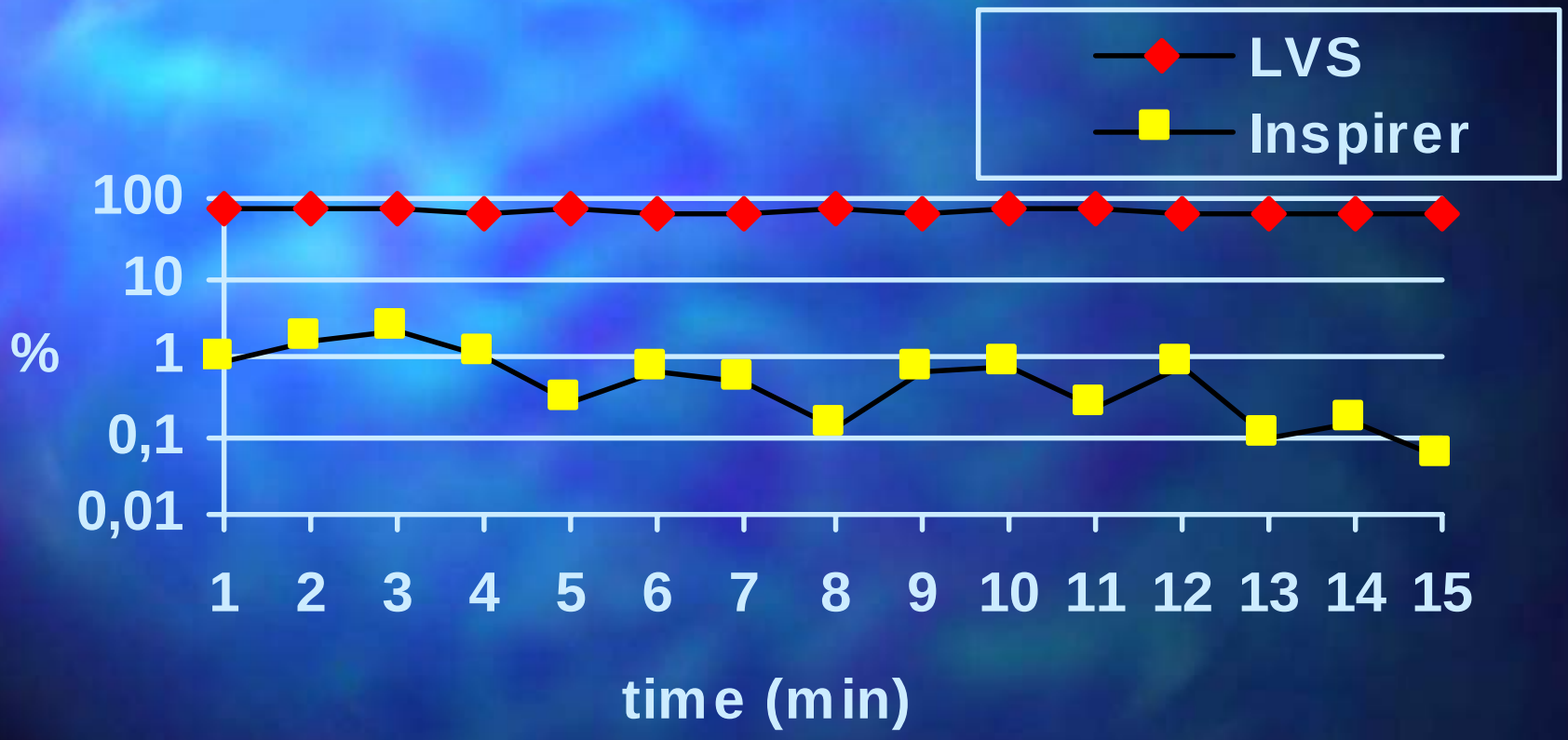
SPHERE: diffuse-specular-diffuse energy transfer.

- a diffuse sphere
- 3 mirror coordinate planes
- exact ambient illuminance
- form-factor is the same for all pairs of points



- total illuminance in the center of sphere octant = 1353.247 lux

SPHERE: Simulation error vs. time



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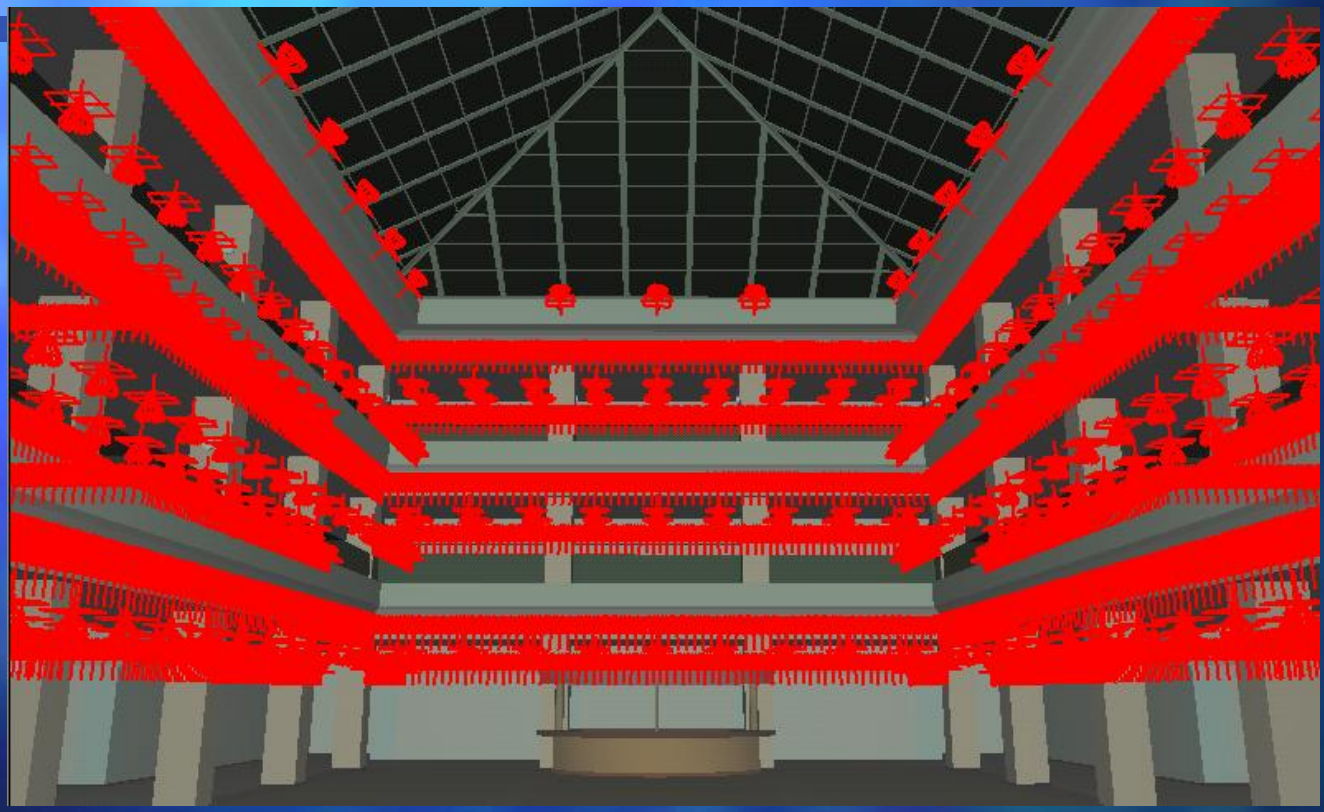
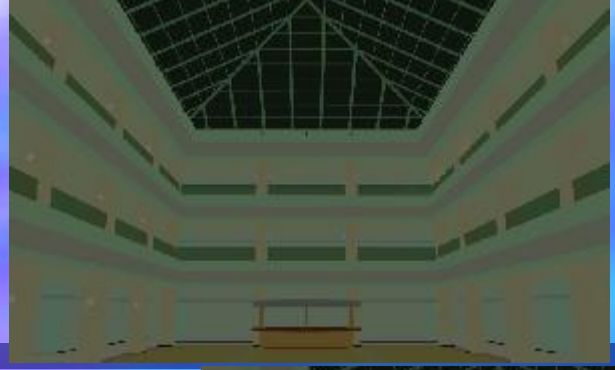
TEST-E: Practical test



- about 10000 triangles
- 2626 luminaries for 3 types of photometric data



- 1 min

- 8 min

Inspirer

- 64 min

- 68 hours

LVS

NOTE

- Inspirer reports progress in form of error estimation
- LVS produces progress reports in terms of initial energy. For example, 33.44% left means that 33.44% of initial energy still unshot. The actual accuracy level is unknown

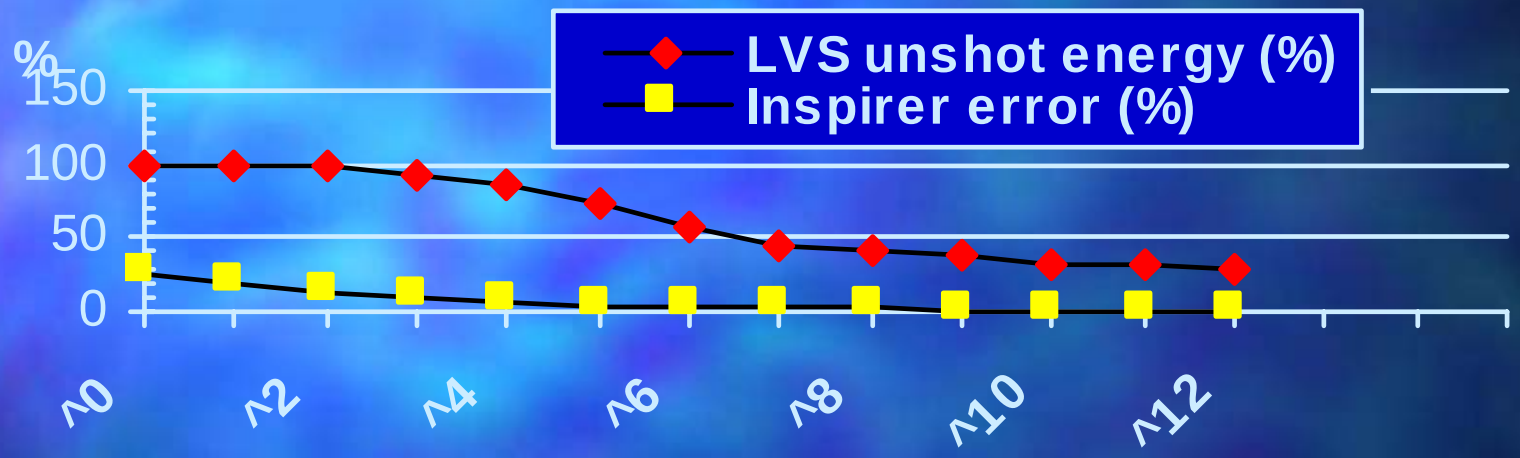
Note about shadows

LVS

Inspirer

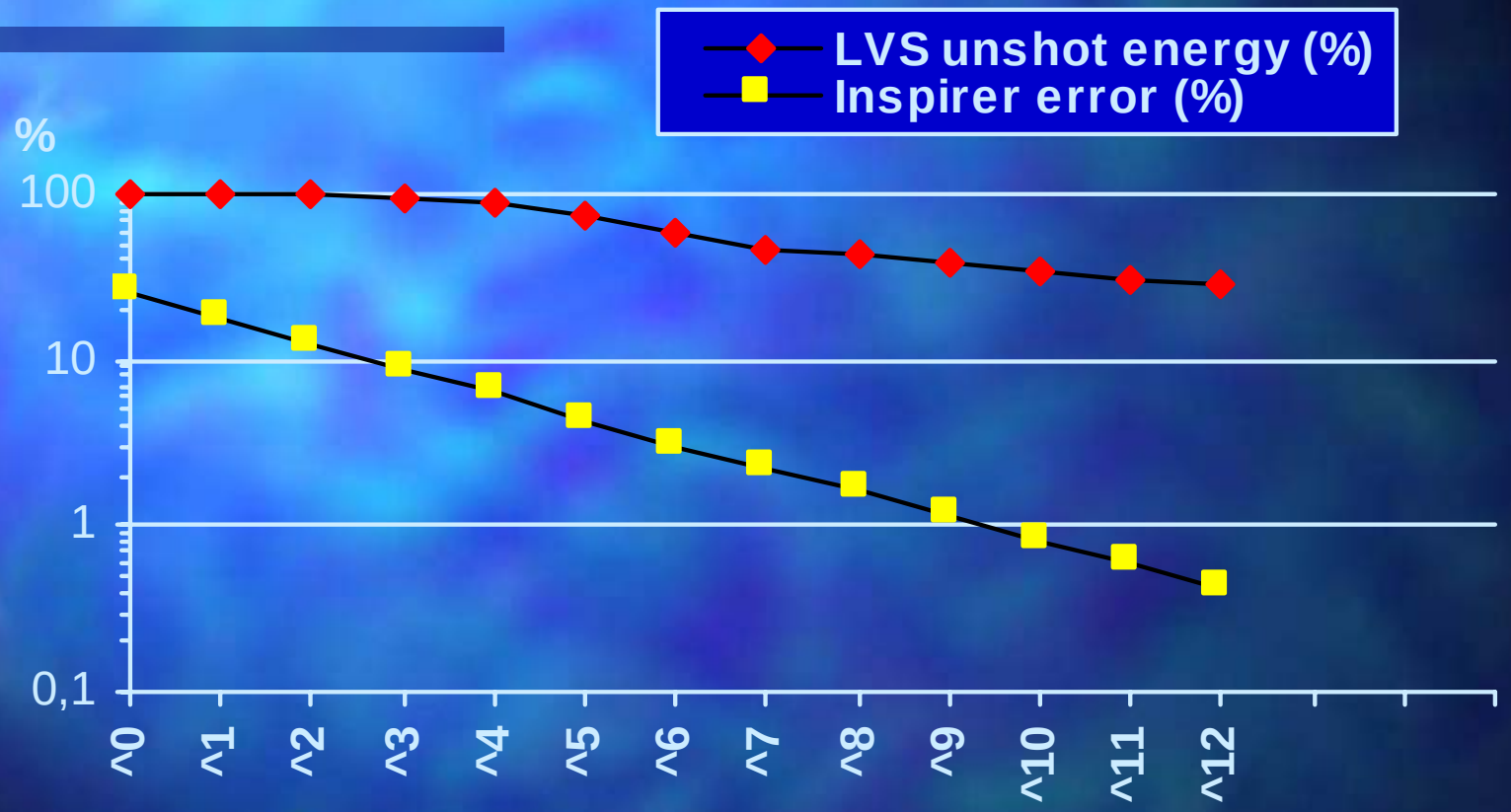
- incomplete calculation at this step for LVS

Reported progress vs. time



time (min) expressed by pow ers of 2: 1min, 2min, 4min, 8min ...

logarithmic scale



time (min) expressed by powers of 2: 1min, 2min, 4min, 8min...

- logarithm of error is changed linearly with logarithm of time

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Analysis of convergence speed

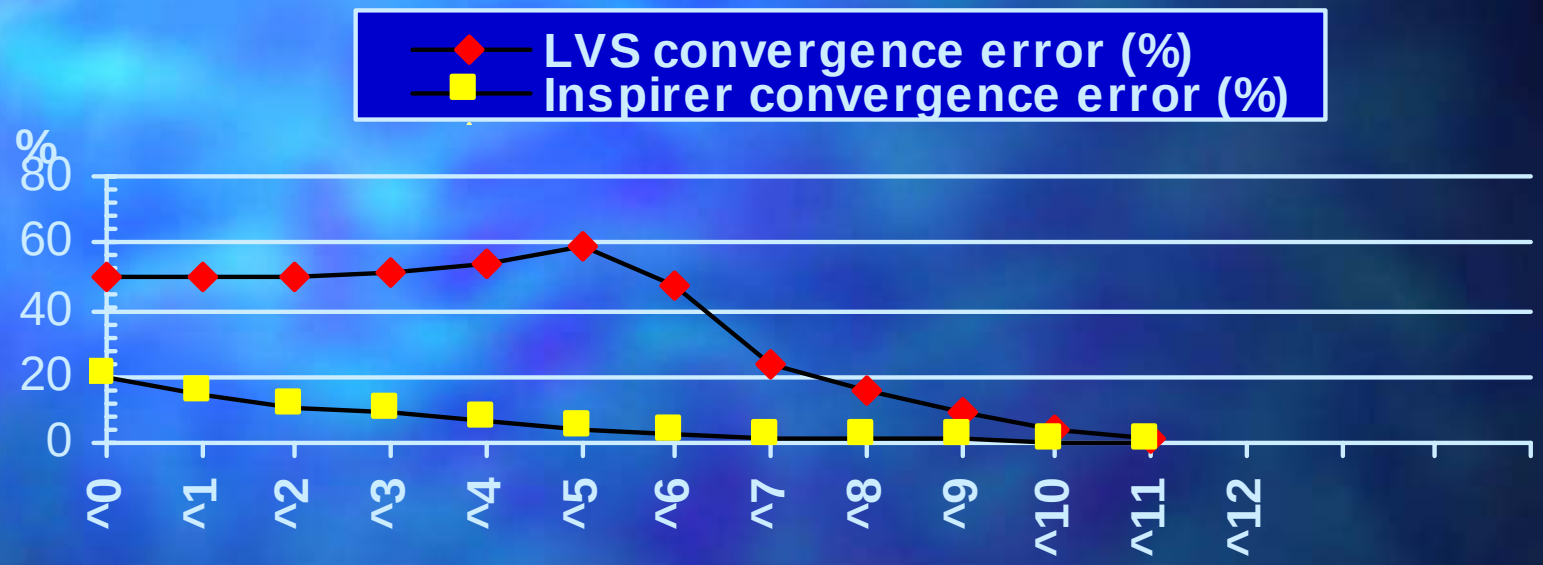
$$d(f,g)=\sqrt{\frac{1}{N}\sum_{i=1}^{N}(f_i-g_i)^2}$$

$$d_{rel}(f,g)=\frac{d(f,g)}{\|f\|}$$

- This comparison is based on calculation of a distance (L2 in RGB) between intermediate images and some reference image
- 2^12 minutes (about 68.5 hours)

N- number of pixels
f - color component of reference image
g - color component of compared with

Convergence of images to reference one vs. time



time (min) expressed by powers of 2: 1min, 2min, 4min, 8min...

- L2 metric in RGB

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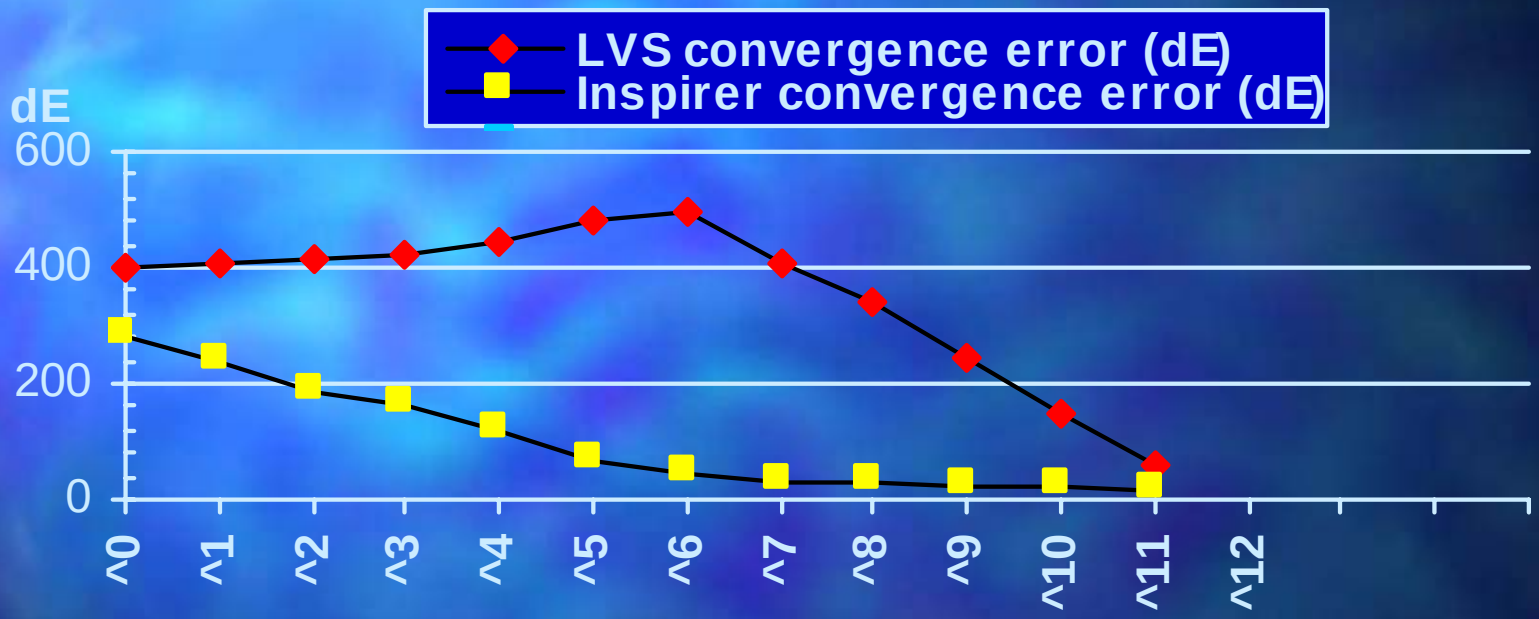
Convergence of images to reference one vs. time



- Euclid metric in Lab CIE 1976

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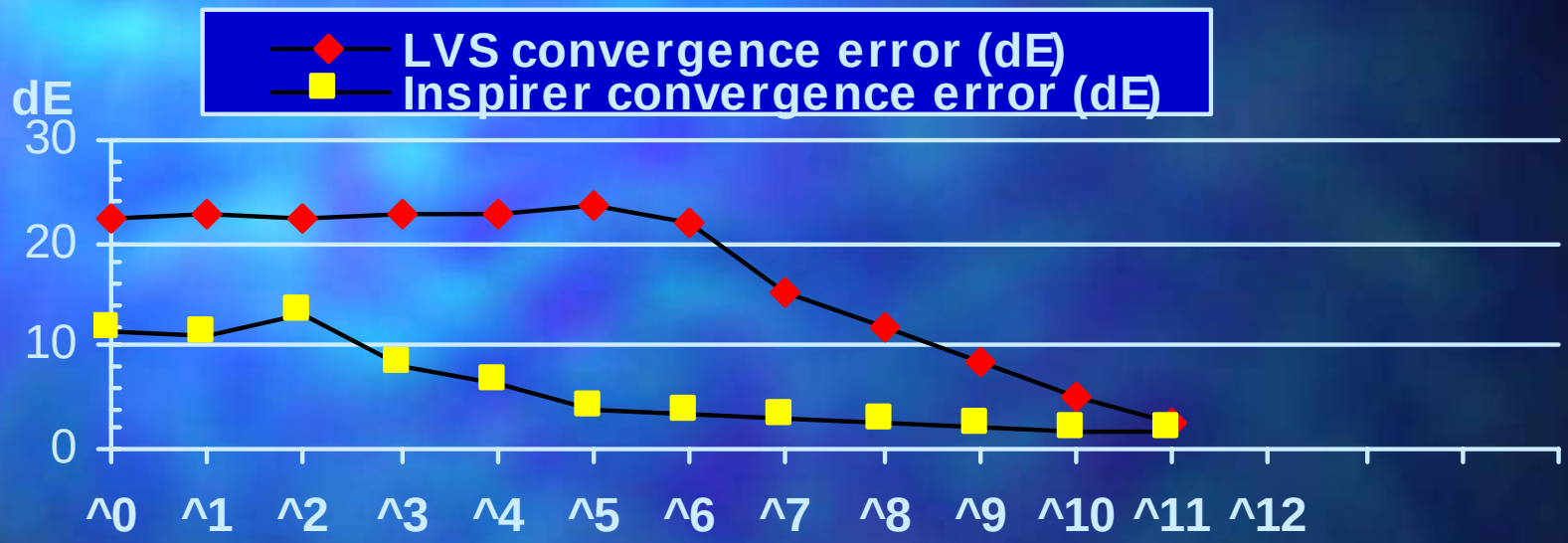
Convergence of images to reference one vs. time



- Euclid metric in Lab CIE 1995

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