

# **Visualizing illuminance levels, generated in *Radiance*, in a Maya environment**

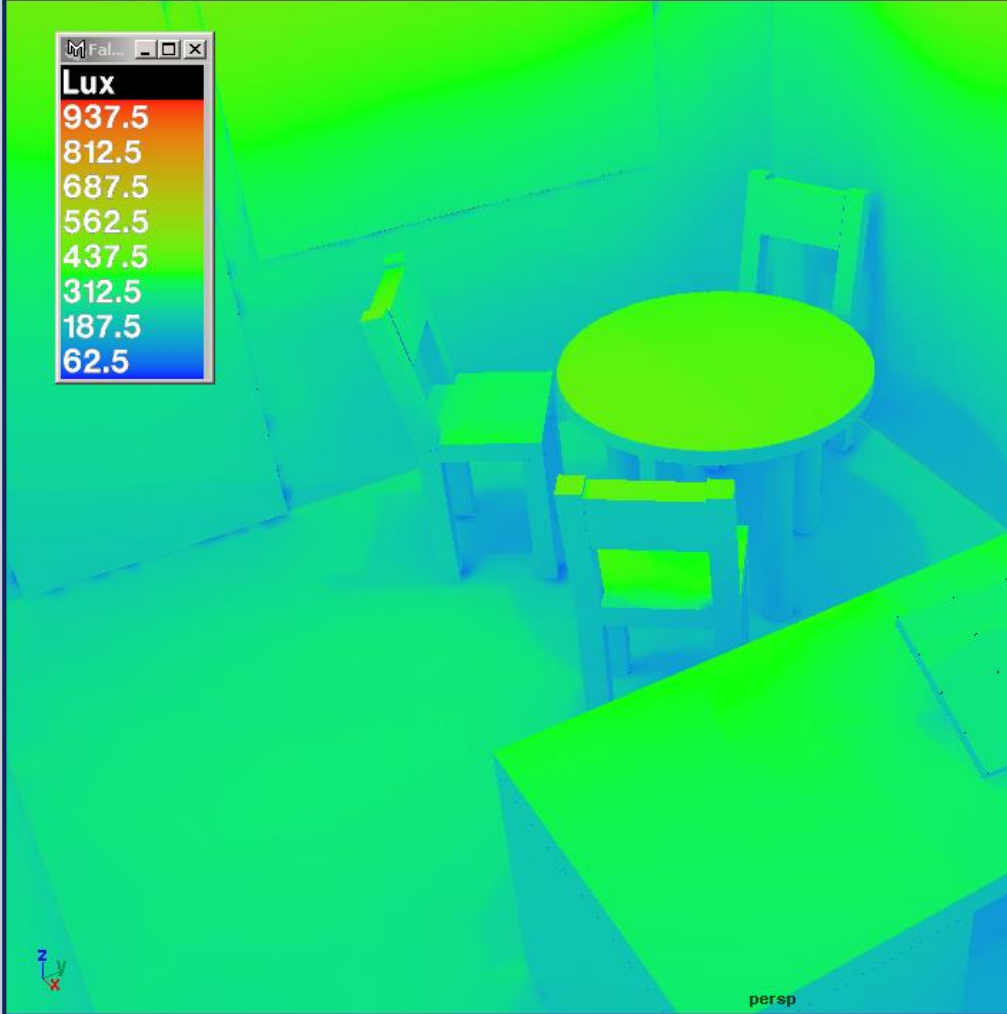
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Maya 4.0: \untitled

File Edit Modify Create Display Window Edit Curves Surfaces Edit NURBS Polygons Edit Polygons Help

Modeling

View Shading Lighting Show Panels



### Lighting Assessment

Materials | Light Types | Geometry | Lights | .rif | Apply Colours

---EITHER---

Open Existing .rad File  Browse

---OR---

Set New Geometry File  Change

#### Import Existing Radiance Geometry File as Single Object

Existing Geometry File  Browse

Name in this scene  Check

Import Geometry

#### Update or Delete Geometry

Update/synchronise Radiance file(s)

Delete selected geometry from scene and Radiance file

Warning: If one side of a box is selected all sides will be deleted

Materials File  Browse

Material Name

#### Primitives

##### Sphere

Name  Check

Centre Point    cm

Radius  cm

Create Sphere

##### Box

Name  Check

Insertion Point    cm

0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 110 120 130 140 150 160 170 180 190 200 210

0.00 0.00 0.00 200.00 200.00 200.00 No Character Set

Select by object type: Surfaces (RMB for more info)

# Introduction

- The real world can presents luminance levels ranging from  $10^{-4} \text{ cd/m}^2$  (starlit) to  $10^6 \text{ cd/m}^2$  (sunlight).
- Knowing the luminance levels in an environment can be very useful in light design.

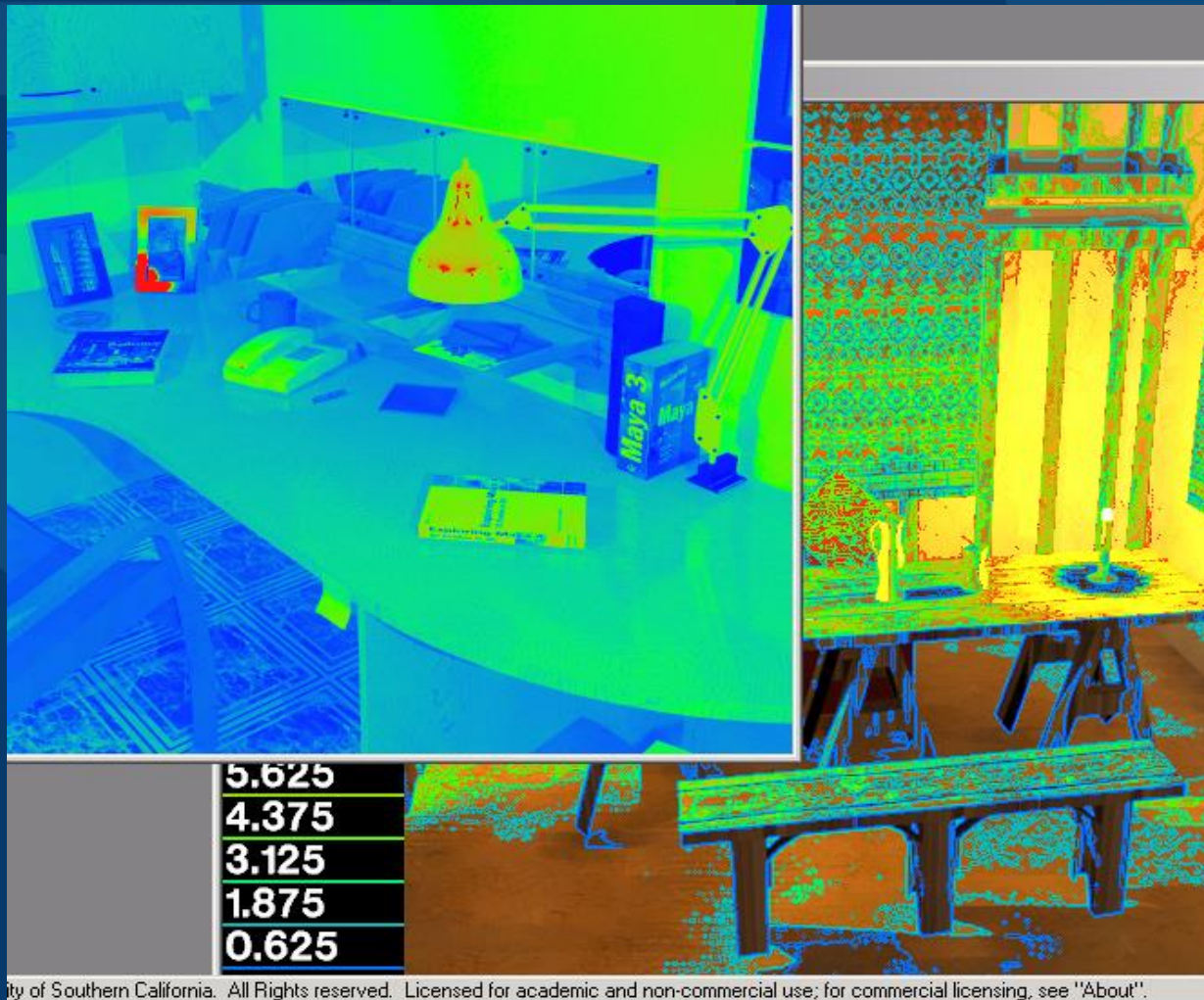
# Illuminance standards

- National standards proscribe minimum illuminance levels for a variety of tasks and situations.
- From these standards it is then possible to determine suitable lighting conditions.
- These standards (at least UK ones) take into account only *illuminance* and therefore are not view dependent.



- **Probably the easiest way to visualize luminance levels in an environment is to generate a false color version of the scene.**
- **This can be easily done in *Radiance*.**
- **Depending on rendering options we can create luminance or illuminance false colored images.**

# False-coloring...



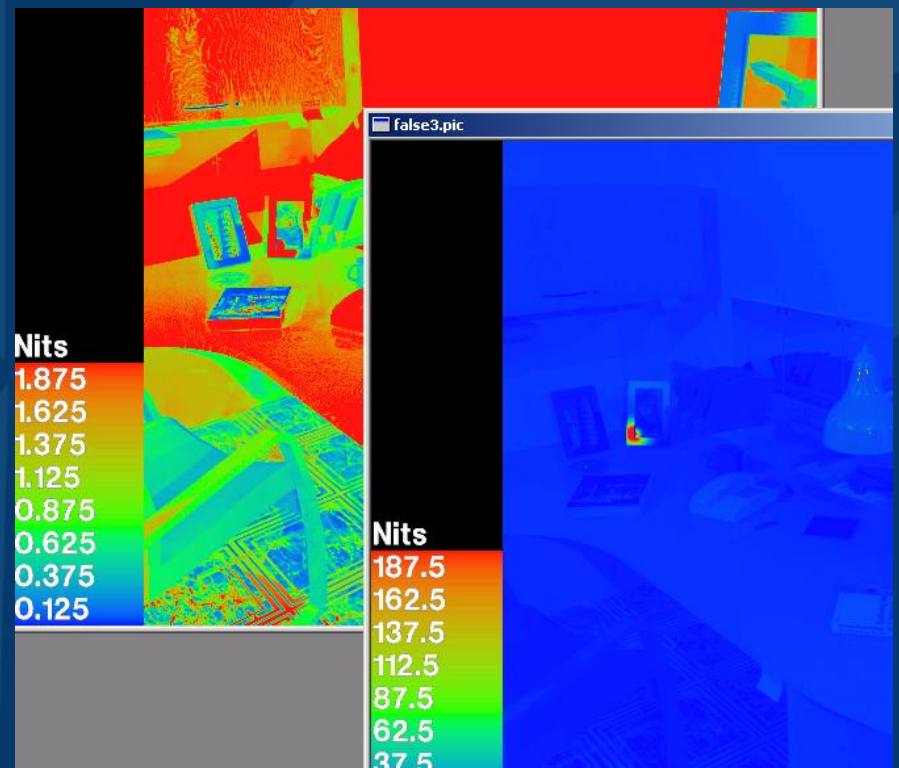
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# ***Radiance – falsecolor* program**

- ***Radiance* produces false color images based on irradiance/radiance data.**
- **This is achieved by:**
  - Reading radiance/irradiance values from a .pic image
  - Calculating luminance/illuminance
  - Re-displaying or compositing based on a color scheme.

# Setting the correct scaling

- The scale used is very important because it can affect the visualisation and understanding of the scene.





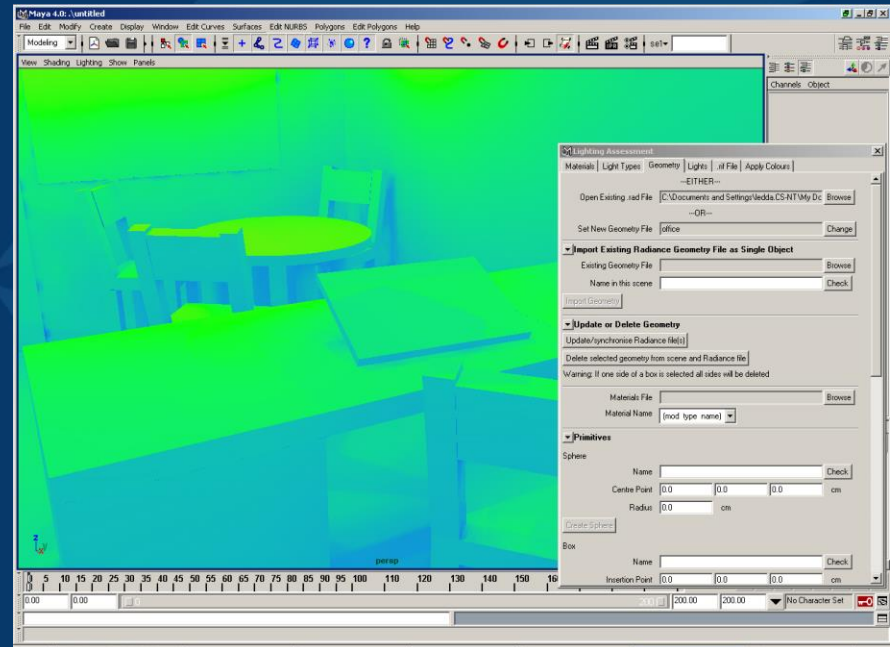
# A problem...

- Because *Radiance* takes data from a .pic file, it can only generate false color images from the same view point.
- It would be nice if we could know the illuminance in a particular area of a scene even if it has not been rendered.



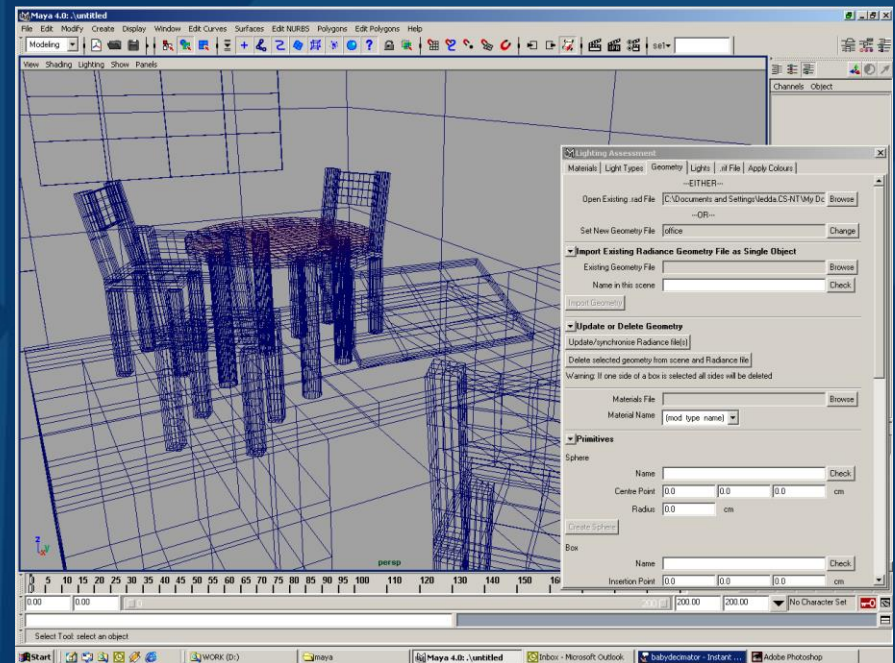
# Our approach

- Visualise the lighting levels of an environment in 3D.
- This is possible because illuminance is inherently view independent.



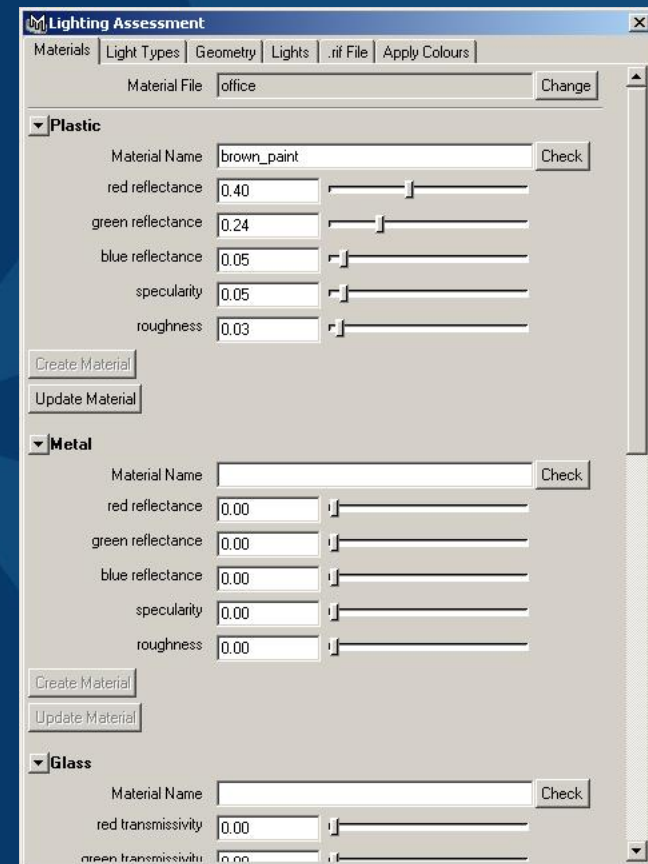
# How does it work?

- We developed a tool for Maya that directly generates *Radiance* files.
- Using the GUI, materials, geometry and lights can be created and easily modified...



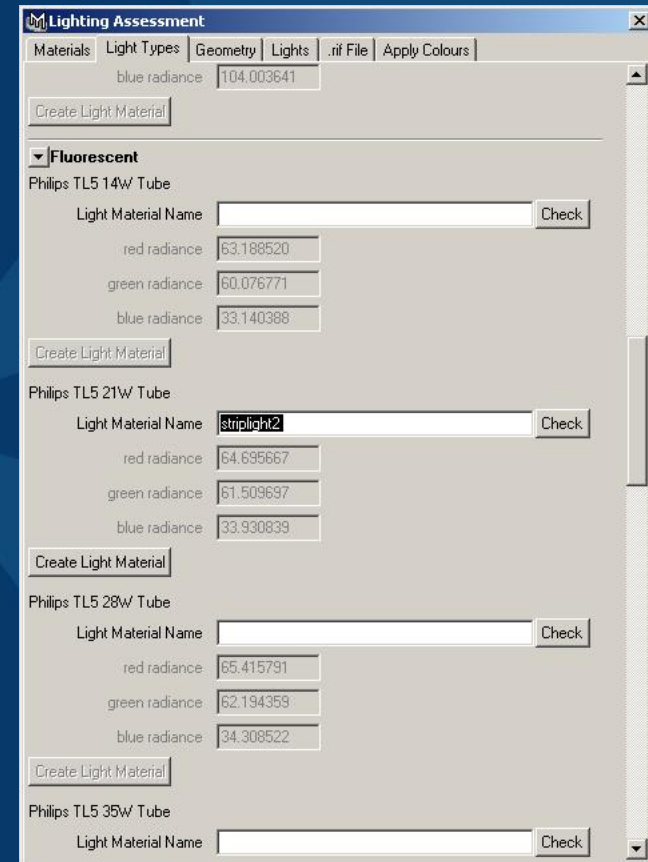
## Our approach (2)

- The GUI allows us to simultaneously generate geometry in *Radiance* (.rad file) and in Maya (on screen)
- In Maya the position of the geometry can be easily modified. The new position is the re-written to the *Radiance* file.

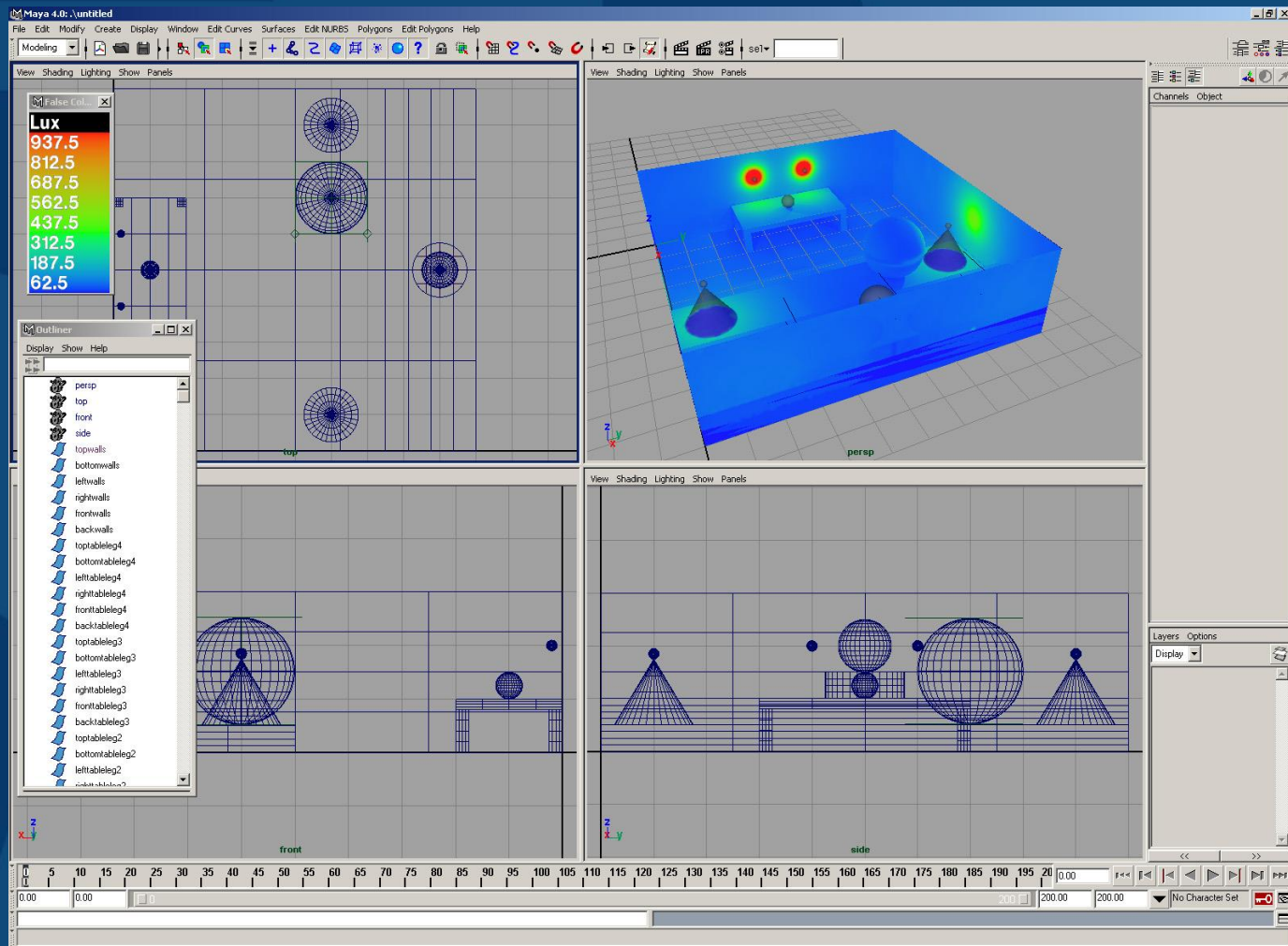


# Our approach (3)

- **Lights and models can be easily imported into any scene and saved to .rad file.**



# VIDEO

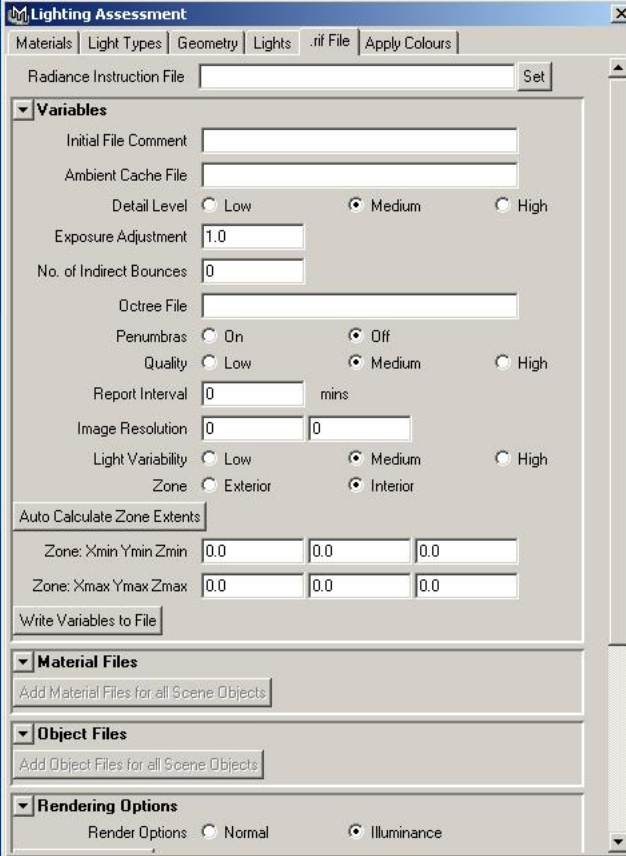




# Generating a .rif file

- The GUI enables us to create a .rif file for the scene
- Similar to *trad*
- However the advantages are that it automatically includes :
  - geometry
  - Materials
  - View descriptions
  - “ZONE”, “AMB”, “OCT”

# Generating a .rif file - GUI



The screenshot displays the 'Lighting Assessment' GUI window. The window has a title bar and a menu bar with the following tabs: Materials, Light Types, Geometry, Lights, .rif File, and Apply Colours. The '.rif File' tab is currently selected.

Under the '.rif File' tab, there is a 'Radiance Instruction File' field with a 'Set' button next to it.

The 'Variables' section is expanded, showing the following settings:

- Initial File Comment: (empty text field)
- Ambient Cache File: (empty text field)
- Detail Level: ☐ Low, ☒ Medium, ☐ High
- Exposure Adjustment: 1.0 (text field)
- No. of Indirect Bounces: 0 (text field)
- Octree File: (empty text field)
- Penumbras: ☐ On, ☒ Off
- Quality: ☐ Low, ☒ Medium, ☐ High
- Report Interval: 0 mins (text field)
- Image Resolution: 0 (text field) x 0 (text field)
- Light Variability: ☐ Low, ☒ Medium, ☐ High
- Zone: ☐ Exterior, ☒ Interior

Below the 'Variables' section, there is a button labeled 'Auto Calculate Zone Extents'. Under this button, there are two rows of three text fields each, representing zone coordinates:

- Zone: Xmin Ymin Zmin: 0.0, 0.0, 0.0
- Zone: Xmax Ymax Zmax: 0.0, 0.0, 0.0

There is a button labeled 'Write Variables to File' below the zone coordinates.

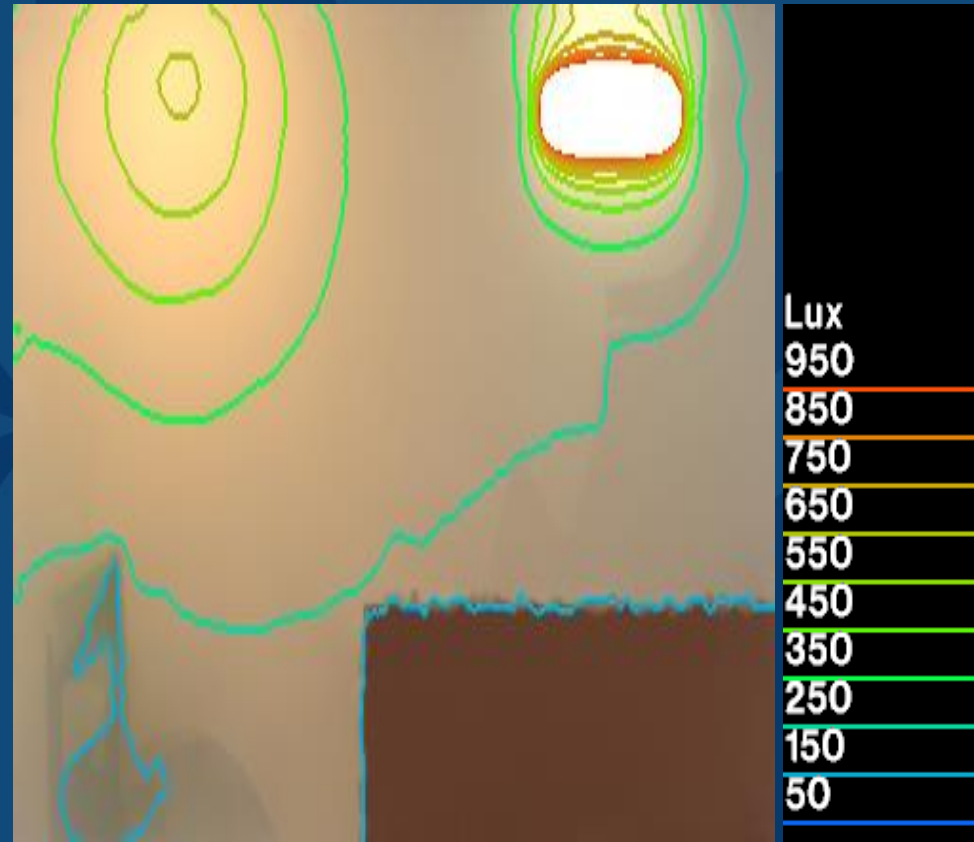
The 'Material Files' section is expanded, showing a button labeled 'Add Material Files for all Scene Objects'.

The 'Object Files' section is expanded, showing a button labeled 'Add Object Files for all Scene Objects'.

The 'Rendering Options' section is expanded, showing a 'Render Options' section with two radio buttons: ☐ Normal and ☒ Illuminance.

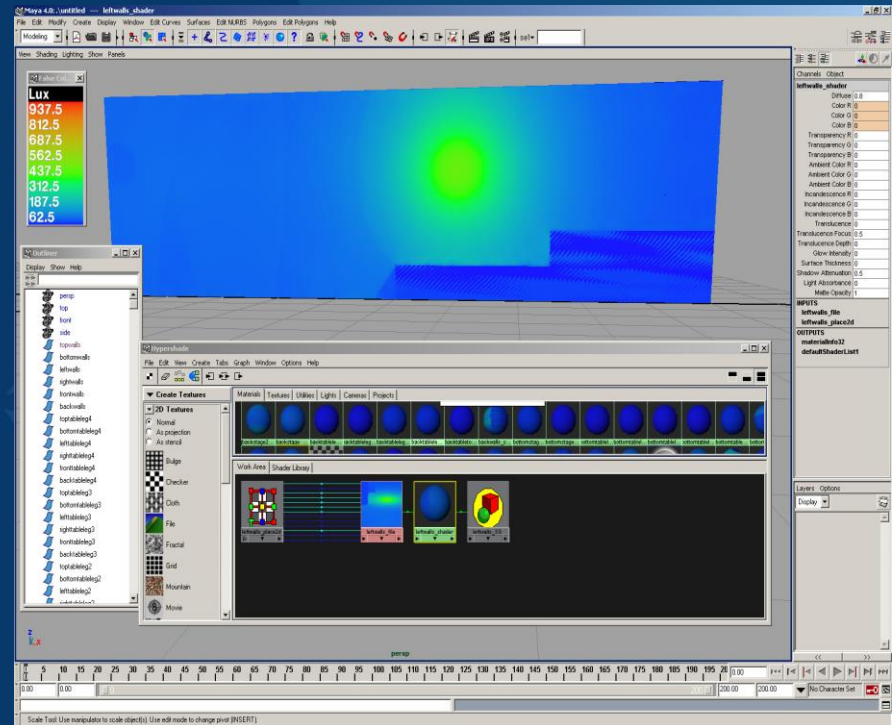
# Generation of views

- For every plane, the program generates an individual view.
- Each view is a parallel projection



# The view parameters

- For each plane, the view point is determined by finding the center of the plane and its normal.
- The view point (-vp) is then located along the normal at a very short distance from the surface.



# The view parameters (2)

- The view direction (-vd) is simply the vector from the view point previously calculated back to the surface (along the normal).
- The view up (-vu) is determined by interrogating the surface's orientation.
- The width & height (-vh, -vv) are matched to the dimensions of the surface.

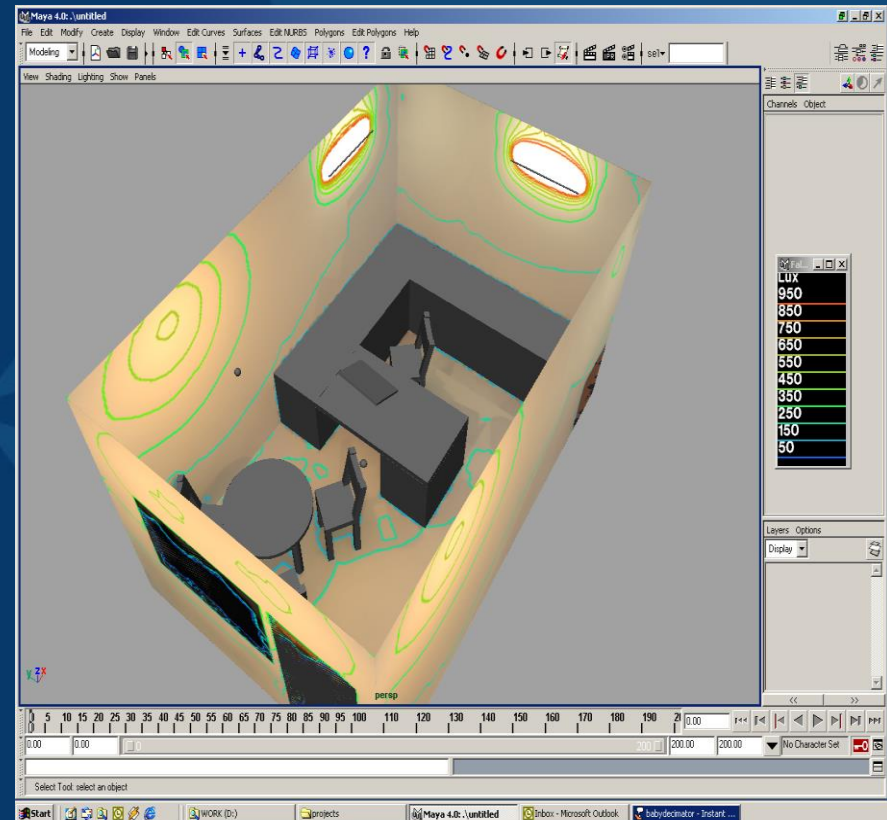


# Non-planar objects

- We are still working on this feature...
- We can already create luminance data for non planar objects such as spheres, cones and cylinders but it still needs some improvements...

# Useful Features

- **Automatically both falsecolored and rendered images can be produced separately and as a combined contoured image.**



## Other features

- Also, the tool automatically generates a *Radiance* view based on the current perspective view.
- Another nice feature is that animation paths can be easily created and written as view files for *Radiance*.

**Video**

The background of the slide is a dark blue field filled with a complex, abstract geometric pattern. This pattern consists of numerous triangles of varying sizes and shades of blue (ranging from deep navy to a slightly lighter, muted blue) that radiate from a central point, creating a star-like or crystalline effect. The triangles are arranged in a way that they interlock and overlap, giving the background a sense of depth and movement.

# Conclusions

- We have presented a tool that allows the user to model in Maya and then automatically writes *Radiance* files.
- This tool is mainly used to visualize luminances in a true 3D way.
- Normal renderings and other features such as animation are also possible.
- However, much work still needs to be done to make it more useful in light design...



# Future work

- **Extend the tool to include arbitrary shapes**
- **Use both NURBS & polygons**
- **Allow the use of *modifiers* for materials (this has little effect on the illuminance calculation)**
- **It would be nice to include modifiers for the “light” material.**
- **So far only plastic, metal, dielectric, trans, glass and light can be used. Other materials just need to be hard-coded in**