

# Maya to Radiance

Combining the best of both worlds

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# Introduction

- Archaeologists are using virtual reconstructions both to communicate/educate people about their discoveries and experiment/validate theories.
- Modern scanners can be used to capture geometry and textures.
- This presentation describes a collection of tools to streamline the process of taking this scanner data through Maya to a final rendered Radiance scene, as part of the Rendering on Demand project.



# Rendering on Demand - RoD

- University of Bristol Department of Computer Science project funded by 3CResearch.
- Our aim is to provide “realism in real time”.
- Animations and walkthroughs rather than single images.
- Radiance rendered scenes with interactivity.
- Using parallel processing and visual perception to produce the most efficient use of resources.



# Scanner to Maya – Gavin Ellis

- Scanner only exports textures in VRML1.0 and SOFTIMAGE|XSI, images are low resolution.
- .obj exports are geometry only with no texture information.
- The solution was to develop a tool to convert the VRML to .obj with texture information in .pic and other standard formats.
- Also allows the use of high res camera pictures.



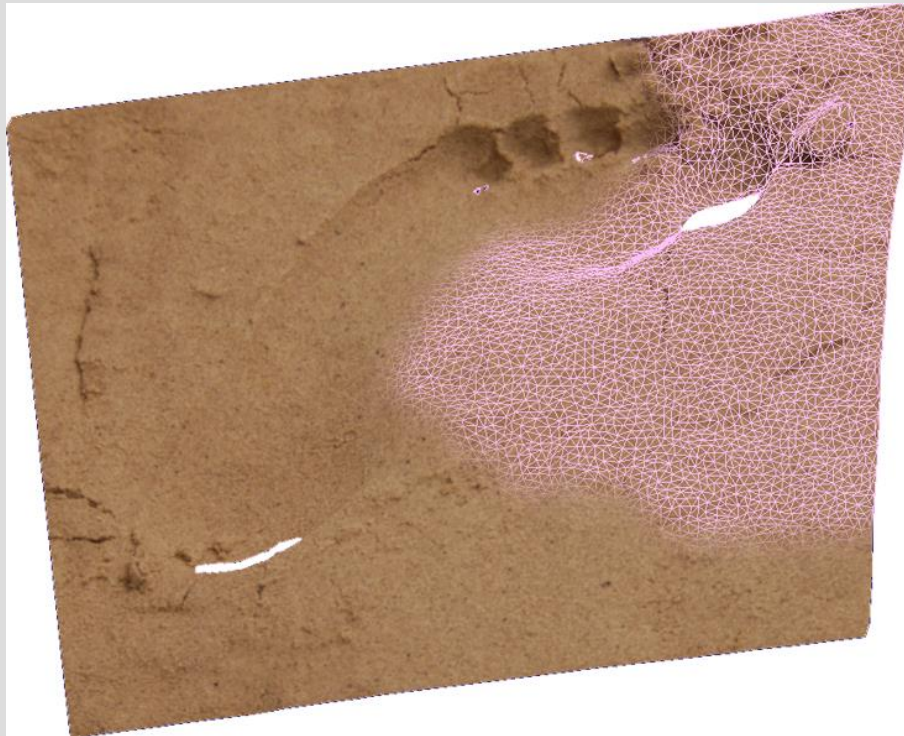
# Scanner examples



Scanning a footprint



# Scanner examples



Footprint texture and mesh



3D pot scan



# Using the scanned data

- Once the data is in usable form the next stage is to use it.
- Reconstructions (almost) always involve some additional modelling.
  - Replacing missing geometry and adding context scenery to scans.
  - Adding/altering specific lighting conditions.
- Which program to use to do this?





# Pros and cons –Maya (Alias|Wavefront)

- Pro
  - Intuitive interface.
  - Visual feedback when modelling.
  - Easy camera positioning.
  - Visual material/shader construction.
  - Easily customisable using Maya Embedded Language.
- Con
  - “Non-Realistic” Rendering.
  - Results aesthetic rather than quantifiable and scientific.





# Pros and cons -Radiance

- Pro
  - Accurate lighting simulation rather than shading based on preconceptions.
  - Results quantifiable.
- Con
  - Hard on beginners.
  - Unable to place items “by eye”.
  - Animated views hard to produce.



# Solution - combination

- The solution is to use Maya to model the scene and then use Radiance to render it.
- Since Radiance and Maya share compatibility with the .obj format this could be used.
- This is not necessarily seamless however and still requires knowledge of Radiance.
- The ideal is to run Radiance transparently from within Maya.

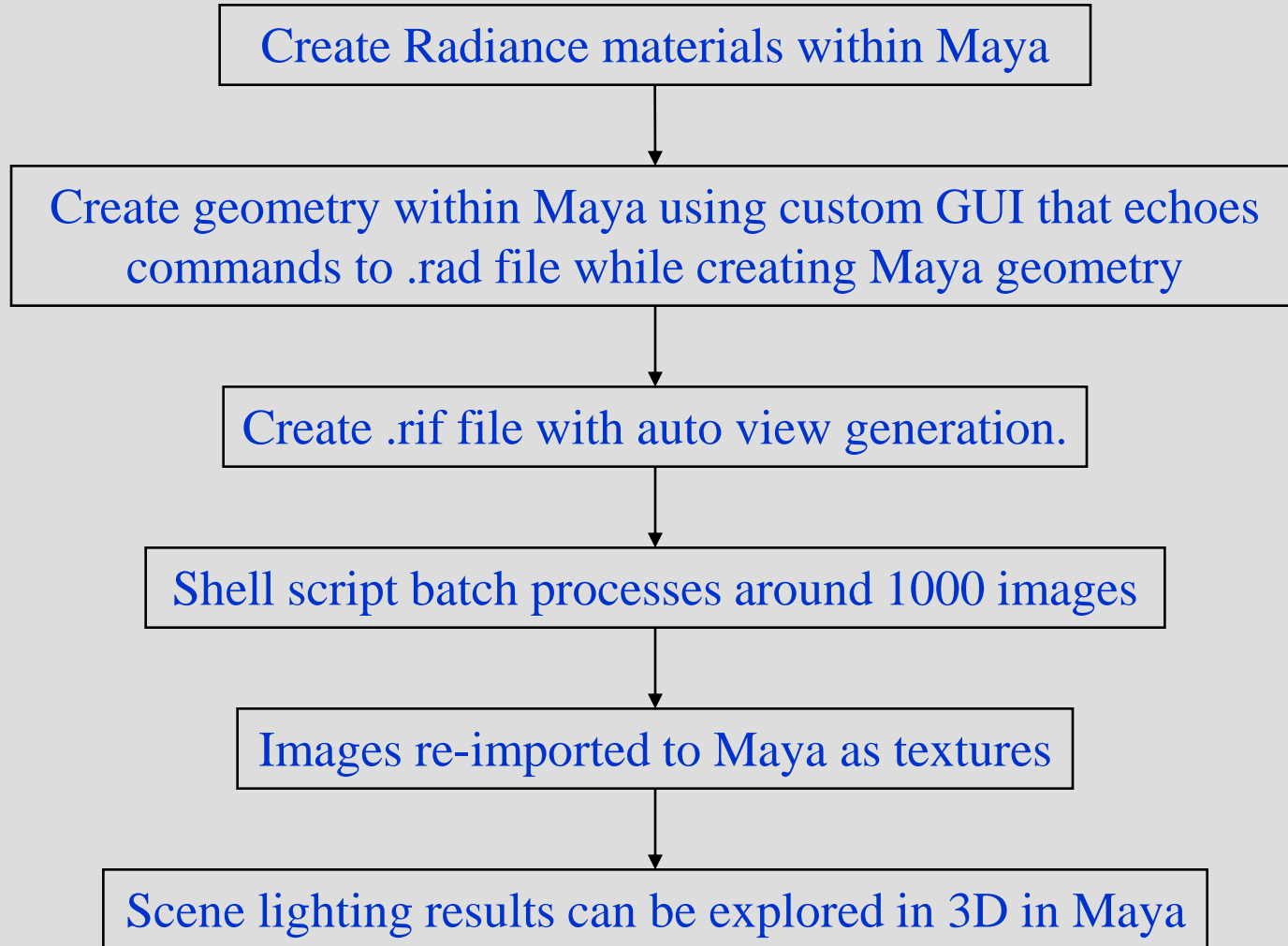


# First implementation

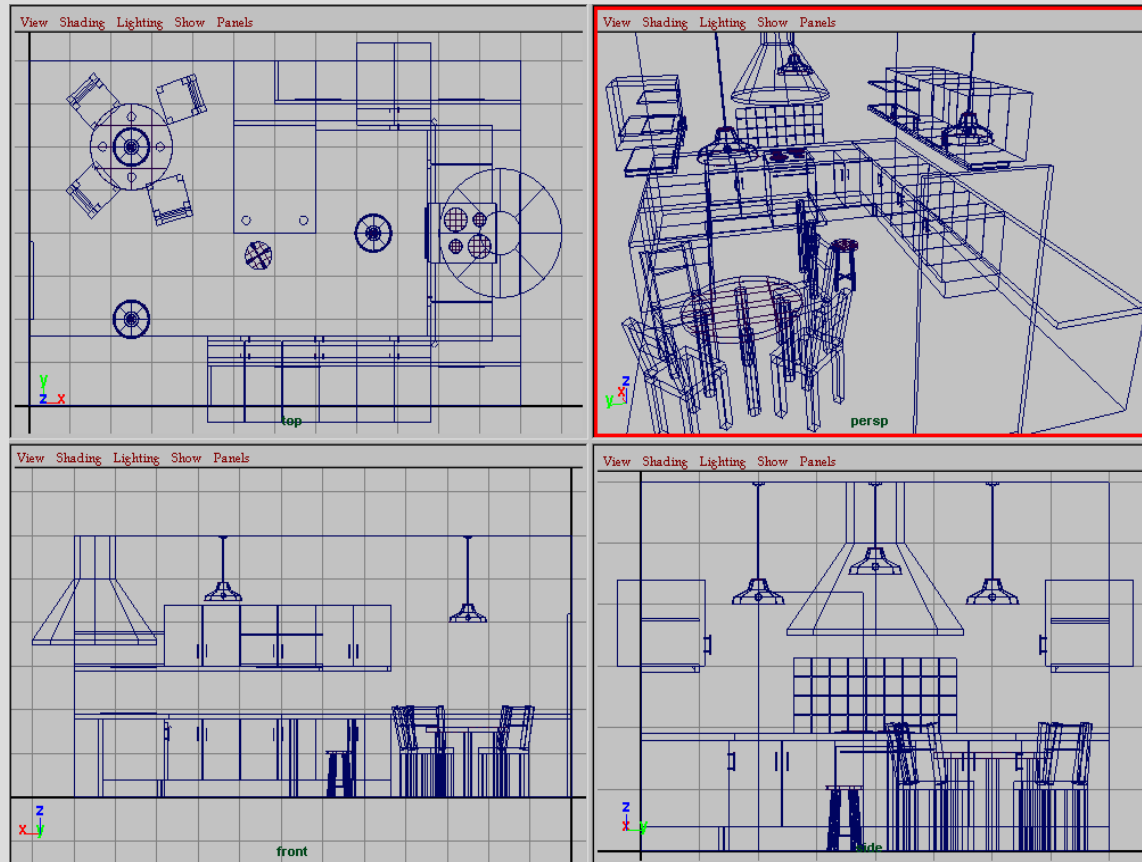
- My MSc project last year was a tool to help lighting design visualisation.
- Scenes modelled using custom GUI in Maya had their lighting levels across each of their surfaces rendered in Radiance.
- Rendered images reapplied to Maya geometry as textures to allow interactive exploration of the results for the scene.



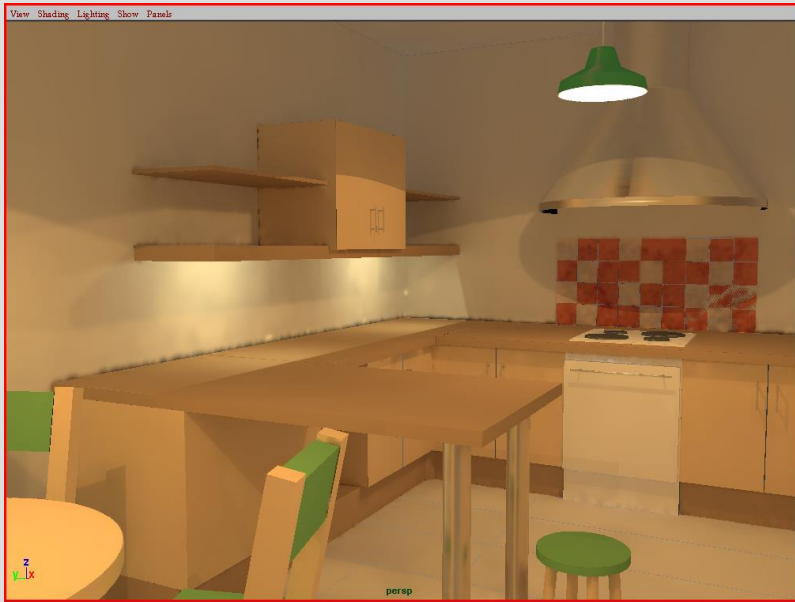
# Workflow for typical scene



# Results – Kitchen scene



# Results – Rendered



Textured Maya scene (above)  
with Radiance picture (right)



# Results – Rendered with contours

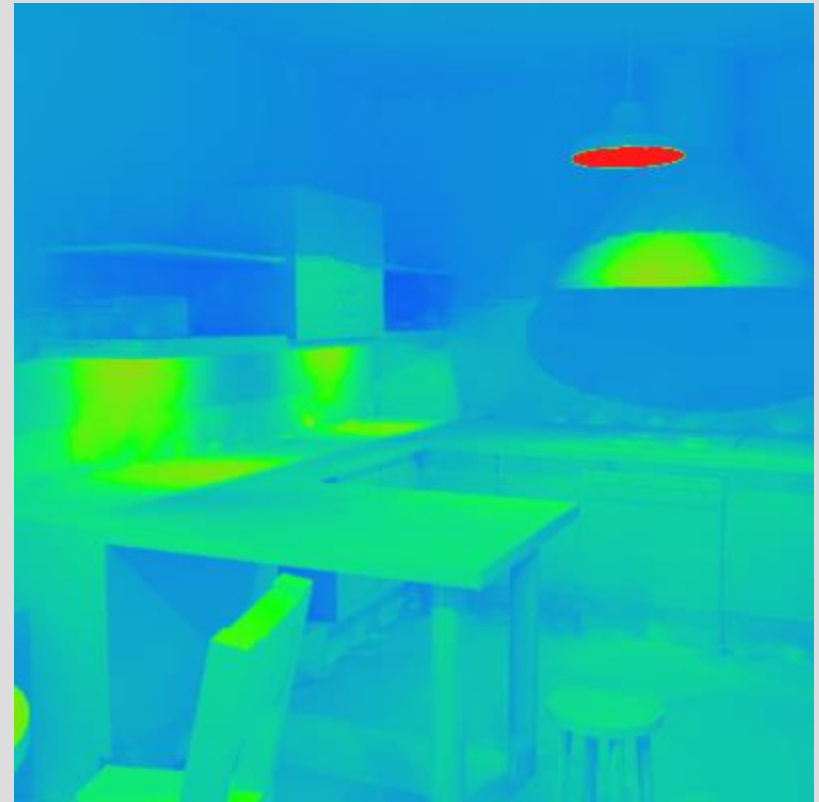
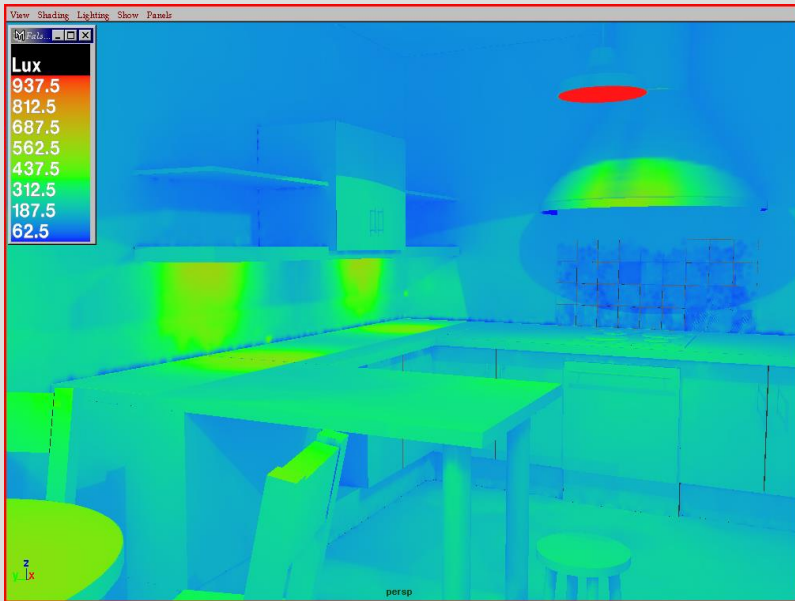


Textured Maya scene (above)  
with Radiance picture (right)





# Results – False coloured



Textured Maya scene (above)  
with Radiance picture (right)



# Compatibility issues

- Initial implementation was tailored for the MSc Project and restricted by the associated time constraints.
- Radiance workflow in Maya window.
- Forced workflow and hindered general Maya user.
- Needed to remove the restrictions to become generally useful.



# Achieving compatibility

- Scripts still written in Maya Embedded Language (MEL).
- Single interface split into series of tools.
- Scene can be modelled in any order.
- Existing Maya scenes can be loaded then exported to Radiance.
- Single exporting stage reduces problems with loss of synchronisation and duplication.

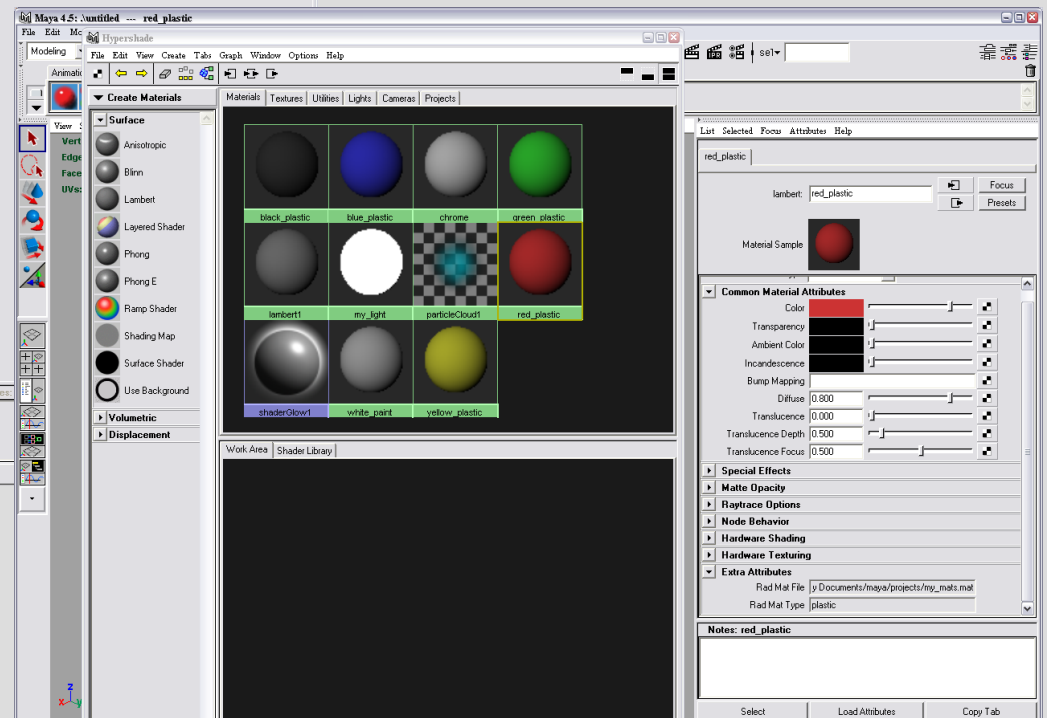
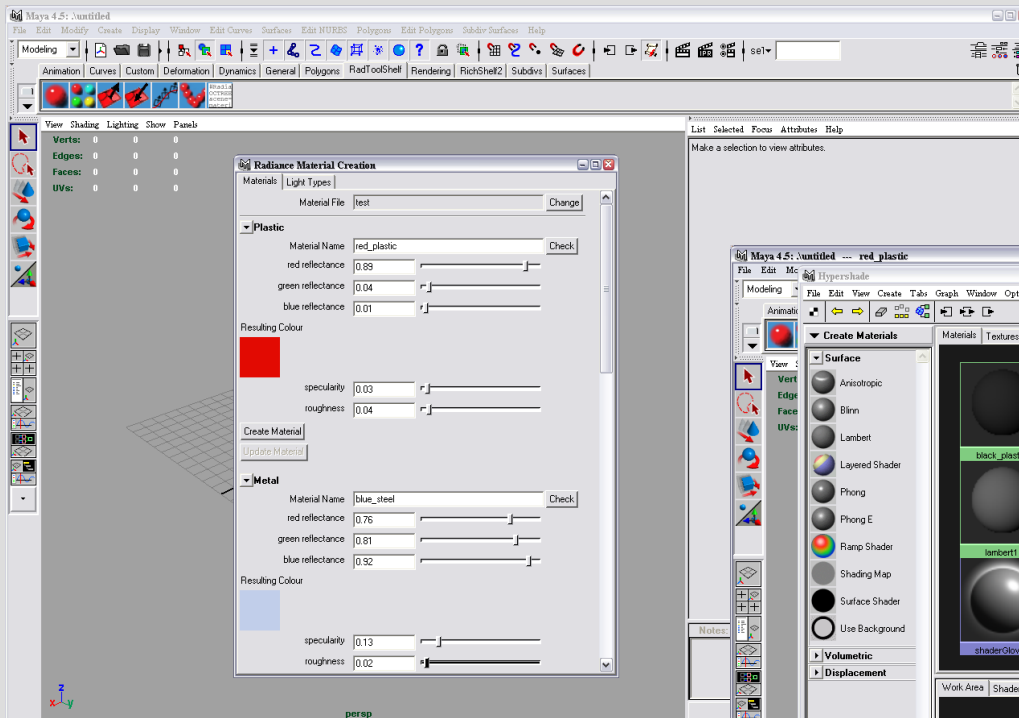


# Material creation

- Radiance Materials created through GUI have Maya “stand-ins”.
- Stand-in materials are basic Maya shaders, with similar colours to Radiance materials to aid application.
- Stand-in materials applied to geometry using standard Maya methods.
- When geometry is exported, Radiance material applied using names taken from Maya stand-ins.



# Material interface



Maya stand-ins for  
Radiance materials



# Object export/import

- Objects modelled as usual in Maya in polygons (or NURBS and converted to polys).
- Selected geometry exported directly into Radiance .rad files.
- File per object or file per selection options.
- .rad files can also be read into Maya (currently sphere and polygon primitives only).



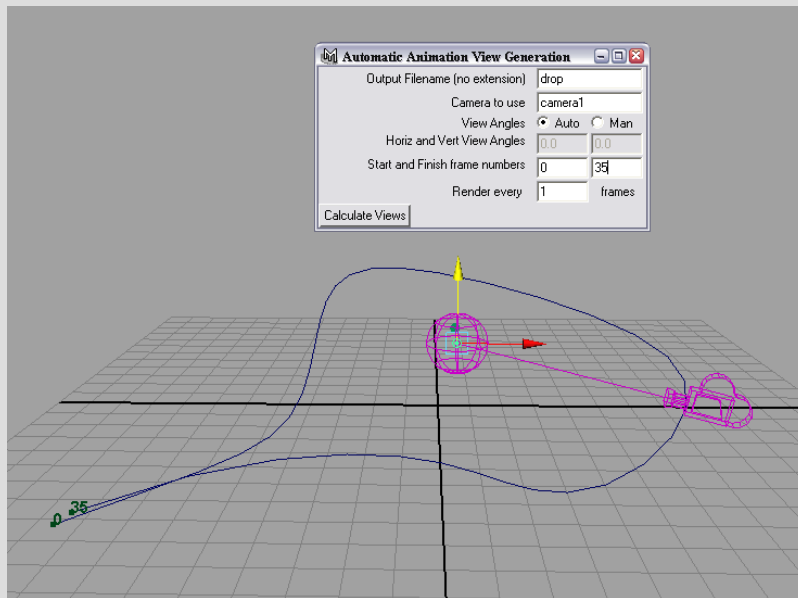
# View file generator

- Camera animation created in Maya.
- Keyframed and motion path methods are valid.
- Automatically takes parameters from Maya Camera.
- View description generated for each frame in turn.
- Options to generate every frame or selection.
- Output to .vf file as numbered frames for each camera.





# View file interface



```
VIEW= camera1_00 -vtv -vp -8.576826196 -8.274559194 0 -vd 9.220406135 9.725732088 12.77031303 -vu -0.4
VIEW= camera1_01 -vtv -vp -7.567200172 -7.063721421 0.001827492062 -vd 8.21078011 8.514894315 12.1816
VIEW= camera1_02 -vtv -vp -6.532052166 -5.875745444 0.01971079709 -vd 7.175632104 7.326918338 11.5773
VIEW= camera1_03 -vtv -vp -5.486099197 -4.699132061 0.09665760174 -vd 6.129679135 6.150304955 10.9137
VIEW= camera1_04 -vtv -vp -4.51891001 -3.487953623 0.3634912722 -vd 5.162489948 4.939126517 10.060294
VIEW= camera1_05 -vtv -vp -3.939896765 -2.200513408 1.03386801 -vd 4.583476703 3.651686302 8.80328644
VIEW= camera1_06 -vtv -vp -3.755458791 -0.923366214 1.936661043 -vd 4.399038729 2.374539108 7.3138616
VIEW= camera1_07 -vtv -vp -3.645245582 0.3755000117 2.821339153 -vd 4.28882552 1.075672882 5.84255186
VIEW= camera1_08 -vtv -vp -3.324300028 1.757483028 3.491753112 -vd 3.967879967 -0.3063101339 4.585506
VIEW= camera1_09 -vtv -vp -2.513778319 3.061505735 3.771686738 -vd 3.157358257 -1.610332841 3.7189406
VIEW= camera1_10 -vtv -vp -1.267147873 4.007815223 3.681914597 -vd 1.910727812 -2.556642329 3.2220812
VIEW= camera1_11 -vtv -vp 0.157420741 4.611467209 3.395327884 -vd 0.4861591972 -3.160294315 2.9220362
VIEW= camera1_12 -vtv -vp 1.639604857 4.991773612 3.019641353 -vd -0.9960249192 -3.540600718 2.711091
VIEW= camera1_13 -vtv -vp 3.141589823 5.200081431 2.59284109 -vd -2.498009885 -3.748908537 2.55125966
VIEW= camera1_14 -vtv -vp 4.644005799 5.220751424 2.124028742 -vd -4.000425861 -3.76957853 2.43344023
VIEW= camera1_15 -vtv -vp 6.11365781 4.978719468 1.61321179 -vd -5.470077871 -3.527546573 2.357625465
VIEW= camera1_16 -vtv -vp 7.416896507 4.298633836 1.074197488 -vd -6.773316569 -2.847460942 2.3100080
VIEW= camera1_17 -vtv -vp 8.141303929 3.012012069 0.6129770049 -vd -7.49772399 -1.560839175 2.1845966
VIEW= camera1_18 -vtv -vp 8.129751495 1.46861061 0.3337160775 -vd -7.486171557 -0.01743771578 1.87722
VIEW= camera1_19 -vtv -vp 7.737024425 -0.04455717382 0.1512116721 -vd -7.093444487 1.495730068 1.4730
VIEW= camera1_20 -vtv -vp 7.119278313 -1.486200727 0.00514661535 -vd -6.475698375 2.937373621 1.03255
VIEW= camera1_21 -vtv -vp 6.315497067 -2.832511215 -0.1422102596 -vd -5.671917129 4.283684109 0.59325
VIEW= camera1_22 -vtv -vp 5.288096515 -4.005942014 -0.3435944015 -vd -4.644516577 5.457114909 0.20800
VIEW= camera1_23 -vtv -vp 3.922361034 -4.436186154 -0.7760565247 -vd -3.278781096 5.887359048 0.05386
VIEW= camera1_24 -vtv -vp 2.930789788 -3.375180735 -1.326938526 -vd -2.28720985 4.826353629 0.0180902
VIEW= camera1_25 -vtv -vp 2.235374529 -2.02552174 -1.74752826 -vd -1.591794591 3.476694634 -0.1479516
VIEW= camera1_26 -vtv -vp 1.501817915 -0.6668342276 -2.057503602 -vd -0.8582379771 2.118007122 -0.424
VIEW= camera1_27 -vtv -vp 0.3937977353 0.4117556286 -2.153637221 -vd 0.2497822029 1.039417266 -0.9151
VIEW= camera1_28 -vtv -vp -1.08350457 0.2316202235 -1.820392624 -vd 1.727084508 1.219552671 -1.834982
VIEW= camera1_29 -vtv -vp -2.331528468 -0.6294149503 -1.399675898 -vd 2.975108406 2.080587844 -2.8423
VIEW= camera1_30 -vtv -vp -3.444599363 -1.674790347 -1.013816853 -vd 4.088179301 3.125963242 -3.81482
VIEW= camera1_31 -vtv -vp -4.490367292 -2.805652763 -0.6777268191 -vd 5.13394723 4.256825657 -4.73754
VIEW= camera1_32 -vtv -vp -5.497471763 -3.985395698 -0.3994264651 -vd 6.141051701 5.436568592 -5.6024
VIEW= camera1_33 -vtv -vp -6.482651936 -5.196629614 -0.1866667245 -vd 7.126231874 6.647802508 -6.4016
VIEW= camera1_34 -vtv -vp -7.45661 -6.428324322 -0.04923797594 -vd 8.100189938 7.879497216 -7.1259274
VIEW= camera1_35 -vtv -vp -8.425692695 -7.670025189 0 -vd 9.069272633 9.121198083 -7.761797126 -vu 0.
```

Maya camera motion (above)  
produces Radiance views (right)

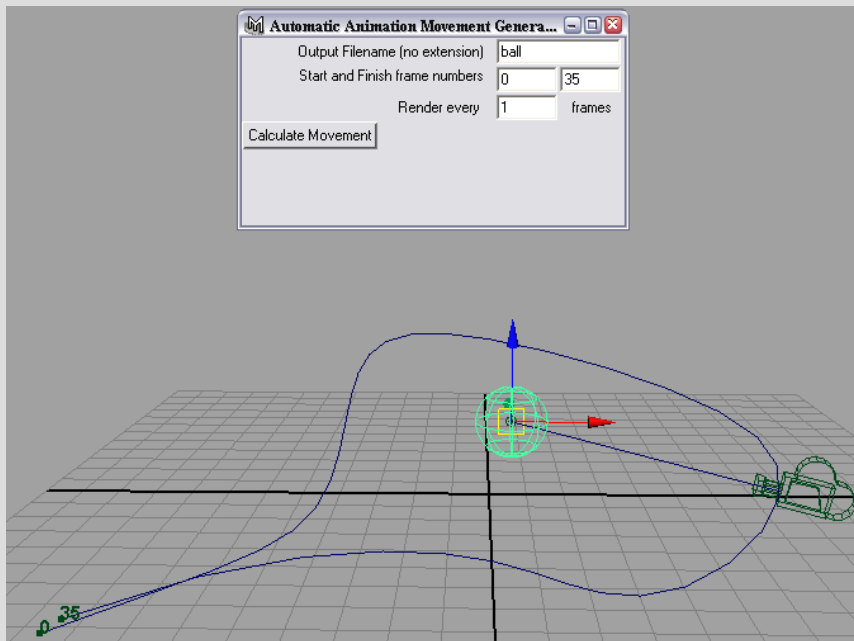


# Movement file generator

- Animation production using ranimove.
- For each moving object a separate movement file needs to be created.
- Similarly to the moving view, movement created in Maya.
- Keyframed, motion path, dynamics and any other Maya produced motion is valid.
- xform parameters written out to .xf file for each frame for each object.



# Movement file interface



```
-rx 0 -ry 0 -rz 0 -s 1 -t 0.6435799381 1.451172894 12.77031303
-rx 0 -ry 0 -rz 0 -s 1 -t 0.6435799381 1.451172894 12.18368131
-rx 0 -ry 0 -rz 0 -s 1 -t 0.6435799381 1.451172894 11.5970496
-rx 0 -ry 0 -rz 0 -s 1 -t 0.6435799381 1.451172894 11.01041789
-rx 0 -ry 0 -rz 0 -s 1 -t 0.6435799381 1.451172894 10.42378617
-rx 0 -ry 0 -rz 0 -s 1 -t 0.6435799381 1.451172894 9.837154452
-rx 0 -ry 0 -rz 0 -s 1 -t 0.6435799381 1.451172894 9.250522735
-rx 0 -ry 0 -rz 0 -s 1 -t 0.6435799381 1.451172894 8.663891017
-rx 0 -ry 0 -rz 0 -s 1 -t 0.6435799381 1.451172894 8.077259298
-rx 0 -ry 0 -rz 0 -s 1 -t 0.6435799381 1.451172894 7.490627579
-rx 0 -ry 0 -rz 0 -s 1 -t 0.6435799381 1.451172894 6.903995859
-rx 0 -ry 0 -rz 0 -s 1 -t 0.6435799381 1.451172894 6.317364139
-rx 0 -ry 0 -rz 0 -s 1 -t 0.6435799381 1.451172894 5.730732418
-rx 0 -ry 0 -rz 0 -s 1 -t 0.6435799381 1.451172894 5.144100697
-rx 0 -ry 0 -rz 0 -s 1 -t 0.6435799381 1.451172894 4.557468976
-rx 0 -ry 0 -rz 0 -s 1 -t 0.6435799381 1.451172894 3.970837255
-rx 0 -ry 0 -rz 0 -s 1 -t 0.6435799381 1.451172894 3.384205533
-rx 0 -ry 0 -rz 0 -s 1 -t 0.6435799381 1.451172894 2.797573812
-rx 0 -ry 0 -rz 0 -s 1 -t 0.6435799381 1.451172894 2.21094209
-rx 0 -ry 0 -rz 0 -s 1 -t 0.6435799381 1.451172894 1.624310369
-rx 0 -ry 0 -rz 0 -s 1 -t 0.6435799381 1.451172894 1.037678647
-rx 0 -ry 0 -rz 0 -s 1 -t 0.6435799381 1.451172894 0.451046926
-rx 0 -ry 0 -rz 0 -s 1 -t 0.6435799381 1.451172894 -0.1355847952
-rx 0 -ry 0 -rz 0 -s 1 -t 0.6435799381 1.451172894 -0.722216516
-rx 0 -ry 0 -rz 0 -s 1 -t 0.6435799381 1.451172894 -1.308848237
-rx 0 -ry 0 -rz 0 -s 1 -t 0.6435799381 1.451172894 -1.895479957
-rx 0 -ry 0 -rz 0 -s 1 -t 0.6435799381 1.451172894 -2.482111677
-rx 0 -ry 0 -rz 0 -s 1 -t 0.6435799381 1.451172894 -3.068743396
-rx 0 -ry 0 -rz 0 -s 1 -t 0.6435799381 1.451172894 -3.655375115
-rx 0 -ry 0 -rz 0 -s 1 -t 0.6435799381 1.451172894 -4.242006833
-rx 0 -ry 0 -rz 0 -s 1 -t 0.6435799381 1.451172894 -4.82863855
-rx 0 -ry 0 -rz 0 -s 1 -t 0.6435799381 1.451172894 -5.415270267
-rx 0 -ry 0 -rz 0 -s 1 -t 0.6435799381 1.451172894 -6.001901983
-rx 0 -ry 0 -rz 0 -s 1 -t 0.6435799381 1.451172894 -6.588533698
-rx 0 -ry 0 -rz 0 -s 1 -t 0.6435799381 1.451172894 -7.175165413
-rx 0 -ry 0 -rz 0 -s 1 -t 0.6435799381 1.451172894 -7.761797126
```

Maya object motion (above)  
produces Radiance description (right)



# .rif file generator

- Basic rif file items (scene geometry and materials) added automatically based on Maya scene.
- Common user options available in the GUI.
- Zone information added from Maya scene properties
- Views descriptions added from specified cameras.
- Prompts user for data that they might otherwise forget to add to standard .rif file.



# .rif file interface

**Radiance Instruction File Creation**

RIF File Name

**Variables**

Initial File Comment

Ambient Cache File

Detail Level ☐ Low ☒ Medium ☐ High

Exposure Adjustment

No. Indirect Bounces

Octree File

Penumbra ☐ On ☒ Off

Quality ☐ Low ☒ Medium ☐ High

Report Interval  mins

Image Resolution

Up Axis Direction ☐ Y ☒ Z

Light Variability ☐ Low ☒ Medium ☐ High

Zone ☐ Exterior ☒ Interior

Xmin Ymin Zmin

Xmax Ymax Zmax

**Material Files**

**Object Files**

**Rendering Options**

Render Options ☐ Normal ☒ Illuminance ☐ Both

Note: Selecting "Both" will result in two .rif files, <name>\_fc.rif is for the illuminance

**Views**

Manual Generation

View Name

Source Camera Name

```

### Office Test Scene
AMBFIL= office.amb
DETAIL= High
EXPOSURE= 1
INDIRECT= 4
OCTREE= office.oct
PENUMBRAS= False
QUALITY= Medium
REPORT= 1 office_radreport.txt
RESOLUTION= 400 400
UP= Z
VARIABILITY= High
ZONE= Interior 0 500 0 320 0 280
materials= office.mat
materials= office_lights.mat
scene= office.rad
scene= office_lights.rad
view= topwalls -vtl -vp 250 160 279.99 -vd 0 0 1 -vu 1 0 0 -vh 320 -vv 500
view= bottomwalls -vtl -vp 250 160 0.01 -vd 0 0 -1 -vu 0 1 0 -vh 500 -vv 320
view= leftwalls -vtl -vp 250 0.01 140 -vd 0 -1 0 -vu 1 0 0 -vh 280 -vv 500
view= rightwalls -vtl -vp 250 319.99 140 -vd 0 1 0 -vu 0 0 1 -vh 500 -vv 280
view= frontwalls -vtl -vp 499.99 160 140 -vd 1 0 0 -vu 0 1 0 -vh 280 -vv 320
view= backwalls -vtl -vp 0.01 160 140 -vd -1 0 0 -vu 0 0 1 -vh 320 -vv 280

```



# Results



The Temple of Kalabsha - Veronica Sundstedt.



# Future Work

- Major work is to streamline the transfer of textured geometry.
- Incorporate the Radiance triangle mesh geometry.
- Produce texture maps and Radiance materials automatically from Maya shaders.





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