Renderman Vs Mental Ray

An in-depth study of the world's most recognized 3D render engines.

Major Research Project

Submitted in fulfillment of B.A. (Honors) – Digital Animation

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Abstract

Whether you are a 3D artist working for a major post production facility or an independent artist working at home, at one point in your life –usually at an early stage- you come across the question;

"Which 3D application should I use to make the most stunning imagery?"

I believe the correct question to be asked is:

"Which render engine should I use?" or "Which render engine works the best with my 3D application?"

The reason for that is because nearly 50% of what is finally presented to the audience is the task of the render engine. A 3D render engine is essentially the transition of the 3D models and mathematical formulas into images that can be seen and processed by the human eye. It is also the engine's responsibility to add effects such as lighting, shadows and reflections to achieve the necessary realism for the computer generated images.

This study will report an in-depth comparison between the two most famous and recognized 3D Render Engines, utilized in the field of 3D computer Animation and Visual effects.

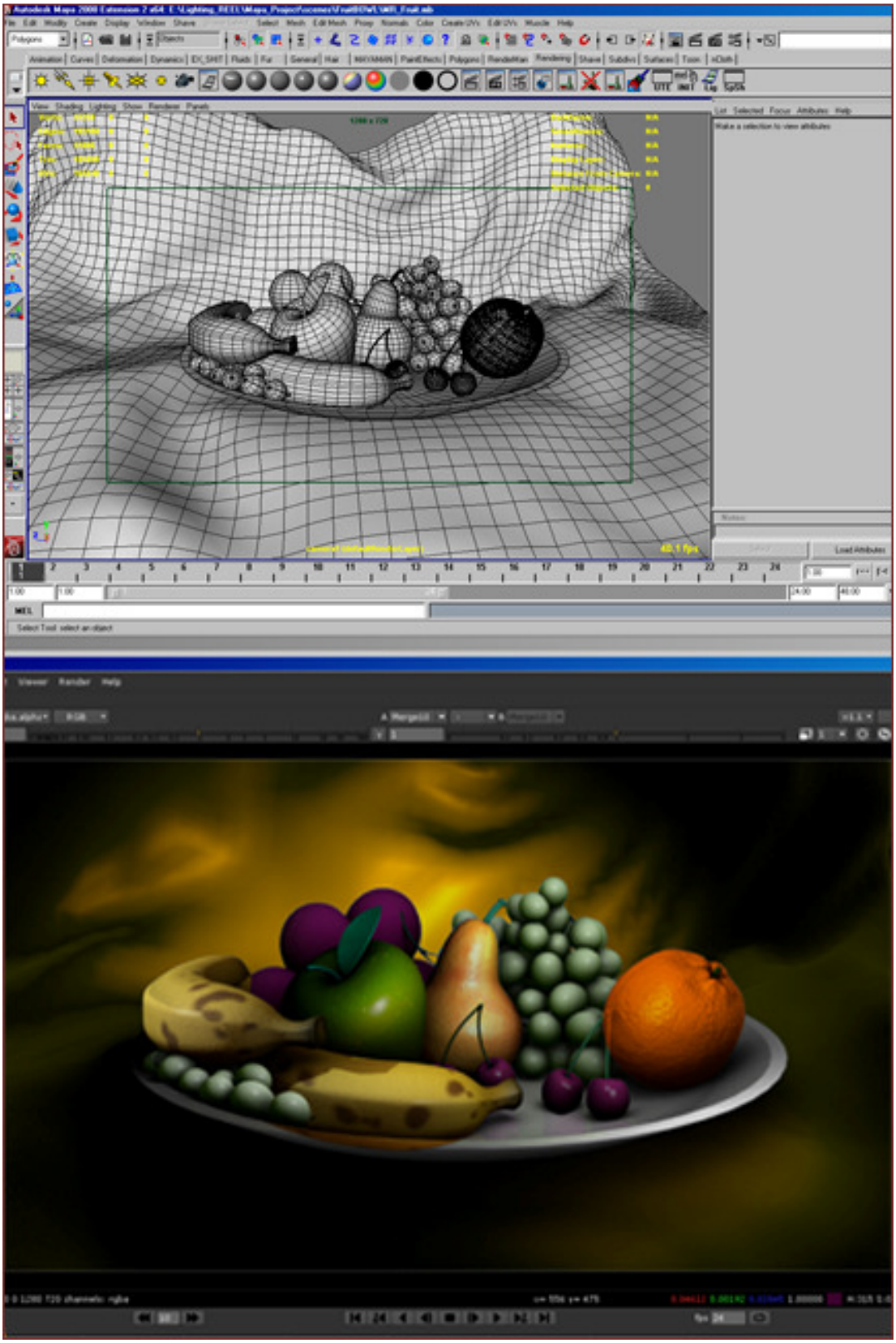
The need for such comparison and study is substantiating; with over 20 professional render engines to choose, the choice left upon the artist or technical director is a tedious choice, at the first glance there might be many parameters that solely influence the decision, parameters such as the price of the engine or the credits behind the engine.

However in an in-depth study there is more than one or two parameters that should be taken into account, parameters such as price, efficiency, speed, learning resources and many others, in this study I have categorized all this parameters into two main category and studied each of them separately on its own, in the real production level many if not all of these aspects should be considered together in order to produce one single image.

The way this research is conducted is by setting a series of scenes in both engines in question here and run a series of tests between them, the results later on are being compiled and contrasted against each other.

In most cases the judgment is bases on the quality versus time, the time might either be the time spent tweaking the image by user or the time spent computing it.

This study will finally answer the “research questions” in an academic way with the results from the practical work. The two images on the next page show the task of the render engine, the transition between the 3D models and mathematical formulas in a 3D application into a “rendered” image.



Task of a render engine, Transition between 3D application (top) and image (bottom).

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Preface

In this study I will be dealing with two of the world's most recognized and advanced render engines, Mental Ray and Renderman, at a personal level I would love to learn more about these two main applications of the industry, the differences aside, there is one major similarity in both of them, they both have contributed to some of the most successful and famous productions of the motion pictures industry. Though there are tons of technical similarities and differences at this first stage I would like to talk about one of their main differences; which is most notably the intention from different major Visual Effects companies towards either of the two engines; Major studios such as Pixar Animation Studios, DreamWorks and Industrial Light and Magic have Renderman as their primary rendering pipeline while those other major companies such as Frame Store CFC, Manex and Luma Pictures have taken Mental Ray's side. However the very early statistics illustrate that Mental Ray has far more users in the industry, but less credit on its back as major production, this fact on its own brings a lot of questions in mind, questions such as "is the complexity of Renderman a major player for fewer users in the industry, or is it the free integration of Mental Ray in most 3D applications to be playing a role in here?"

In either case, this study will enlighten all the known parameters and will try to find new and hidden parameters that contribute to the success of either application.

At the risk of sounding crass, I am asking which one of the renderers is "better", asking such question without considering the type of production planned and the perspective of the user – being artist or technical- would result in a study that is not like to like. No doubt that these two engines both have their strengths and weaknesses, we are here to find out which one fits the criteria required by your given task the best. Other things to consider here are the specific task you will be working on, the type of output which is required by your work, being; print, web, TV, or high resolution movie output, other parameters such as production budget and user skills will also have a major role. In the main body of this research all these parameters are being categorized into two main groups and discussed thoroughly.

1.1 Research background

A quick search of the keyword " Renderman Vs Mental Ray" on the Google website will bring almost 144,000 results, this many web pages have both this engines mentioned in them, many dedicated to either one and very few have done a contrast between them, though many research have been carried out so far, not even one has got away from heavy criticism by industry pioneers and professional, mainly due to the conditions of the research or an unequal opportunity given to the engines, or in most cases simply because the entire production pipeline has not been considered. In this study I have compiled a list of all the necessary elements needed for the contrast to be realistic. I also have taken so many "Real World Production" conditions into account while doing the tests.

Renderman was first created by Lucas Films computer graphics division, later on the year 1986 it was bought by Apple Computers CEO Steve Jobs and became the building block for the company Pixar. Renderman soon became the industry standard for feature film and visual effects rendering, this was however not to last beyond the year 2001 when Mental Images introduced their end user render engine, Mental Ray;

> *"The landscape for renderers has been changing significantly, now there is more than one engine in the market, Pixar and Mental Images are the top two rendering software vendors. Mental Images, which built its business in the field of computer-assisted design for industrial products like buildings and cars, relies solely on licensing its software and is targeting the digital entertainment market, while major competitor, Pixar relies more on the feature film production and licensing engines is more of a "side business".*"

Said Wanda Meloni, principal analyst at M2 Research. The Encinitas firm specializes in technologies used to create digital media.

The competition between the two companies has grown even bigger in the past three years after Pixar introduced a new render engine built upon their original engine called "rfm".

rfm or Renderman for Maya is a much cheaper version of the former Pixar engine and has almost come into market to solely compete with Mental Ray.

> "We want to replace every Renderman license, except those at Pixar,"

Said Rolf Herken, the Mental Images president and scientist who founded the company is 1986."

Whether this ambitious plan comes true or not is the main subject of this study.

1.1.1 Personal interest / Prior knowledge

I have been using Mental Ray for nearly six years now and also have used Renderman in production for the past 3 years, so I believe I have a balanced view of both applications.
My background is more towards Mental Ray and at the same time Renderman is mainly utilized in the feature film production which is far from the kind of production we do in this part of the world. Despite these two facts, I am taking this study on and believe have the grounds to study this further.
The least outcome of this research in my opinion will be a wealth of knowledge that is by definition the main objective of any research of this nature.

1.2 Research Goals

> *"Misinformation about 3D applications is surprisingly prevalent, and incorrect advice is regularly propagated from one artist to the next with such fervor that biased rumor is soon erroneously viewed as industry fact."*

Says Justin Winters, the creative Director of Zaon productions, that being completely true the main goal of this study is to contrast the world's top two 3D render engines in terms of functionality, speed and efficiency.

The most important parameter in here is to study everything in an academic level rather day to day production level that may compromise many parameters. Another main objective is to enlighten the path for the new artists joining the industry; those who are willing to start studying a new engine can use the results of this study as a starting point for their education.

Lastly the goal of this research is to shed some light for the small to medium size post production houses thinking of obtaining or upgrading render engines. This study will finally categorize the type of the production against the engines, so any small to medium size company can choose the appropriate engine according to their type of production.

1.3 Audience

The audience of this research covers a very wide range of professionals, artists, TDs and company owners, each of which has to deal with the rendering aspect of the 3D pipeline, however as a starting point for the audience I would like to mention a few fact:

If someone is willing to produce still imagery for web or print media any render engines would essentially have the capability, the downfall however might be the learning process. Therefore it is the intention of this study to enlighten facts about the motion pictures and works exclusively for an animated shot. one more thing to mention is the segment of the industry this research is focusing at which has its own characteristics, it is dealing with film production level which means only high resolution rendering (basically HD and above) are taken into consideration, any lower quality such as PAL, NTSC is being ignored in here. The focus of this research is mainly to the high-end render engines used specifically in the film environment.

Another thing to discuss is the level of importance that rendering has in the audience work, if you fall in any of the categories of "not important" or "moderately important" which essentially means artists and companies

dealing with modelling for games or visualization, or perhaps companies working for middle level advertising animation, then this research is not intended for you, this study is done for users with "critically important" level of rendering, most notably, rendering technical directors, shader developers, render wranglers, and also in the business side it is intended for the small to medium size company owners who are willing to make a choice in buying a new renderer or upgrading to a new one.

1.3.1 Industry segments

One of the main parameters to be considered for this study is the particular segment of the industry. The 3D animation and visual effects industry has the following segments, each of which requires certain artists and packages to function:

- Feature Film and Visual Effects
- Game
- Advertising
- Visualization
- Simulation

Although both of the render engines studied here are utilized in all of the above segments, not all of them require the same features from the engine, also in different segments different compilations of the software is being utilized, compilations that may be not be available to the public, such as “Mental Ray Real Time” that is vastly used in the gaming industry but it is not available publicly to the end user. It was based on this very fact that I have chosen the “Feature Film and Visual Effects” segment. This segment of the industry makes the most use of the render engine compared to the other segments, also up to certain extent the very default version of the engine without much implementation of the in-house software is being used in here, so the copy of Renderman and Mental Ray on my workstation is very much similar to the one used in a major office, this is a critical precaution to make sure that the comparison is happening in the right benchmarking environment.

1.4 Participants

Participants who helped me with this research are most notably,

Mr. Mujeeb Sayd

Animation co-ordinator at SAE Dubai who has been very helpful with the technical advice

Dr. Megan Knight

Middlesex University Dubai helped me a lot to find the appropriate research method at the proposal time.

Mr. Predrag Toncev

Degree Co-Coordinator at SAE Dubai who has been extremely supportive

Another main participants and advisors I had during this study, was a the great help form the online computer graphics community, most notably the “Computer Graphics General Discussion” forum at “www.cgtalk.com” and also “Renderman Products” forum at “www.pixar.renderman.com”.

2.0 Acknowledgements

This study is being conducted as the final research project for the Degree of Digital Animation at SAE Dubai, Middlesex London. All written contents are results of my personal trials and my personal opinions, although at many stages these ideas have been discussed and reviewed by members from the industry over the internet forums.

Scenes used during the test period have been all created by me and the entire test period has been happening on the same computer machine.

Scenes used in the final batch of renderings as the “Lighting Show reel” have been obtained from the “www.3drender.com” the “challenges” segments and are royalty free for personal study and research.

In order to achieve the most accurate comparison the scenes used in the trials during this research have been obtained by studying the important elements of the 3D pipeline and they don’t fall in favour for either of the applications, any similarity between these tests and scenes from any render engines should be considered accidental.

3.0 Main Body

3.1 Introduction

This study will focus on solving the research questions through a practical way of measuring the strengths and weaknesses of the world's top two render engines.

At the first stage of this study a few terms should be introduced to the audience, what do they mean and more importantly why are they major players of a render engine's efficiency?" these key terms are not the main technical terms studied at later stages, they are more of the consideration for the study.

A very important key term should be explained in here, the existing Mental Ray and Renderman applications that exist in the market are as following:

- Photorealistic Renderman or PRman, currently residing at version 14
- Renderman for Maya or rfm, currently residing at version 2.0.1
- Mental Ray for Maya, currently residing at version 3.6.51.0 rev 23078
- Mental Ray Stand Alone, currently residing at version 3.6.5

Since the focus of this study is on rfm, the Renderman for Maya plug in and the Mental Ray for Maya plug-in, from here onwards the terms Renderman or rfm stand for Renderman for Maya unless otherwise specified, also the term Mental Ray stands for Mental Ray for Maya unless otherwise specified.

Following will be an introduction of the two renderers and their developer's background.

3.1.1 Renderman

Renderman is essentially the specification of the Pixar's render engine; there are many Renderman compliant renderers, which still Pixar's version called PRman and its Maya plug-in called rfm stay the best and most well known and reliable version.

PRman and its Maya specific plug-in are the renderer of choice by large studios such as Industrial Light and Magic, Sony Pictures Image-works and many others.

Renderman specification provides countless tweaking controls in order to adjust the rendering speed, it is also one of the most customizable applications in the entire 3D animation pipeline.

Renderman has a powerful shading language and anti-aliased motion blur that helps the companies to make 3D composited with live-action footage.
One very important aspect of Renderman is that the software is being designed and programmed by people who make some of the most stunning 3D animation feature films, so the challenge of producing realistic imagery is well taken care of.

Pixar's website states:

> "Pixar's Renderman was used in 41 of the last 44 films nominated for a Best Visual Effects Oscar by the Academy of Motion Pictures Arts & Sciences."

The very first movie that utilized Renderman capabilities is "Young Sherlock Holmes" of the year 1985, some of the more recent productions that benefited Renderman during the production are:

- Indiana Jones and the Kingdom of the Crystal Skull
- Star Wars: The Clone Wars
- WALL-E
- 300
- Beowulf
- The Golden Compass
- Harry Potter and the Order of the Phoenix
- Pirates of the Caribbean: At Worlds End
- Ratatouille
- Surf's Up

Pixar has won several awards for their contribution to the visual effects industry as a result of Renderman, their website states:

> "The Academy of Motion Picture Arts & Sciences' Board of Governors has honored Ed Catmull, Loren Carpenter, and Rob Cook, with an Academy Award of Merit (Oscar) for
>
> *"Significant advancements to the field of motion picture rendering as exemplified in Pixar's Renderman."*
>
> The award was presented as part of the 73rd Scientific and Technical Academy Awards ceremony presentation on March 3, 2001. This was the first Oscar awarded to a software package for its outstanding contributions to the field."

Renderman's developers have also been awarded a

> *"Scientific and Engineering Achievement Award for their contribution to the motion picture industry."*

in the year 1993.

Although Pixar's Renderman has been collaboratively working with all the software packages, it has recently turned into a plug-in for Maya as an integrated package.

3.1.2 Mental Ray

Mental Ray is a production-quality rendering application developed by Mental Images. Mental Images which was built as an independent company in the year 1987, was bought in December 2007 by Nvidia. Its core functionality is to do the rendering task by Ray Tracing technique and therefore is being used in creating photorealistic imagery.

Mental Ray has also contributed in production of many feature films, the following list represent some of the most recent movies that used Mental Ray in the rendering pipeline:

- The Matrix Reloaded & Revolutions
- The Day After Tomorrow
- Poseidon.
- Spiderman™ 3
- Alexander
- The Hulk
- Fight Club

Mental Images website states:

> *"In 2003, Mental Images was awarded an Academy Award for their contributions to the Mental Ray rendering software for motion pictures."*

Mental Ray's main functionality is to be incorporated in a 3D application as integrated package. Almost every high-end 3D application has a plug-in that allows it to communicate with Mental Ray.

3.2 Question which this research will answer

Finally the goal of this study is to answer the following questions:

1- *"If I am an artist working in a major post production facility focusing on feature films, which of the two main renderers, Renderman or Mental Ray should I spend my time learning?"*

2- *"If I am a company owner planning to obtain a new render engine with the production focused on visual effects which of the two render engines fits me the best?"*

The answer to these questions can ease the way for those who are already working and thinking of moving on and up, also for those willing to join the industry in the motion picture level.
The answer found by the end of this study will show the path to either of these groups in a practical and academic way that leaves no doubts about the capabilities, difficulties, advantages and disadvantages of either of the two software application. It will cover all aspects of the engines, whether the capabilities aspect, the learning aspects and financials.

3.3 Planning

3.3.1 Research methods

The method used in this research in essentially a bench marking system that allows for both of the packages. A set of scenes has been made and tested via either of the two packages.
Also to make the comparison a "like for like" comparison the emphasis is given to "using the similar technique rather than making the same image", that is due to the fact that the approach which each package may have in producing a similar image might be different, therefore in here on each of the tests I compare one feature of either of the two engines and compile the results, the results then will be contrasted together in terms of the render quality and time efficiency. Though the technique of studying every aspect on its own may not result in the most accurate it does however properly illustrates the strength and weakness

of either of the engines in contrast to the other. At the end I will also be doing another pass of tests that will represent the collection of the aspects and their overall contribution to the image production.

Another important thing to consider is the technique of the rending for both images, as it will be explained in future chapters there are essentially two main rendering techniques, Ray Tracing and Scanline, although each of this renderers acts in a different algorithm, they both can benefit either of the algorithm, therefore it is the objective of this research to compare both algorithm for the renderers.

The set of the scenes used in here, have a combination of all possible objects, so that they don't fall in favor for either of the renderers.

It is also considerable to mention that this entire test and trial period takes place in the interface of another 3D application called Maya.

3.4 Main Categories

As discussed earlier the entire test and bench marking has been divided to two main categories, one dealing mainly with the manipulation, customization and learning of the engine and the second one dealing with specific features of the engine and it's advantage over the other one, in either section of the categories a brief description has been introduces. Also images have been supplied whenever possible.

3.4.1 WORKFLOW

The first category of parameters of this research deals with the generic values of a render engine, or in some aspects a 3D application, features such as the price, maintenance, how well is the engine incorporated in major 3D applications. It will also talk about the learning resources and how easy the application is by nature as well as the engine's up to date nature for the 64 bit processors and different platforms.

3.4.1.1 Major 3D packages integration

The very first matter in hand here is the proper integration of the engine into the main 3D applications, our main 3D application here being Maya does the task of modeling and preparation for the renderer. In order for the production to go smoothly there should be a stable connection with the render engine.

This is a vital stage since we are not comparing the Stand Alone version of the applications but we are comparing the plug-in version and every integrated version may not offer all features of the engine.

As for Mental Ray, it was previously packged and almost exclusively packaged for a 3D application called XSI, it is still up to today a known fact that it has the best integration to XSI and offers almost every feature of the Stand Alone renderer.

Mental Ray's integration for Maya was first introduced in Maya version 6 (Maya currently stands at version 9.5), the first three integrations have been some of the worst possible implementations, a lot of bugs and memory handling errors were causing the software to crash very often.

Renderman plug-in for Maya, was introduced less than three years ago but already is very well optimized, also in terms of the controls, Renderman for Maya gives you so much controls more than Mental Ray.

In a shading level Mental Ray for Maya provide its own library of custom shaders that Renderman for Maya does not. At the same time Renderman for Maya has its own shader builder module called "Slim" that can be used to make and modify shaders, the problem though is that this module is an external module and every shading model made inside it needs to be compiled and translated for Maya, assigned to the surfaces and then compiled back into the render engine and that introduces a huge extra rendering time.

As for their translation from Maya scenes and shading models, Mental Ray offers a better integration and has 98% support for Maya's shading network while as Renderman For Maya does not support majority of Maya shaders.

Many interface errors have also been seen while doing the tests, Mental Ray for Maya has a tendency to crash which needs the module to be restarted, the new setup can be done without restarting the main application (Maya) but a new render pass can't be produced without re-booting the main 3D application. Renderman for Maya has less crashing errors but each time it crashes the entire package (Maya and Renderman) should be restarted.

Finally in my opinion Renderman for Maya does have better integration than Mental Ray for a huge scene and as for the stability. In a scene test of five million polygons Renderman for Maya rendered the scene in 8' 12" while Mental Ray for Maya faced a memory error and the software needed to be restarted.
This is true only for scenes with huge number of polygons. On the other hand if a scene has a huge number of lighting elements, such as lights or shaders, it is Mental Ray that renders the scene faster.
A scene with 12,000 lights was rendered in Mental Ray in 5' 12", the same scene took 9' 23" to render in Renderman. Also Renderman faces a memory overhead while rendering scene with many lights while the number of the lights doesn't actually affects Mental Ray's functionality. According to Mental Images' president Rolf Herken, his software can compute about 60,000 different light sources.

3.4.1.2 Price/ Maintenance/ Support

One of the main factors while making a decision about a render engine is the price to be paid for it. as a home user level, the difference might be about two to three thousand dollars which compared to the cost of the whole setup (Hardware, OS Software..) is negligible, however in a corporate perspective where sometimes up to six hundred licenses should be purchased the difference will be magnified.
Currently the prices below describe the cost of both application and their maintenance fees.

- Mental Ray for Maya is an embedded plug-in for Maya that ships with every copy of Maya for free.
- Renderman for Maya is a 999 $ application that should be purchased separately.

- Photorealistic Renderman is 8000 $ plus a 700 $ yearly maintenance fee.
- Mental Ray stand alone resides at 2350 $ plus 199 $ yearly Maintenance fee

Also whether you have purchased Mental Ray or not you can still benefit from a the features at Autodesk (Developers of Maya) website, however Mental Images the founders of Mental Ray don't have any end user support or maintenance or forums and the entire support has been handed over to the Autodesk maintenance. As for Renderman For Maya, there is a 24/7 maintenance team that services only “the paying customers”, you can at any time contact them via phone or E-Mail and ask for technical help, Renderman for Maya forums are not open to the public and only if you are a paid member you can have access to the forums.

COMPARE CHARTS	
Renderman	**Mental Ray**
999 $ for the plug-in 8000 $ for the Stand Alone 700 $ maintenance fee Direct support from developers Forums are not open to public	Free plug-in with every Maya 2350 $ for the Stand Alone 199 $ Maintenance fee No direct support from developers Forums open to public

3.4.1.3 Multithreading

Multithreading is the ability of the software to run more than one instance of the current task, it means that several instances of the software will be running concurrently on several cores of the CPU.

Renderman for Maya as of version 2.0 (current) and above is a multithreaded application that support as many processors that your system has, which means you can run four Renderman renders at the same time on a Quad CPU machine, each rendering different frame ranges. However this feature has not been there before the recent version.

Mental Ray on the other hand was initially designed to render on

multiprocessor machines and render farms, therefore it has a better structure for multithreading, a main feature of Mental Ray is to render single frame over several processors resulting in parallelism. It means a single frame can be dispatched between several frames so even the test renders can be done much faster.

Though the tests in this study were running on a quad core machine, a trial at www.anandtech.com shows that Mental Ray for Maya couldn't accept more sixteen cores. Renderman however hasn't been tested in that benchmark and the facilities running this research couldn't access such machine either, therefore there is up no result from how many cores Renderman can accept.

3.4.1.4 Cross platform/ 64 bit capability

The new 64 bit processing technology has definitely changed the Visual Effects industry, scenes that used to take days to render can now be rendered in a matter of hours, and it is up to the renderer architecture to efficiently use the new technology.
There are mainly three stages to be considered before something can be rendered in a 64 bit environment,

First of all is the access to a 64 bit machine, a recent survey by 3D world magazine illustrates that more than 60% of computer animation users are already using 64 bit processors and more than 13% are willing to switch into 64 bit machines in less than a year, this survey however belongs to the month of February 2008, subsequently there should be more than 60 % users who are benefiting from 64 bit machines in the 3D society.
Second step however is to have a reliable 64 bit operating system, at the time of this research there are about seven main 64 bit operating systems, between those only three that can be used in a Visual Effects environment with a public 3D package and renderer for it, these three are:

- Microsoft Windows, three different flavors as: XP 64, Vista 64 and Microsoft Window Server x64.

- Linux, more than seventy-four flavors, most notably, Ubunto 64, Debian 64, Suse Enterprise 64, Red Hat Enterprise 64.
- Apple Mac OSX. One flavor; Leopard 64

Third step in this setup is to have a 64 bit compatible 3D application, our main 3D package here being Maya has the following 64 distributions:

- Autodesk Maya Microsoft binary 64, Supported for both XP 64 and Vista 64.
- Autodesk Maya has a compilation under Linux 64, although not exclusively, it is only tested under Red Hat Enterprise 4 and Fedora Core 5.

Maya however doesn't have any 64 bit compilation under Mac operating systems, which would essentially take MAC machines out of this equation.

Last step in rendering a scene in a 64 bit environment, is the access to the 64 bit render engine, as for Mental Ray, since it is being shipped with Maya as a free plug-in, it has a 64 bit Compilation for Both Windows and Linux operating systems.

Renderman, on the other hand has a 64 bit compilation under Linux operating systems but not under Windows Operating systems, this is true only for the current public version of Renderman, being 13.5, the next version of Photorealistic Renderman (PRman) will have a 64 bit compilation for both Windows and Linux Operating Systems, this release is due to be public by November 2008.

The importance of 64 bit processing is up to a level that Microsoft used Mental Ray to demonstrate the power of a new Windows Vista 64-bit operating system.

	WINDOWS	LINUX	OSX
RENDERMAN	32 bit	32 bit 64 bit	32 bit
MENTAL RAY	32 bit 64 bit	32 bit 64 bit	32 bit 64 bit

3.4.1.5 Scene handling efficiency

Again the speed in which the engine handles millions of polygons and its stability is a very influential parameter while evaluating an engine.
A very few engine can handle millions of polygons as smooth and flawless that Renderman does. Surprisingly the core code of Renderman is being written almost twenty years ago and up to now some parts of the code are still the same.
Mental Ray on the other hand has many memory issues which are mainly unknown errors, unknown errors are essentially the errors that don't output a bug log to user for debugging, this is mainly due to the fact that the compilation used in these tests are the plug-in version of the software and made upon the main software's API (Application Programming Interface" so it may not be able to make the most of the original application.

As a technical test I rendered a scene with about four million polygons, it took 6' 20" to render on Renderman while the CPU usage never went higher than 85 % and the Virtual Memory used reached 853 MB. The same test on Mental Ray took 8' 33" with CPU usage mainly staying at 100% and memory usage up to 1.6 GB. Doubling the number of polygons introduced an extra 4' 21" on the Renderman time and caused Mental Ray to crash.

3.4.1.6 User friendly/ learning Resources

When choosing a new application one of the very important elements is to find out how easy or difficult it is to learn the new software, as for the softwares in here, It is true to say both renderers have very poor learning resources but in a different aspect, the study I did made obvious that there are barely any tutorials about rfm on the net. The only reliable resources are the Siggraph papers made throughout the past two decade, which all of them deal with Photo Realistic Renderman rather than Renderman for Maya.
Other resources for Renderman would be the existing books written on it which are only five books.

For Mental Ray on the other side there are tones of tutorial, video tutorials, books and papers, one studio alone, called the Gnomon workshop has over twenty hours of video tutorials on Mental Ray
Pixar has also recently started using a studio as their educational environment, the problem however is you have to pay 999 $ to have access to the information.

At the same time in a higher level of education there a few websites and societies that offer learning material for Renderman, the problem though, none of them is targeting the end user, and they mainly deal with shading TDs or rendering developers. Mental Ray on the other hand has very few educational materials in the high-end level, there is barely any tutorials on the net that can help one learn how to write a shader or customize a node with Mental Ray.

A point about learning Renderman that might be interesting is, about a year ago someone posted a scene in the Renderman official website asking for a challenge by Renderman users, though many people downloaded the scene and expressed their interest in the challenge not even one posted a result back (one of them being me myself). I believe the reason could be either of the two, either regular Renderman users just don't have the knowledge to render such things or Renderman users are busy doing commercial work so they can't get to challenges.

RENDERMAN	MENTAL RAY
High – end education available End user data is poor Five books in 20 years Numerous Siggraph Papers Very few tutorials Very few websites and forums Only one video tutorial	Numerous books and articles Data for end user Many books About 50 hours video tutorial Not much high-end information Uncountable websites, forums

3.4.2 TECHNICAL

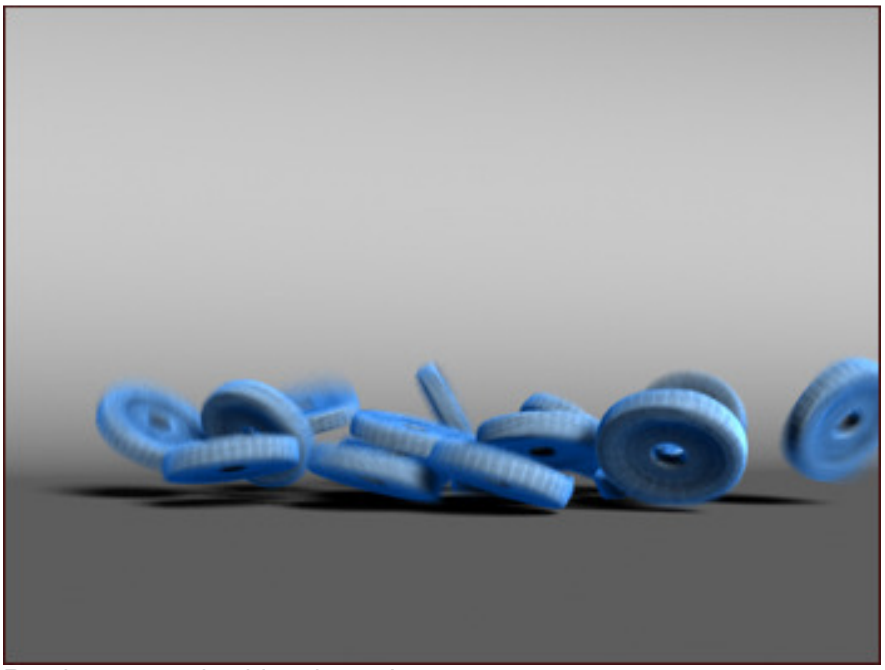
In this chapter of the study I will be talking about the technical differences between the two softwares. It is as if we have access to both applications and beyond the price and other workflow elements I compare the efficiency of the two softwares in a technical level.

3.4.2.1 Motion Blur

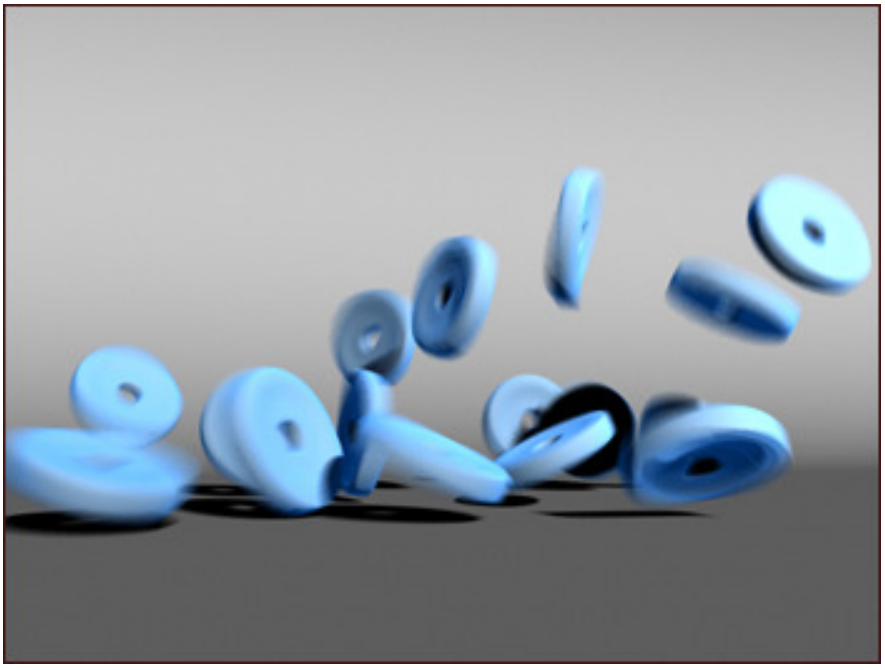
Motion blur is the effect of light being dragged through time. such effect is being captured by a live-footage camera if the camera shutter is open for more than "The Stable Time", in essence if the camera captures more than one shape of the object for one frame, it has to blend the two shapes and make the output frame, the effect is what it is called the motion blur, for a 3D camera however the opening and closing of the shutter is not a natural element of the camera and has to be tweaked by the artist, such effect, happens in almost every sequence in a movie, so the comparison between two engines in this regard is critical.

The results shown below and the test I ran, proved a point that is being widely supported by the community as well. During this study I figured out that Renderman's motion blur compared to Mental Ray is by far faster, the results shown at the bottom of the images show the time spent on each of the renderers to render the frame.

The time spent on Mental Ray side is almost three times more than the time for Renderman, also at the time of this test, Ray Tracing was applied to the scene as well that is a point of strength of Mental Ray. If Ray Tracing was taken out Renderman would have rendered the scene almost six times faster than Mental Ray.



Renderman motion blur, time: 0’ 17”



Mental Ray motion blur, time:0 44”

Mental Ray however offers a unique type of motion blur called the rapid motion blur which is in fact a none 3D blur but still results in smooth images, yet still in terms of speed it can’t make it anywhere close to Renderman.

Another noticeable feature of Renderman was that it can even render faster based on the different scene, meaning that it has different sampling technique based on the different LOD (Level of Details) applied to the image.

Renderman also benefits from a true motion blur which means that objects moving under different distances from the camera still produce the accurate motion vector, the same thing is also true for Mental Ray but the trade off which is the render time is about 600% to 1000% slower rendering.

The last point on Motion Blur is that although both engines have a fully integrated Motion Blur for Maya, not both of them can handle every feature of Maya, for instance Renderman for Maya can not handle Maya dynamics and needs every animation to be fully baked into key frames.

3.4.2.2 Ray Tracing/ Scanline

Scanline is essentially a technique of rendering that at any given point during the rendering process only one row (most commonly from top to bottom) is being calculated, therefore the objects that are not seen in that one row need not to be rendered and subsequently calculated, this technique only processes the objects visible in the current row.

Ray Trace in the other hand is a reveres technique of reality, in the real world a light ray reaches the human eye that has gone through many different stages, bouncing millions of times until reaching a human eye, computing millions of bounces is technically impossible therefore in computer imagery a ray is being sent from the camera and bounced a few times and then it comes back to the camera and makes the images. Therefore it is the entire scene (which is a possible location of the bounce) that matters and gets computed during rendering, and subsequently it takes a much longer time to render compared to Scanline.

Renderman by nature is a Scanline renderer and doesn't render anything in the Ray Trace mode unless specifically required, Mental Ray

on the other hand is a totally Ray Tracing engine and its strength relies on its fast Ray Tracing.

As for the contrast between them:

Mental Ray is a Ray-Tracer which is slower than a Scanline renderer like Renderman. At the same time Mental Ray offers a much more physically accurate calculation for reflections, shadows, Global Illumination and caustics. One thing to consider here is that these parameters are all between the advanced rendering techniques and subsequently are very dependent on the skills of the user as well.

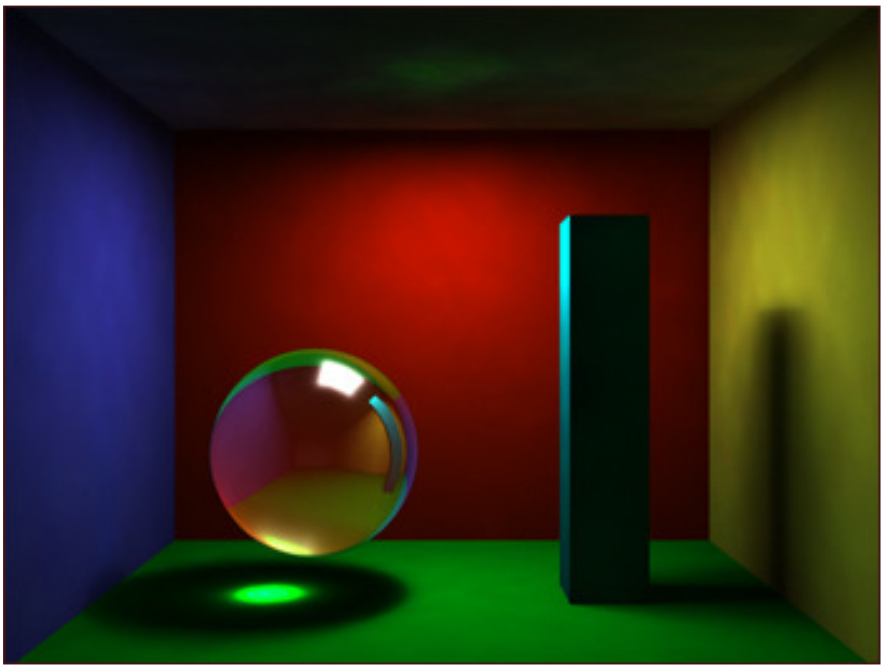
Some very interesting result that came through my study was that although Mental Ray renders features such as reflection and tracing very fast when combines them with another feature such as motion blur, it becomes extremely slow, to the level that it is not usable.
Renderman however, is still very slow while computing the Ray Tracing but the combination of the features doesn't affect its render times.

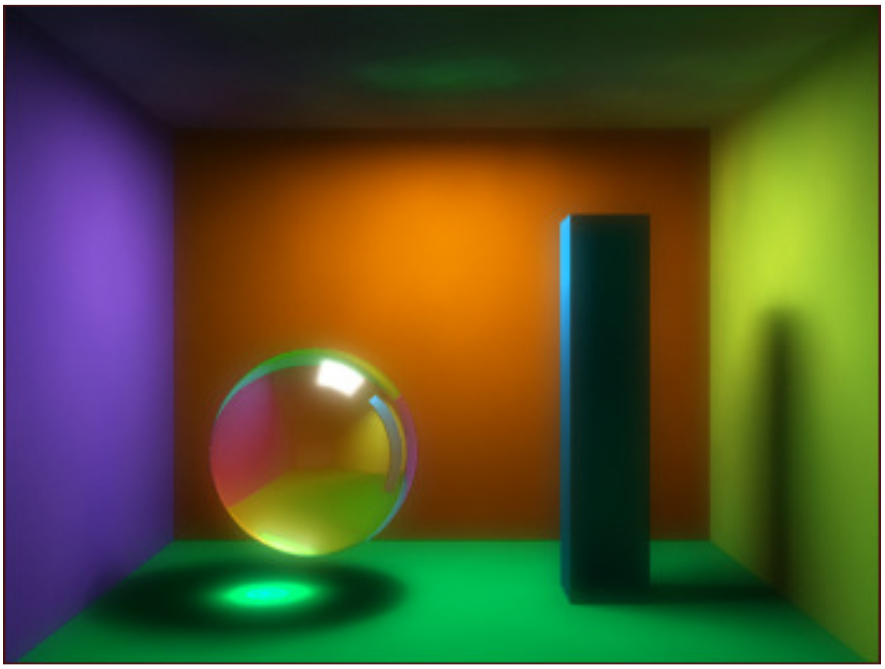
3.4.2.3 Caustics/Global Illumination/ Radiosity

Caustics and Global illuminations are some of the newest techniques introduced to the Visual Effects industry in less than a decade. In simple words, Caustics is the effect of the focused light coming from shiny and/or transparent objects, and Global Illumination is the effect of colour bouncing from coloured objects and their effect on other objects.
These two effects are by far between the most expensive effects and usually take a very long time to render, the very known technique utilized by most render engines is to emit photons, the light photons that physically reach the objects, bounce back and make the result. Considering that in a real world there are billions of photos around any environment, it properly explains the long render times.

As for the comparison, between Renderman and Mental Ray, Mental Ray is by nature a Ray Tracer that essentially means things such as photon emission and mapping is incorporated in its nature, Renderman on the other side, didn't have any Ray Tracing or photon Mapping up

until about seven years ago, the result of the tests I ran between the two renderers are shown below, each of them illustrates the time spend for the rendering of the image.
as you can see the time spent on Mental Ray side is almost half of the time for Renderman side besides the quality achieved by Mental Ray is smoother than the one by Renderman.

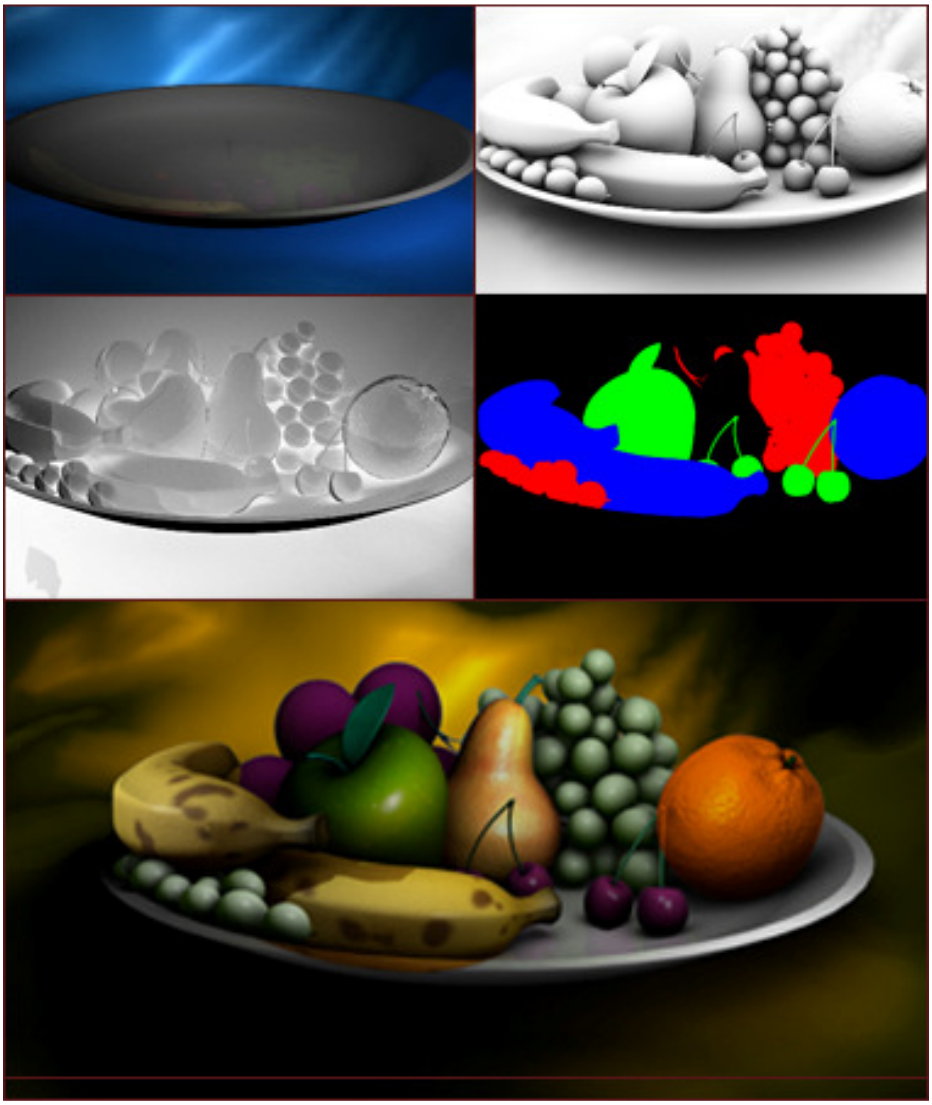

Renderman Caustics, time: 12 ‘ 55


Mental Ray Caustics and Global Illumination, time: 6’ 23”

In this category Mental Ray wins the contest. Renderman however has recently (year 2004) introduced a new technology for Global Illumination called Colour Bleeding, without getting into the technical side; the colour bleeding is about three times faster than the photon mapping for Renderman, yet still by far behind the Mental Ray photon Emission.
The superiority of Mental Ray in this matter is so obvious that even Pixar doesn't use its own Photon mapping technique for their own feature films, an interview with Brad Bird, the director and writer of “the Incredibles” at www.highened3d.com says that some scenes that required an extensive use of Ray Tracing and caustics to simulate a real water were rendered using another render engine called “Brasil”.

3.4.2.4 Pass rendering and management

A real life photograph is essentially comprised of several passes. Passes such as colour, reflection, shadows and many more.
In 3D computer imagery however this is one the most tedious tasks, to make the passes and then separate the passes from each other and finally merge them together in the right order and the right intensity is the entire pass management, this task is partially up to the render engine and partially up to the compositing software, however the part which is the creation and separation happens in the render engine and that is where our focus stays.
The images below show an example of the passes made for an image and how the combination of them makes the final image.

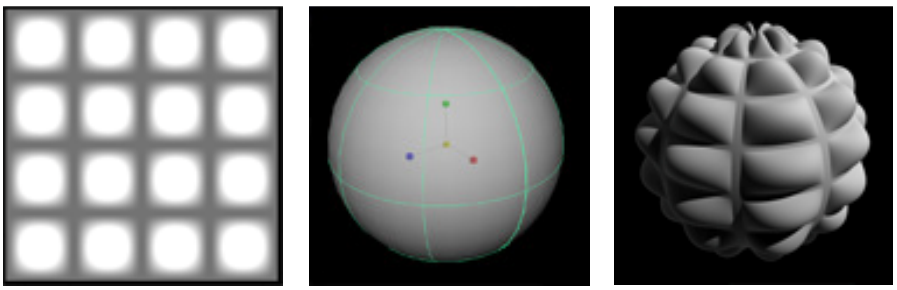


Passes merging together the shape the final image.

As for the comparison between the two renderers, Mental Ray can benefit from the built-in layer rendering system in Maya which is very well integrated in Mental Ray. Renderman for Maya however doesn't recognize Maya render layers. At the same time for extra passes and tweaking, Renderman offers a very intuitive, one click solution that can make almost any render pass while as Mental Ray doesn't provide any setting without an extensive use of programming.

3.4.2.5 Displacement

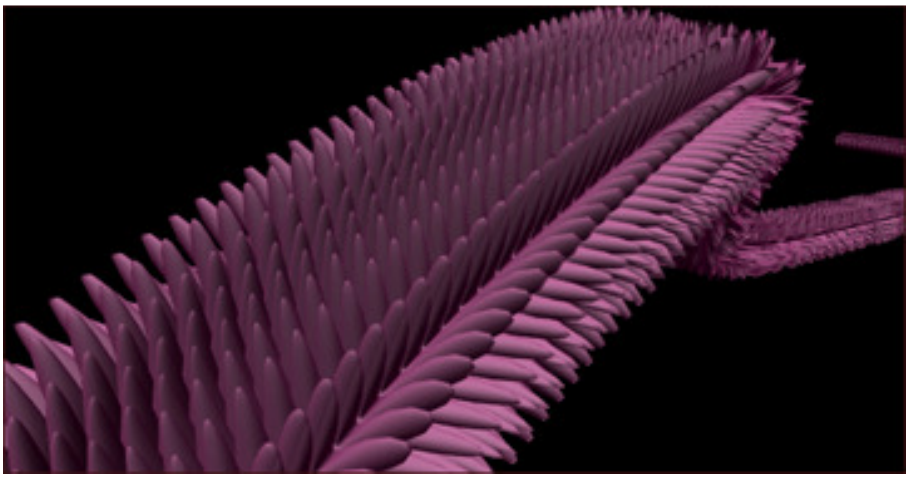
Displacement is an effect of "physically" pulling and pushing the vertexes of an object at the render time. This effect can massively reduce the modelling time and the fact that the pulling and pushing happens upon an image file, gives the artist a very fine control on the model at the last stage (rendering stage). However in order to render a fine displacement a high level of polygon is a necessity which obviously results in a huge number of polygons and a memory overhead and a long scene handling time might be introduced. The figures below show the definition of displacing an image on an object at a render time. As you can see displacing the image at left on the sphere model results in a bumpy surface at the rendered image.



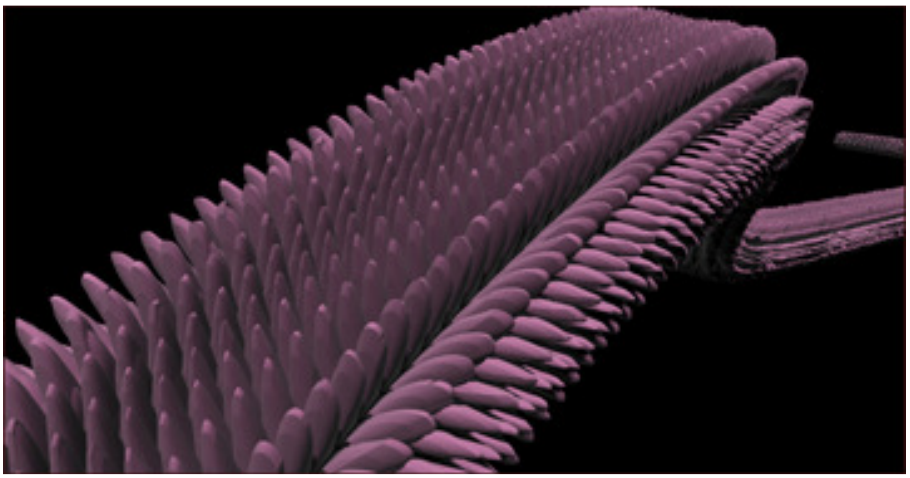
Displacement definition.

however as for the comparison, both renderers can render very fine displacement, they both subdivide the polygon in the render time and apply the displacement map, however the big difference is, Renderman by nature subdivides the geometry into micro polygons at the rendering stage, that means there is no memory overhead for the displacement calculation and the render time is by far faster than Mental Ray.

The two images below show the result of either of the renderers and their time for rendering. Once again in this category Renderman Wins.



Renderman Displacement, time: 0’ 17”



Mental Ray Displacement, time: 4’ 22”

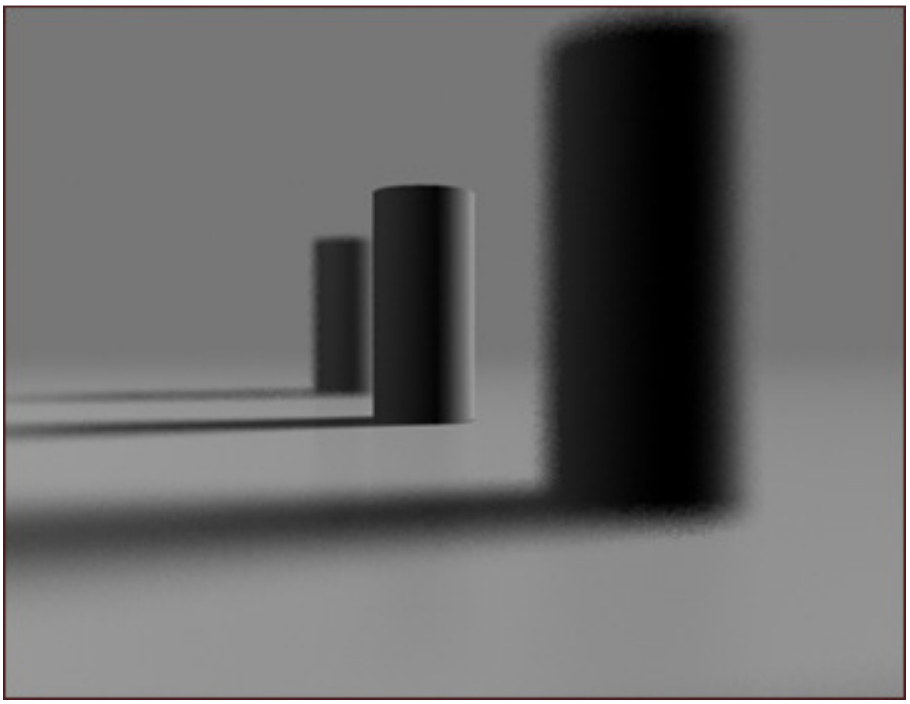
The result in here is surprisingly interesting, the scene, almost a simple scene take about five minutes to be rendered in Mental Ray and the low number of micro polygons is evident. The same scene renders in only seventeen seconds by Renderman and the smoothness of the surfaces is very apparent.

3.4.2.6 Depth of field

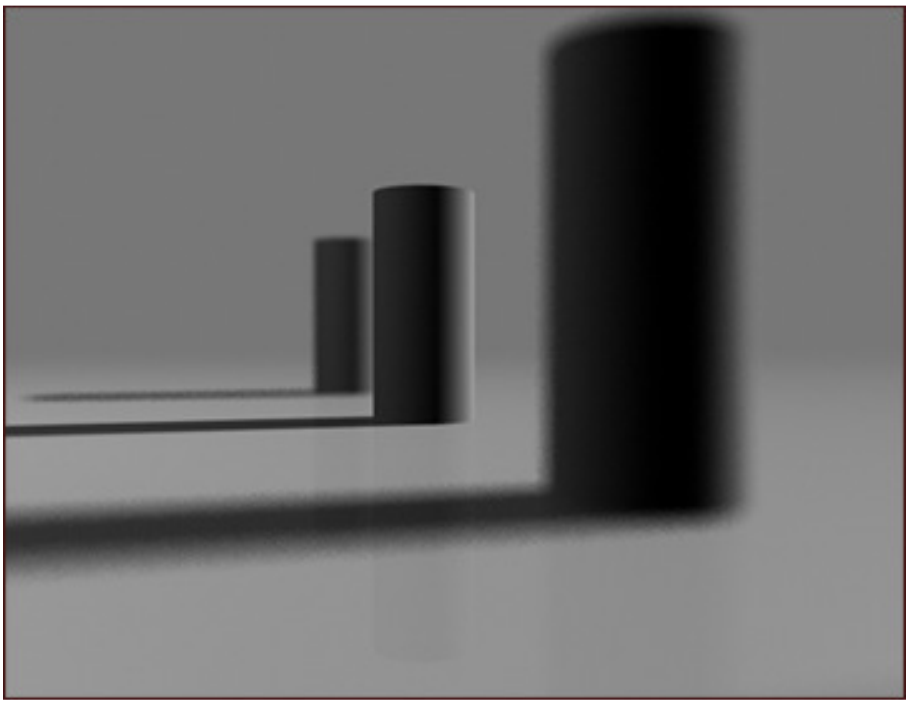
Depth of field as indicated by the figures below is the effect of the camera lens focusing on a certain distance from the lens and applying a blur to the rest of the image.

In this category both renderers, rendered the image with absolute perfection and not much tweaking time was needed by either of them. As for the time spent on each on them, once again Renderman wins.

Renderman renders this category almost six times faster than Mental Ray. One thing to mention though is that the setup for the Depth of Filed as a “post process” was much easier for Mental Ray compared to Renderman.



Renderman, time: 7”



Mental Ray, time: 41”

3.4.2.7 Fur/ Hair rendering

Computing Fur and Hair is one the most challenging tasks in the Computer Graphics industry, due to the nature of the Hair being thousands and thousands of strands and the fact that each of them should be treated individually to achieve the most realistic image. However what is interesting to know is that the rendering of the fur is not the time consuming or slow process, what slows the process down is the computation of the shadows between the fur and hair.

The setup I made for the fur calculation is a similar setup, with the similar quality required, although one thing is very different. Renderman is benefiting a particular shadow mapping technique called, deep shadows, that doesn't exist in Mental Ray, it renders very fast and makes very smooth results, that have soft shadows, Mental Ray on the other hand can utilize its Ray Trace shadowing that renderers very fast but the shadows are very crisp, and trying to soften them will result in slower render.

Both renderers come with their default, out of the box shading model for fur and hair. The images below show the result of the render and the time spent on either of them. Here I believe the two engine tie, for a soft shadow, you may use Renderman and if you need a crisp shadow you can benefit from using Mental Ray.

Renderman Fur, time: 32’ 20”

Mental Ray Fur, time: 43’ 10”

A point to mention in here is that the time difference between the two engines –which is noticeable- is very much dependent on the type of the shadows calculated; otherwise, if the same type of shadows was used in both tests, a very similar result would have appeared.

3.4.2.8 Shader programmability/ SDK

SDK, or software development kit is a vital element of a high-end application, it is mainly designed to give access to the software under the hood, meaning if you need to develop the software any further or modify a particular feature, and it is also designed to add your customized features. Both Renderman and Mental Ray come with an extensive SDK ready to make any changes to the software. Of course not many technical directors or developers have the sufficient knowledge to do the task. At the same time on a render engine level there is another programming considered, the Shader programming, Shader in essence is the look of an object, it is what makes the wood look different than metal or water, it is the characteristics of a certain material that is being interpreted by human brains and makes us see metal, wood or water, these characteristics could be, reflections, refraction, color, transparency and many more. The choice of combining these known parameters or

perhaps coming up with a new characteristic for shader is left upon the shader, and the shader developer.
In the level of comparison, both softwares provide an extensive shading language implemented inside the core of the renderer, Renderman has always been known for its shading language –RSL- which at the same time is not a simple language by itself. Mental Ray also provides the Mental Ray's C interface for coding shaders, once again not a very easy language to learn.

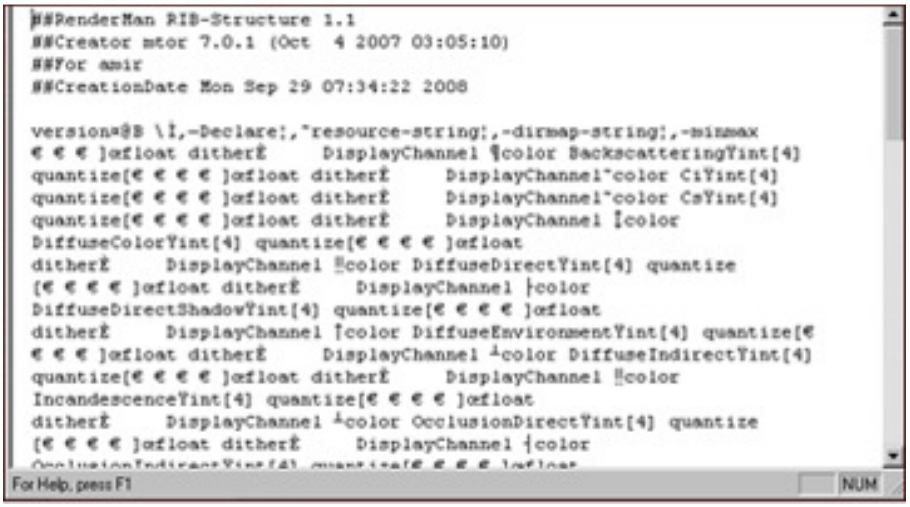
Another primary difference between Renderman and Mental Ray is that Mental Ray has an extensive pack of shaders out of the box that can simulate almost everything, Renderman on the other side doesn't have such a pack of shaders but gives you the shading language as a fundamentals of shader creation so that you can design your own shading model, one main advantage of this technique is that you only worry about the characteristics of the shading model you need and need not to calculate every aspect of the shading model if you are not going to use it.

As for the final shading languages comparison I refer to Stefan Fangmeier, Senior visual effects supervisor, at Industrial Light and Magic who believes:

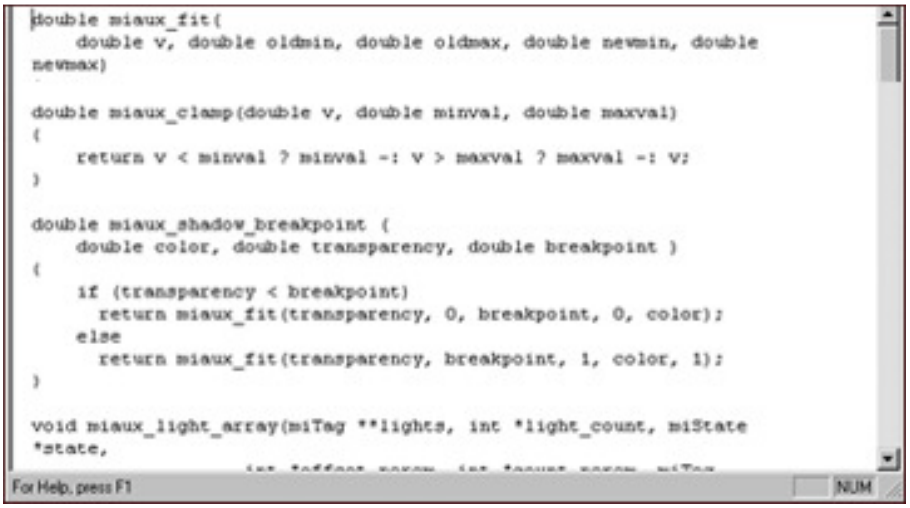
> *"Mental Ray shading technology is much more advanced and it has much newer architecture, therefore making it easier for the developers and artists to develop any type of shader."*

Besides the shader development, both this applications offer a scene language. The scene language is essentially the translation of the 3D application into a render ready format for the engine. This core functionality allows companies and developers to add their own features to the software or perhaps write their own translator.
In this level however, the format introduced by Renderman which is called RIB (Renderman Interface ByteStream) is smaller than the Mental Ray format called mi2 (Mental Images 2), but at the same time the code of RIB is a binary code that makes it extremely difficult to read and debug. Mental Ray's format however is hybrid that would be much easier to read and debug.

A sample of the two different formats is being pasted below:



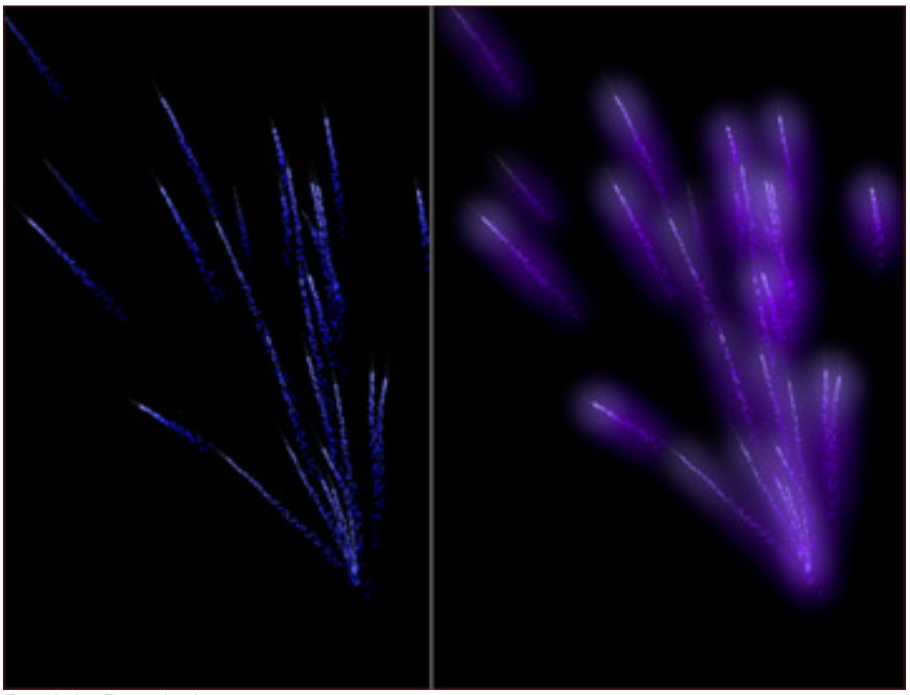
Renderman RIB, Binary Format



Mental Ray mi2, Hybrid

3.4.2.9 Hardware/ software particle rendering

Particles are the dynamics calculator of a 3D application, they are designed to calculate phenomenon such as dust, snow, smoke or anything else that by nature is comprised of particles, this brief introduction obviously makes it clear that –like fur and hair- every particle should be treated individually and also their interaction on each other should be computed. Below is a sample of particle rendering:



Particle Rendering

As a comparison point of view both Renderman and Mental Ray have a full support for Maya particles and since the task of “dynamic calculations” is left upon Maya they require a relatively similar time to render the scenes.

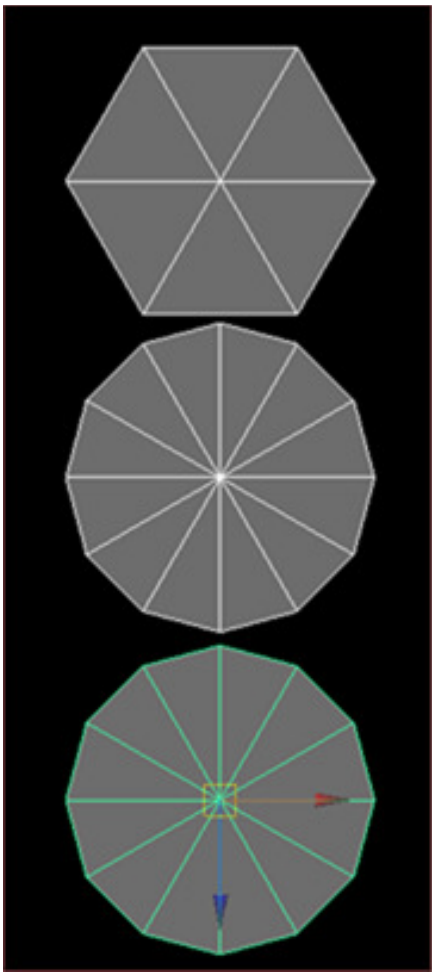
Mental Ray however takes a much longer time to render the scenes with huge particle count which would make sense since Mental Ray essentially doesn’t handle heavy scenes smoothly.

One last thing to mention is that Maya particles are essentially designed to be rendered in a hardware mode using the processor of the graphics card. Renderman for Maya has a unique render feature that allows it to render Maya particles in software mode. Not even the native Maya renderer can do this. This feature gives a lot of controls to the user and is quite out of reach of Mental Ray.

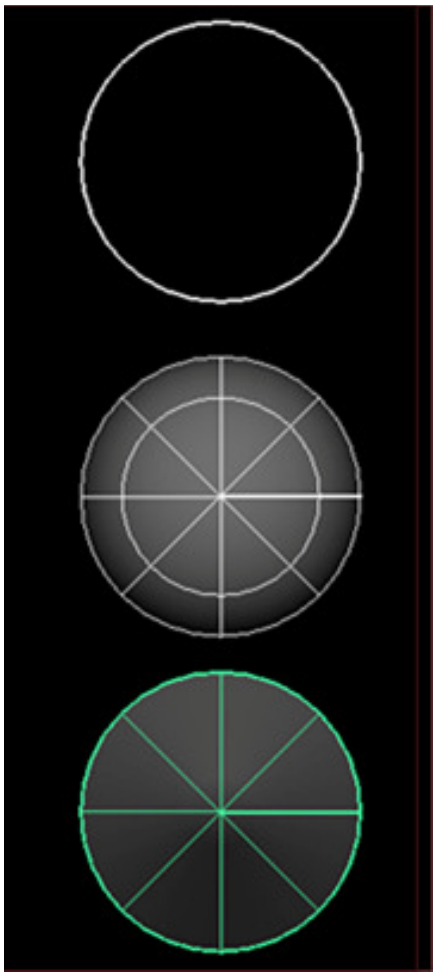
3.4.2.10 Polygon/ parametric rendering

There is essentially two types of geometry in the 3D world, one being polygons, and micro polygon, as shows in the figures, which is the connection of triangles that make any shape and the subdivision of them

to represent smooth areas, and second one is a parametric model, a model which is designed upon formulas and curves, as in the figure.



Polygon Object



Parametric Object

The handling of these two types of geometries is different from a renderer to renderer and it makes a huge difference in time spent for rendering. As for rfm, it can render three main surfaces from Maya, Polygons, NURBS, Subdivision surfaces (a type of polygon object with parametric handlers), during the test renders, it was proved that Renderman renders NURBS surfaces much faster than Mental Ray since it is by nature a parametric renders. That also helps in rendering subdivision surfaces.

The idea of having parametric models is to minimize the chance for low tessellation; tessellation is essentially the number of levels that a model is being subdivided during rendering.

For a polygon rendering also, when the test environment relies on a few number of polygons, one could say that both engines tie or even at some points Mental Ray is faster, but when it comes to a level of heavy polygon count the clear choice is Renderman.

4.0 Conclusion

Finally is the conclusion of this study and a structured format of the outcomes, I have categorized the results in several sections, first section deals with what is or is not supported by either of the engines:

Renderman:

- Many of Maya's built-in features such as glow, optical effects, envy fog, volume shader, or fluid effects are not supported.
- Interactive rendering is not supported.
- Many industry formats such as .psd are not supported.
- Installation and management is much harder than Mental Ray
- The design is essentially made for big productions and doesn't really fit home users.
- Rendering's Ray Tracing has a long way of development ahead.
- Very difficult to learn!

Mental Ray

- The Mental Ray for Maya integration has a lot to be improved on.
- Mental Ray's shading language is so difficult that very few people know how to use it.
- Mental Ray can't handle any high poly scene with none Ray Tracing features such as Motion blur or Displacement.
- Mental Ray core unlike the public belief is very old.

In this next section you can find which rendered is best suited for a specific feature:

Renderman

- Animated shots with high quality filtering
- Motion Blur
- Deep Shadows
- Depth of field
- Displacement
- Custom shader development
- Supports every type of geometry

Mental Ray

- Photorealistic imagery
- Raytracing
- Final Gathering
- Global Illumination
- Caustics
- Ray Tracing
- Ray Trace Shadows
- Renders every geometry type, most efficient with polygons
- Easier to learn

Finally in my opinion the bottom line of this entire study could be narrowed down to Ray Tracer versus Scanline Rendering, as I said before Mental Ray is a Ray Tracing technique while Renderman is a Scanline Renderer and over the past few years we have seen a tremendous effort from Pixar to put more Ray tracing into Renderman as there has also been so much going on at Mental Images side to bring more Scanline into Mental Ray.

At the same time there is no doubt the role which hardware plays in the rendering technology is quite substantiating, it becomes more and more obvious that users and companies tend to have technologies that can handle difficult project through more mathematically complicated solutions than those where artist has to do everything on his own. When you have much stronger hardware at your render farm, rendering the scenes with Mental Ray becomes easier and easier.

One more thing to notice in here is that during this research anywhere I found that the setup is based on Renderman, the facility is essentially a very big production house where the rendering task it is undoubtly supported by huge number of in-house tools that are not available to public.

At the same time the landscape for rendering is growing more and more, with motion picture industry to become more hungry for visual effects there would be room for both renderers anyway;

> *"Whether one technology wins over another is hard to tell. In fact, with Hollywood's increasing appetite for more complex visual effects, "one shot may have 10 or 15 or 20 different technologies."*

Says Allen Fangmeier, the development technologies at ILM.

Finally in my belief if you are a small to medium size shop dealing with movie visual effects, that requires a stable renderer that can render almost everything, I believe Renderman is the clear choice, at the same time the great implementation of Mental Ray to every High-end application should be properly considered, this common integration makes it easy for anyone to jump from one 3D application to another. One more thing to consider is also the difficulty of learning and manipulating Renderman.

5.0 Reflective Logbook

The reflective logbook in this research will be mainly dealing with process I went through the practical work accompanying this research.
In here instead of logging the information on a daily basis I have logged it based on the major events during the practical work, how far did each task take and what were the challenges involved, I believe this technique would be more friendly for the audience and will get more into the important aspects of the study.

This logbook is divided into the following categories:

Studying for the research
Preparing the test environment
Communication with industry members
Accuracy and average timing
Lighting show Reel
Research involvement in my Short Film

Having this categorization in mind I start off writing the sections:

Studying for the research

No doubt in an academic environment the research and study should be backed by negotiable proof and scientific reasons, this fact aside, it was also the nature of this study to be as technical as possible for myself to learn, it was therefore one of the main challenges for me to learn the

most up to date technologies and techniques in order to have a comparison that would be closest to reality.

About nine months ago when I submitted the research proposal for this study I knew I am up against a heavy task of studying and since then I started learning more and more about the entire rendering process and in particular this two engines. However as it was in the “learning resources” segment of the research, the task of learning either of these two engines is quite tedious, mainly due to the lack of information. For me fortunately I had a very balanced view of both softwares. However when I started the research once again I felt the need of a brush up on my knowledge and skills and this was how I got myself enrolled at Escape Studios for their online Renderman courses. The course that cost me 999 $ but brought a wealth of knowledge to me that can’t be measured by money. The same thing applied to me on studying Mental Ray, though I didn’t enrol in any courses, I did a re-cap of all the existing video tutorials and some of the most important books written in this matter.

The second part of my study however, was the “How to evaluate a render engine”, essentially every evaluation has its own very laws and regulations, that added on top of the comparison in here made it very clear for me that I need to find a proven setup for comparison.

Finding a setup for the render engine comparison is almost an impossible task; the best result I found on the internet is about three pages maximum and unfortunately is flooded by the author’s personal opinions rather than facts.

So when I failed at finding a proper technique to evaluate a render engine I had a look at 3D application evaluations, fortunately there are many known and approved techniques for comparing 3D applications, so I decided to study those and see how does a parameter become a vital parameter and apply the same technique to the render engines and that is how I came up with my major parameters.

Preparing the test environment

One of the major steps I needed in order to validate my study was to collect information on the same subject mainly to find out if the same test has been carried out by someone else. This at the first stage sounded

unnecessary to me since I was going to do everything on my own, but studying the very first few posts on the internet forums proved me wrong. So many people had done a similar thing –in a much smaller scale- and many of them have proven to be in a "none equal" conditions or technically wrong aspect of the rendering. So I had to find all of this information through the internet forums and find those parameters that may not be very apparent at an early stage. One of the most interesting parameters I had to consider for my test environment was the version of the applications I was going to use, since both applications I am benchmarking here are integrated inside another 3D application the amount of communication between the softwares are huge. This by its own introduces a lot of inequality. Every new version of these softwares has a better integration with the main 3D application, at the same time every new version has to take care of more features and subsequently new bugs and errors are being introduced.

Finally the most stable version of the two softwares that are being released at the same time (relatively) was found and put in the contrast.

Another main test environment issue was the machine and the operating system used for the trial. I personally preferred to run the entire test period on a 64 bit operating system. But a quick look into the forums made it clear that the 64 bit compilation of Renderman is still under development and can't utilize the most of 64 bit technology yet. Therefore the choice was made to use a 32 bit machine with equal terms for both renderers.

Communication with industry members

Another interesting stage of this project was the communication I had with other members of the computer graphics industry. I always believed internet is one of the greatest innovations of the human history, during this project it was truly proved to me. Information that used to take months if not years to reach someone, can now reach you in less than hours, you can even push it further and receive the information in real time. One of the industries that to me sounds like the pioneer of internet communication is the computer graphics industry, internet has always been a primary tool for the computer graphics artist, not only to

showcase their work but also to communicate with each other, learn from and teach to others. This being said; during this research I benefited from three main forums and groups. One being the by far the most recognized computer graphics forum on the industry,

http://www.cgtalk.com

This website was first online in 1999. Nine years later in the year 2008 they have 345,505 active users, over 578,654 threads and over five million replies, (statistics gathered on September 16th 2008).

Almost everyone in this industry or similar industries has an account there. Another main forum I benefited from was the official Pixar Renderman forum:

http://renderman.pixar.com/forums

Though this forum is not the main Pixar forum and is designed for public, I could still find some of the most skilled and talented Renderman users there to answer many of my questions.

Accuracy and average timing

Another major issue I was facing during the test renders was the timing method, as illustrated on the main body of the research, some of the tests have taken less than ten minutes and the difference between the two engines has been less than two to three minutes, that means in a time length of ten minutes a tolerance of three minutes could have happened. Now the question is how does this timing become accurate? At any given point there might be more than a hundred different processes running on a computer, specifically with a Windows Operating system that is well known to have numerous unknown events happening on it. The events could be as simple as a user input such as moving the mouse or pressing a key on the keyboard, or an input from internet. Other retypes of processing tasks could be the change of a track being played on the media player or a bit more complicated one can be the automatic change of the priority due to the CPU heat.

It is based on these many parameters that a test render that took 500 seconds at one point was extended to 530 at another stage and was done in less than 468 in the optimised situation (Having killed all the unnecessary processes).

Optimized conditions would introduce the best testing environment, however having those conditions requires a lot of caution and by itself requires a system management application that was not accessible during this study.
The solution which came to my mind and was also backed up by the forums was to render every frame more than once and get an average of the rendering time.
So essentially during my test renders, I kept the rendering part o the times at night when I wasn't working on the machine and I also disconnected my machine from the internet, then I rendered a sequence of one hundred frames and found the average time spent per frame. This technique, though is not the most accurate to find the exact time spent on the task, it is a very accurate way of comparing the two results.

Lighting show reel

Over the past few years I have always introduced myself as a lighting TD or rendering TD. That being my personal objective I never really had the opportunity to work in an organization as the very specific title I desired. Therefore up until now, although I have made so many projects and added to my own show reel I never had the opportunity to make myself a specific lighting show reel. Most works on my reel is the work of a generalist technical director, an all rounder that does everything during the project.
It was for this reason that the opportunity of this research project and the chance for me to solely work on the lighting section of the image was really a “god sent”.
Using the scenes from some of the lighting challenges on the www.3dredner.com I started making a final contrast between the two engines and therefore I had to do a different lighting setup for each of the scenes. The scenes from www.3drender.com have been around since the year 2006. And there have been more than five thousand posts on the forums about using them and lighting them, so I used all these information to make my own lighting reel and find the statistics for both renderers. I mainly picked eight different scenes that were at the end narrowed down to six, each of them rendered twice, once by Mental Ray

and once by Renderman. At this point the whole package is going through the last touches and will be presented at the final presentation.

Research contribution to my Short Film

One of the major outcomes of this study for me was the contribution this study had to my animated short film which will be ready by the end of 2008. This short will be the very first independent movie I have made myself and there has been quite a bit of debate happening between me and the other people who are working on it as for the render engine of choice. One thing is for sure and that is none of us has done a movie in this scale and this quality, therefore we all lack the necessary experience for making such thing, that is why such study as the one I carried out in this research could be a very good staring point. By the end of this research I have decided to split the rendering task of my show reel between the two renderers and make it based on the strength of either engine. Things that require high motion blur or displacement or scenes with a lot of polygons will be rendered by Renderman and those scenes that require a high accuracy of Ray tracing or global illumination will be rendered by Mental Ray.

Another thing that was cleared was the choice for rendering the fur on main character for the movie. I have been kind of worried about that part until the time that I rendered the fur for this study, the concern was mainly due to the fact that every frame of fur is taking almost about an hour and a proper solution should have been assigned. The solution I chose however is to use Renderman for fur rendering.

I wish that this study has fulfilled its objectives and could have been of an assistance to you choosing a path of rendering engine.

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