

24th DAAAM International Symposium on Intelligent Manufacturing and Automation, 2013

Realistic Scenes in CAD Application

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Abstract

3D computer graphic artists have focused more on animated films, broadcast, feature films, interactive video games, visual effects and web. Especially for industrial and technical design, rendering process is not given due attention. This paper presents a way to achieve realistic images in the technical field. Creating quality images in CAD programs depends on Render. Render is the process of creating a sequence of images of a scene. CAD graphics programs make intense mathematical calculations and apply the laws of physics to achieve in a realistic way light, shadows, reflections and textures. The render of lights, shadows and textures is realized using Render software that includes two basic categories: ray casting and ray tracing. Ray casting can lead to the creation of high-quality images using light, shadows, textures and different effects. However, for a greater realism, requires reflection and refraction which can be achieved with ray tracing.

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Selection and peer-review under responsibility of DAAAM International Vienna

Keywords: Render; realism; reflection; textures; light; CAD

1. Introduction

Achieving realistic three-dimensional - 3D scenes depends heavily on how their modeling, textures applied and how to apply lights and shadows.

As Albert Einstein said, „imagination is more important than knowledge” - 3D geometric modeling develops computer skills identical to those developed for the effective implementation of physical models. Realistic modeling of various mechanical assemblies and their implementation in virtual reality lead to the development of imagination. This paper introduces engineering design concepts and applies engineering graphics to the design process.

Engineering problem at the core and that require organization, analysis, graphics, communication, and skill (Fig. 1) [1].

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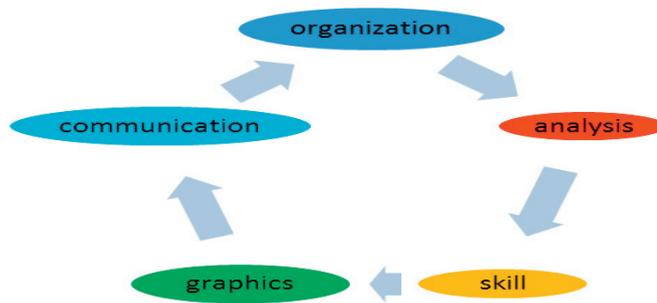


Fig. 1. Engineering.

In designing 3D solids can be started from a drawing done in 2D (Fig. 2).

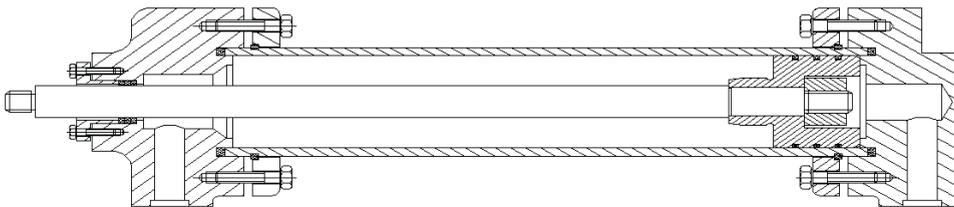


Fig. 2. 2D drawing.

Numerous modeling techniques exist, as well as many modeling formats. Point modeling, edge loop modeling, box modeling and paint modeling are a few of the polygon modeling techniques.

Polygon proxy modeling is a variation of subdivision modeling. NURBS surfaces are used extensively in industrial design, manufacturing, and the automotive industry.

Texturing and lighting transforms the dull-gray denizens of the modeling world into lifelike objects. Although texturing is nothing without good lighting, good lighting is nothing without good texturing. Elementary spatial geometric shapes are basis for modeling any object whatever its complexity.

These elementary spatial geometric shapes, also called primitives of 3D modeling, are geometric models preset for CAD applications.

2. Solid modeling

Thanks to the computer use in the design field, the process of creating shapes is improved and they can be viewed before the manufacturing process.

The shapes created can be then analyzed from different points of view, such as: color, material, resistance, technology etc.

Already known and established facilities for creating 3D parts (functions as extrude, revolve, sweeping and helix) and surfaces features 3D editing (creating complex surfaces) are implemented in almost all CAD programs (Fig. 3).

Inclusions of dimensional and geometric constraints are possible modular control concept. If a designer can create a very complex shape, and the used CAD program allows its modeling, the spatial shape is limited at a time by both the product function and its manufacturing technology.

a

b

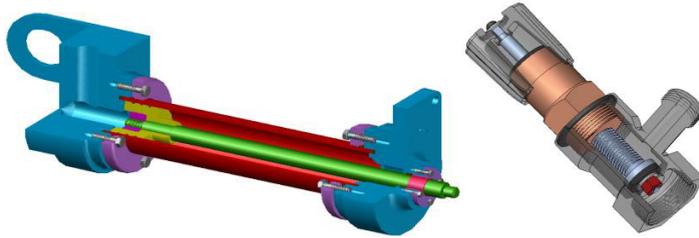


Fig. 3. (a) Graphical representation of a piston; (b) Graphical representation of a valve.

3. Realistic images

To obtain realistic images, often, it requires a transfer modeling into program application where textures and lighting is much easier (Fig 4. (a) and (b)). Render lights, shadows and textures are performed using software render (Fig. 5). Maya has the ability to perform hardware rendering, which is substantially enhanced with graphics.

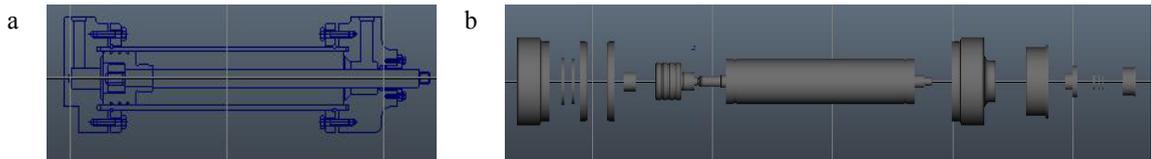


Fig. 4. (a) 2D drawing; (b) 3D drawing.



Fig. 5. Software render.

Material, which will be made part design, you can choose from a standard database (Fig. 6).

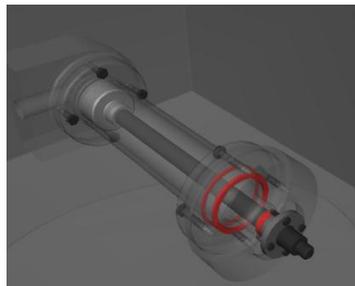


Fig. 6. Part design.

Initial stage of modeling objects have a gray matte by assigning a color to a surface can be differentiating components of a whole. But this is not sufficient for a realistic picture accomplishment. Achieving realistic surfaces is more than a color application. A texture is an image (Fig. 7), often closely linked to material object. However, you can map a texture to the object.

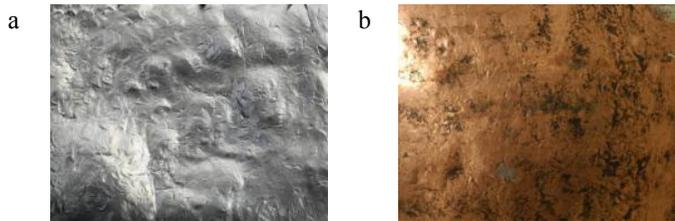


Fig. 7. (a) Steel texture; (b) Copper texture.

Once placed on the image surface, it can move, rotate or duplicate. If you want an image to be placed in two or more areas, we must use a map projection which is similar to a projector pointing towards the surface. Maya supports various image formats, including JPEG, TIFF and format IFF. If using a standard database material does not meet the visual aspect of the piece, then we choose a texture that is at a resolution related to the desired result. Every time you change a material or apply another light must be render the scene again. This makes complex elements consume a lot of render time necessary. Obtain realistic rendering requires reflections and refractions. In this case, render will have a much greater amount of time, but the images will be more realistic. Area type lights are ideal for situations where lighting is required rectangular type - for example, fluorescent light. However, excessive use of such lights in a scene can slow down rendering. If the property is reflected on the surface of another object, light rays strike the surface is required to be reflected, then hit another area called reflectors and are then directed to the eye. So in a scene multiple objects must be present to talk about reflection, an object to have something to reflect (Fig. 8). Refraction is the change in angle of light rays when they enter a denser medium. CAD programs allow setting an index of refraction, which can control the angle of the light deviates when joining surface of contact between two different environments. One of the features of the “designer-computer” system is the possibility to create. This system can analyze a large number of variants in a short time, to compare different solutions.

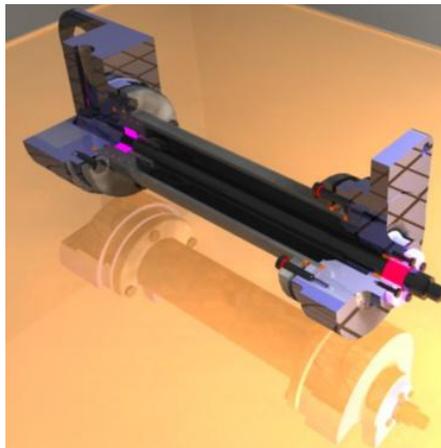


Fig. 8. Refraction.

Thus, a close connection exists between the artistic creation and the technical one. Models can be studied in different colors and shadows, leading to remarkable visual effects.

There is the possibility to include shadows in a scene for both the object and the light. The both ways create some realistic shadows, the last being applied faster.

The ray trace type shadows need a longer processing time (Fig. 9), so the shadow time used depends on the user option. To make shadows as realistic as possible is a real challenge for the scene creator, as the same time, to keep a minimum rendering time for each scene.

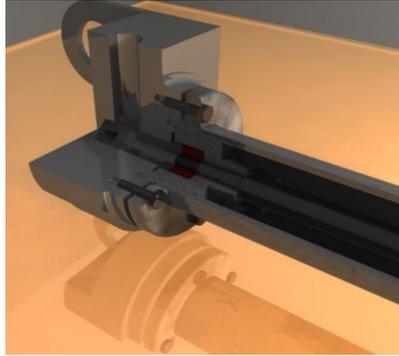


Fig. 9. Ray trace type shadows.

In Maya there are six types of lighting: ambient, area, directional, point, spot and volumes. These can be combined to produce virtually any type of lighting.

The study of the light in a 3D scene depends on certain factors, such as: direction, angle of incidence, reflection and refraction (Fig. 10).

Light sources in a scene create shadows. There are two types of light sources: natural (overall sources in 3D modeling) and artificial (punctual sources in 3D modeling).

Refraction is a change in the angle of light rays when they reach into a dense medium, as glass or a liquid [2].

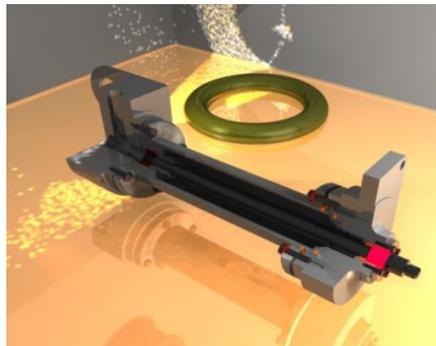


Fig. 10. Study of the light.

Too much light can make a scene look dull, drab, cold and unpleasant viewer (Fig. 11). A suitable light intensity can be chosen to highlight some of the major and highlight it.

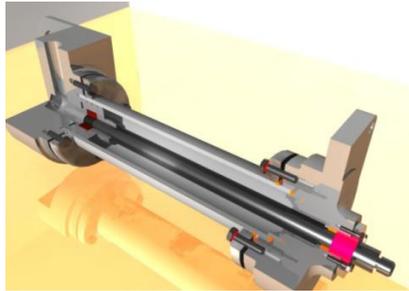


Fig. 11. Strong illumination.

Hardware Renderer in Maya benefit from the processing power and speed of the latest generation of video cards. Hardware Renderer produces high-quality images. It helps the user to produce quality images at a significantly lower than Software Renderer.

Acknowledgements

The new generation of computers and CAD programs give the possibility to create some complex shapes with a proper material, as well as to use a color in a suitable place. A modern designer knows all these and can associate them to create a product [3], [4], [5]. The way a surface reflects the light can give the opacity or the glow of an object. The reflection is different for each material attached. The texturing given by mapping the surface with a certain image controls the way the texture is placed on a surface (Fig. 12). In a forth coming paper, from a study of the process of animation, it would be interesting to analyze the phenomenon of wear of different parts. Following this analysis, the future will achieve realistic images to emphasize the parts wear in certain are as in time.

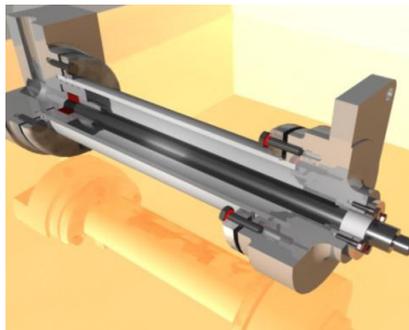


Fig. 12. Optimal outcome.

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