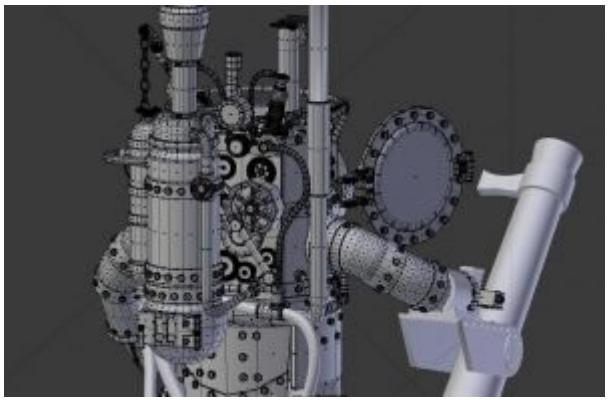
2019 Formats of the most common 3D file

3D Impressions September 12, 2019 News



What 3D formats? How do they compare? What should you use? We simply explain the 3D file formats most commonly used today: STL, OBJ, FBX, COLLADA, 3DS, IGES; STEP and VRML / X3D.

A 3D file format is used to store information on 3D models. You may have heard of the most popular formats STL, OBJ, FBX, COLLADA, etc. They are widely used in 3D printing, video games, movies, architecture, academia, medicine, engineering and earth science. Each sector has its own popular 3D file formats for historical and practical reasons. We will learn more about the 3D file formats and we'll delve into 8 3D file formats most common of this article.

You can also go directly to the most popular 3D file formats.

What is a 3D file format?

A 3D model of a pigeon with information on the colors, the light sources (note the shade) and animations

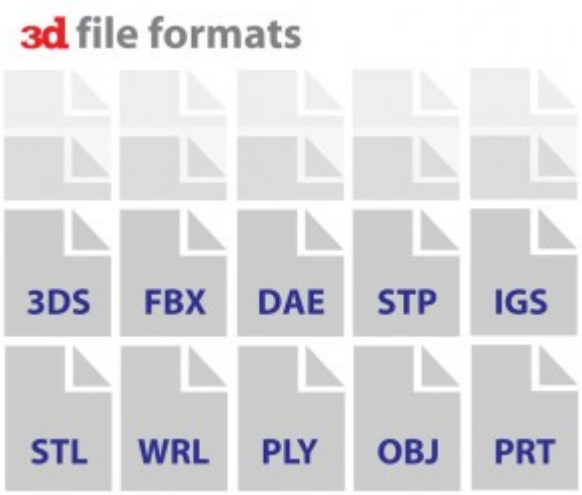
The fundamental purpose of a 3D file format is to store information on the 3D models as plain text or binary data. In particular, they encode the geometry, appearance, stage and animations of the 3D model.

The geometry of a model described shape. For appearance, we hear the colors, textures, material type, etc. The scene of a 3D model includes the position light sources, cameras and peripheral objects. Finally, the animation defines the movement of a 3D model.

However, all 3D formats do not store all this data. 3D file formats such as STL store only the geometry of the 3D model and ignore all other attributes. For cons, the COLLADA format stores all.

STL and COLLADA are just two of the many 3D file formats used. We estimate that there are hundreds of 3D file formats currently used in the wild!

How many he has 3D file formats?



The problem with 3D file formats is that there are literally hundreds. All CAD software companies such as AutoDesk and Blender have their own proprietary format optimized for their software. So if you use AutoCAD, you get a DWG file. If you are using Blender, you get a BLEND file.

3D file formats owners impede interoperability

However, the presence of so many proprietary file formats is a big problem. Suppose you are using AutoCAD (which is a product AutoDesk) and your friend uses Blender. Suppose you want to also share your 3D model with your friend.

It is not so easy. Your software provides AutoCAD DWG because it is the native format of AutoCAD. But your friend's software, Blender, can only function with a BLEND file. This means that you can not work on the same 3D model.

The neutral 3D formats solve this problem

To solve the problem of interoperability, neutral formats and open source were invented as intermediate formats for converting between two proprietary formats. Naturally, these formats have become extremely popular now.

Two famous examples are neutral formats STL (with an STL extension) and COLLADA (with .dae extension). They are widely used to share models of CAD software. If you want to share your 3D model, convert the DWG file COLLADA file during an export process called and then pass the COLLADA file to your friend. Your friend takes the COLLADA file and imports in Blender, where the COLLADA file is converted to the native format BLEND. This way, you can continue to use different software and collaborate with others.

The owner or neutral is one of the most important dichotomies in the world of 3D file formats. Nowadays, most 3D modeling software supports reading and writing currents neutral formats. In addition, most software also supports reading and writing to a subset of popular proprietary formats so they can not be ignored. We will discuss eight 3D formats of this type in this article. Here is the list where 3D file formats are marked with their type.

3D File Format Type Neutral STL OBJ ASCII variant is neutral, the binary variant is the exclusive property of FBX. Property Neutral COLLADA. 3DS Property IGES STEP Neutral Neutral VRML / X3D Neutral

But before we discuss each of these formats in detail, let's first examine the general characteristics of a 3D file format and discuss important points to keep in mind when selecting your project format.

General characteristics of 3D file formats

As we have seen, the general features of a 3D file format are:

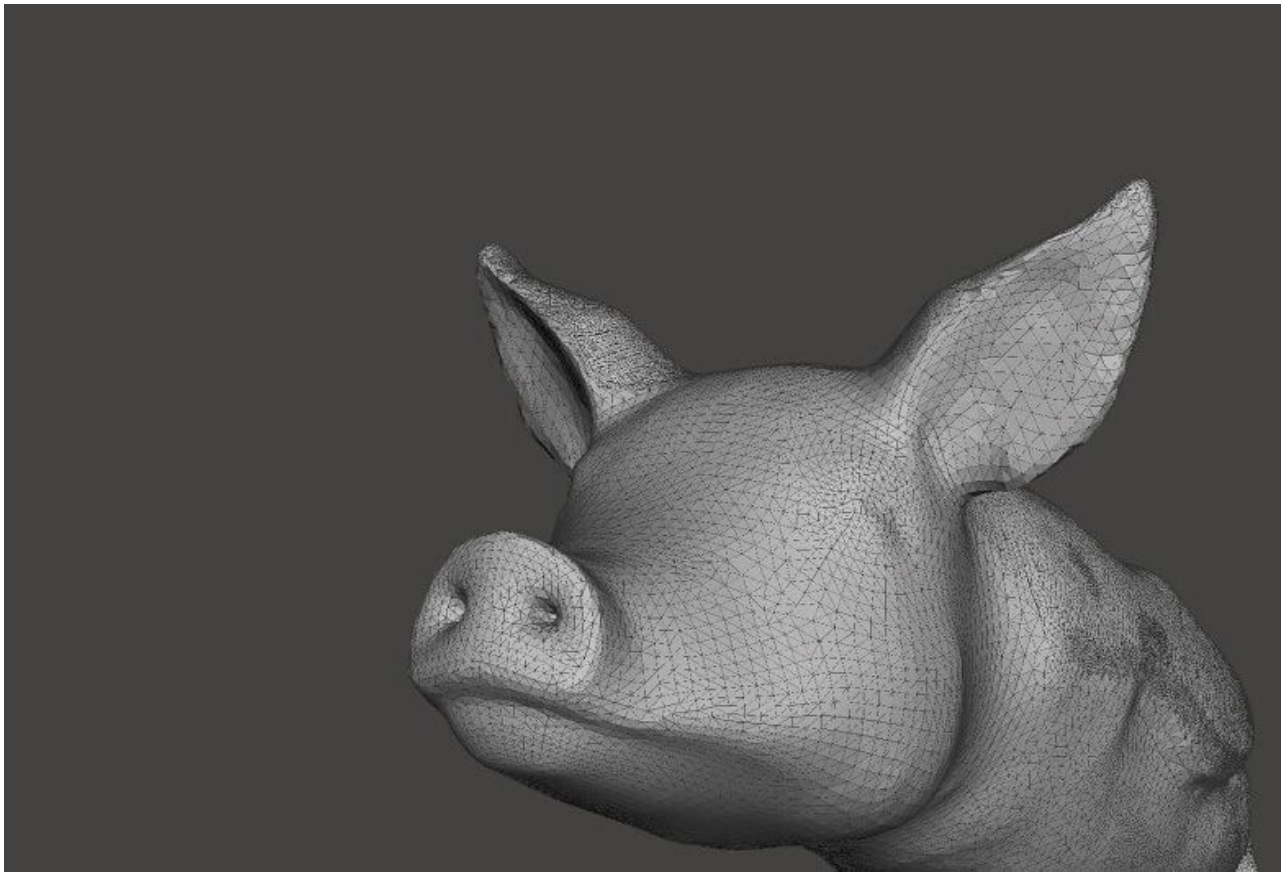
encoding 3D model geometry Recording the appearance of the 3D model of the scene registration information coding Animations

1. 3D File Formats: Geometry encoding 3D model

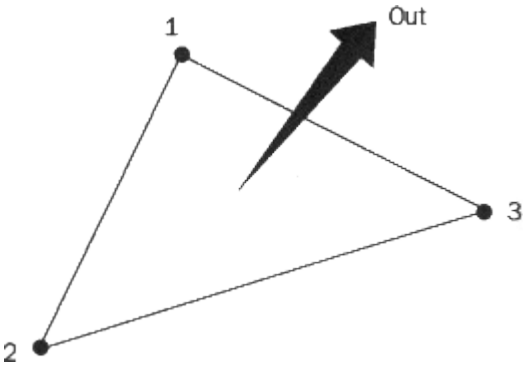
Each 3D model has a unique geometry and this geometry coding capacity can be considered the most basic functionality of a 3D file format. All 3D formats allow - otherwise they would not be considered as 3D file formats.

There are three different ways of encoding the surface geometry, each with their strengths and corresponding weaknesses. They are called approximate mesh, mesh precise and constructive solid geometry (CSG).

1.1 Geometry 3D file format: the approximate mesh

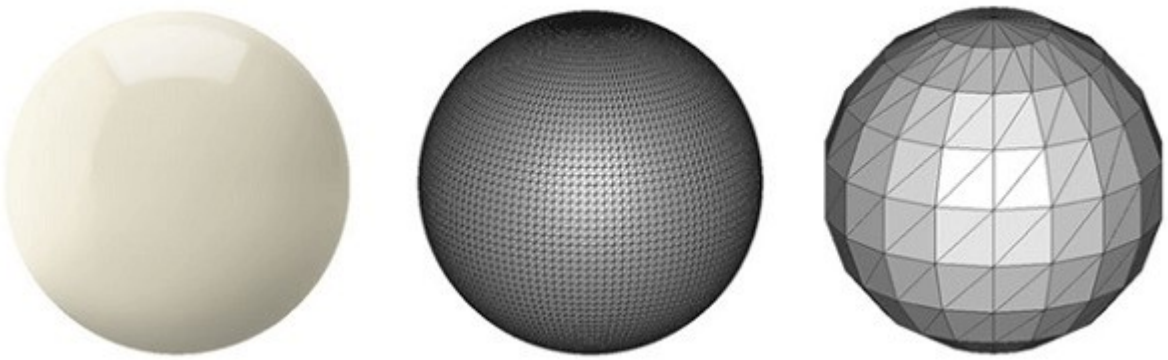


In this encoding, the surface of a 3D model is first covered with a tiny imaginary polygon mesh. Triangles are the most commonly used form. The tops of the collection of triangles and the normal vector coming out of the triangles are stored in the file. This represents the surface geometry of the target model.



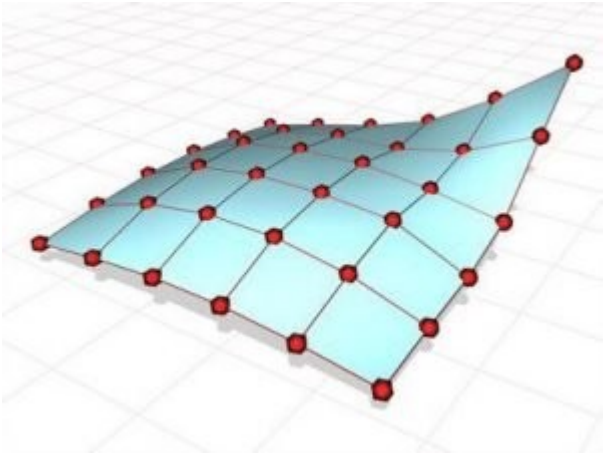
The process of coating a surface of geometrical shapes nonoverlapping is also known as "tiling". Therefore, these file formats are also called mosaic formats.

The triangles are similar to the smooth surface geometry. It is an approximate size. The approximation improves as the triangles become smaller. However, the more triangles are smaller, the required number of triangles to go to the surface is great. This implies that the file is to store a greater number of vertices and normal vectors. Thus, better approximations are made at the cost of increasing the size of the file.



The approximate sizes or tiled are best used in situations where you do not need ultra-fine resolutions of the 3D model. A good example is 3D printing. 3D printers can not print beyond a certain resolution and, therefore, this type of 3D printing file format is ideal. In fact, 3D printing file format most popular, STL, actually belongs to this class of file formats.

1.2 Geometry 3D File Format 2: the precise mesh



Of course there are situations where an approximate coding the 3D model is not enough and requires accurate encoding of the geometry of the surface. For example, during the construction of the body of an aircraft, especially a round hull, a discrete polygonal mesh will not work. Although the model may seem good for small resolutions, the flat surfaces and sharp angles become apparent closely.

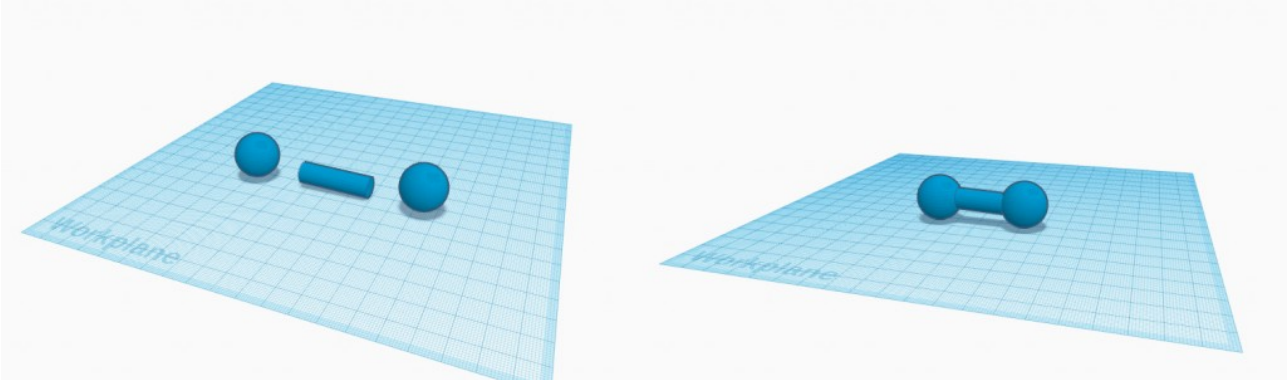
The specific file formats around this problem by using Rational B-Spline patches nonuniform (or NURBS) instead of polygons. These parametric surfaces consist of a small number of weighted control points and a set of parameters called nodes. From nodes, a surface can be mathematically calculated by interpolating smoothly on checkpoints.

These surfaces have a smooth, whatever their size, and can reproduce the geometry of the surface of a small part of a 3D model in detail. However, there is always a compromise. Although the precise mesh is true regardless of the resolution, it is slower and should be avoided in applications where fast rendering is important.

1.3 Geometry 3D file format 3: Constructive Solid Geometry, CSG alias

Finally, there is another type of file format that does not involve mesh. In this format, the 3D shapes are constructed by performing Boolean operations (addition or subtraction) of

primitive shapes such as cubes, spheres, etc. For example, to make a dumbbell, just take two spheres and add a cylindrical rod linkage. If you have used CAD software, you've seen it in action, since most of them use this principle.



The solid constructive geometry is ideal for 3D models design and is very user friendly. Another great benefit is that each individual editing step (addition, subtraction, primitive forms of transformation) is stored in this 3D file format. Therefore, you can undo and redo any stage at any time.

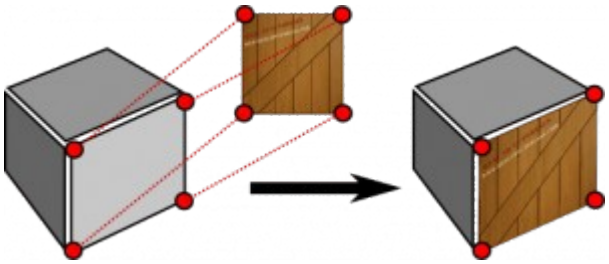
Clearly, if you convert this format in a mesh format, you lose the information on the individual editing steps.

2. 3D file formats: appearance

The second important feature of 3D formats is the ability to store information relating to appearance. In many applications, the appearance of the 3D model is of paramount importance. For example, no one wants to play Need For Speed cars with dull and colorless. The cars better be colorful and brilliant! The color and brightness of a car are examples of properties related to appearance. In simple terms, the appearance describes the surface properties, such as the type of material, texture, color, etc. This determines the appearance of the model when rendering.

Information on the appearance can be encoded in two different ways.

2.1 Appearance of 3D file format: texture mapping



In the texture mapping, each point on the surface of the 3D model (or polygonal mesh) is mapped to a 2-dimensional image. The coordinates of the 2D image have attributes such as color and texture. When rendering of the 3D model, a coordinate is assigned to each surface point in the 2-dimensional image. The vertices of the mesh are mapped first. The coordinates of the other points are then allocated by interpolation between the coordinates of the vertices.

Most 3D file formats support texture mapping. In this case, the 2D image containing texture information to be stored in the same file or separately in a different file.

2.2 Appearance of 3D file format: Facial attributes

Another common way to store texture information involves assigning a set of attributes to each face of the mesh. Common attributes include color, texture and material type.

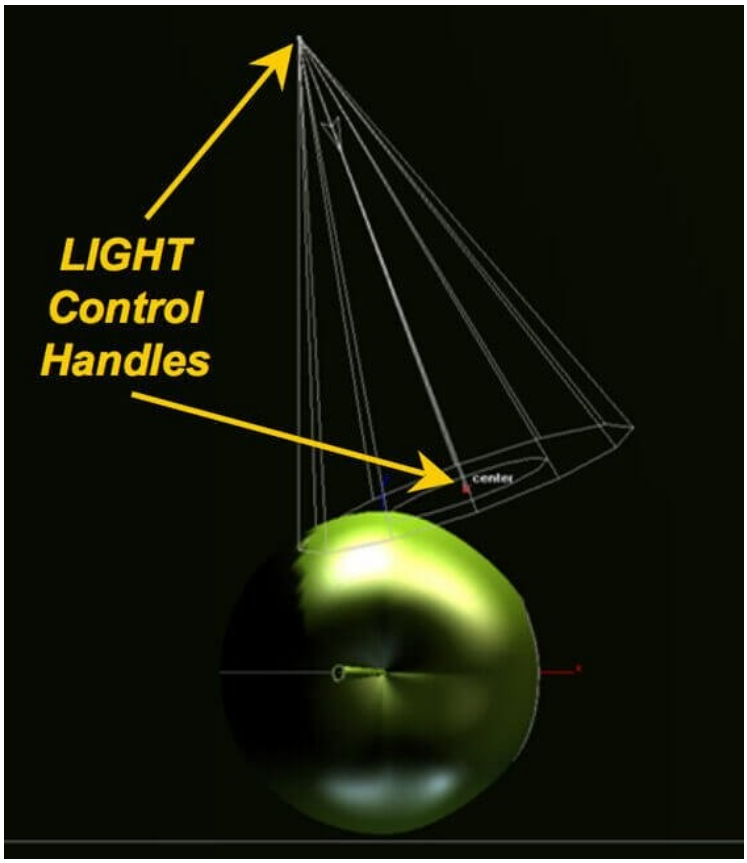
In addition, a surface may have a specular component indicating the color and intensity of reflections in the exact mirror of the light sources and other nearby surfaces. Surfaces can be transparent or semi-transparent. This is encoded in a transmissive component describing the color and intensity of light passing through the surface. The transparent surfaces generally distort light passing through them. This distortion is represented by a refractive index property, associated with the type of the model material.

File formats 3.3D: Information on the stage

The ability to encode information about the scene is another important feature of some 3D file formats. The scene describes the layout of the 3D model in terms of cameras, light sources and other 3D models nearby.

The camera is defined by four parameters: the extension and the main point, the location, the direction in which the camera is directed and an arrow indicating the upward direction.

The coding of the light source depends on the nature of the light source. In the simplest case of a point source, simply store the location, color and intensity of the source.



The spatial relationship between the 3D model and other close models is also sometimes stored. This is especially important if the model is composed of several parts, which must be arranged so as to constitute the scene.

Note that most 3D file formats often do not take care of the scene information. This stems from practical reasons. As for the layout, you can always make sure that the parts of the model are placed in the right place before saving the model. In this case, the file format does not need to explicitly define the relationships between the parties. The camera and light attributes may be ignored because it is expected that end users however will change the camera position when browsing in a scene.

4. 3D File Formats: Animation

Some 3D file formats used to store animations of a 3D model. This is very useful in game design or filmmaking where animations are heavily used.

4.1 3D file format Animation: Skeletal Animation

The most popular way to animate a 3D model is called "skeletal animation". In a skeletal animation, each model is associated with an underlying skeleton. The skeleton is composed of a hierarchy of virtual bones. The movement of the highest in the hierarchy bones (bone parents) affects the bones down the hierarchy (bones children). This is similar to the human body, where a tibia motion affects the position of the toes.

It is important to understand that these bones are not real bones but just mathematical constructs that help a leader to define the movements of a model. The bones are generally represented by a 4 × 3 matrix where the first three columns represent the rotation, scale and shear bone. The last column is the translation on the space-world parent.

In addition to processing, every bone is assigned a unique ID and is associated with a subset of the mesh encoding the geometry of the surface. This subset moves with the virtual bones.

The bones are connected by "joints". The joints introduce constraints in possible changes associated with bone, limiting the way a bone can move relative to its parent. This is similar to the human body: the elbow can rotate on a specified axis, while the ball joint between the thigh and the pelvis allows rotation about all axes.

Here's a short video explaining how to use nice bones and joints to create basic animations in Cinema4D.

4.2 3D file format Animation: Animation Techniques

There are many different techniques to store animations skeletal structures. The most important techniques are the direct kinematics, inverse kinematics and keyframes. You can learn more about animation techniques and encodings in this thesis Bachelor Marcus Lundgren.

Which 3D file format should you use to export and share your model?

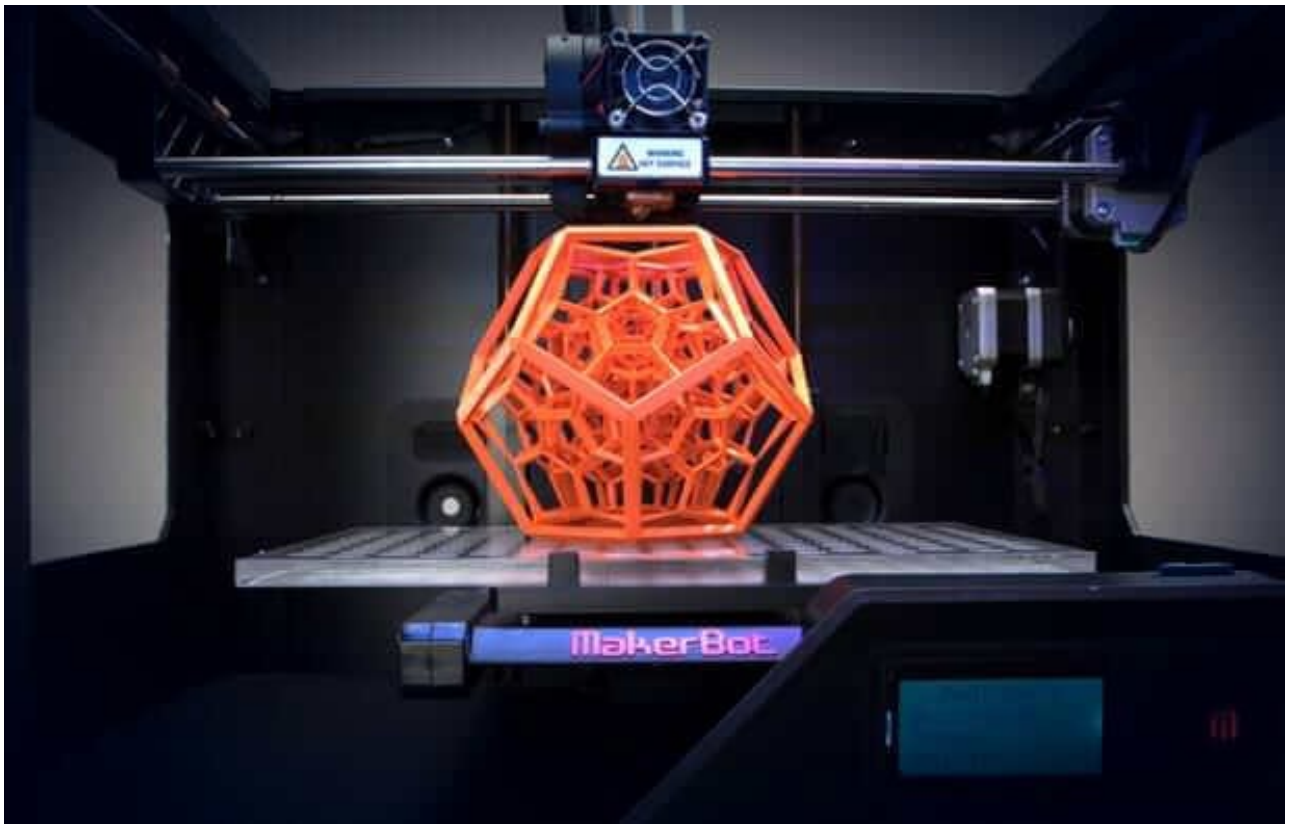
We are now well placed to answer this question.

Each 3D modeling software can export in many formats from different 3D files. However, the one you choose for your application depends largely on the features you need for your job and the software you will use. Since we are now familiar with the features of 3D file formats, we are ready to take a look abstract on the various considerations underlying the choice of a particular file format. There are three main considerations.

1. 3D files formats: what features do you need?

3D file formats are used in many sectors and industries, and each has its own needs and requirements. Depending on the industry you work in, you can choose different sets of features in the 3D file format ideal. To explain what we mean, talking about three major industries using 3D file formats.

1.1 3D file formats for 3D printing

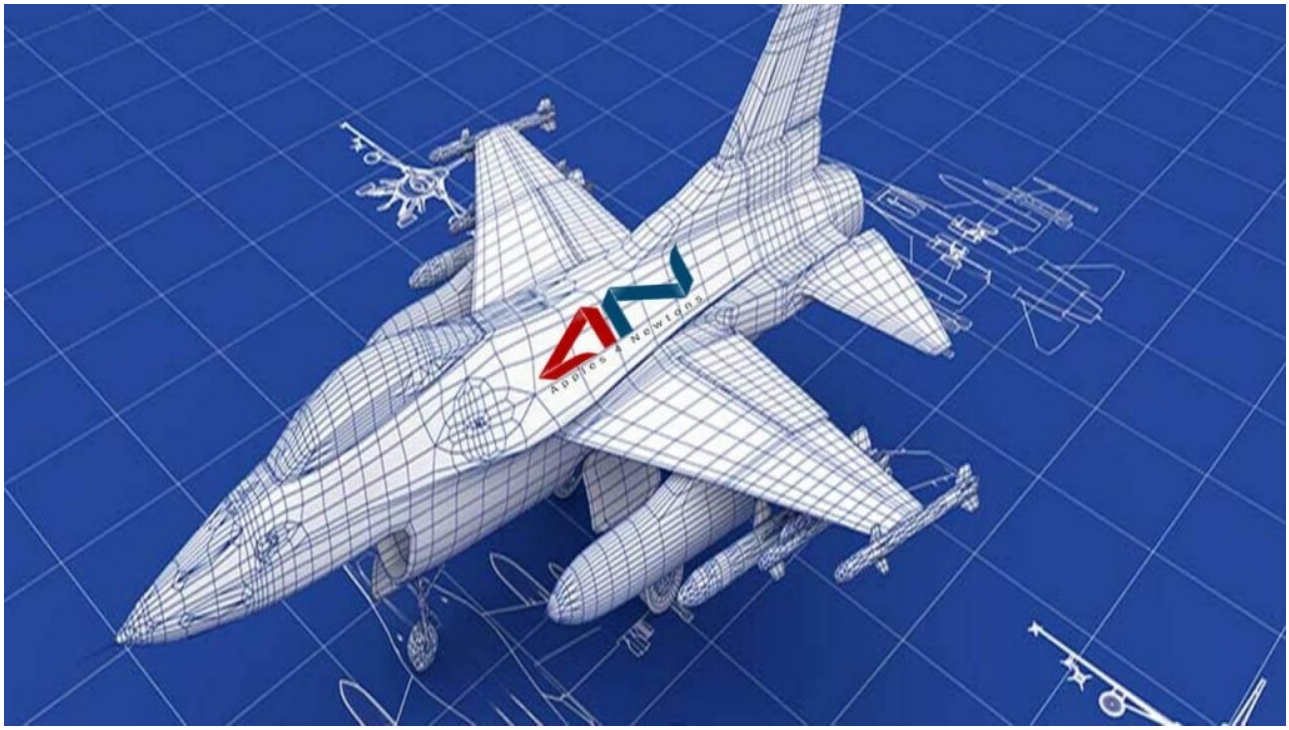


In 3D printing, high precision is not necessary because the current printers can not print beyond a certain resolution. Therefore, using the approximate file encoding formats of the surface geometry are ideal for the job. STL is one such file format and is the 3D printing format most widespread to date.

STL could not store information relating to appearance. So if you want to print a multicolor pattern, you can not use STL because it can not store information regarding the color or material. There are other file formats such as OBJ or AMF, which can store information related to appearance. Thus, these formats (OBJ being the most popular) are the best choice for multicolored designs.

1.2 3D file formats for graphics applications (games and movies)

In graphics applications, the requirements differ from 3D printing. Since we have passed the era of black and white, 3D models used in games and movies require color and rich texture. The games and movies should also handle the animation. Also, all graphics applications typically require high rendering speeds. Therefore, the best formats for this type of work would be those using a rough geometry for fast rendering, can encode the appearance and handle the animation. FBX formats and COLLADA tick all these boxes and are therefore ideal for graphics applications.1.3 3D file formats for high-precision engineering



All in the name. In the discipline of engineering precision as aerospace engineering, 3D models must be smooth and precise at any scale. Therefore, the formats using precise geometry such as IGES or STEP, will be best suited to this task.

The features of a 3D file format is crucial for identifying the ideal size, we have provided a table of features supported by 8 major 3D file formats in the annex to this article. You can take a glance when you need to make a decision.

2. What software pipeline will you use?

The next important consideration is the software pipeline that you use for your job. All the software does not support the import and export of all 3D file formats. You must choose a supported file format by the software of your choice.

Source : https://www.lesimpressions3d.com/2019-most-common-3d-file-formats/

3. What software uses your employee he?

The file format you choose should not only fit into your pipeline, but also that of your collaborator. If you know your employees, ask them what they use and discuss the file format that best suits your workflow and that of your collaborator.

If you do not know your employees, it is better to play safe. Just choose the most popular format that meets the above requirements. It is preferable that the format is neutral and non-exclusive.

Top 8 3D file formats in detail

So far we have discussed the 3D file formats at a level high and abstract. We discussed the various features implemented by the 3D file formats and how you can choose the ideal 3D file format based on this knowledge. Now look at the 8 major 3D file formats and determine what features they support, what is their popularity and what industries use the most.

If you are looking for information on a 3D file format, you can ignore the other and directly access this 3D file format.

STL OBJ FBX COLLADA 3DS IGES STEP VRML and X3D

3D file format

STL (stereolithography) is a 3D file formats most important neutral in the field of 3D printing, rapid prototyping and computer-aided manufacturing. He is a native of stereolithography CAD software developed by 3D Systems. The corresponding file extension is STL.

STL is one of the oldest 3D file formats. It was created in 1987 by Chuck Hull, currently technical director of 3D Systems. He also invented the first 3D stereolithography printer in the world. The STL file format was created later as a simple way to transfer information on 3D CAD models to the 3D printer.

main Features

STL code surface geometry of a 3D model estimated using a triangular mesh. As this was the first of a 3D file formats to exploit the mosaic to encode the surface geometry, it has several backronymes such as "Standard Tessellation Language" and "Standard Triangle Language".

STL ignore the appearance, stage and entertainment. This is one of the formats of 3D files simplest and easiest currently available. The STL format specifies both ASCII and binary representations. Binary files are more common because they are more compact.

Popularity and outlook

Since its invention, the STL file format was quickly adopted by industries rapid prototyping, 3D printing and computer-aided manufacturing. This is still the most used file in 3D printing format.

The reign of STL on 3D printing, however, could end soon. In recent years, 3D printing technology has advanced rapidly. The fidelity of the print process has now reached a level accuracy of one micron. The STL is an approximate size, it requires very small triangular facets to reach this resolution, which generates large and bulky files. Second, many 3D printers now allow color printing, a technology that should be generalized in the near future. STL can not encode information in color and is unnecessary for this purpose. For these reasons, the reign of STL on the world of 3D printing may not last and formats such as OBJ, 3MF or AMF could replace.

What industries are using it?

3D printing, rapid prototyping, computer-aided manufacturing. To learn more about the STL file format, you can consult our detailed article on STL.

3D file format

The OBJ file format is another heavyweight neutral in the field of 3D printing. It is also widely used in 3D graphics. It was first developed by Wavefront Technologies for its Advanced Visualization animation package. 3D file format extension OBJ.

main Features

The OBJ file format supports approximate and precise encoding of the geometry of the surface. Using the approximate coding does not limit the surface mesh with triangular facets. If the user wishes, he can use polygons as quadrangles. When using a specific coding, it uses curves and smooth surfaces such as NURBS.

The OBJ format can encode color and texture information. This information is stored in a separate file with the extension .mtl (material models Library). It does not support any type of animation. The format specifies the ASCII and binary encodings, but only the ASCII code is open source.

Popularity and outlook

The OBJ file format, because of its neutrality and its opening is one of the most popular transfer formats for 3D graphics. It is also gaining ground in the 3D printing industry as and as the industry evolves to color printing.

What industries are using it?

3D Graphics, 3D printing

For more information on the OBJ file format, you can see his Wikipedia page.

3D file format

FBX is a proprietary file format used extensively in the film industry and video games. Originally developed by Kaydara, it was acquired by Autodesk in 2006. Since the acquisition, Autodesk FBX used as bargaining for his own wallet, which includes AutoCAD, Fusion 360, Maya, 3DS Max and other packages.

main Features

The FBX file format supports the properties related to the geometry and appearance, such as color and texture. It also supports skeletal animations and morphs. Binary and ASCII are supported.

Popularity and outlook

FBX is one of the most popular choices for entertainment. In addition, it is also used as facilitating exchange format high fidelity exchanges between 3DS Max, Maya, MotionBuilder, Mudbox and other proprietary software.

What industries are using it?

the video game industry and film industry. To learn more about the FBX file format, you can see its Wikipedia page.

3D file format

Collada is a neutral file used in the video game industry and film format. It is managed by the technology consortium nonprofit, the Khronos Group. The file extension for the COLLADA format is .dae.

main Features

The COLLADA supports geometry, properties related to appearance, such as color, materials, textures and animations. Moreover, it is one of the few formats that support kinematics and physics. The COLLADA format stores data using XML markup language.

Popularity and outlook

The original intention behind the COLLADA was to become a standard among 3D file formats. Indeed, in 2013, it was adopted by ISO as publicly available specification ISO / PAS 17506. Following this history, many 3D modeling software supports the COLLADA format.

However, the consensus is that the COLLADA has not kept pace. The COLLADA was once widely used as an exchange for Autodesk Max / Maya format in the film industry, but the industry is now more focused on the OBJ, FBX and Alembic.

What industries are using it?

film industry, the video game industry. For more information on the COLLADA file format, see the official documentation of the Khronos Group.

3D file format

3DS is a proprietary file format used in architecture, engineering, education and manufacturing. He is a native of the former Autodesk 3D Studio DOS, a popular modeling software that was replaced by his successor 3D Studio MAX in 1996. Developed in the 90s, he is a 3D file formats oldest. It has become a de facto standard 3D models of the storage material in industry or exchange between two other proprietary formats.

main Features

The 3DS file format retains only the most basic information about the geometry, appearance, scenes and animations. It uses a triangular mesh for encoding the geometry of the surface approximate the total number of triangles is limited to 65536. It stores appearance-related properties such as color, texture, material, transmissivity, etc. The scene information such as the position of the camera, the lights can also be stored, but the format does not support the directional light sources.

The 3DS format specifies a binary encoding and stores the information into pieces. This allows the analyzer to skip songs they do not recognize and extract the format.

Popularity and outlook

As one of the formats of older files, 3DS has become a standard for storing 3D models and exchange between other 3D file formats. Virtually all 3D software packages support it. However, as this format preserves only the most basic information about the 3D model, it can not be used in situations where you do not want to lose information. In this case, this format should be completed by the size MAX (now replaced by the PRJ file), which contains additional information specific to Autodesk 3DS Max, to allow a scene to be fully saved / loaded.

What industries are using it?

Architecture, engineering, education and manufacturing. To learn more about the 3DS file format, you can consult the Wikipedia page.

3D file format

IGES (pronounced eye-jess) is a former neutral clock used mainly in the defense industry and in the field of engineering. It was developed in the middle of the seventy years by the US Air Force.

At the time, the air force lost a lot of time in the tedious process of sharing and conversion of data between proprietary systems used by its suppliers. The situation was particularly difficult with larger projects such as aircraft carriers or missile delivery systems involving hundreds of suppliers. The IGES format was developed by the Air Force, in partnership with Boeing and others, in order to serve as exchange format that can be shared among all CAD systems. Since the 80s, the US Defense Department requires all defense contracts and weapons use IGES as standard file format. The extension file for the IGES format is .IGS or .IGES.

main Features

IGES is an extremely flexible ASCII encoding to represent the surface geometry. It is capable of using circuit diagrams, wireframes, free-form surfaces or CSG accurate to store information relating to the geometry. The format can also store color but do not support the material properties such as textures, material type, etc. The animation is also not supported.

Popularity and outlook

IGES enjoys great popularity since its invention in the 70s It was adopted as a national standard in many countries such as the UK and Australia. Virtually all CAD software support it.

The IGES file format is no longer developed, yet it is still widely used to transfer data between CAD software, CAM and CAE. This is a popular choice for 3D modeling, creation of technical drawings and product design. He has the reputation of being a good choice for fans in 3D; 3D artists professionals now prefer his successor STEP.

What industries are using it?

Defense Engineering

3D file format

STEP (Standard for the Exchange of Product data) or ISO 10303 was developed to succeed the IGES file format. It is widely used in engineering-related areas such as automotive and aerospace engineering, building construction, etc. The file format is corresponding .STP.

The stated purpose of development of STEP was to create a mechanism capable of describing product data throughout the life cycle of a product, regardless of any particular system. However, due to the complexity and size of the original standard, it was then split into four smaller, modular specifications in four major releases.

main Features

The STEP format supports all the features supported by the IGES format. In addition, it can also encode topology, geometric tolerances, material properties such as textures, types of materials and other data of complex products.

Popularity and outlook

STEP, IGES as, is a popular format for data exchange between CAD software, CAM and CAE. For compatibility reasons, it is always recommended to use IGES because it is the most common format, and is most likely to work with the recipient's software. However, in cases where it is necessary to transfer information concerning the appearance of the model, the tolerances of the parts, etc., STEP is the right format.

What industries are using it?

Engineering, for example automotive, aerospace, building construction, etc.

For more information, read this comparative discussion of IGES and STEP formats.

3D file format

The latest 3D file format that we will discuss is VRML and X3D. VRML (pronounced Vermal and having the file extension .WRL) is Virtual Reality Modeling Language. This is a 3D file format that has been developed for the World Wide Web. X3D succeeded him.

The VRML term was coined for the first time in an article by Dave Raggett entitled "Extending the WWW to support a platform independent virtual reality platform," submitted to the first conference on the World Wide Web 1994. Three more years were needed to create a mature version of the VRML97 format. and became an ISO standard.

VRML97 was used in some personal home pages and discussion sites in 3D such as "Cybertown". However, the format failed to be adopted significantly. Also, VRML capacity remained stagnant, while the 3D graphics in real time rapidly improving. Finally, the VRML Consortium changed its name to the Web3D Consortium and began to develop the successor to VRML X3D format, released in 2001.

main Features

X3D is a 3D file format based on XML. It supports all VRML format with some additions.

The VRML format uses a polygonal mesh to code the surface geometry and can store information about the appearance such as color, texture, transparency, etc. X3D size adds NURBS encoding the geometry of the surface, the ability to store information relating to the scene and the management of the animation.

Popularity and outlook

The purpose of X3D is becoming the standard 3D file format for the Web. In particular, the X3D applets can run in a browser and view content in 3D using OpenGL 3D graphics technology. X3D has also been designed to integrate seamlessly with HTML5 pages, like SVG format for images. However, to date, the format has not been widely accepted.

What industries are using it?

Internet and the Web. For more information on the X3D format, read this guide from the Web3D Consortium.

Conclusion

We learned a lot about 3D formats in this article. We explained how and why there are hundreds of formats and how they can be classified into two broad categories: owners and neutral. We then explored the most important features of a 3D file format and provided advice on how to choose the right size for your application. We finished with a discussion of the 8 3D file formats most important, focusing on their characteristics, their popularity and their use cases. The appendix contains a wealth of information on the compatibility of the 3D file formats with software and 3D modeling engines the most common. It also has an array of

We hope you enjoyed this article. Share it with your friends who are interested in the world of 3D modeling, development games, special effects, engineering, architecture and 3D printing. If you have any questions, opinions or comments, please share them with us in the comments section.

appendage

1. Matrix features 8 3D file formats Popular

Green: Supported, Red said: unsupported geometry Appearance Scene File Format Animation Mesh Mesh approximate specific CSG Material Texture Color Camera Lighting Relative positioning STL OBJ FBX COLLADA 3DS IGES STEP X3D

2. Support for import / export in popular 3D modeling software and motors

STL OBJ FBX COLLADA 3DS IGES STEP VRML X3D Sketchup No export Export Both Neither No Exporting No Solidworks Both No Both Both Neither Both Fusion No Both Fusion No Both No No AutoCAD No No Both No No Importation two Import No mixer both both both both both No both both both Exports Imports Imports Imports both Export

Cinema4D both versions both both Import No both No Unit No Imports Imports Imports Imports No No No no

The 3D file formats most common after 2019 appeared first on All3DP.

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