
PIXYZ
SOFTWARE

PiXYZ PLUGIN for Unity

The power of PiXYZ in your favorite 3D engine

 | Version 2018.1 - March 2018

TABLE OF CONTENTS

THE AIM OF THIS DOCUMENT IS TO DEMONSTRATE THE PiXYZ PLUGIN for Unity EASE OF USE AND POWER.

PiXYZ PLUGIN for Unity DOCUMENTATION

GENERAL INFORMATION

VERSION

PiXYZ PLUGIN for Unity comes as a standard *.unitypackage, ready to use in Unity3D

FUNCTIONALITY	PiXYZ PLUGIN FOR UNITY
ALL INPUT FORMATS	✓
CAD REPARATION	✓
PRODUCT STRUCTURE PRESERVATION & SIMPLIFICATION	✓
DATA OPTIMIZATION PRESETS	✓
LODs AUTOMATIC GENERATION	✓
UV AUTOMATIC GENERATION (Channels 1 & 2 – CAD only)	✓
POLYGON REDUCTION for tessellated models	✓
UP-TO-DATE COMPATIBILITY WITH UNITY	✓

PiXYZ PLUGIN FOR UNITY

PREREQUISITES

RECOMMENDED

Processor
Intel core i7 2 GHz or more
RAM
16 GB or more
Graphics Hardware
nVidia Geforce GTX 980Ti or more
Disk Space
1 GB or more (with dynamic swap)
Operating System
Windows 10, 64-bit

MINIMUM

Processor
86 dual-core 2GHz
RAM
4 GB
Graphics Hardware
OpenGL 4 compatible
Disk Space
200 MB
Operating System
Windows XP, Seven, 10 64-bit

+ unity

FORMATS Compatibility with CAD file formats :

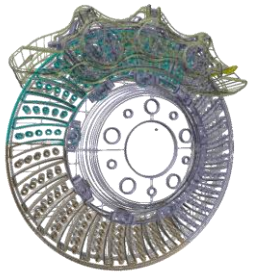
FORMAT	PiXYZ PLUGIN	DETAILS
ACIS	✓	
AutoCAD 3D	✓	
Autodesk Alias	✓	
Autodesk FBX	✓	Version 2011 to 2017
Autodesk Inventor	✓	
CATIA V4 – V5	✓	CATProduct, CATPart 3DXML & CGR MODEL
CATIA V5 [3DXML]	✓	
CATIA V6 [3DXML]	✓	
Creo - Pro/E	✓	
COLLADA	✓	
CSB Deltagen	✓	Partial. Up to DG18
IFC	✓	
IGES	✓	
JT	✓	Mesh + NURBS | Includes PLMXML support
OBJ	✓	
Parasolid	✓	
PDF	✓	
PLM XML	✓	
PLY	✓	
PRC	✓	
Rhino3D	✓	
SketchUp	✓	
Solid Edge	✓	
SolidWorks	✓	
STEP	✓	
Stereo Lithography (STL)	✓	
U3D	✓	

Unity3D can natively read .fbx, .dae, .3ds, .dxf and .obj files. And can import, through conversion, Max, Maya, Blender, Cinema4D, Modo, Lightwave and Cheetah23d files.

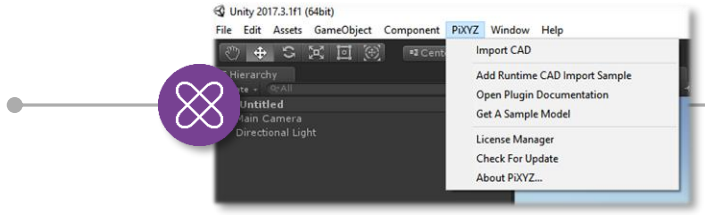
However **native CAD** like CATIA files (CATProduct, CATPart, 3DXML), SIEMENS/NX (JT, PLMXML), CREO, IGES, STEP, ... files cannot be easily imported in Unity3D.

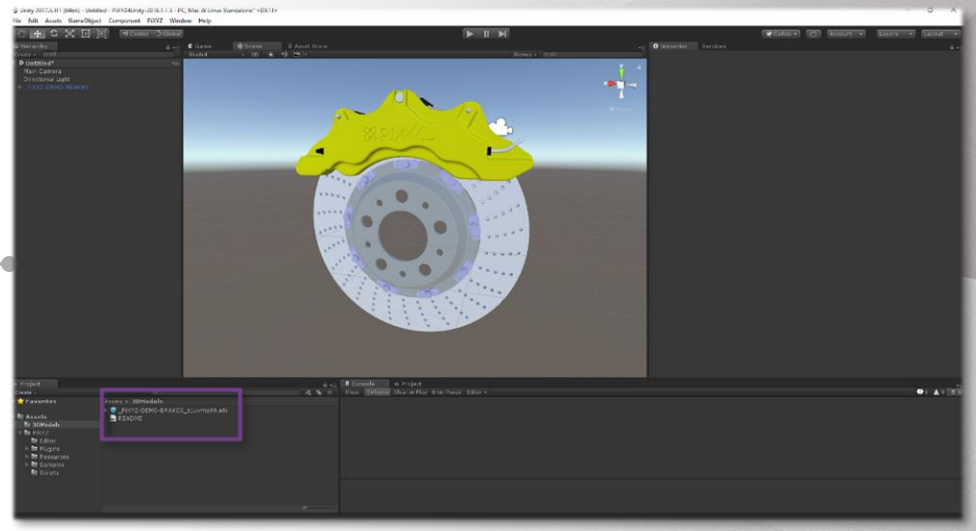
PiXYZ PLUGIN for Unity is a plugin for Unity3D that allows to import and tessellate CAD files for your realtime applications. It guarantees:

- The Product Tree (or hierarchy) preservation
- High quality tessellation through optimized presets
- Data correction to optimize the consistency of the 3D model
- Intuitive usage in Unity3D
- **Runtime import compatibility** for your AR/VR/realtime applications



Raw CAD data



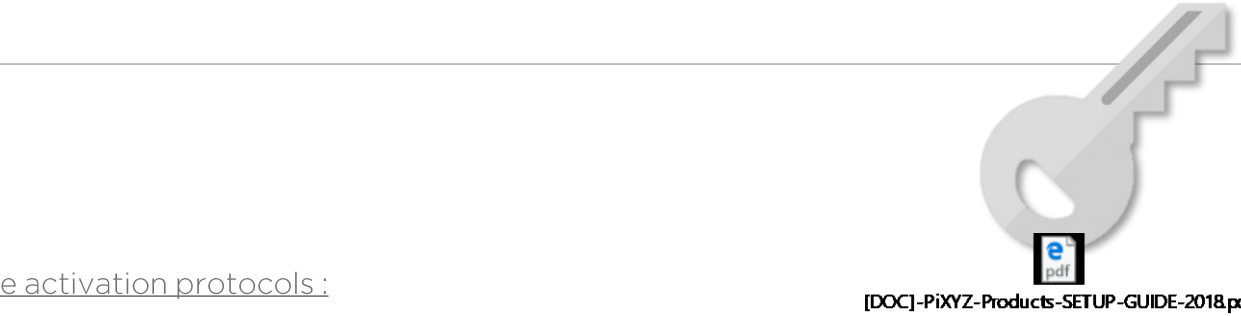


Once the 3D model is imported, the plugin creates a prefab for the model.

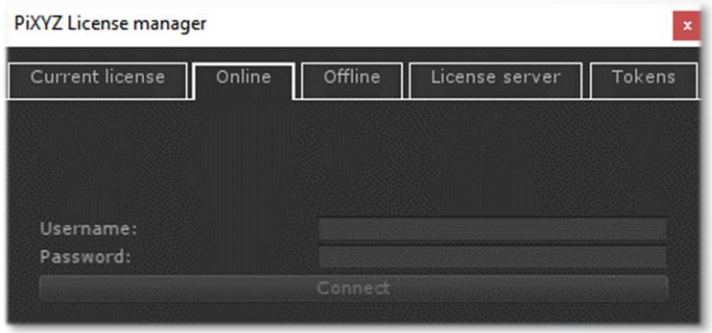
A license is required to use PiXYZ PLUGIN for Unity. Please refer to the attached document *[DOC]-PiXYZ-Products-SETUP-GUIDE-2018.pdf* for installation details and license acquisition (or find it here: https://www.pixyz-software.com/download/).

You can also visit PiXYZ website and register to obtain an evaluation license and or buy a PiXYZ PLUGIN for Unity license : https://www.pixyz-software.com/plugin/

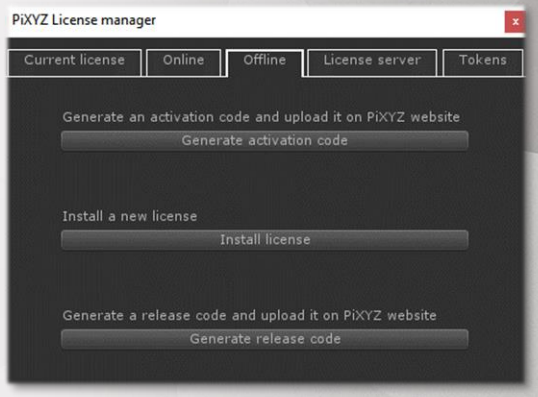
License activation protocols :



License manager: current license status



License manager : Online activation using PiXYZ account



Offline activation for local machine or firewall issues

PiXYZ PLUGIN DOCUMENTATION

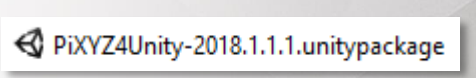
SETUP AND USE

STEP 1 – PLUGIN INSTALLATION

The PiXYZ PLUGIN for Unity is available on PiXYZ website download page : https://www.pixyz-software.com/download/
Once you are connected, download the file from the line **PiXYZ for Unity**.

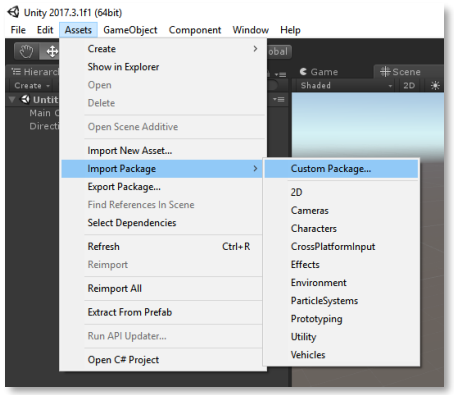
The PLUGIN comes as a Unity Package. In Unity3D environment, a package is a collection of files and data used by a Unity Projects, which are compressed and stored in one file similar to ZIP files.

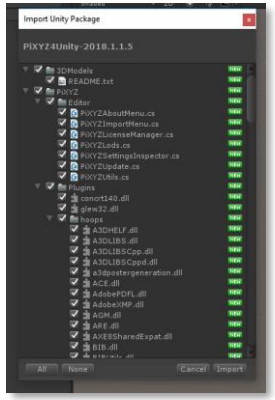
To install PiXYZ PLUGIN in your Unity3D Project, follow the next instructions:

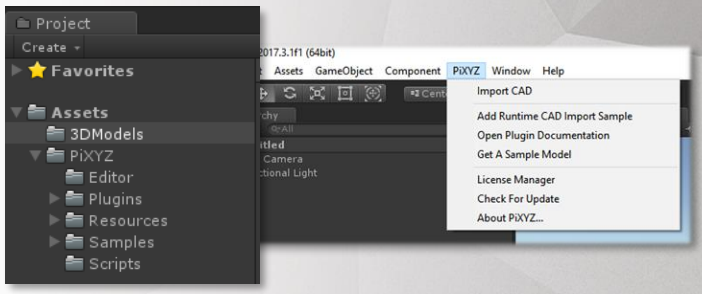
- From the « Assets » menu, choose « Import Package » and « Custom Package »
- Select the recently downloaded PiXYZ Unity Package in the Explorer and click on the « Open » button 

- Control that all the boxes are checked and click on the « Import » button

News files and scripts have been added to your project. PiXYZ PLUGIN can now be used and a new « PiXYZ » menu has been added to the Unity toolbar.





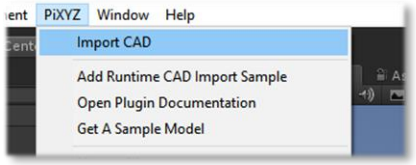


The PLUGIN needs to be installed for any new Unity Project where it is meant to be used.

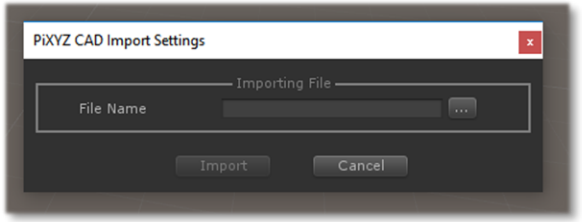
STEP 2 – BASIC MODEL IMPORT

To start using PiXYZ PLUGIN and import a 3D model in Unity :

- From the « PiXYZ » menu, click on « Import CAD »



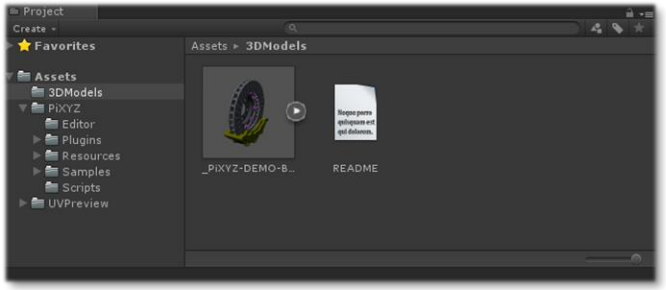
- A new window appears
- In the Explorer, select your CAD file and click on the « Open » button



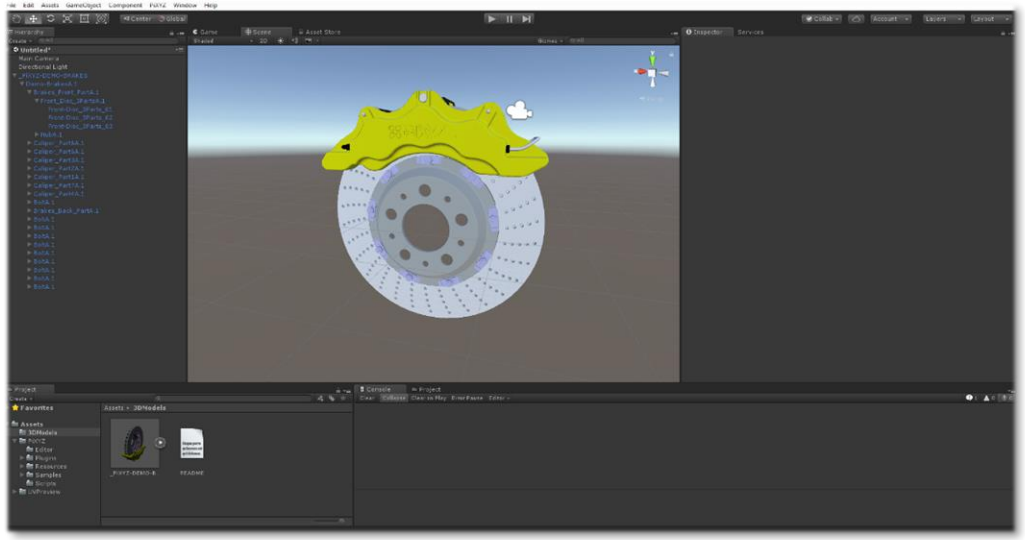
- The *PiXYZ CAD Import Settings* window appears
- From there, you can adjust the default Import Settings if required
- Finally, click the « Import » button to import your CAD model

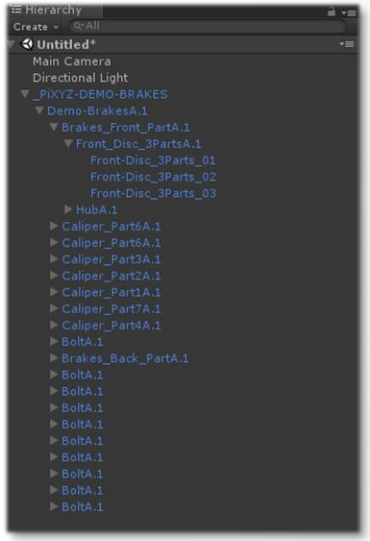
STEP 2 – BASIC MODEL IMPORT

- The model has been imported and processed following desired input settings, and is now available in the Project assets as a prefab object. Each Part within the hierarchy is a Game object.



- The asset is also immediately available in the scene and hierarchy. The Product Structure (or hierarchy) has been preserved.





STEP 3 – ADJUST DEFAULT SETTINGS

When opening the *PiXYZ CAD Import Settings* window, all settings are set to PiXYZ default values.
All settings can be adjusted to user's requirement, and saved. Use the 3 buttons at the bottom of the window to administrate settings.

PiXYZ PLUGIN Default import settings

- **SAVE USER SETTINGS**

Adjust the settings, and when happy with them, click this button to save them as default settings. Each time the *PiXYZ CAD Import Settings* window will be open, these default values will be loaded.

- **RESTORE USER DEFAULT SETTINGS**

Current settings can be restored to User default settings by clicking this button.

- **RESTORE PiXYZ DEFAULT SETTINGS**

Current settings can be restored to PiXYZ default settings by clicking this button. Caution, this action will delete User saved settings.

SETTINGS AJUSTMENT & OPTMIZATION STRATEGY

The settings used in PiXYZ PLUGIN for Unity used to import a 3D model **will impact deeply the way it will be processed and optimized**.

There is no set of preferences that will work every time, for each use case, as input 3D data can vary dramatically, assuming the user imports a simple tessellated asset (or mesh) coming out of a DCC software (Maya, Max...) or complex engineered model out of a CAD software (CATIA, NX, SolidWorks,...).

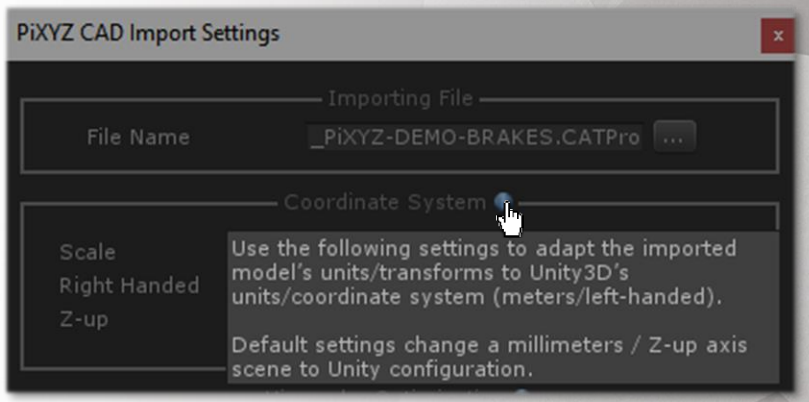
To understand better the difference between, native CAD models and tessellated models (or meshes), please refer to page #26.

Default settings proposed are representative of a **simple, non-destructive CAD model import scenario**. They are to be used as guidelines for beginners, but are meant to be adjusted to user's requirement. The process to find the suitable **optimization strategy** requires fine-tuning and trial&error. Additionally, it is better if the user also knows the kind of data the original file contains, plus the data that needs to be maintained.

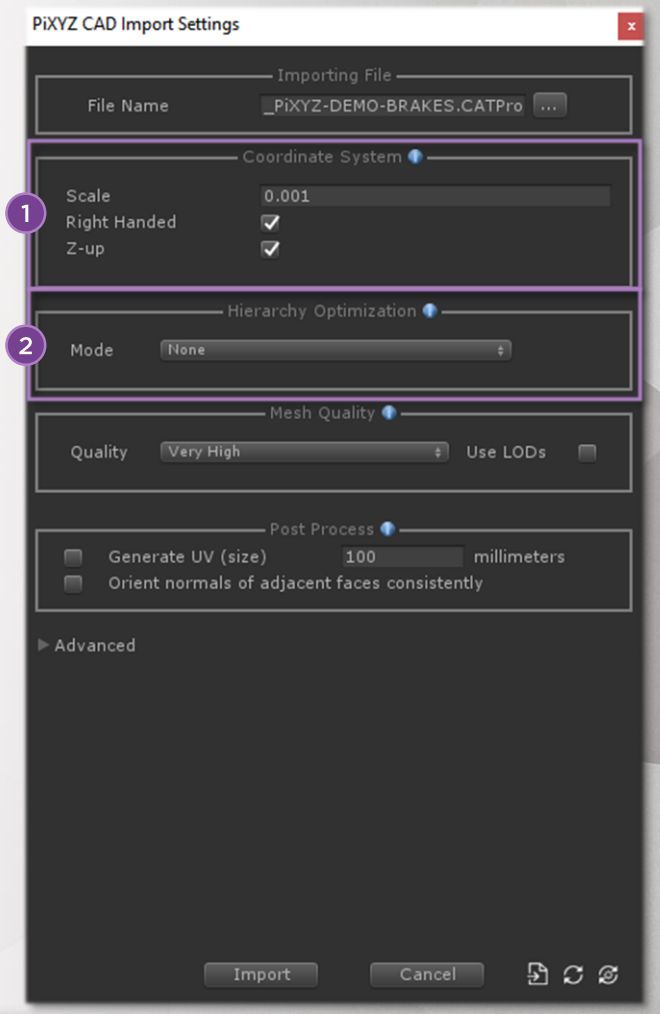
Please read the information thereafter for information about each exposed setting in the *PiXYZ CAD Import Settings* window.

Use the icons to display tooltips for each Group box in the *PiXYZ CAD Import Settings* window.

Additional tootlips are also available by flying over most settings titles with the mouse.



SETTINGS INFORMATION



- **COORDINATE SYSTEM** 1

Use the Coordinate System settings to adapt the imported model's units/transformation to Unity3D units/coordinate system (left-handed).

Default settings change a millimeters/Z-up axis scene to Unity configuration with meters as Scene units.

Scale: Set the scale of the imported model.

Right-handed: Use this setting to mirror model from a right-handed coordinate system to a left-handed one.

Z-up: Use this setting to rotate model from Z-up axis to Y-up axis.

- **HIERARCHY OPTIMIZATION** 2

Choose one of the proposed mode to optimize the imported model's hierarchy (or Product Structure)

None (default setting): No modification of the hierarchy

Clean-up intermediary nodes: Compresses the hierarchy by removing empty nodes, or any node containing only one sub-node.

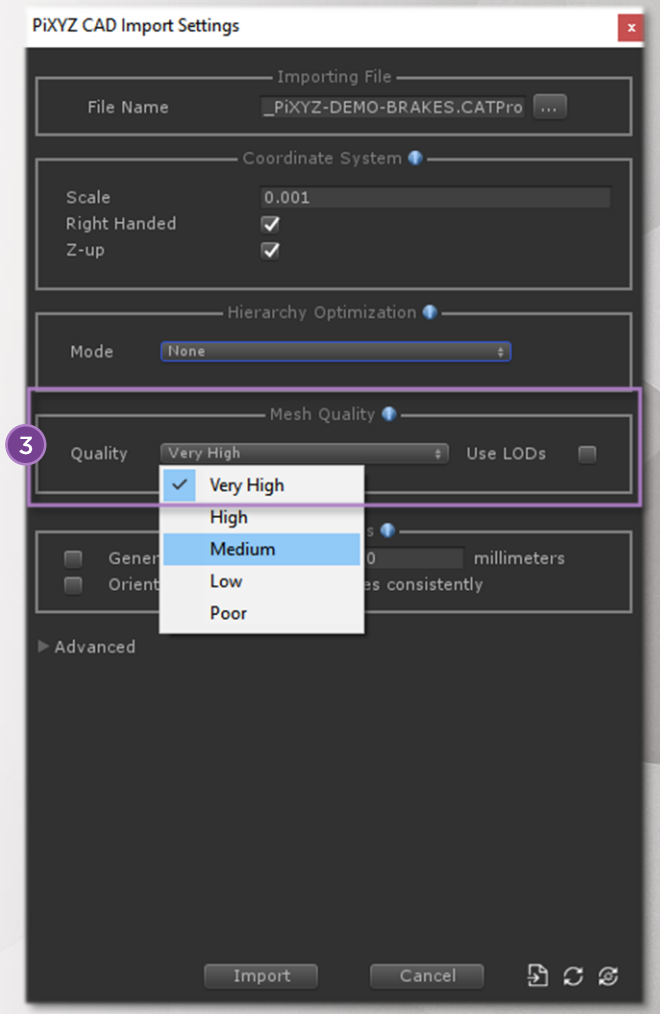
Transfer all objects under root: Simplifies the hierarchy by transferring all imported 3D objects (or GameObject) under the root node of the imported model.

Merge all objects: All objects contained in the original model will be merged together, as one single object.

Merge all objects by material: All objects contained in the original model that share the same material will be merged together.

PiXYZ PLUGIN preserves *instances* included in a 3D model. BUT, instantiation will be lost if the hierarchy is optimized by using either *Transfer all objects under root*, *Merge all objects* or *Merge all objects by material* (each previous instance will be transformed as 1 single object).

SETTINGS INFORMATION



- **MESH QUALITY** 3

Choose the quality level for the imported model, among 5 predefined presets.

Quality defines the **density/visual quality** of the mesh that PiXYZ delivers. Depending if you import a **native CAD model** (exact geometry) or a **Tessellated model** (mesh geometry), PiXYZ will automatically perform either a *tessellation* or a *decimation* on the model, amongst other optimization algorithms.

Available presets:

Very-High:

- *With a CAD model*: Use this setting if you wish to obtain a **very dense and precise mesh** (quality is a priority over low-density) OR if you are importing a **very small asset** (under 1cm). A tessellation process is run.
- *With a Mesh model*: The imported mesh will be fully preserved: **no optimization** will be run.

High:

- *With a CAD model*: Is a modulation of the *Very High* preset. PiXYZ will deliver a **superior quality mesh**. Gives high-quality results for small objects. A tessellation process is run.
- *With a Mesh model*: The imported mesh will be **slightly optimized** through a subtle and limited decimation process, preserving smoothing (through surfacic and normals control) and UVs.

Medium (default preset):

- *With a CAD model*: Is often the best option to obtain a **balanced mesh** between quality and polygon budget. A tessellation process is run.
- *With a Mesh model*: The imported mesh will be **optimized** through a controlled and efficient decimation, preserving smoothing and UVs. Resulting mesh might start showing smoothing irregularities.

SETTINGS INFORMATION

- **MESH QUALITY** 3

Available presets:

Low:

- *With a CAD model*: Is efficient to obtain a **low-density mesh**, or to process **large objects** while limiting polygon count. A tessellation process is run.
- *With a Mesh model*: The imported mesh will be **highly optimized** through a controlled and efficient decimation. Resulting mesh might show smoothing and topological irregularities.

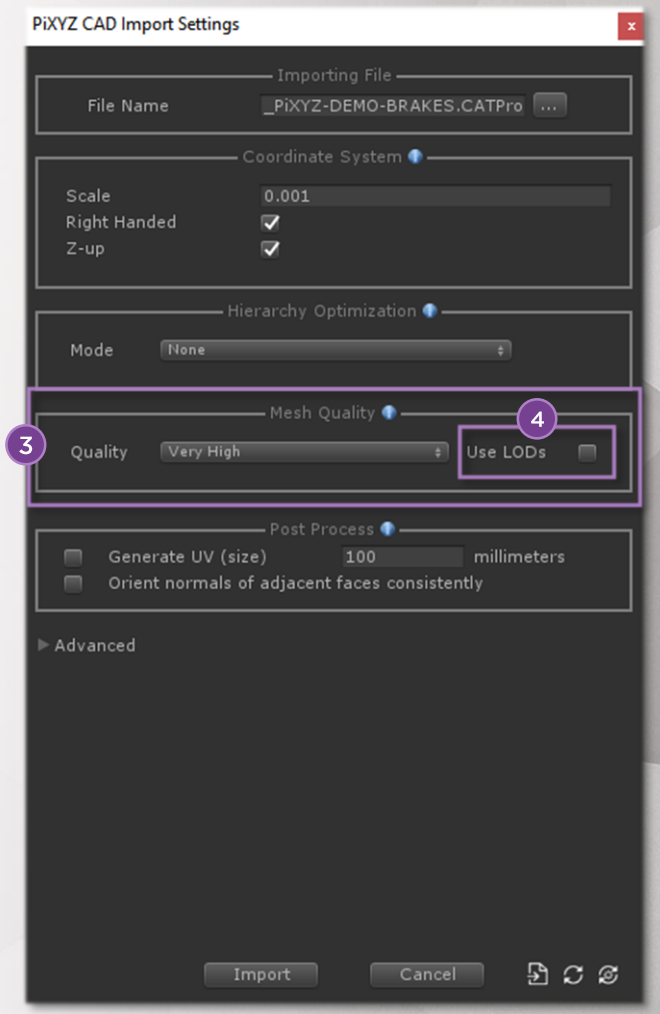
Poor:

- *With a CAD model*: Is efficient to obtain a **very low-density mesh**, or to process **large objects** while strongly limiting polygon count. A tessellation process is run.
- *With a Mesh model*: With this preset, the imported mesh will be **strongly optimized** through a strong a powerful decimation. Resulting mesh will be showing smoothing and topological irregularities, which can be suitable for LODs.

LOD automatic generation: 4

PiXYZ PLUGIN for Unity allows to generate LODs (Level of Details, up to 5 levels) "on-the-fly" during the import phase. It works by automatically adding a Unity *LOD Group* on top of the targeted node in the imported model.

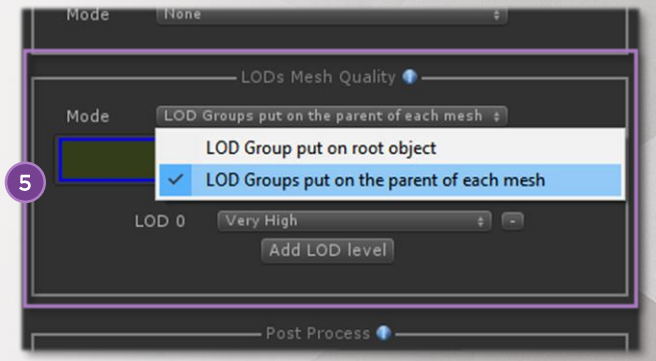
To learn more about LODs in Unity, please visit this page: https://docs.unity3d.com/Manual/class-LODGroup.html



SETTINGS INFORMATION

- **LODs MESH QUALITY** 5

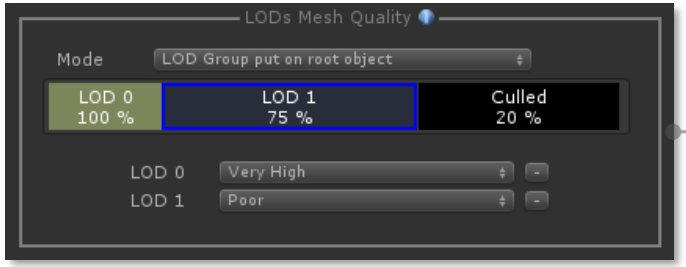
Once the « Add LOD level » checkbox is enabled, the Group box is renamed « LODs Mesh quality ». From that point, the user can add multiple LODs and define a *Mesh Quality* preset for each added LOD.



A first LOD (called LOD0) is automatically added, keeping the previously-defined *Mesh Quality* preset.

To learn more about LODs in Unity, please visit this page: https://docs.unity3d.com/Manual/class-LODGroup.html

Adjust the visibility percentage for the current LOD, and the culling. The percentage value represents the maximum visible proportion of a part/model when the camera is moving forward/backward before switching to the following LOD available, until disappearing (culling percentage).



Intial settings for LODs : 2 LODs + Culled value

LOD 0 = Very-High preset
100% to 75%

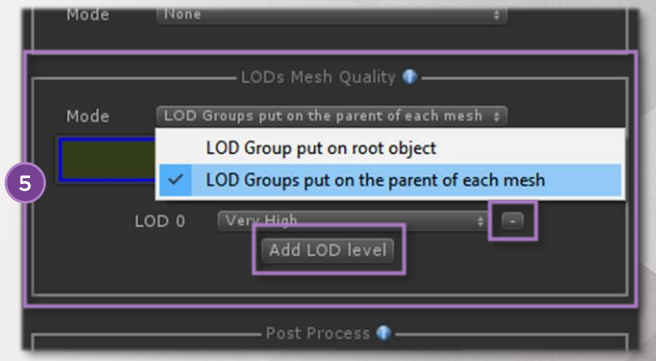
LOD 1 = Very-High preset
75% to 20%

Culled
Under 20%

SETTINGS INFORMATION

- **LODs MESH QUALITY** 5

Use one of the following modes to define the *LOD Group* behavior:



LOD Group put on root object: The *LOD Group* is placed on the root node of the imported model. Use this setting if you wish to control the **global visibility** of the entire imported model at once.

LOD Group put on the parent of each mesh **(default mode)**: The *LOD Group* is placed on the parent-node of each mesh (or object) existing in the hierarchy. Use this setting if you wish to control the **visibility of each sub-part** of the imported model.

Use the « Add LOD level » to add another LOD (up to 5). Natively, a newly added LOD will have its *Mesh Quality* set as a lower *Mesh Quality* preset than LOD0.

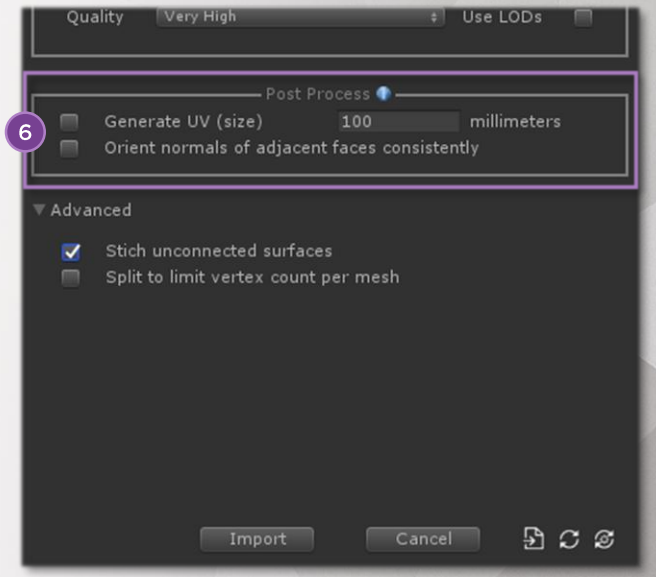
Use the « **–** » button to remove LOD levels.

In PiXYZ PLUGIN , the way a LOD is created is different from a **native CAD model** (exact geometry) to a **Tessellated model** (mesh geometry). To simplify:

- *With a CAD model*: LOD0 is created by PiXYZ through a tessellation, and next levels are an optimized version of LOD0 (decimation).
- *With a Mesh model*: LOD levels are created by optimizing (decimation) the original mesh file, or LOD0. In this particular case of meshes, it is often better to use the *Very High* preset for LOD0, so that other LODs will be created from a sufficiently-defined mesh.

NOTE: Remember that an imported mesh (already tessellated) object processed with a Very High preset will be delivered without any optimization whatsoever

SETTINGS INFORMATION



- **POST PROCESS** 6

Use one of the following modes to define the *LOD Group* behavior:

Generate UV (size): Use this setting to add a new primary UV set (channel #0). Set the size of the projection box used to create UVs.

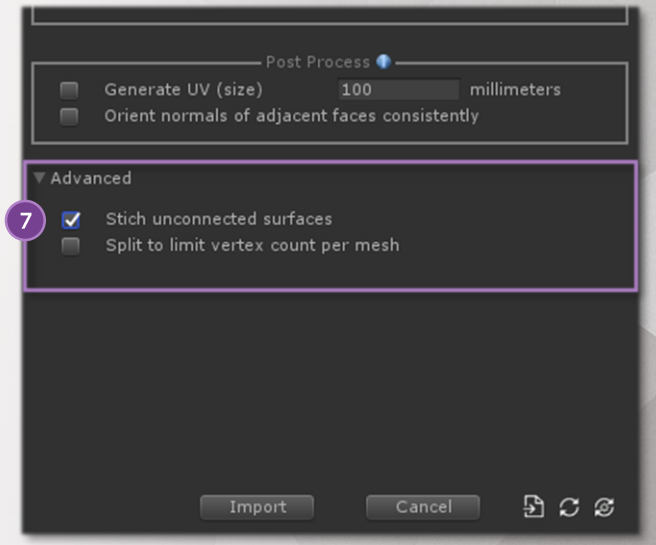
Caution: PiXYZ will override the existing UV set, do not use this setting if you wish to preserve the UVs embedded in the imported model (tessellated model).

When importing a native CAD file, UVs are automatically generated for the second channel (channel #1) for the generated meshes. A padding of 0,01 is used.

Orient normal of adjacent faces consistently: Use this setting for PiXYZ to perform a unification of all triangles/faces orientation.

Caution: Do not use this setting if the imported model is a mesh (tessellated geometry) and is already correctly oriented.

SETTINGS INFORMATION



- **ADVANCED** 7

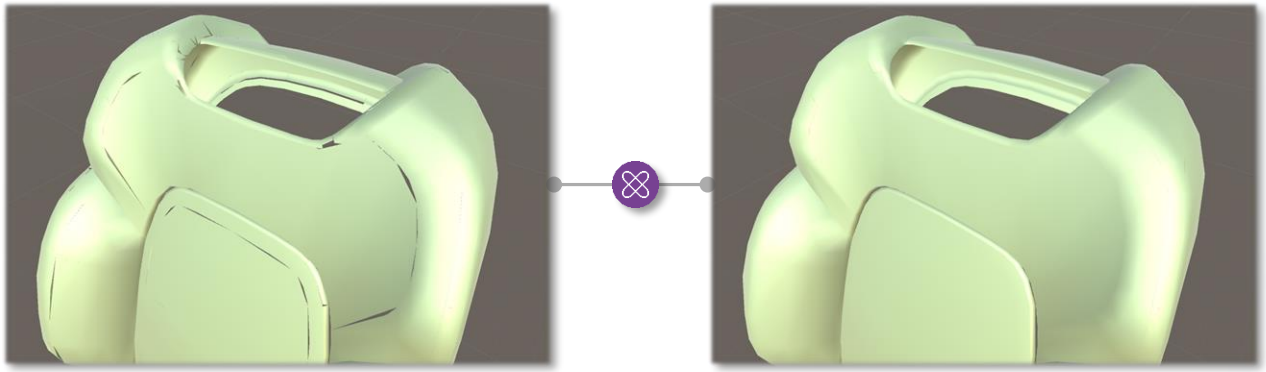
Use one of the following modes to define the *LOD Group* behavior:

Stitch unconnected surfaces: Use this setting to stitch together unconnected **CAD surfaces** prior to any data treatment at import.

Sometimes, CAD surfaces contained in a file inherited from a CAD software, are delivered as multiple sub-surfaces unconnected respectively to one another, where they should be unified as one big surface.

If they are not connected together prior to mesh creation by PiXYZ, the resulting mesh will be delivered as multiple sub-meshes, and might show gaps where there is supposed to be continuity.

Here is an example of this bad behavior, showing gaps between unconnected faces:



Stitch unconnected surfaces setting OFF

Stitch unconnected surfaces setting ON

Split to limit vertex count: Use this setting if you wish to create meshes limited to 65k vertices. Meshes will be created with a 16 bit index buffer (32 bit by default).

Consider using this setting if you wish to publish the model on platform with limited power.

PiXYZ PLUGIN DOCUMENTATION

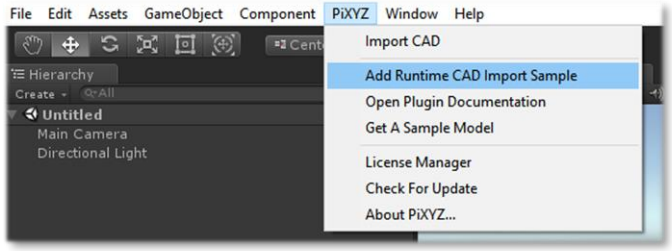
RUNTIME EXECUTION & IMPORT

USE PiXYZ PLUGIN FOR RUNTIME APPLICATIONS

The PiXYZ PLUGIN for Unity can be embedded in runtime Unity3D applications (build). Yet be aware that the built application needs a PiXYZ Plugin for Unity license at runtime.

- Runtime import “boiler plate” prefab

A sample prefab is contained in the PiXYZ Plugin package. Simply click on “PiXYZ_Runtime_Import_Boiler_Plate” from PiXYZ menu to add the prefab in your scene



This sample proposes a simple CAD import GUI in the 3D view

USE PiXYZ PLUGIN FOR RUNTIME APPLICATIONS

- C# script for PiXYZ CAD loader

Basically this sample instantiates a <PiXYZ4UnityLoader> object, configures it with import settings and loads the CAD file

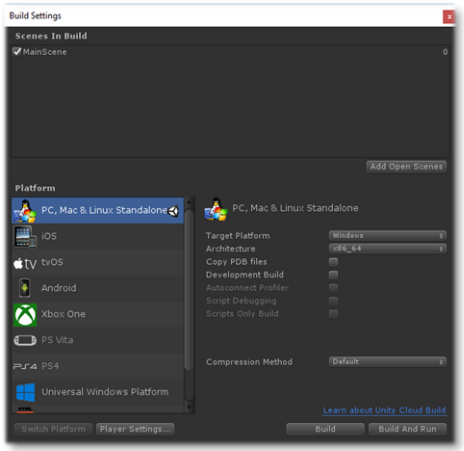
`PiXYZ4UnityLoader::setSourceCoordinatesSystem(bool rightHanded, bool zUp, float scaleFactor)`

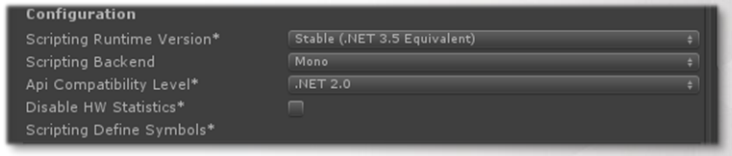
`PiXYZ4UnityLoader::configure(bool orient, double mapUV3dSize, TreeProcessType treeProcess, bool useLods, List<PiXYZLODSettings> lods, bool support32BytesIndex)`

`PiXYZ4UnityLoader::loadFileRuntime(GameObject rootObject, string filePath, bool editor, UnityEngine.Object prefab)`

- Build settings

This sample contains a .NET system.windows.form dll which requires to build with API level compatibility set to: ".NET 2.0"

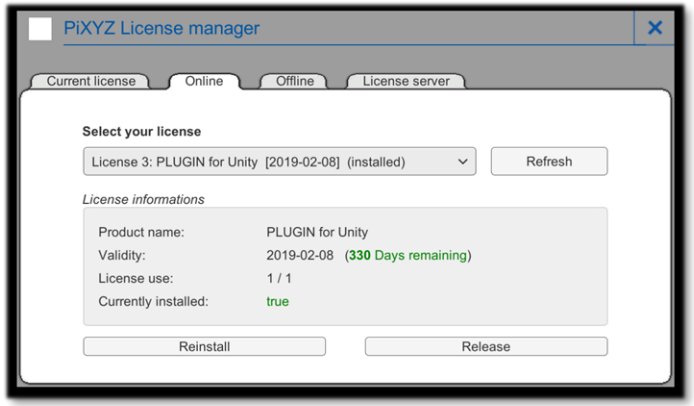


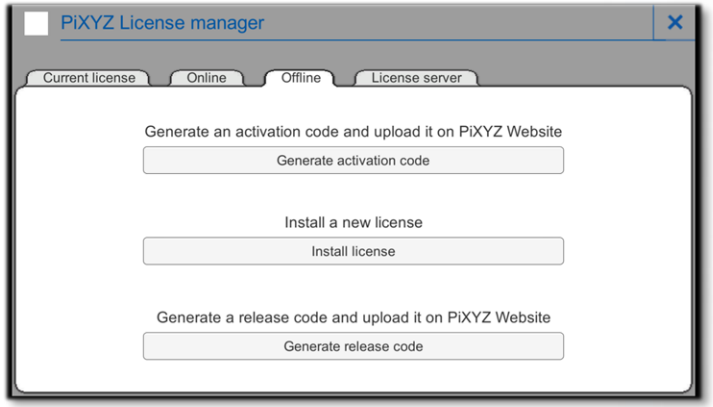


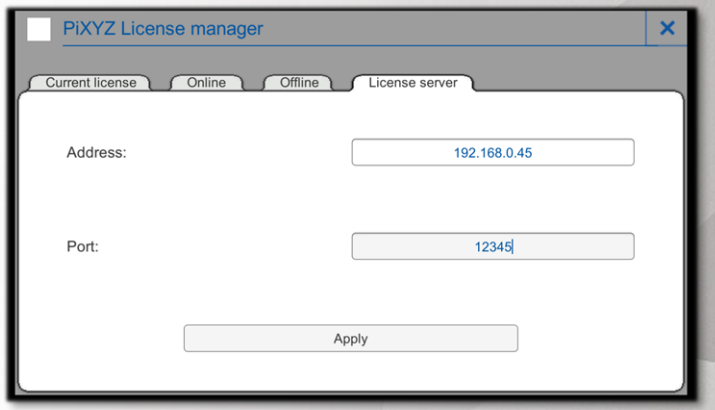
USE PiXYZ PLUGIN FOR RUNTIME APPLICATIONS

- License:

The prefab contains a license manager GUI sample, which works same way than the license manager from the editor and can help the end-user to install PiXYZ Plugin license at runtime, the first time he/she run the built application on his/her computer. There are 3 ways to activate license: online, offline or license server







For more detailed information regarding the application setup and execution, please contact PiXYZ Support Team at contact@pi.xyz

INFORMATION DIFFERENCES BETWEEN CAD MODELS AND MESH MODELS

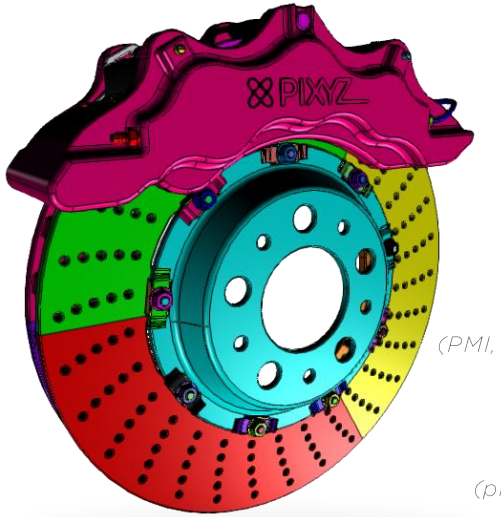
CAD models inherited from CAD software (CATIA, NX, SolidWorks, Alias, STEP...) are not tessellated. They contain exact parametric/mathematical surfaces.

A CAD body (closed volume) or CAD surface (open shell surface) is composed of CAD faces (or patches), delimited by boundaries (see Glossary).
To be displayed in a 3D application, these CAD faces need to be translated into meshes. A mesh is composed of multiple connected polygons, or triangles (1 polygon = 2 coplanar triangles), forming a mesh surface that is understandable by a Graphic Card, to be rendered in a 3D application.

Moreover, CAD models can contain additional engineering and design data (metadata, PMI,...), that can be very useful to perform a targeted Data Preparation process based on targeted properties.

DCC software (Maya, 3DSMax, Blender,...) natively create tessellated geometries, or meshes, than can be exported as FBX files (for example) to be re-imported in Unity3D using PiXYZ PLUGIN. Note that these meshes often come with UVs (1st channel and/or 2nd channel), that can either be kept at import, or overridden using the "Generate UVs" setting (1st channel only).

Already tessellated meshes are meant to be optimized to create LODs by performing efficient and conservative decimation on them.



CAD

(patches/faces, boundaries) **BREP**

PARAMETRIC EXACT GEOMETRIES

DESIGN PRODUCT STRUCTURE

(PMI, manufacturing info, properties,...) **METADATA**

(visualization) **SURFACE COLORS**

(physical properties for simulation) **MATERIALS**

MESH

MESHES *(polygons, edges, vertices)*

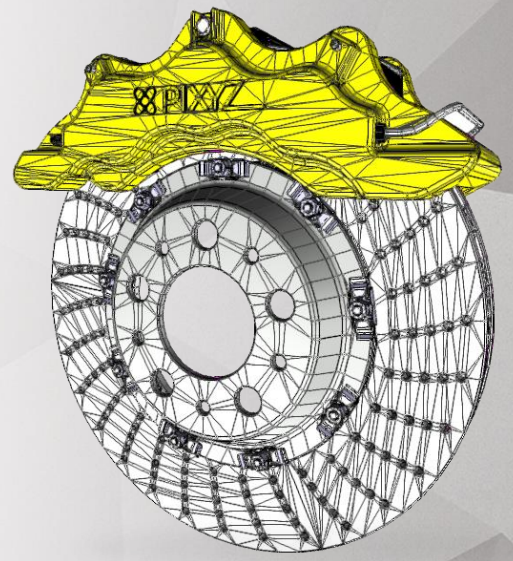
« **DEAD » DATA**

SIMPLE HIERARCHY

NO METADATA

MATERIALS *(visualization)*

UVs *(texture coordinates)*



INFORMATION ABOUT TESSELLATION & DECIMATION

TESSELLATION – When creating a mesh out of a CAD model, PiXYZ PLUGIN uses this algorithm to create a surface mesh.

2 main parameters are defined for a surface mesh generation:

- **MAX SAG:** The maximum distance between the geometry and the tessellation. This parameter ensures that mesh is similar enough to the original analytical surface (exact geometry).

A low value means that a very fine mesh is created. The distance values are expressed in millimeter.

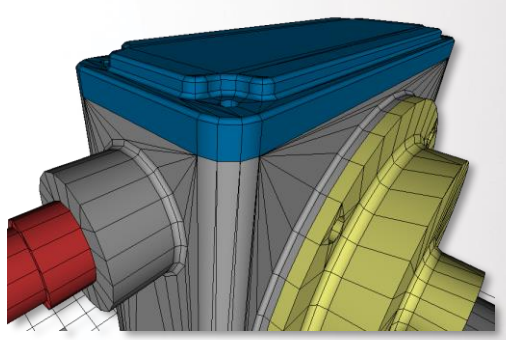
- **MAX ANGLE:** The maximum allowed angle between normals of two adjacent polygons (on a same face). It allows to add more precision on short radius fillets.

Adjust the « Max angle » parameter to keep enough polygons in high curvature areas whose radius is lower than the « Max sag » value: fillets and chamfers for example.

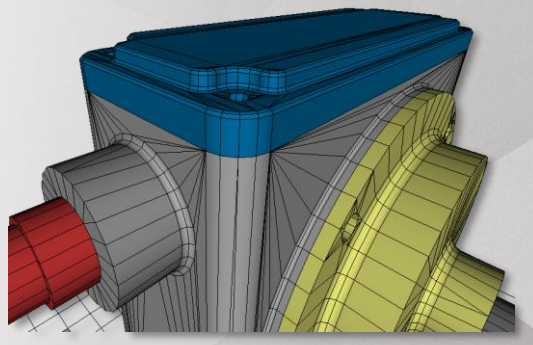
Other parameter possible – *not used in PiXYZ PLUGIN*

- **MAX LENGTH:** Used to control the length of a polygon (edge).

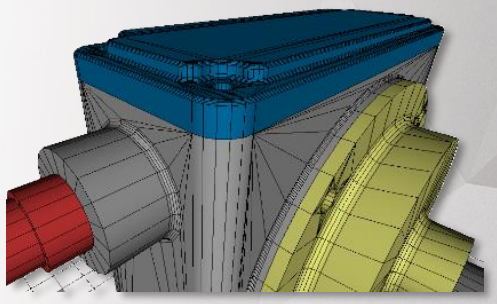
For a rendering usage, it is often not recommended to use the « max Length » parameter. It increases the polygons count without significant improvement on the visual aspect. But in case of very long objects (a plane body, a train cabin...), this setting can avoid lighting artefacts caused by too long polygons.



Ex. with Max Sag = 0.2 mm



Ex. with Max Sag = 0.1 mm



Ex. with Max Sag = 0.2 mm - Max Angle = 20°

In the above example, the « Max angle » parameter has improved fillets precision by adding a row of elements without increasing polygons number of the yellow piece contour.

DECIMATION – When optimizing a tessellated model, PiXYZ PLUGIN uses this algorithm to reduce the mesh polygon density by smartly deleting vertices. It allows precise control, preserving from bad smoothing and topological irregularities.

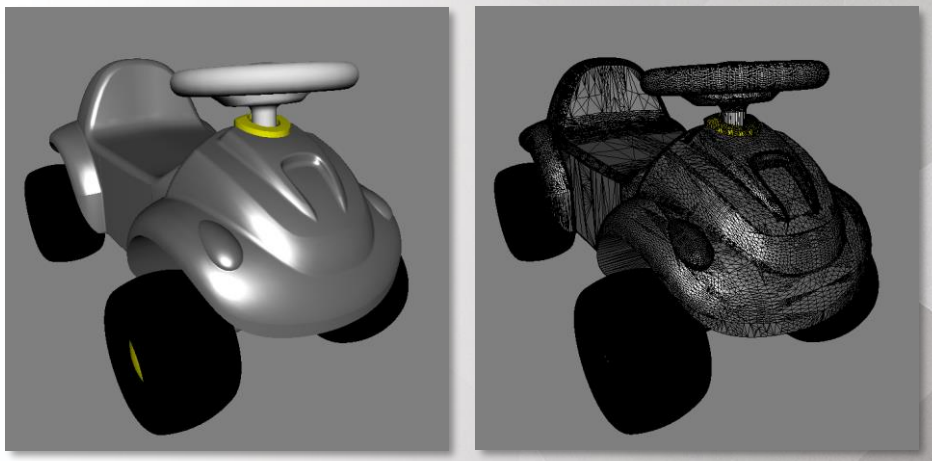
The algorithm uses a combination of the 3 following parameters to obtain the lighter model possible while keeping an acceptable quality:

- SURFACIC TOLERANCE: the maximum distance between vertices of the original model and resulting simplified surfaces.
- LINEIC TOLERANCE: the maximum distance between lineic vertices of the original model and resulting simplified lines.
- NORMAL TOLERANCE: the maximum angle between original normals and those interpolated on the simplified surface.

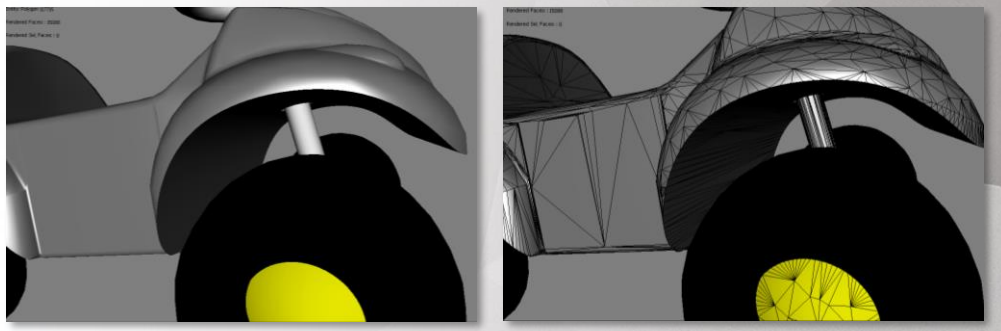
The *Normal Tolerance* setting preserves the quality of how the light reacts on a surface/mesh. Combined with the *Surface Tolerance* setting, it will act as a quality controller, keeping polygons where the surface curvature is important, preserving the visual quality of the model.
The *Lineic Tolerance* is meant to preserve the boundaries of the original surface (where the edges are "sharp").

Other parameter possible:

- TEXTURE COORDINATES TOLERANCE: this setting is meant to preserve the UV (or Texture Coordinates) while decimating a mesh (0,01 is a good value).



Original mesh model: 140 846 triangles



Ex. Surfacic tolerance = 1 mm – Lineic tolerance = 0,1mm – Normal distortion tolerance = 5°

The polygon count is reduced to 13126 with an almost imperceptible quality loss even on sharp edges. The quality is better than using only a Surfacic tolerance of 0.1mm with a triangle count widely inferior (13 126 against 66 636)

GLOSSARY VOCABULARY AND DEFINITIONS

Assembly A scene node that contains components. It allows to hierarchize the Product Structure

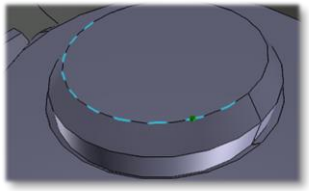
Component Part or Assembly

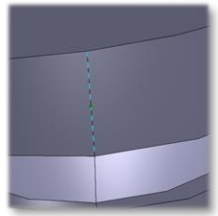
Instance Scene node used to instantiate a Component

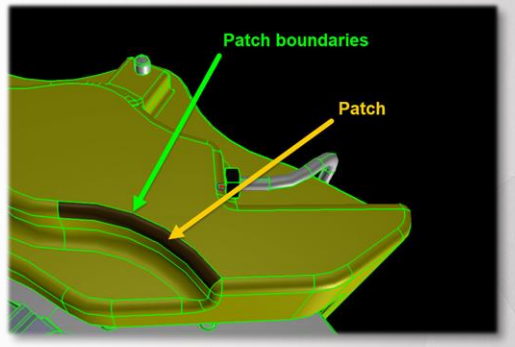
Occurrence As Parts and Assemblies can be instantiated, an Occurrence is the instantiated occurrence of a Component. For example, if a wheel part is instantiated 4 times, there will be 1 Part but 4 Occurrence of the wheel.

Patch CAD face or surface limited by spline curves

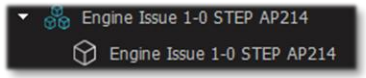
Patch boundary A non-discontinuous patch border or edge



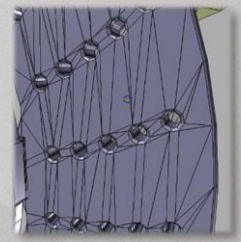




Part Scene node representing a single object



Tessellation In surface modeling and solid modeling, Tessellation is the method used to represent 3D objects as a collection of triangles or other polygons. All surfaces, both curved and straight, are turned into triangles either at the time they are first created or in real time when they are rendered. The more triangles used to represent a surface, the more realistic the rendering, but the more computation is required



SUPPORT

PIXYZ-SOFTWARE.COM

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