FREDOGHOST

PROXY FRAMEWORK FOR SKETCHUP

OVERVIEW

VERSION 1.2 – 03 JUN 2019

BY FREDO6

The **Plugin page of FredoGhost** is hosted on the Sketchucation web site at:

https://sketchucation.com/plugin/2191-FredoGhost

Contents

1. Overview

FredoGhost is a **Proxy framework for SketchUp**. By 'proxy framework', I mean the capability to <u>temporarily</u> replace an object by another one, the proxy, and switch back and forth between the original version and the proxy version.

In **FredoGhost**:

- A Proxy is called a **Ghost**, and the original object is called a **Real**.

- FredoGhost operates on Components and Groups, called generically **Objects**.

FredoGhost provides several methods to generate a Ghost from a Real object. These **Ghost Methods** are split into 3 main categories:

- **Styling methods**, which change the material of faces and edges to simulate some generic styles like Xray, Wireframe, Edge-mesh, Color masking. The main interest is that you can apply styles to individual objects, whereas SketchUp currently applies styles uniformly to all objects in the model.

- **Simplifying methods**, whose purpose is to construct a lighter version of real objects to ease the navigation in SketchUp viewport, typically bounding box, no texture, and simplification methods. You can also create a ghost as a frozen version of an object, and then continue working on the real object (say you freeze the ghost of a cube, and then make corner rounding and add other details).

- **Proxy method**, allowing to replace a real object with an arbitrary object picked in the model.

FredoGhost provides some optional features:

- **You can auto-switch between Real and Ghost** based on the distance of the object to the viewport camera. If an object is far away, it will dynamically switch to its ghost version. This can be useful if you have heavy objects and want to replace them with a lighter version when they are far away in the model viewport.

- **You can attach a Ghosting state to Scenes**. Then, pushing the Scene tab will recall this state.

- **FredoGhost is compatible with Layout**. So, you can build your documentation with mixed styling for objects in different scenes.

Credit: in this documentation, all furniture objects are by DaveR, unless specified otherwise. Dave was also very helpful to advise about the functionality.

2. Installation

➤ **SketchUp Versions**: **SU2016 and above** (Make and Pro).

➤ **Platforms**: Windows and Mac OSX

➤ **IMPORTANT:** FredoGhost requires the Shared Library **LibFredo6**.

FredoGhost is hosted at the **Sketchucation** site.

There are now several ways to install a plugin.
- **SCF ExtensionStore**, recommended method
- **SketchUp Extension Warehouse (EWH)**
- SU Extension Manager to manually install a **.rbz file**

Instructions for installation of FredoGhost and LibFredo6 can be consulted at:

https://sketchucation.com/plugin/2191-FredoGhost

All installations must end up with the following **footprint** in the SketchUp Plugins directory:

- **one script file Fredo6_FredoGhost.rb**
- **one subfolder Fredo6_FredoGhost**. This subfolder contains the library files, the icons, cursor files, language files, …

Name	Type
📁 *SU Plugins root directory*	Plugins Root Folder
📁 **Fredo6_FredoGhost**	Folder
📕 **Fredo6_FredoGhost.rb**	Ruby file
📁 **Fredo6_!LibFredo6**	Folder
📕 **Fredo6_!LibFredo6.rb**	Ruby file

CAUTION: **NEVER rename or move files from their folders**.

Note: you can select an alternative plugin directory (see **AdditionalPluginFolders** at http://sketchucation.com/forums/viewtopic.php?f=323&t=39073#p345150).
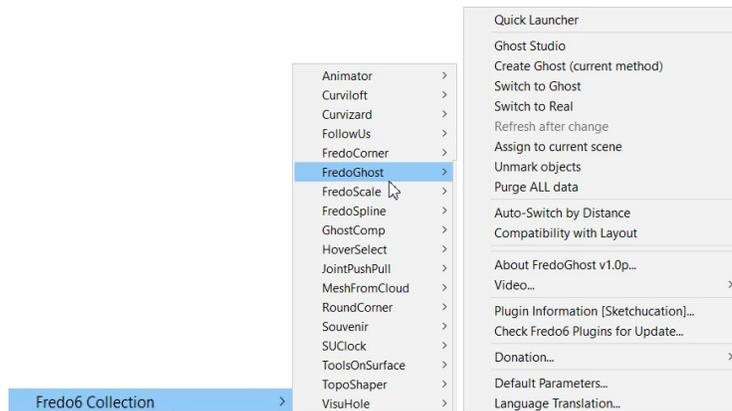
3. Menus, Toolbar and Configuration

Toolbar

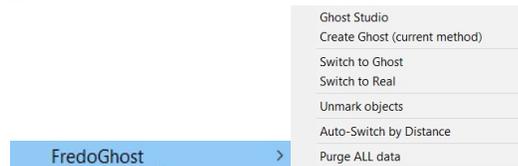Toolbar name is **Fredo6_FredoGhost** by default. There are 11 icons[1].

Main menu

By default, in *Tools > Fredo6 Collection > FredoGhost*. All functions are available in this menu, whether shown or not in the toolbar.

Contextual menu

Whenever the selection includes a group or a component, the contextual menu shows an entry for FredoGhost:

Quick Launcher

This is a small floating window which displays all FredoGhost tools in a list. It can be invoked from the menu or the toolbar icon:

Optionally you can **pin** the Quick Launcher window on your viewport for subsequent use. If unpinned, the window closes after you launch a command.

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[1] Warm thanks to **JClements** for designing the icons!

## *Configuration of contextual menu and toolbar*

All icons are shown right after installation, as well as all contextual menu entries. However, you can configure which icons and menu entries are visible from the Default Parameters dialog box. You can also change the name of the toolbar.
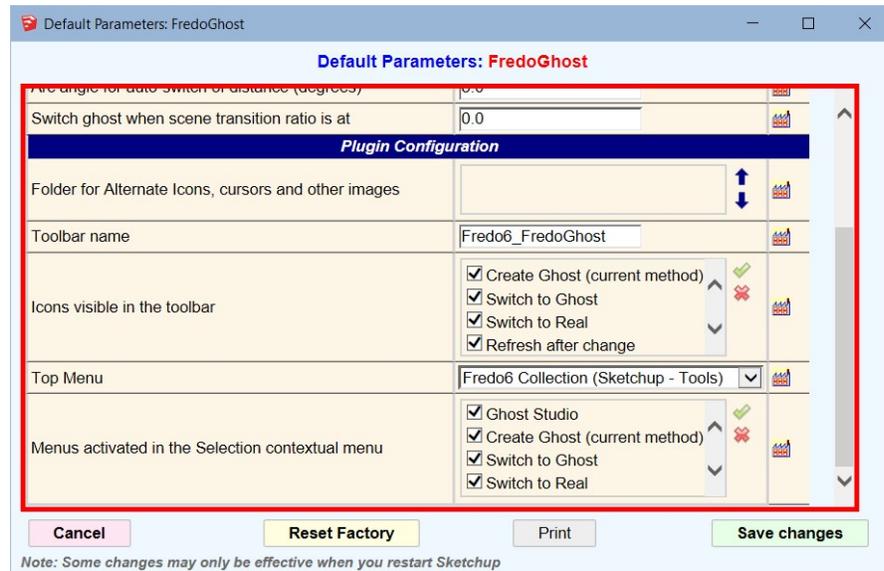
Error Handling

In some circumstances, FredoGhost may be unable to perform the operation, either because the objects are too complex to handle or simply because there are still bugs in the extension.

If this happens, you may get an error message shown as the dialog box below:
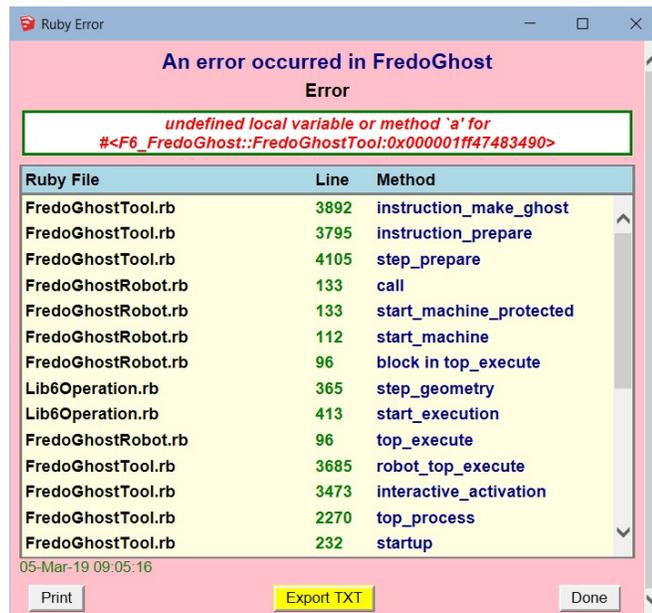
Although this is purely technical information related to the Ruby extension, it can be useful for the author to trace the cause of errors. You can export this log as a txt file (or simply copy / paste it) and post it on Sketchucation.

4. Basic workflow

The typical FredoGhost workflow includes the following steps:

1) **Object selection** – Select groups or components in the model, using the **native SketchUp Selection tool** (or the outliner).

2) **Invoke the Ghost Studio dialog box**
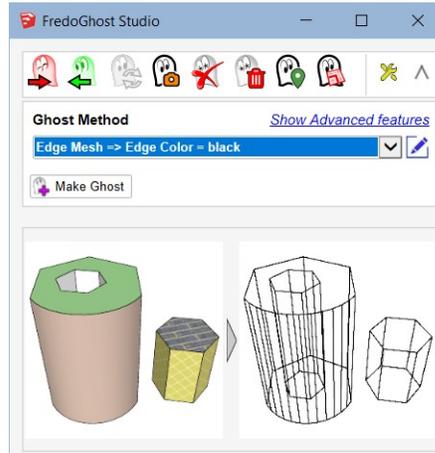
Note 1: you can change the selection in the model while the Ghost Studio dialog box is open.

Note 2: You can **shrink / expand** the Ghost Studio dialog box, which can be useful to select object in the model.

– **Pick a ghost method** in the combo box.

Note: A preview of the ghost transformation is shown at the bottom of the Ghost Studio dialog box.

– **You can optionally customize the ghost method** by clicking on the Edit button at the right of the combo. A dialog box will appear will all available methods and their parameters.
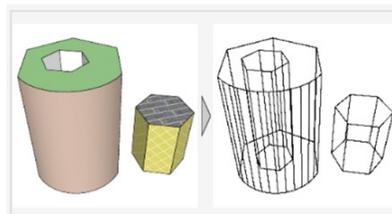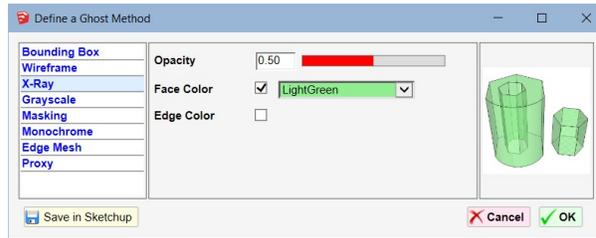

– **Click the Make Ghost button** to generate the ghosts for the selected objects. By default, the selected objects are converted to their ghost version.

Note 1: If there is no selection, FredoGhost will ask you to confirm whether you want to apply the operation to all visible objects in the active context.

Note 2: You can re-apply a new ghost method to an object already ghosted. This can be done whether the object is in its Real state or in its Ghost state.

– **This toolbar button** can be invoked as a shortcut to perform the ghost generation on the selection with the current ghost method (i.e. the last one set in the Ghost studio).

3) **Switch to Real or to Ghost**

– Use the buttons in the toolbar (or Ghost Studio) to switch the state of objects, between their Ghost and Real versions.

– The switch applies to the selection in the model, down to all nested levels.

– If there is no selection, the switch applies to ALL visible objects in the model, at any nested level.

4) **Customizing ghosts with several methods**

– A ghost method applies to an object and ALL its embedded groups and components at any nested level.

– You can however assign another method to those embedded groups and components.

▪ Just open the Ghost version of the top object at desired level
▪ Select one or several sub-objects
▪ Apply a ghost method to the selection

Step 1: *Ghosting the table in XRay lightgreen*

Step 2: *Ghosting the tabletop in Monochrome yellow, one leg as original textured, one leg and 2 crossbars as edge-mesh*

Note: FredoGhost preserves the ghosting methods of the sub-objects if you later change the method of the top object. If you wish to override this behavior, you must keep **Ctrl** pressed when clicking on the 'Make Ghost' button.

5) **Refresh after Modifying objects**

- **You can freely modify the position of the objects, and apply them regular transformations** (scaling, rotation, flip), whether in their Real state or in their Ghost state; the other state will get the same transformation.

- **If you modify a Real object**, whether directly, or in another instance if it is a component, you will need to perform a *Refresh*. The corresponding icon will automatically become enabled. Just click on it to refresh the ghosts for the modified objects. Note that, until you perform this Refresh, the Ghost and Real versions might be desynchronized.

6) **Unmarking objects**

- **To remove the ghosting of object(s)** (i.e. **Unmark**), just select them and click on the Unmark button. The object will be first converted to Real if necessary and all information related to its ghosting will be removed.

7) **Purging all FredoGhost data in the model**

- **You can remove all ghosting information in the model**. Objects which are in their ghost state will first be converted to their real version. This action is radical, but it can be undone.

8) **Undo / Redo**

- **FredoGhost fully relies on the native SketchUp Undo / Redo** (Ctrl-Z/Ctrl-Y, toolbar icons or menu).

9) **Copying and Deleting objects**

- If you copy an object which has been ghosted, then:
  - **For Groups**, the new freshly copies groups will <u>not</u> inherit the ghosting.
  - **For component instances**, the new instances will optionally inherit the ghosting based on the setting in the Default Parameters:

Inherit the ghost behavior when objects are copied (Component instances only)	☑

- You can delete an object, whether in its real version or ghost version.

10) **Copying, saving and transferring SketchUp model files**

- **All FredoGhost information is stored in the model**. Therefore, the information is kept across SaveAs or SaveCopyAs. You can freely copy and transmit the skp files over the wires.

- **If you transfer the model to a user not having FredoGhost installed**, then this user can freely work on the real objects. When transferring it back to you, you may have to perform a Refresh in FredoGhost if some ghosted objects have been modified.

  <u>**IMPORTANT**</u>: be sure to convert all ghosted objects to their Real versions before transferring the model.

11) Modifying a Ghost

You can modify a Ghost by editing it, that is, by changing the content <u>inside</u> the ghost group or component. This can be useful, in particular when you use Proxy method where the replacing object may need to be adjusted for scale and orientation.

Because this may be done intentionally or accidentally, you will see a confirmation box the next time you switch the object to Real:
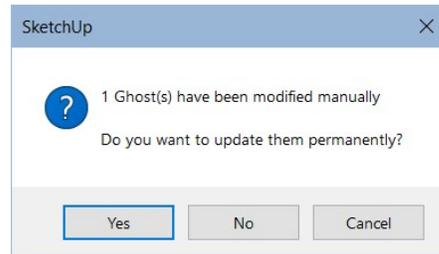
If you answer yes, then the modified ghost will become the registered ghost for the object.

Note that if you create a ghost for the object with another method, the ghost modifications will be lost.

12) Performance

The duration of each FredoGhost operations in indicated in the Measurement window (label and value fields).

As a general guideline:

- The construction of ghosts may take some time, as FredoGhost needs to treat each face and edge of the original object, create and assign new materials and textures to them. So, the response time for Make Ghost, Refresh and Unmark depends on the complexity of the object.

- However, the switch between Real and Ghost state is uniformly fast, almost independent of the complexity of the object. It is typically under $1/10^{th}$ second.

5. Scene Capture and Layout compatibility

You can assign a ghosting state to a scene. A ghosting state is simply the list of objects which are in their Ghost version. This functionality is available only if you have scenes defined in the model.

1) *Assigning a ghosting state to a scene*

To assign the ghosting state to the <u>current scene</u>, just click on the **Scene Capture button**, whether in the main toolbar or in the top button row of the Ghost Studio dialog box.

If you wish to assign the ghosting state to <u>several</u> scenes or to another scene than the current one, keep **Ctrl pressed** when clicking on the Capture button. You will get a dialog box to select the target scenes.
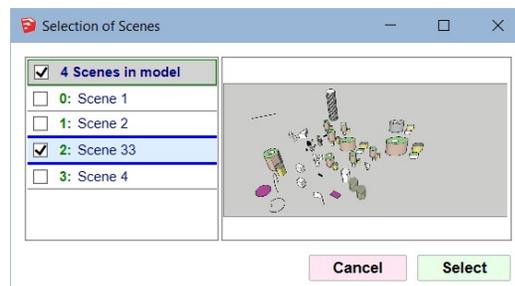
Then, when you select the Scene Tab, FredoGhost will automatically restore the captured ghosting state.

<u>IMPORTANT</u>: **you MUST use the Scene capture mechanism to tell FredoGhost about which ghosting state to assign to the scene**. An update of the Scene (native update function) will not do it. Note that for scenes which have not been assigned a ghosting state by an explicit capture, the change of ghosting state is not predictable when you switch to the scenes.

2) *Layout Compatibility*

[if you don't know what Layout is or do not use it, you can skip this section]

Layout is based on scene settings to display views of the model(s) in the layout document. The issue pertaining to FredoGhost is that scenes only keep track of the camera, layers visibility, style, sections, …. but NOT the state of objects. To work around these issues, FredoGhost implements **two modes** **for switching objects between their Ghost and Real versions**:

- **Definition Substitution**: the definition of the objects is changed. Therefore, the ghosted object is the same group or component instance as the original object. This is the default mode. This mode is **NOT compatible with Layout**.

- **Layer Visibility**: FredoGhost creates the ghost as a <u>separate</u> object, coexisting with the original one, and assign distinct layers to the Real and Ghost objects, making sure that only one is visible at any given time. This mode is **compatible with Layout**, as it is based on **layer visibility only**.

You can freely switch the model between the Definition Substitution and Layer Visibility modes, back and forth. The information on ghosting is kept intact in both modes. This is achieved by toggling the button:

Definition Substitution mode : NOT compatible with Layout *Layer Visibility mode : compatible with Layout*

<u>**With the Layout compatible mode**</u>, you can mix up viewports with different states of ghosting (and therefore styling).

For instance, in each of the 4 SketchUp scenes below, one chair is ghosted with a different method.

Scene 1

Scene 2
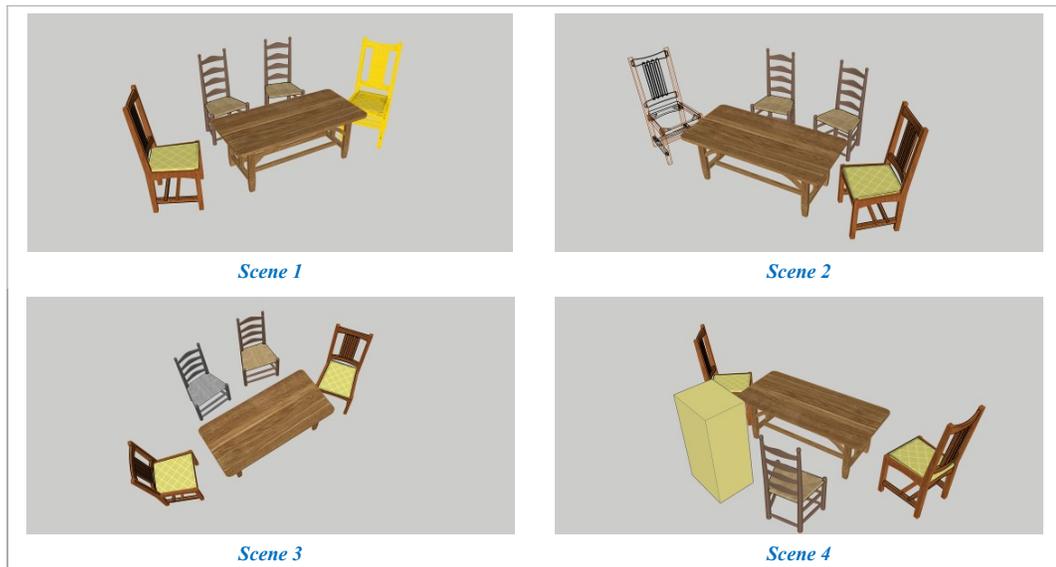
Scene 3

Scene 4

The corresponding **layout** file can display the 4 scenes with the 4 ghosting states:

Scene 1

Scene 2

Scene 3

Scene 4
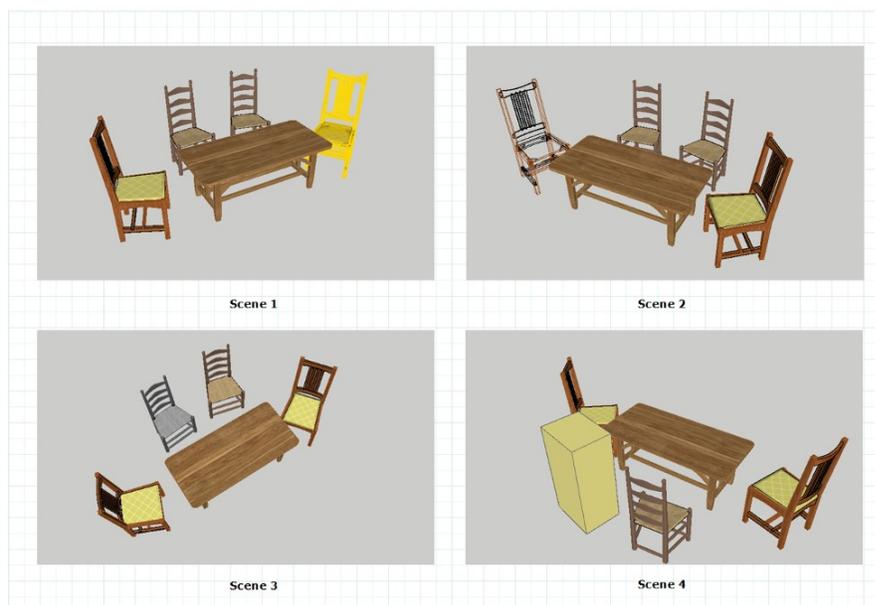
There are however a few inconveniences with the Layout mode:

– **FredoGhost creates technical layers**, which, unfortunately, cannot be hidden in the layer manager. They are all prefixed with ***ZZ_FGh___***. You should ignore them and never change their visibility state manually.

Name		Dashes
👁 Layer0	🟥	Default
👁 Cache	🟩	Default
👁 toto	🟫	Default
◯ ZZ_FGh__1_R		Default
👁 ZZ_FGh__43_R		Default
◯ ZZ_FGh__81_R		Default
👁 ZZ_FGh__200_H		Default
◯ ZZ_FGh__203_H		Default
👁 ZZ_FGh__207_H		Default

– An original object is assigned a technical layer (*ZZ_FGh___*), which replaces its original layer (i.e. natural layer). However, **FredoGhost keeps track of the natural layer of the real object**. Say that the original object was on layer 'Cache'. If you hide or show this natural layer 'Cache' in the model, then both the real and ghost versions of the object will be hidden or shown accordingly.

Likewise, you can change the natural layer of the original object in SketchUp (via the Entity info box). Right after you do it, FredoGhost will substitute the new natural layer by a technical layer but will remember this new natural layer assignment.

– Since there are two objects in the model for each original object, one hidden, one visible, this may create problems with extensions that do not consider object visibility when scanning the model.

6. Ghost Methods

Ghost methods are based on a core algorithm, complemented by optional parameters (for instance, X-Ray has the choice of opacity and masking color). The combination of the algorithm and the parameters instantiates an **active ghost method**.

In a model, the list of active ghost methods is shown in the Ghost Studio dialog box, in the combo box, coming from 3 sources:

- – Predefined methods (in blue)

- – Methods used in the model and already assigned to some objects (in green) or defined in the current session.

- – Methods saved at SketchUp level (in red).

Bounding Box => by sub-object
Clone the geometry
Edge Mesh => Edge Color = Red
Edge Mesh => Edge Color = black
Grayscale
Masking => Face Color = white ; Desaturation = 0.30
Monochrome
Monochrome => Face Color = SpringGreen
NO Texture
Wireframe
X-Ray => Opacity = 0.50 ; Face Color = lightgreen
X-Ray => Opacity = 0.60

Some methods do not have parameters, like *Clone Geometry* and *NO texture*. Others can be customized with parameters via the **Ghost Method Editor**.
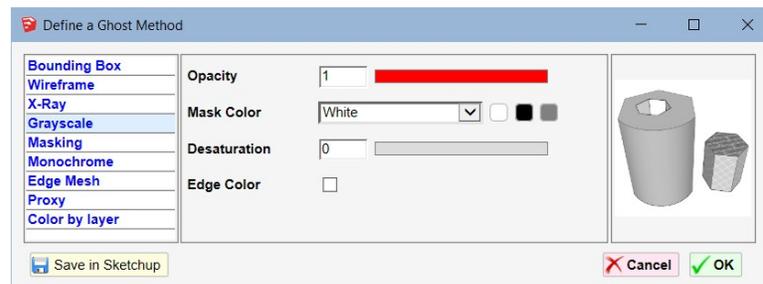
FredoGhost illustrates the rendering for each method and parameters based on a **template shape**[2] shown in real version and in ghosted version. FredoGhost tries to simulate the rendering as accurately as possible, at least for SU2018+.

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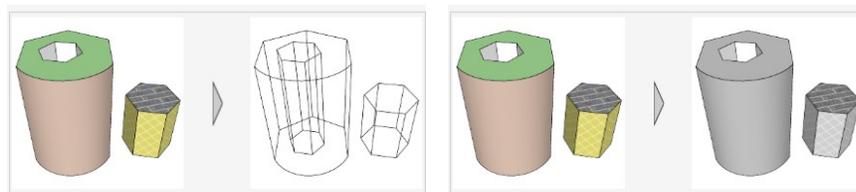
[2]   Note that this template shape may change with future version of FredoGhost.

Specifying Edge Colors

Styling methods usually have a property Edge Color. The 3 buttons on the right are shortcuts to set the edge color to *Black*, *Gray* and *Blend*. There are 3 options:

Edge Color	☐	Edges are **not painted**
Edge Color	☑ Orange ▾ ■ ▢ ◐	Edges are painted in the **specified color**
Edge Color	☑ blend ▾ ■ ▢ ◐	Edges are painted with a **blending of the colors of their bounding faces** (for methods painting faces)

Saving a ghost method at SketchUp Level

- You can define as many methods as you like in the Ghost Method editor. However, they will be available in the SketchUp session only, unless they are used on objects in the model.

- You can however **save a method and parameters for all SketchUp sessions**[3], **regardless of the model**. Just press the **Save** button:

💾 Save in Sketchup
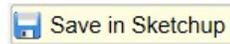
You will be prompted for a method nickname. By default, the name is the expanded list of properties of the method.

Save a method across Sketchup sessions	✕
Method Name	Masking => Desaturation = 0.75 ; Mask Color = black
OK Cancel	

If you give it a nickname, say "My Method"….

Save a method across Sketchup sessions	✕
Method Name	My Method
OK Cancel	

…it will then appear in the main dropdown list of methods in 'red', with the method code and the nick name. The tooltip indicates the details of properties.

Masking => Desaturation = 0.30
Masking => Desaturation = 0.30 ; Edge Color = blend
Masking => Desaturation = 0.30 ; Mask Color = black
Masking => Desaturation = 0.75 ; Mask Color = black
Masking => Face Color = white ; Desaturation = 0.30
Masking [My Method]
Monochrome
Monochrome => Opacity = 0.25 ; Edge Color = blend ; Face Color = SandyBrown
Monochrome => Opacity = 0.50

- If ever you want to remove this method, select it in the main combo box of the Ghost Studio and then open the Ghost Method editor; you will see that the Save button is now changed to a **Forget** button:

❌ Forget

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[3]   As well as all SketchUp versions, past and future

The following sections describe the methods available in the current version of FredoGhost – *See separate document for more details*.

Ghost method	Simplifying	Styling
Proxy Object: *substitution by an arbitrary object*		
Clone Geometry: *make a strict copy of the real object*		
No Texture: *replace all textures by flat average colors*		
X-Ray: *change the opacity of faces, with optionally assigning a color to faces and edges*		
Masking: *apply a color mask to the faces, to make them desaturated, i.e. lighter or darker or water-colored.*		
Grayscale: *paint the faces in their grayscale color. Optionally, you can apply a mask to lighten or darken the grayscale.*		
Color by Layer: *paint the objects with their layer color*		
Monochrome: *paint the objects with a single color*		
Bounding Box: *replace objects by their bounding box*		
Edge Mesh: *replace objects by their edge skeleton*		
Wireframe: *replace objects by their simple wireframe as in SU*		

7. Advanced Features

To reveal the advanced features of FredoGhost, you need to expand the Ghost Studio dialog box:

Basic Features
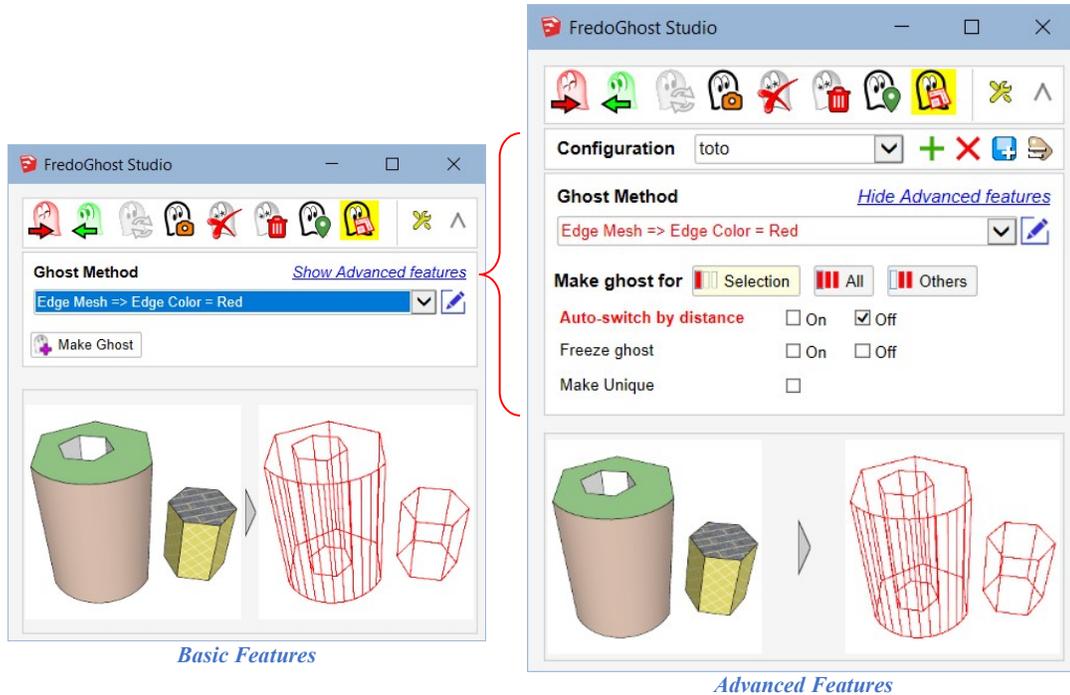
Advanced Features

There are 5 advanced features:
- Auto-Switch by distance
- Freezing of ghosts
- Unique ghosts
- Advanced selection for component instances
- Configurations

1) Auto-switch by Distance

FredoGhost provides a mechanism to automatically switch between ghost and real versions based on the visible size of the object in the current view. Basically, if an object is far away and appear small enough in the SketchUp viewport, then it would be switched to its ghost version.

Although this applies to any ghost methods, it would probably be the most useful for simplification methods (for instance replacement by a bounding box), since the intention would be to make the active model lighter for a smoother navigation.

To make object sensitive to distance

Objects are not sensitive to distance by default. You need to explicitly assign them this characteristic, using the check boxes:

The usage of the two check boxes allows to be <u>explicit</u>, since you can operate on objects which are already ghosted and sensitive or not to distance.

- **ON** will <u>force</u> the distance sensitivity
- **OFF** will <u>remove</u> the distance sensitivity
- **ON** and **OFF** unchecked will leave the property <u>as-is</u> for each object.

The setting of distance sensitivity can be done:

a) <u>At creation of the Ghost</u>.

b) <u>Later on</u>, by selecting the target objects. In such a case, if you check the **ON** or the **OFF** box, an 'Apply' button will appear. This allows to set or unset the property **without regenerating the ghosts**.
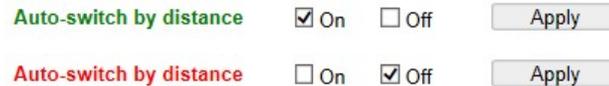
To enable Auto-Switch by distance in the SketchUp session

You must explicitly set the auto-switch capability for the model by toggling the button:

When the Auto-Switch is ON, a change of view may trigger a switch between real and ghost versions for some objects. For convenience,

- No switch takes place while you are using a Tool (native or extension)
- The potential switch takes place half a second after you changed the view, so that you can smoothly zoom, orbit or pan with the mouse.
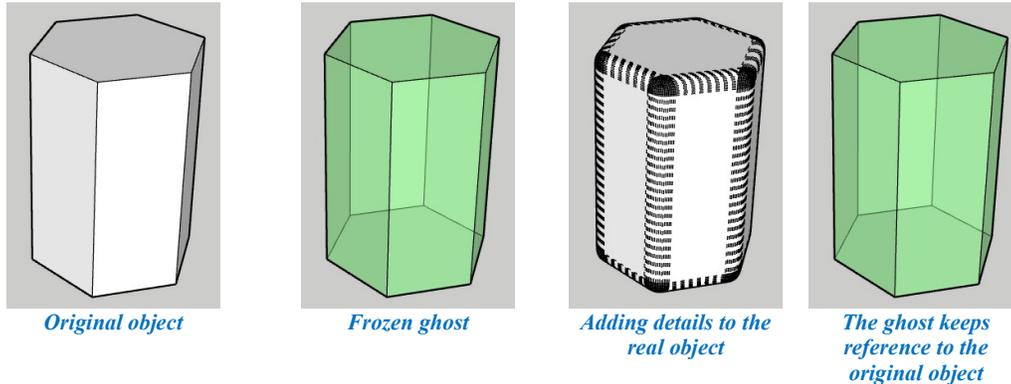
The algorithm to determine when to switch is based on the arc angle of the object viewed from the camera. Default is **8 degrees**. You can change this parameter in the Default Parameters of FredoGhost.

2) Freezing of Ghost

FredoGhost keeps the ghost version in sync with the real version. However, you may want to **freeze the shape of the real object to preserve a fixed reference for its ghost version**.

This would be useful if you plan to make a real object more complex (e.g. adding details or chamfering for instance). The ghost would remain simple, but realistic, while you add geometric complexity of the real object.

| *Original object* | *Frozen ghost* | *Adding details to the real object* | *The ghost keeps reference to the original object* |

To freeze ghosts

Ghost are not frozen by default. You need to explicitly specify this characteristic, using the check boxes:

Freeze ghost ☐ On ☐ Off

The usage of the two check boxes allows to be <u>explicit</u>, since you can operate on objects which have already frozen ghosts.
- **ON** will <u>force</u> a ghost freeze
- **OFF** will <u>remove</u> the ghost freezing and resume synchronization
- **ON** and **OFF** unchecked will leave the property <u>as-is</u> for each object.

The setting of frozen ghost can be done:

a) <u>At creation of the Ghost</u>.

b) <u>Later on</u>, by selecting the target objects. In such a case, if you check the **ON** or the **OFF** box, an 'Apply' button will appear. This allows to set or unset the property **without regenerating the ghosts**.

Freeze ghost ☑ On ☐ Off [Apply]

Freeze ghost ☐ On ☑ Off [Apply]

3) Unique Ghost

This function concerns the case where you assign ghosts to SEVERAL instances of the SAME component definition in one operation.

In this case, FredoGhost construct only a single ghost reference shared by all these instances. This means that any customization of this ghost (i.e. changing the method of sub-objects) will affect the ghost versions of all these instances.

The Unique function allows to force individual construction of a ghost, one by instance. You can set it:

a) At creation of the Ghosts.

b) Later on, by selecting the target instances. In such a case, if you check the box, an 'Apply' button will appear. This allows to set the property **without regenerating the ghosts**.

4) Advanced selection of component instances

This function concerns the cases where you want to assign ghosts to several instances of the same component definition in a **single** operation.

Based on what is selected in SketchUp, FredoGhost offers 3 options:

- **Selection** applies ghost creation to what is selected,
- **All** applies to all instances in active context, whether they are selected or not,
- **Others** applies to all other instances in the model at the same level, EXCEPT those which are selected.

The purpose of this function is to ease the selection when you have numerous instances of the same component definition spread out in the model.

IMPORTANT: the ghost is shared between the instances. This means that if you customize a sub-object of the ghost, it will apply to all these instances.

5) Ghosting Configurations

Configurations are **independent** ghosting contexts within the same model.

This may be useful if you wish to create ghosts with DIFFERENT methods for the SAME object, for instance to get distinct viewports in Layout where the same object would be in XRay or in Wireframe.

Configurations are managed by a combo box and 4 buttons to Create, Delete, Duplicate and Rename a configuration.

The current configuration is indicated in the combo box. By default, you work with Config 0. Here are the operations that can be performed on configurations:

- **Change of configuration**: select the configuration in the drop box. All objects will be first converted to their real version.

- **Add a new configuration**: click on the + button. You will be prompted for a name. All objects will be first converted to their real version. From there on, any ghost creation will be assigned in the context of this configuration.

- **Duplicate a configuration**: click on the ⊞ button. You will be prompted for a name. The new configuration is created as a copy of the current one. The ghosting state remains unchanged.

- **Delete a configuration**: click on the ✕ button. All objects will be first converted to their real version. The current configuration is changed to another one. If you have no other configuration, the current configuration will be Config 0, with an empty ghosting context.

- **Rename a configuration**: click on the �ý button. You will be prompted for a name.

8. Default Parameters

There are a few configuration settings which can be changed in the Default Parameters dialog box, reachable by:

- The menu *Tools > Fredo6 Collection > FredoGhost > Default Parameters…*
- The small wrench icon ✳ on the top-right of the Ghost Studio dialog box

Active Options at start up	
Convert objects to ghost when making ghost	☑
Inherit the ghost behavior when objects are copied (Component instances only)	☑
Layout compatibility by Default	☐
Indicate the ghosting status in the object name ([Ghost]	☑
Auto-switch to Ghost when the ratio [object size / viewport size] is smaller than (in %)	5.0
Retention time of Unit Ghosts (minutes)	15.0

1) **Convert objects to ghost when making ghost**: when you make a ghost out of a real object, it is converted to its ghost version. You can change this behavior and not perform any conversion.

2) **Inherit ghost behavior when objects are copied**, when you copy a component instance, via the Move-Copy, or via the Copy-Paste.

   Note that if the object is a Group, it will not inherit the ghosted behavior.

   Note also that if you insert a component instance from the Component Browser, it will not inherit any ghosting too.

3) **Layout compatibility by default**: this is the compatibility mode for the model when you create the first ghost. Note that you can dynamically change it.

4) **Indicate the Ghosting status in the object name**: by default, FredoGhost prepends a *[Ghost]* prefix to the object name to show visually that the object is in a ghost state.
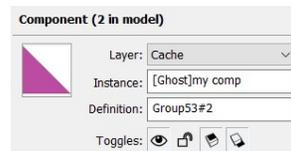
   As this may interfere with other SketchUp operations and extensions using object names, this option is left open.

5) **Retention time of unit ghosts**: this is a technical option related to the ghost generation (see next section 'under the hood').

6) **Arc Angle for auto-switch by distance**: this is the visible angle of the object that triggers an automatic switch between the ghost and real version of objects. I may come with a smarter algorithm in a next version.

9. Under the hood

As FredoGhost is an extension, not a native functionality, it is good to understand how it works under the hood, especially because, in the current version of the API, the nitty-gritty of internal processing cannot be hidden completely.

When FredoGhost creates a ghost:

- **It makes a copy of the original object and its sub-objects** (an instance of their definition actually)

- **It generates a ghosted version for all individual sub-objects**, so that this can be reused for partial ghosting or when sub-objects are shared with other objects in the model.

- **It assembles these ghosted sub-objects into a composite definition**, to be used as the ghost version of the original object.

All these elements are enclosed in a dedicated group, called **Capsule**, which is assigned a technical Layer ***ZZ_FGh_Capsule*** set to invisible[4].

Model in Real version

Model in Ghost version
The capsule is shown on the left.
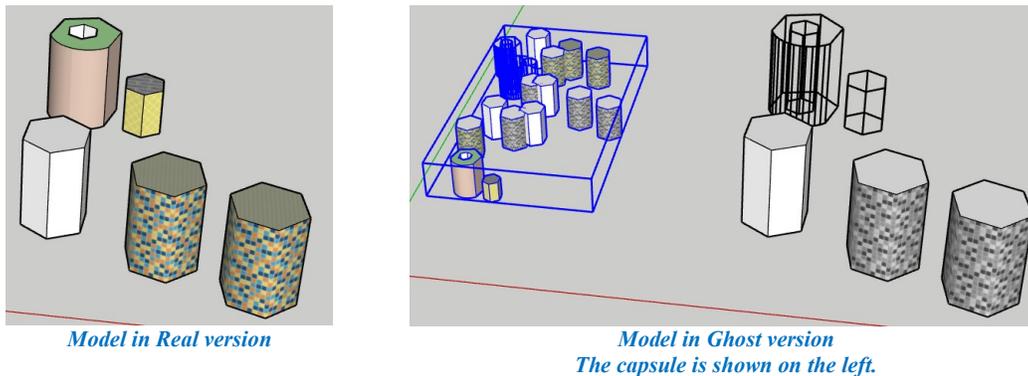
This means that the model gets additional geometry. As it is invisible, this should not alter the performance of navigation in the SketchUp viewport. However, even if it is invisible, the size of the skp file will increase. Because FredoGhost uses instances of definitions for copies of real objects, the increase of size is really related to the ghosted versions.

Note: By default, FredoGhost minimizes the persistent technical objects and keeps only the spare copies and top ghosts in the Capsule. This may impact performance when you generate ghosts from objects which have elements already ghosted, as these ghosted elements need to be regenerated. FredoGhost provides an option to cache these unit ghosts for a limited period of time (15 minutes by default):

Retention time of Unit Ghosts (minutes)	15

FredoGhost also maintains information related to the ghosting state as attributes of objects, scenes, layers and model. These attributes are all encoded in dictionaries with names prefixed by *FredoGhost*. **It is of course strongly advised NOT to alter these attributes in any way**.

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[4]   I left the capability to manually unhide the capsule layer if you wish to see what it contains.

FredoGhost keeps track of the ghosting state and cleans up the Capsule according to the operation of ghost creation and unmarking.

The **PURGE ALL** command erases every trace of FredoGhost in the model, the capsule and all attributes. It is therefore a radical cleanup.

A few notes on what happens to the real objects:

- **In Definition Substitution mode**: the Real object is not altered, except its definition which is changed when converted to ghost. So, it keeps all its original attributes whatever is the version, since it is the same object.

- **In Layout Compatible mode**: the Real object is untouched, except for its layer which is replaced by a technical layer. The Ghost version is however another object and does not carry the original attributes of the real object. Furthermore, FredoGhost must synchronize the position and transformation of the Real and Ghost versions.