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## Introduction

Autodesk® ImageModeler is the only software solution you need to calibrate a modeling perspective and create photo-realistic 3D models based on a single photograph or panorama.

### Goal of this tutorial

This step-by-step tutorial guides you through the Autodesk® ImageModeler™ 2009 single-image calibration workflow. You will learn how to create a 3D photorealistic project with only one photo (and the lessons of this tutorial apply as well if you are calibrating a single panorama).

This tutorial was prepared and illustrated using Autodesk® ImageModeler™ 2009.

#### Shooting advice: Photographs

To successfully create a model from a single photograph, your picture needs to have a **perspective easy to evaluate**. Good perspective for modeling is a picture that clearly shows volume, preferably with angles to facilitate the placement of the calibration tool. In other words, make sure that you include your entire subject in the shot (the software cannot invent what is not seen in the image), and keep perspective in your subject. Do not to take a picture showing only a portion of a flat surface.

To calibrate **one image**, it must **not be modified** (no crop, no deformation ...). Working on single-image calibration is easier if the **EXIF data** are present (initialize the focal length value).

In this tutorial, we took a photograph of a kitchen. As you can see, the kitchen is seen with clear perspective covering the front and the top parts of room:



### Shooting Advice: Panoramas

Autodesk® ImageModeler™ 2009 can also calibrate a **full 360 panorama**. Panoramas are good input for capturing an environment (a landscape, a street, a room, ...).

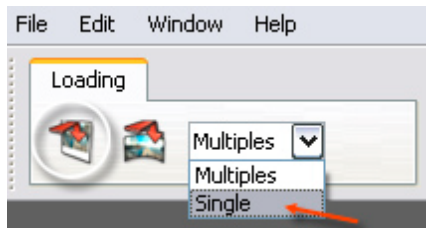
Panoramas are often better input for single-image modeling projects because:

- A panorama generally provides good perspective at some point of view (photos sometimes lack an identifiable perspective)
- No focal length has to be given—a full 360 degrees is available
- No distortion has to be estimated

## Calibrating a single photo

### Loading a picture

As this tutorial is based on single-image calibration, the first step is to choose **Single** in the **Loading** tab.



1. From the **Loading** tab, choose either:
  - a. **Load Image**, or
  - b. **Load panorama**

In our example it is a single image.

2. A file browser opens, **select** the image to import and click **Open**.

This imports the selected image into Autodesk® ImageModeler™ 2009 and automatically adds the image into the **Camera** folder of the **Scene Browser** and installs it into the viewport.

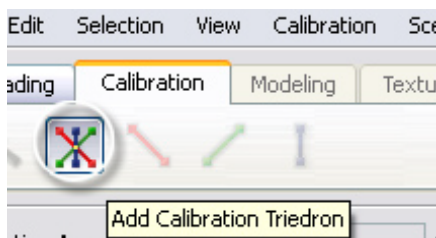
Open the tutorial file, **loaded.rzi**, to see the ImageModeler project file created with the tutorial image loaded as described above.

## Perspective calibration

To calibrate a single image with the **Calibration Triedron** tool you have to provide some basic perspective information:

- A **90° angle** inside the image
- A **parallel line to the x axis** defined on the 90° angle

1. Activate the **Triedron tool**

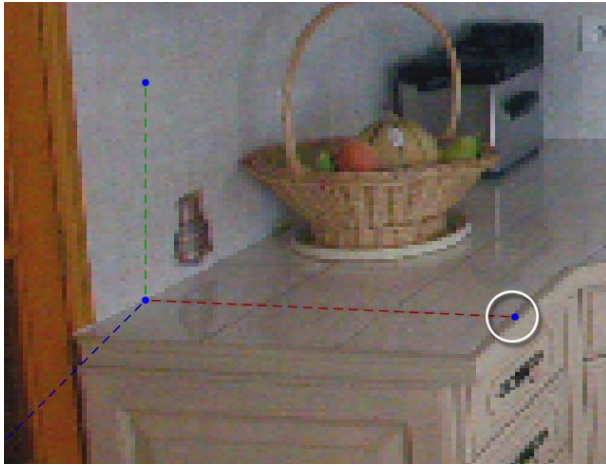


2. Set the origin and the axis as in the following screenshots:

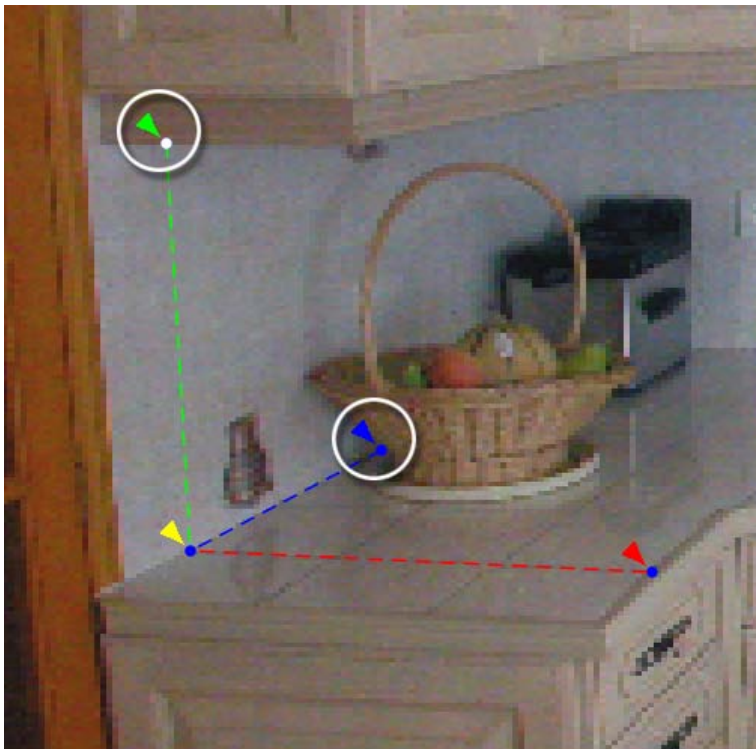
- Click the first point to place the **origin** on the 90° corner



- Then, **position and click** to place the **X axis** (red line)



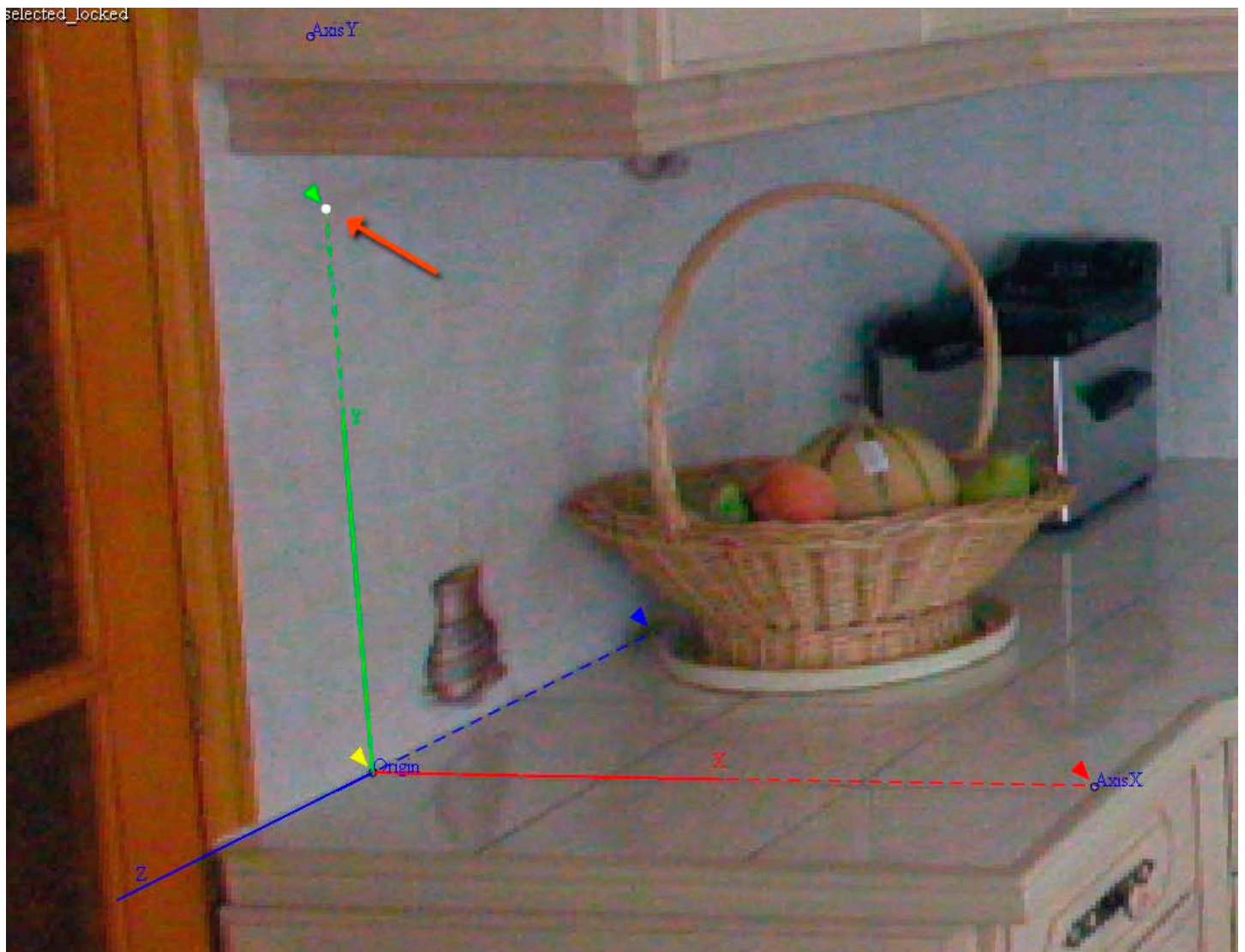
- Do the same with the **Y and Z axis** (green and blue lines): **Y** is parallel to the vertical of the door, and **Z** is at the intersection between the wall and the kitchen plane



**NOTE** To help you in the placement, you can use the **quick zoom** tool. Press “**Z**” to zoom into the image where the cursor is positioned.

All handles of the calibration axes can be edited at any time, by dragging and dropping the extremities of the handles to a new position. Move axes if you need to improve the **Calibration accuracy** value.





1. Add helper X axis by clicking **Calibration Helper X axis**



Place a helper X axis in the image, parallel to the X axis as in the following screenshot:



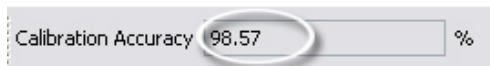
You should see a message that the **calibration succeeded**, as in the screenshot above.

Load the file, **calibrated.rzi**, to see the steps above completed as described.

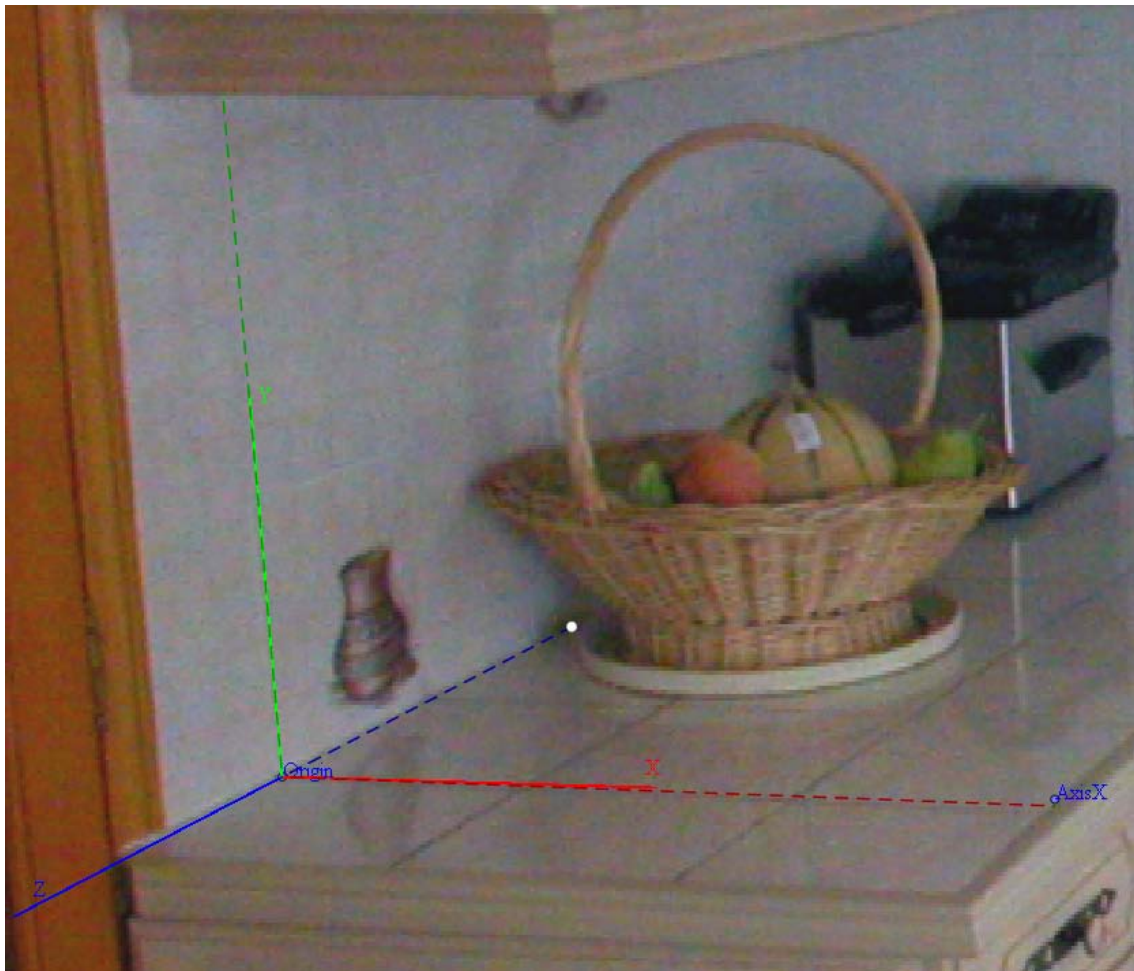


## Adjusting calibration

The **Calibration Accuracy** percentage value represents the quality of the calibration estimated by Autodesk® ImageModeler™ 2009. The aim is to get as close to 100% as you can. In practice, achieving a value of >98 % should be sufficient.



Once calibrated, the calculated coordinate system is placed and drawn with solid lines. You can also check that the calculated lines (solid lines) and the manually-placed lines of the triedron (dotted lines) match.



1. Set the **Focal length** and the **Distortion values**.

Autodesk® ImageModeler™ 2009 will read the focal length value from the EXIF data of the image; if not readable, the default value will be applied and might need to be adjusted manually.

When the focal length is set you have to find the most appropriate distortion value to visually achieve an undistorted image and the calibration accuracy value should be improved at the same time.

These are the values you should find to improve the calibration significantly.



2. **Add Calibration Helper** axes to make calibration more rigid.

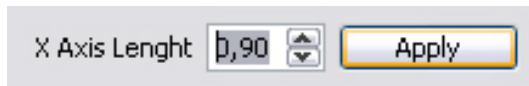
It is also possible to **add more calibration helpers**. Find a parallel line inside the image to an axis and set it. The calibration is automatically updated with this axis as a constraint.

Be careful when adding constraints, as it is a hard constraint, making an error in calibration helper position can reduce the global quality. From the same idea do **not add more than 2 Calibration Helper axes**.



3. Set **reference distance** values.

In order to get your calibrated 3D scene with a true-to-life scale, you have to set a reference distance of a measurable feature in the picture. Set a value for the X axis length as the reference distance (the X axis of the triedron).



Enter a value for the reference distance in the **X Axis Length** field and click **Apply**.

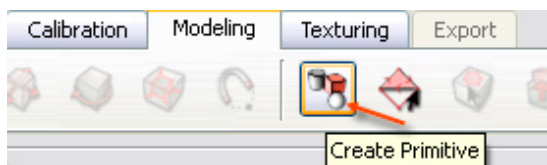
**NOTE** The units of measure for all the distance and angle values can be set in the ImageModeler Preferences (select **Edit > Preferences** (Windows) or **ImageModeler > Preferences** (Mac)).

Load the file, **calibrated\_improved.rzi**, file to view these changes from the above step.

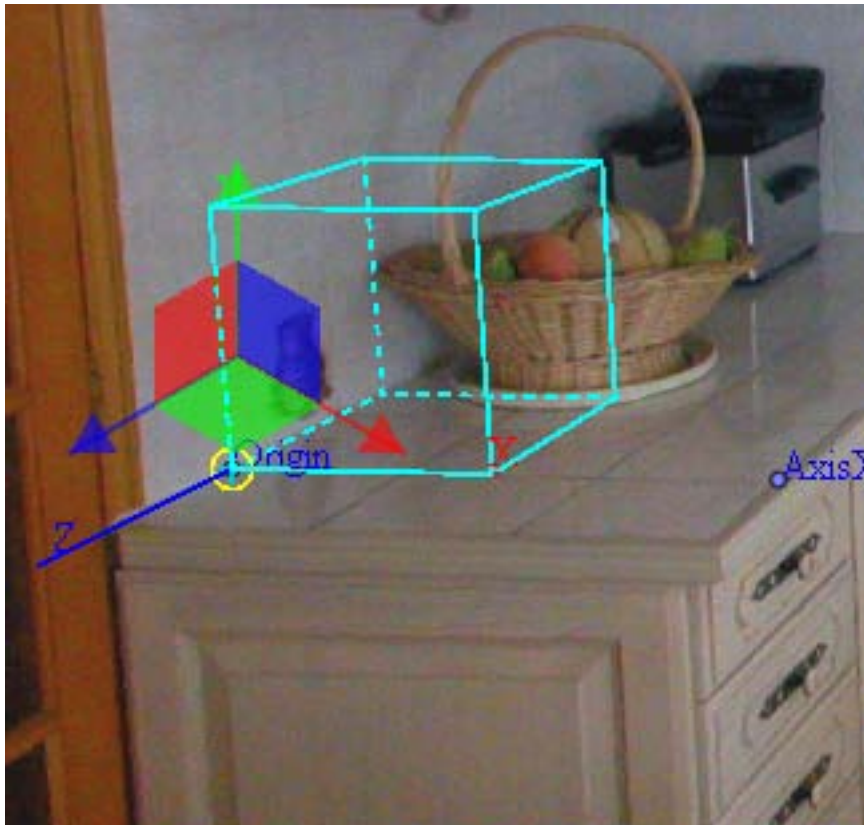
4. Test the perspective calibration quality with a 3D object

To verify the calibration quality, try to place a cube primitive (a basic 3D shape) and check whether ImageModeler automatically places it according to the image's perspective.

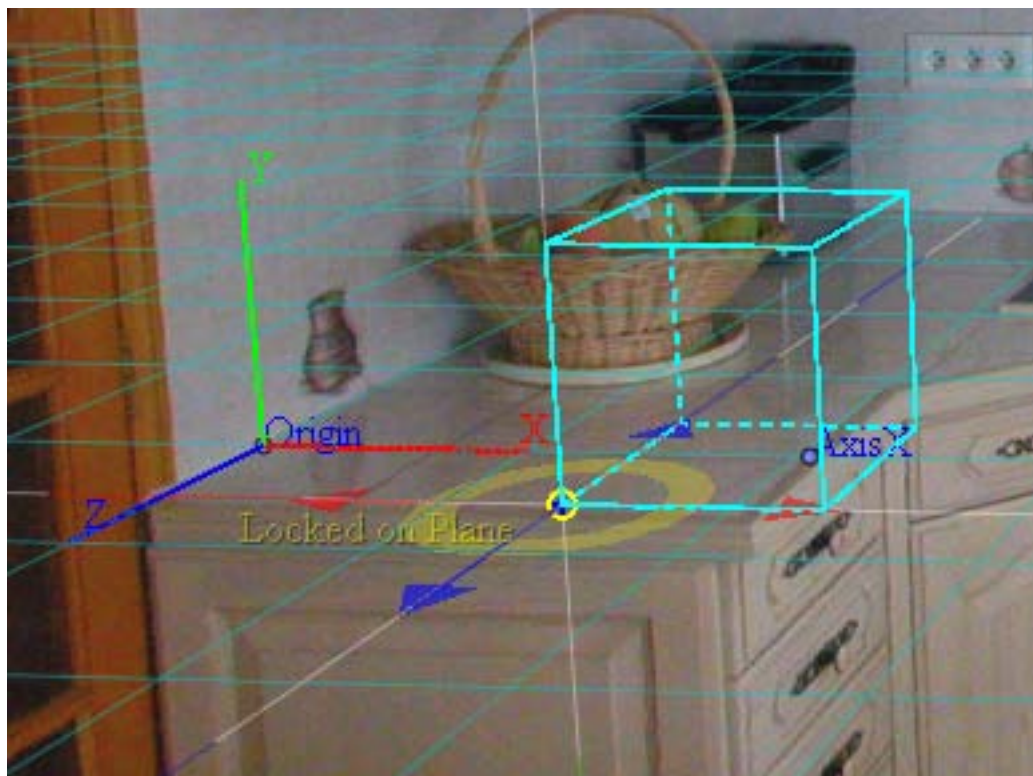
- a. In the **modeling tab**, click **Create Primitive**.



- b. Place the cube to the **Origin** locator without clicking on it
    - c. Activate the snapping constraint by pressing "**V**"

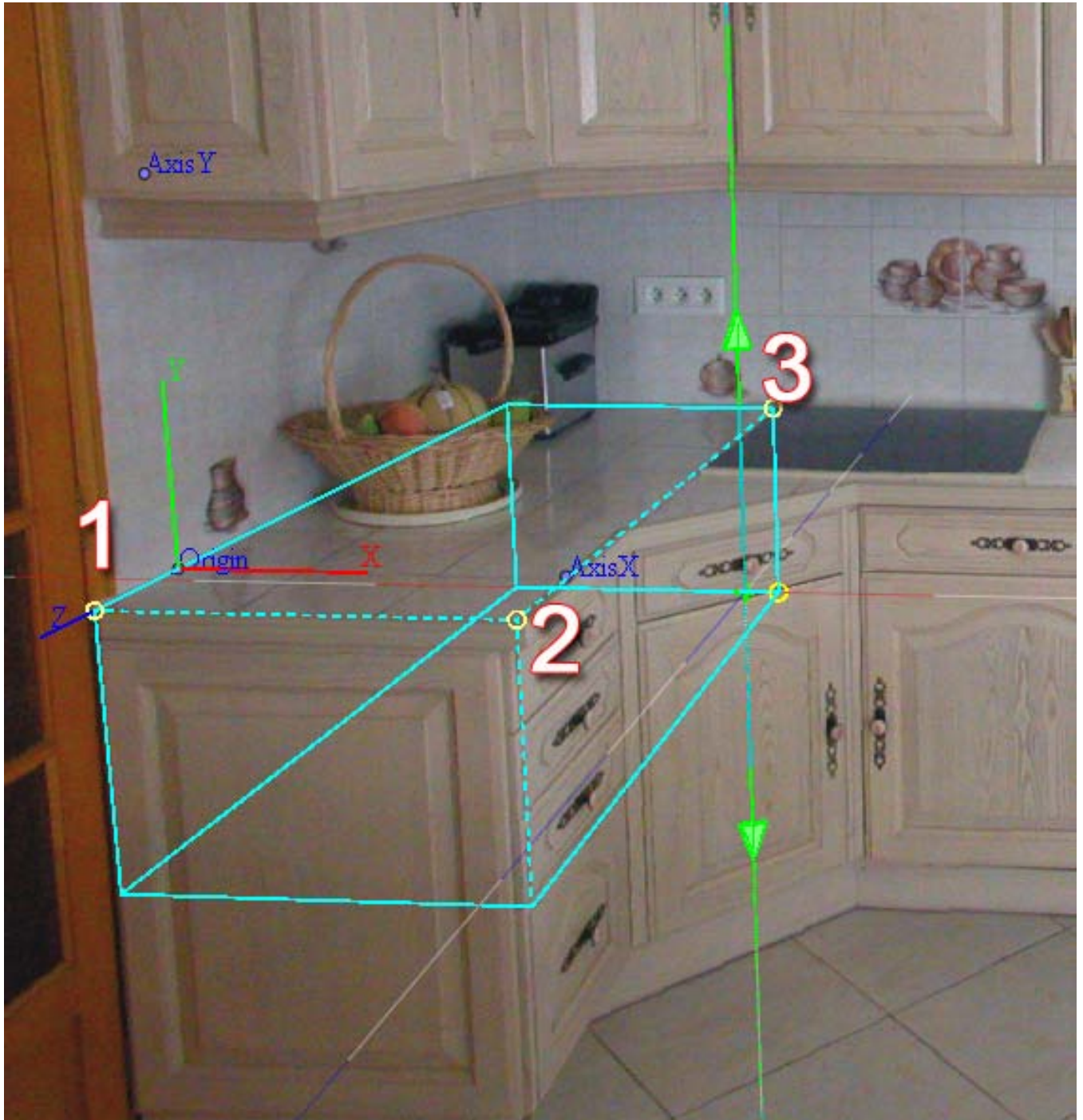


- d. Click on the green square to activate the constraint on the plane normal to Y axes through the Origin locator





- e. Place the cube in the image according to the following screenshot:
- 1<sup>st</sup> corner: at the intersection of the wall and the kitchen counter-top
  - 2nd corner: at the counter-top width's opposite point
  - 3rd corner: at the end of the counter-top



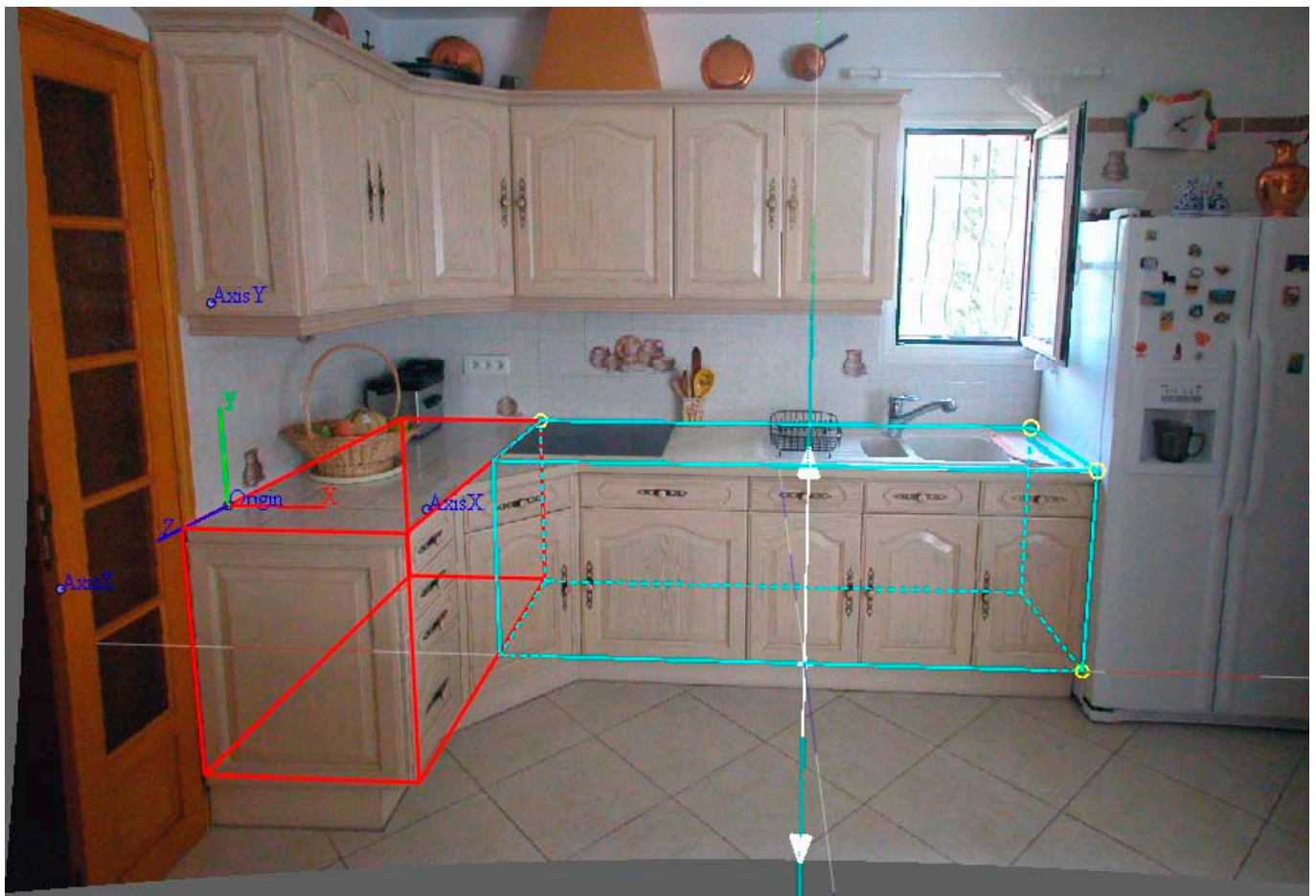
- a) Adjust the height of the cube to match the kitchen cabinet





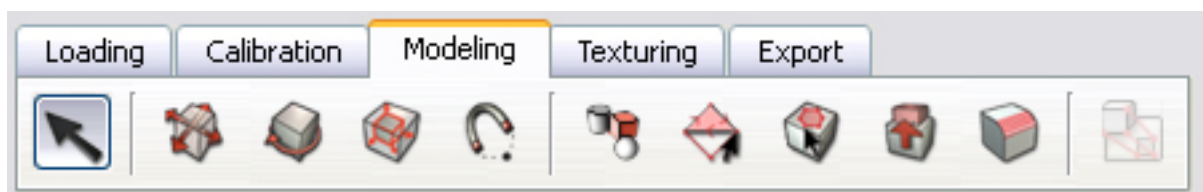
## Modeling and Texturing the Scene

To create the 3D model, from the **Modeling** tab start adding **primitives** and use **constraints** to place and adjust them.

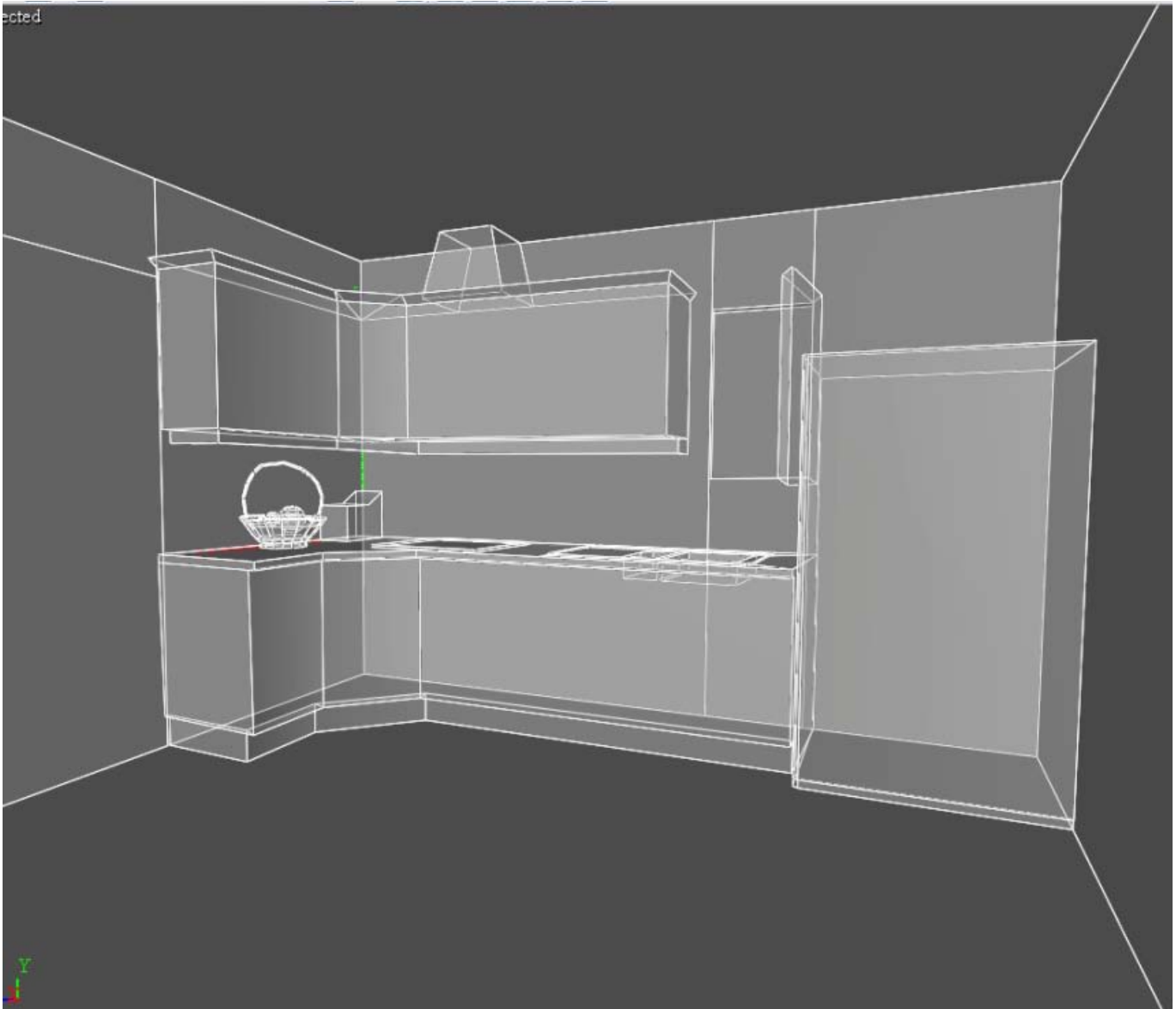


To see these steps completed, load the file, **test\_cube.rzi**.

Continue using the ImageModeler polygonal tools to create the entire 3D model.



The goal is to achieve this:



To see the modeling work completed as above, load the file, **modeled.rzi**.

In order to view the model precisely as you see in the screenshot above, do the following:

1. Choose the **Modeling** tab (make sure the **Select** tool is active in the toolbar)
2. From the **Tool Properties** toolbar, choose **Select Edge** to make all the edges of the objects visible
3. In the **Display Toolbar**, choose "**Solid**", set the **transparency** to about **68%**, toggle off the **Image Plane Display**
4. To orbit around the view, hold down the **Alt + right-click** (Windows) or **Option + Ctrl + right-click** (Mac) and scroll to the angle from which you want to view the model.

## UV Mapping

**NOTE** All the primitives inside ImageModeler™ 2009 have a default UV mapping. If you do not need to do any topological modifications to the primitives you have created, you do not need to do any mapping projections (you can use the default UV mapping).

When new UV mapping is required, you can create a projection on selected objects or faces.

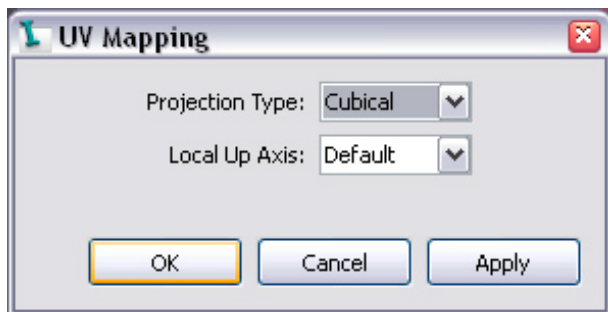
To create a new projection for UV mapping, go to the **Texturing tab** and do the following:

1. Select the objects or faces.
2. Click **Create UV mapping**.

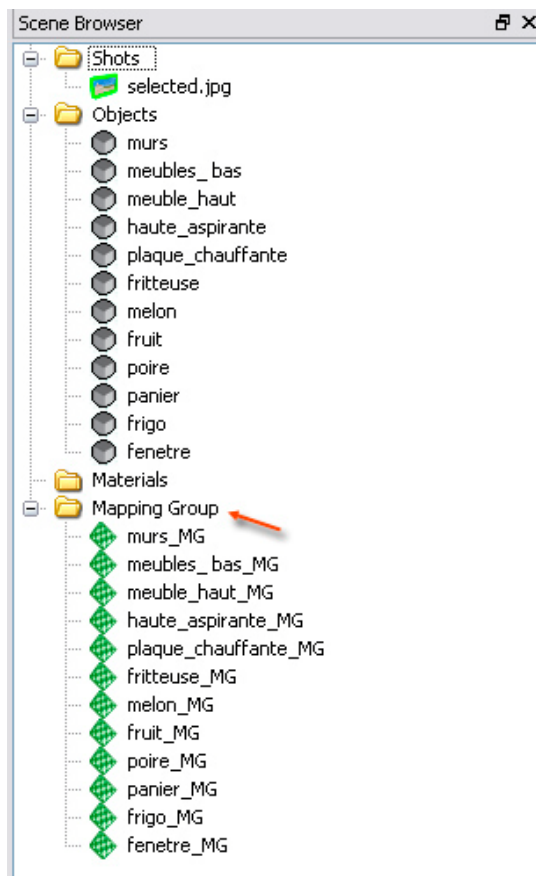


3. Select projection type and the local up axis

**TIP** We recommend using the cubical projection with the default axis which most often provides the best result.

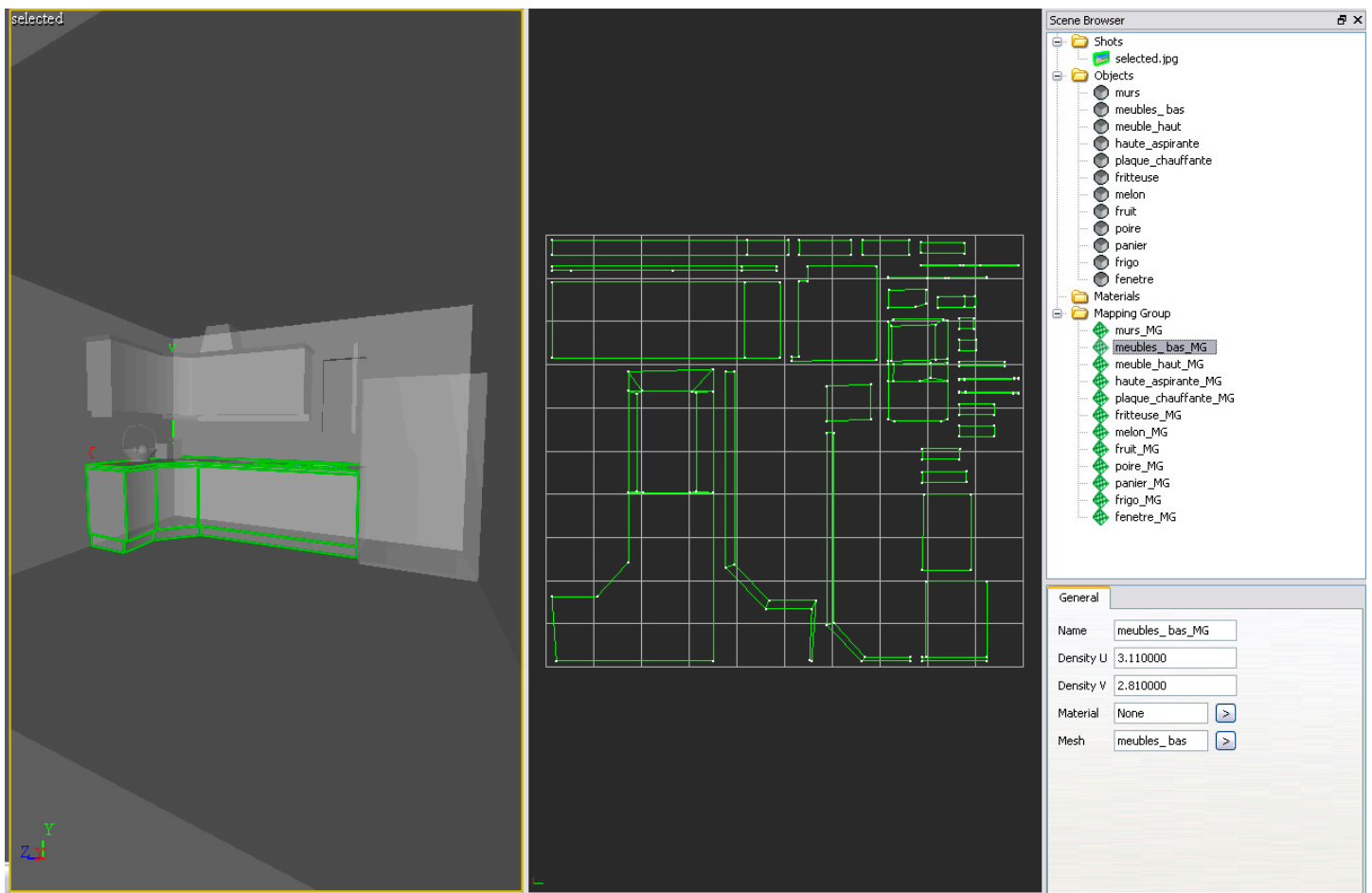


You can access the list of the UV mapping groups in the Scene browser in the **Mapping Group folder**.



**NOTE** To view and edit a mapping group, it is possible to toggle the 3D view into a UV view. Right-click in the viewport and select **Switch to UV view** or press “\”.

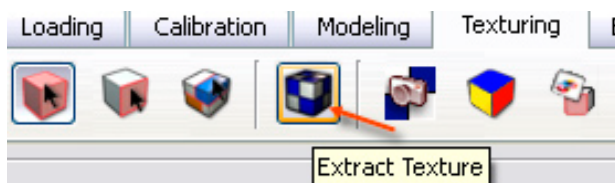




The next step is the **texture extraction** for each mapping group.

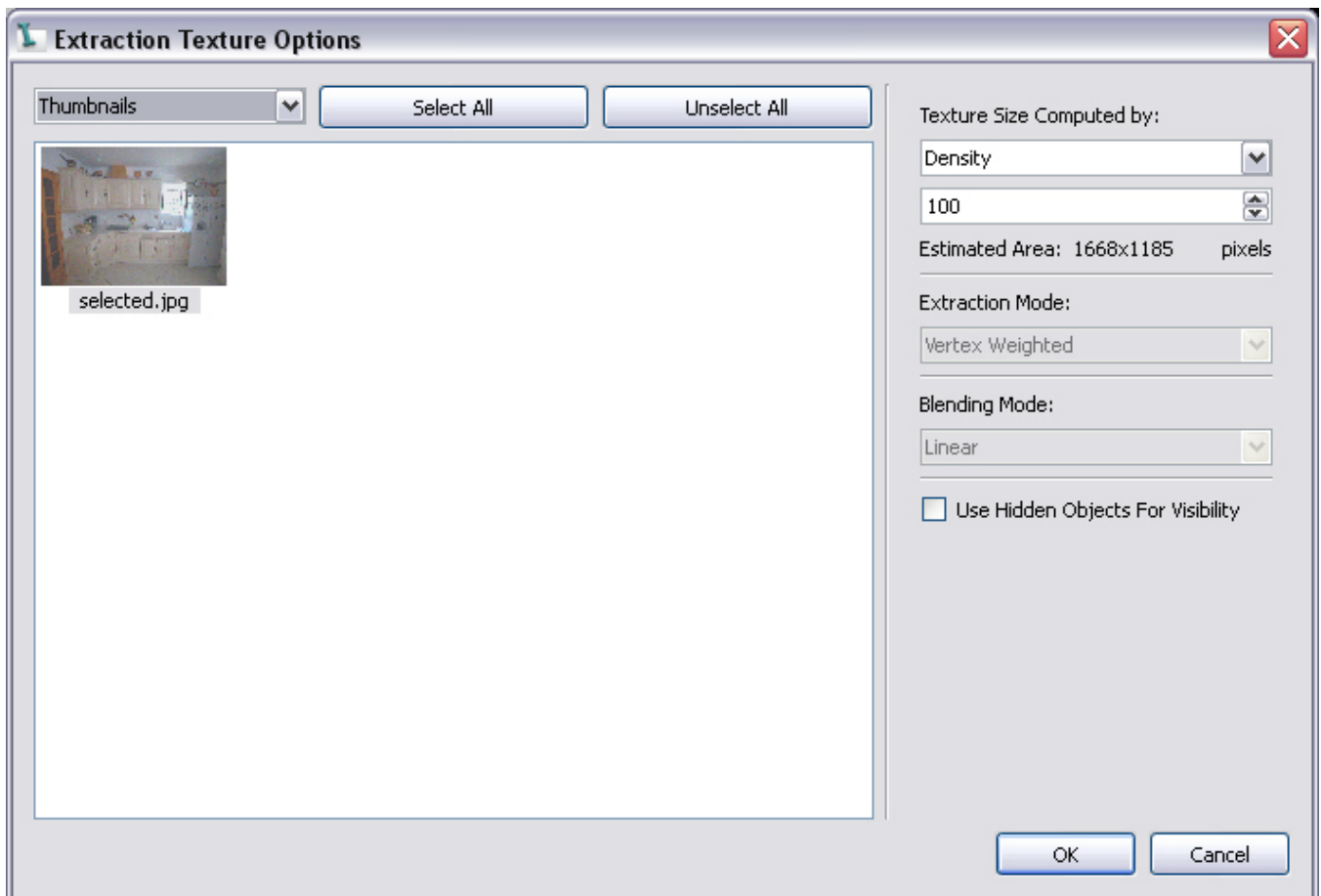
The workflow for texture extraction is as follows:

1. **Select** all the objects
2. Click **Extract texture**



The extract texture dialog is displayed.

You can change all the parameters for texture extraction, but we recommend keeping default values.



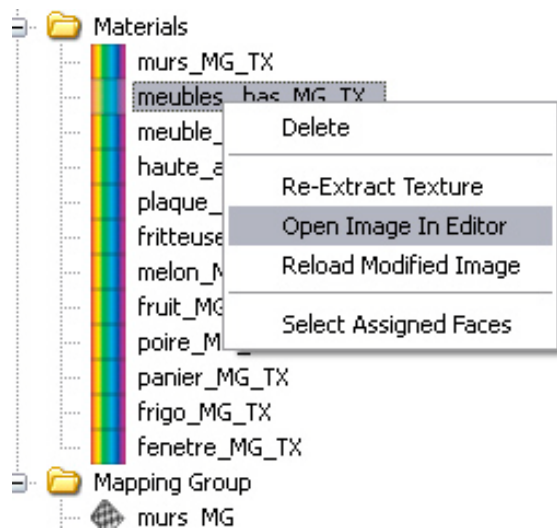
3. Run the extracting process by clicking **OK**.

This is the result you can have with the default extraction option:



Load the file, **textured.rzi**, file to see these results.

4. You can export your extracted textures to an image editor like Adobe® Photoshop in order to refine them further. Select a texture in the scene browser, right-click and choose **Open Image In Editor**.



5. Your texture will open in your preferred Image editor (go to **Edit > Preferences > General** (Windows) or **ImageModeler > Preferences > General** (Mac) to set the external editor you prefer to use for texture editing).
6. Edit the texture in your Image editor.
7. Save it with the same name and in the same location.
8. ImageModeler will ask you to reload the texture. Click **YES**.

This is the result we achieved after editing the wall, ground and roof textures in Photoshop:



Load the file, **final-result-textured.rzi**, to see this in ImageModeler.