

# VFX Project #3: MatchMove

Digital Visual Effects, Spring 2017

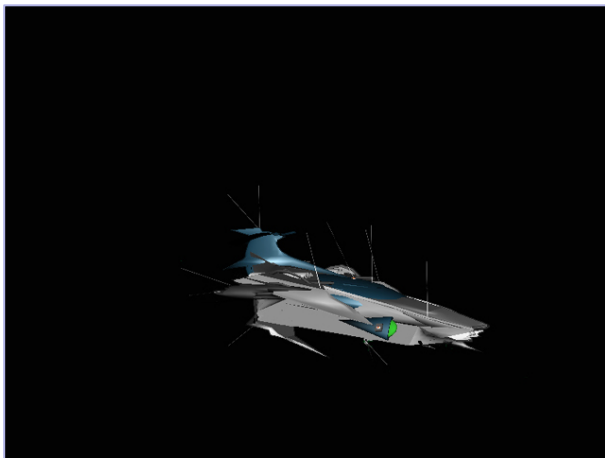
2017/5/10

# Overview

## Input



Video



CGI Animation

**Matchmove** is a technique of estimating camera parameters from an input video sequence so that computer generated imagery (CGI) could be seamlessly inserted into the sequence.

## Example

## Output



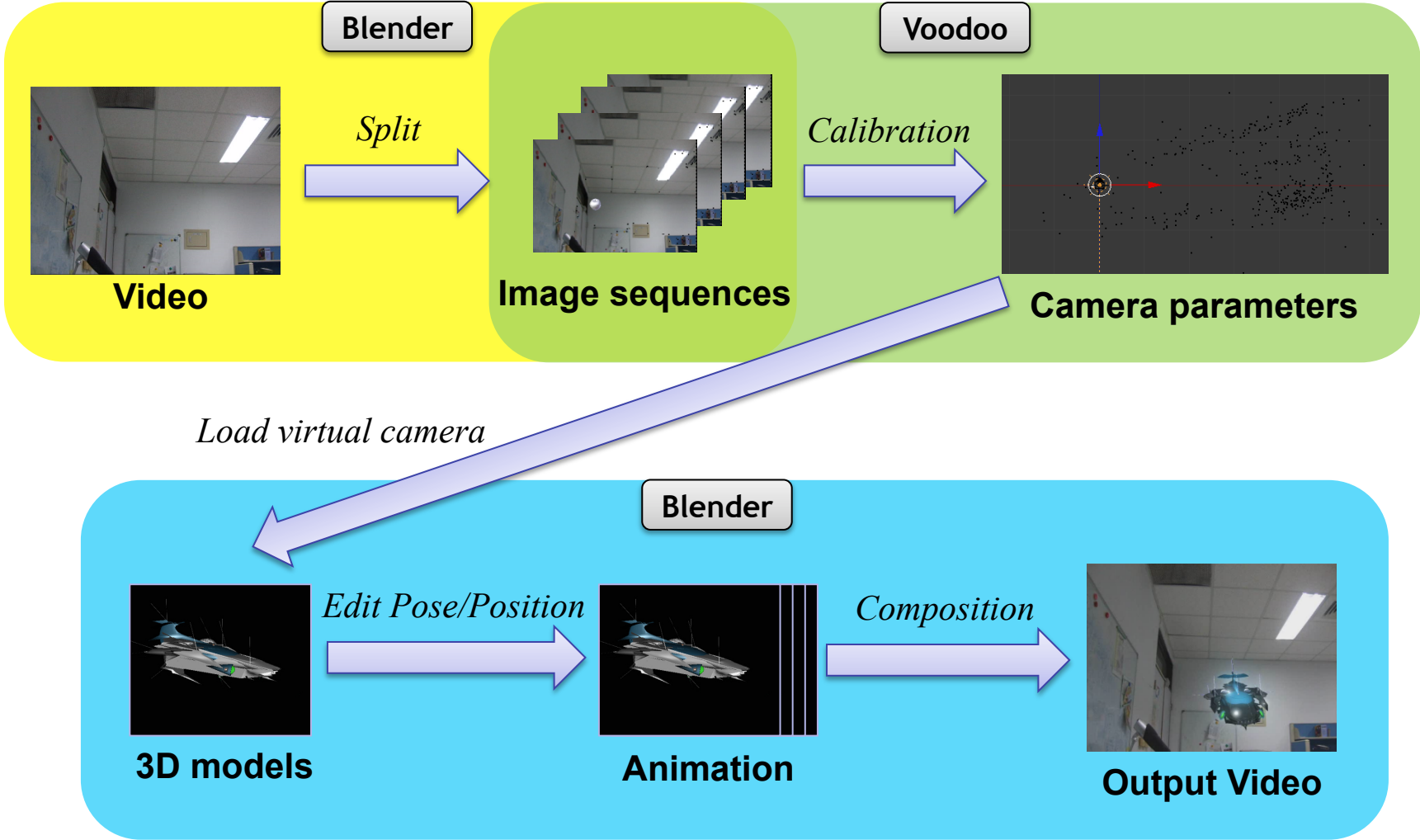
Composite Video

# Environment Setting

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- Blender
  - Version **2.6.2** <http://download.blender.org/release/Blender2.62/>
  - Using version higher than 2.6.6 might get error while running voodoo python scripts
- Voodoo
  - Version 1.2.0 <http://www.viscoda.com/en/voodoo-download>
- Other options
  - Free: Blender + ICARUS
  - Pay: boujou + 3D Max, boujou + Maya, ...
- 3D models
  - \*.obj, \*.3ds...

# Flowchart

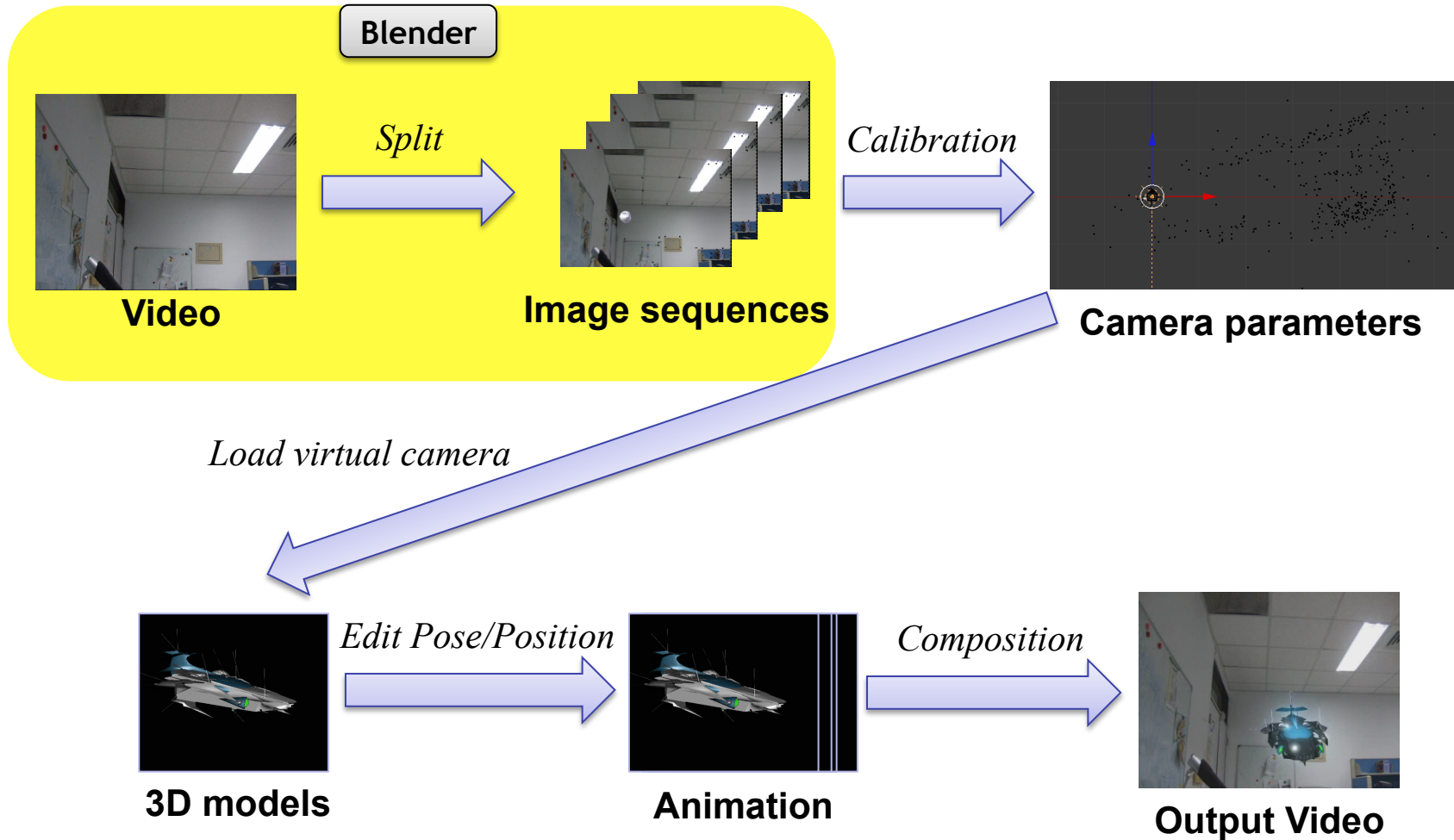


# Flowchart (detailed)

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- Three main stages:
  - 1. In Blender: Split video into image sequences**
    - Input: video
    - Output: image sequence (\*.tga)
  - 2. In Voodoo: Camera calibration/tracking**
    - Input: image sequence (\*.tga)
    - Output: voodoo python script (\*.py)
  - 3. In Blender: Combine video and 3D model**
    - Input: 3D model, video, voodoo python script (\*.py)
    - Output: video with 3D model
  4. (Option) Edit your video with other software (ex. Adobe After Effects, VideoStudio, PowerDirector, Final Cut)

# Stage 1: Get Image Sequence

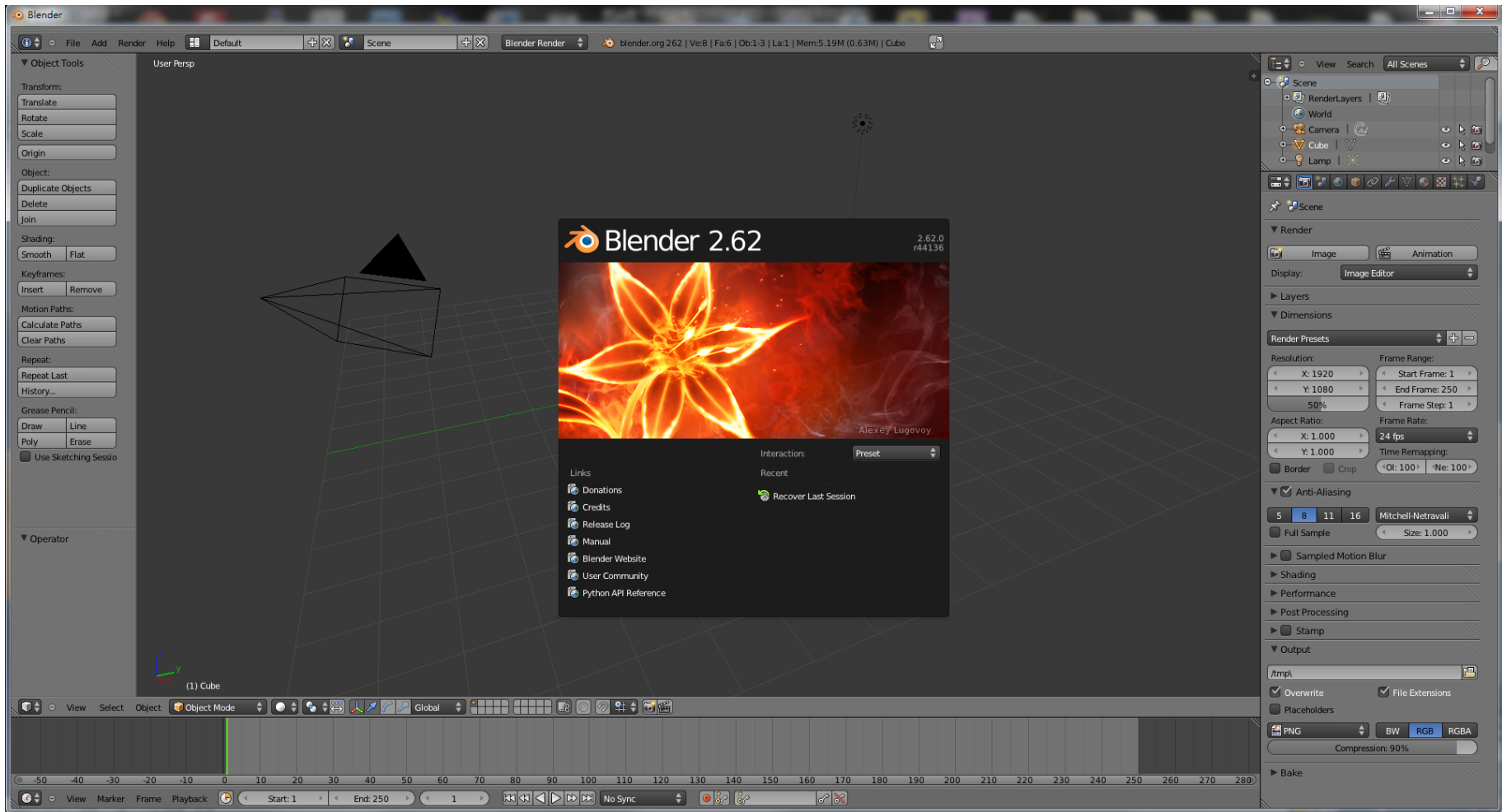


# Stage 1: Get Image Sequence

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1. Open Blender
2. Load video file:
  - Change window type to “Video Sequence Editor”
  - Select Add →Movie
  - Put the strip in Layer 1
3. Do sequence:
  - Frame
    - Set number of frames and resolution of frames
    - Choose output file type (**Targa, \*.tga**)
  - Time interval: select start and end of the sequence
  - Choose output location
4. Click “Animation” button

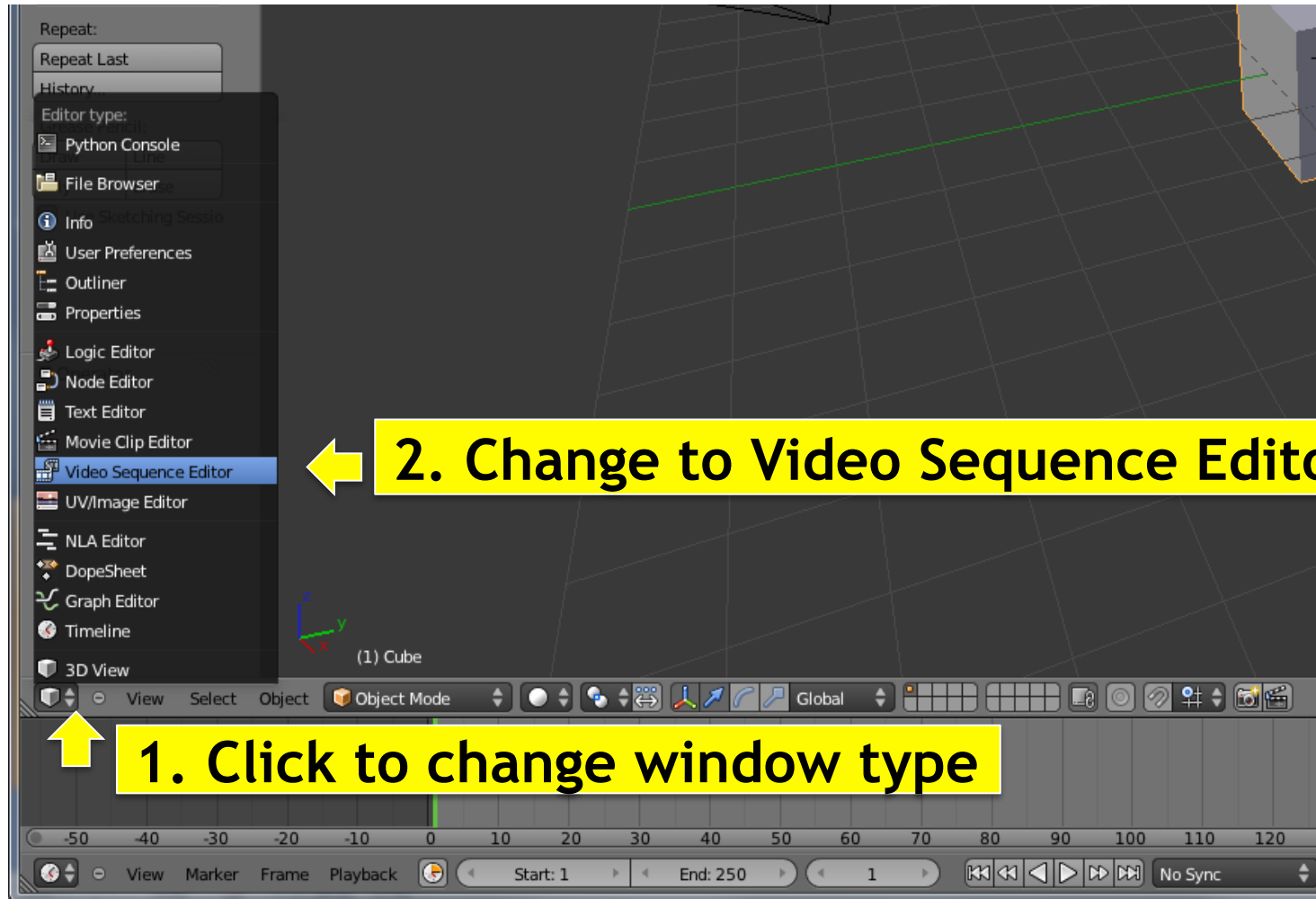
# Stage 1: Get Image Sequence



**Start up Blender**

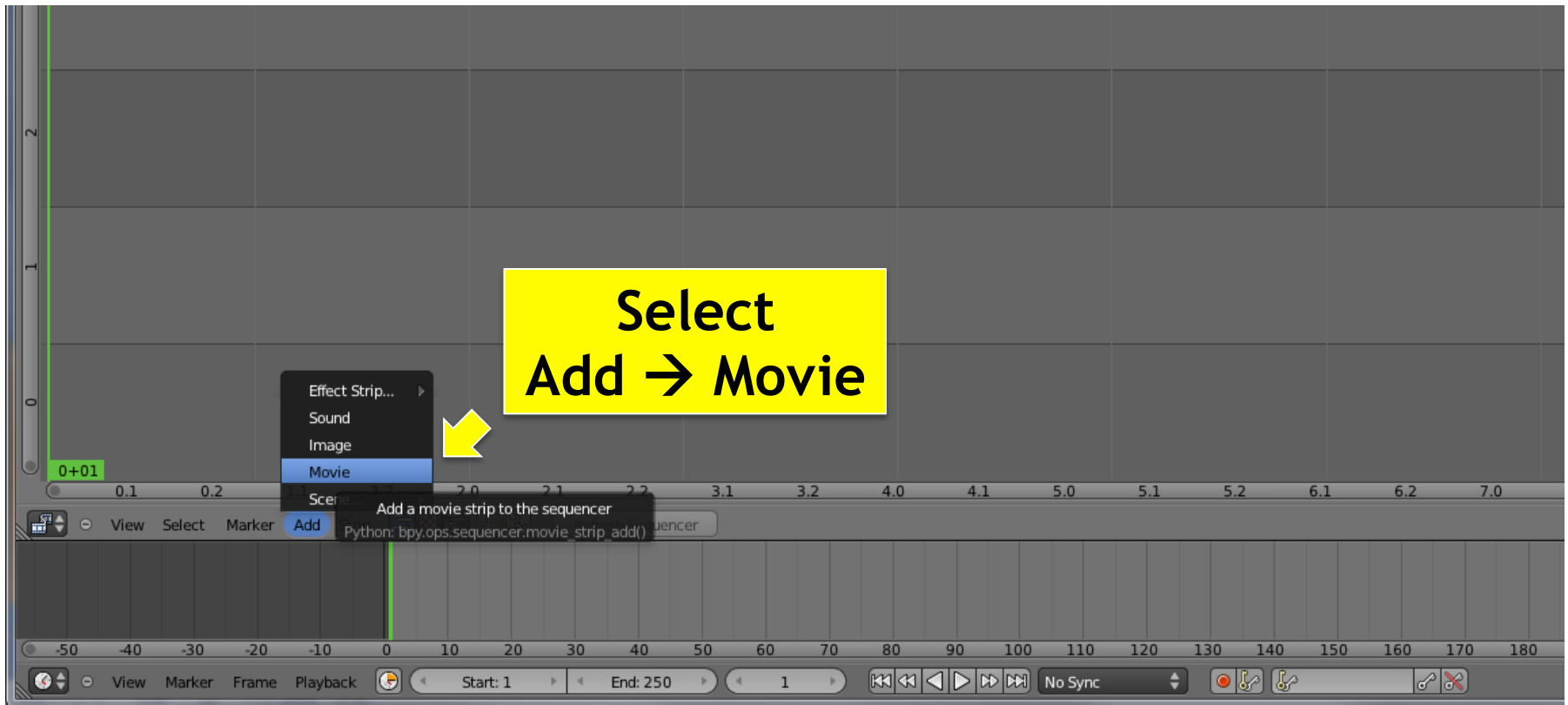


# Stage 1: Get Image Sequence



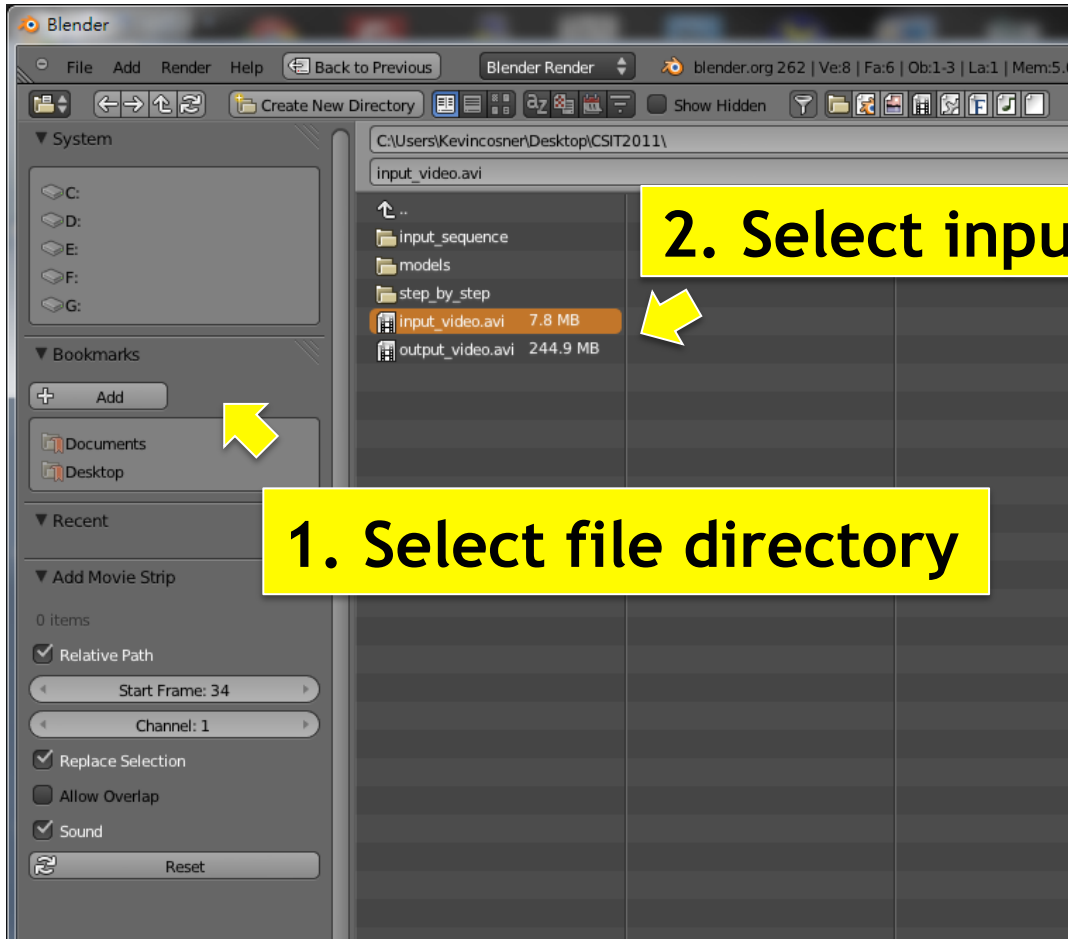
**Change window type**

# Stage 1: Get Image Sequence



**Add video**

# Stage 1: Get Image Sequence



Select input video

# Stage 1: Get Image Sequence

1. Delete unnecessary layer (audio)



210 | input\_video.001: C:\Users\Kevincosner\Desktop\CSIT2011\input\_video.avi

2. Right-click to drag the strip to the “1<sup>st</sup> Frame” in Layer 1



Edit layers (Right click and drag, left click to set)

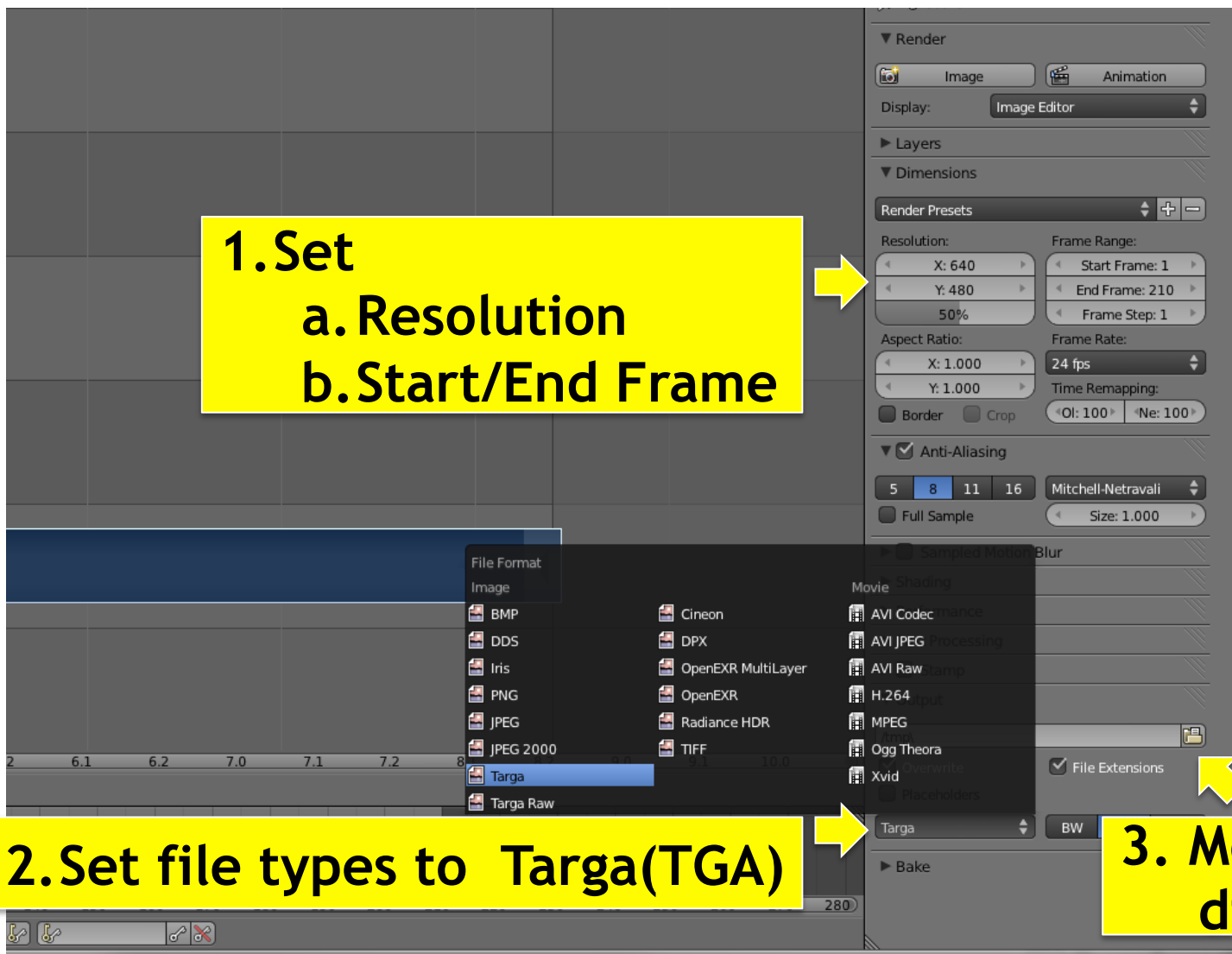
# Stage 1: Get Image Sequence

1. Set  
a. Resolution  
b. Start/End Frame

2. Set file types to Targa(TGA)

3. Modify output directory

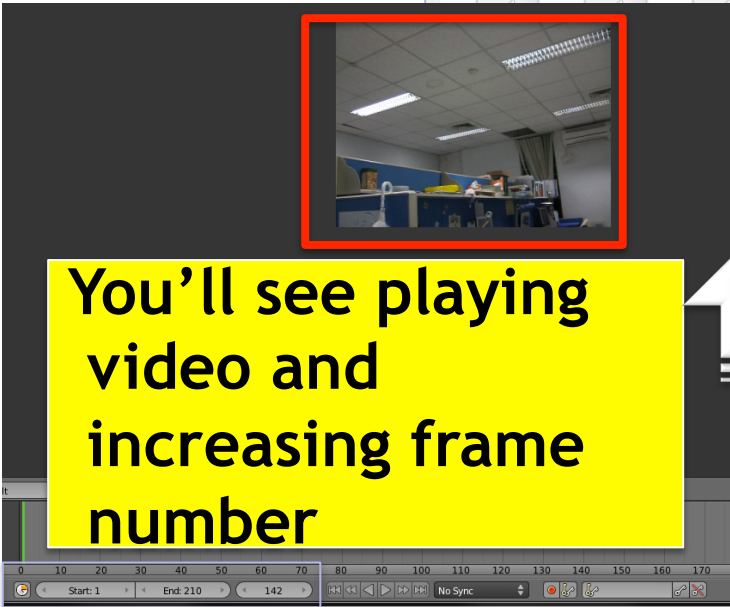
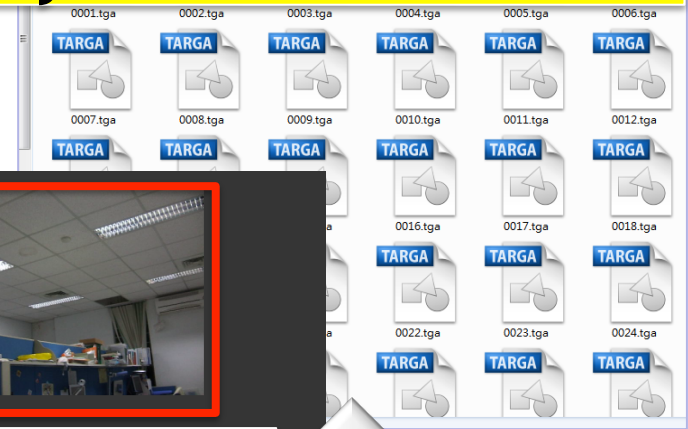
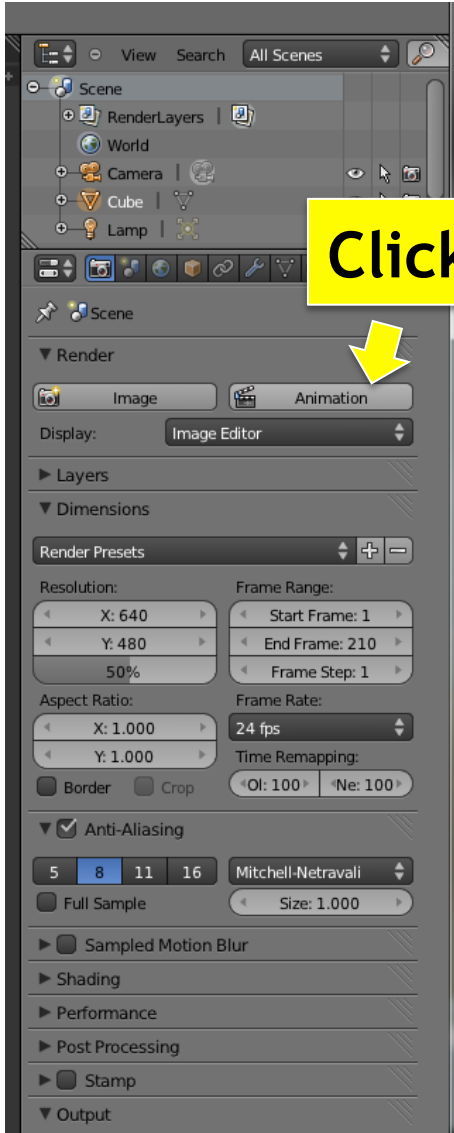
Do video setting



# Stage 1: Get Image Sequence

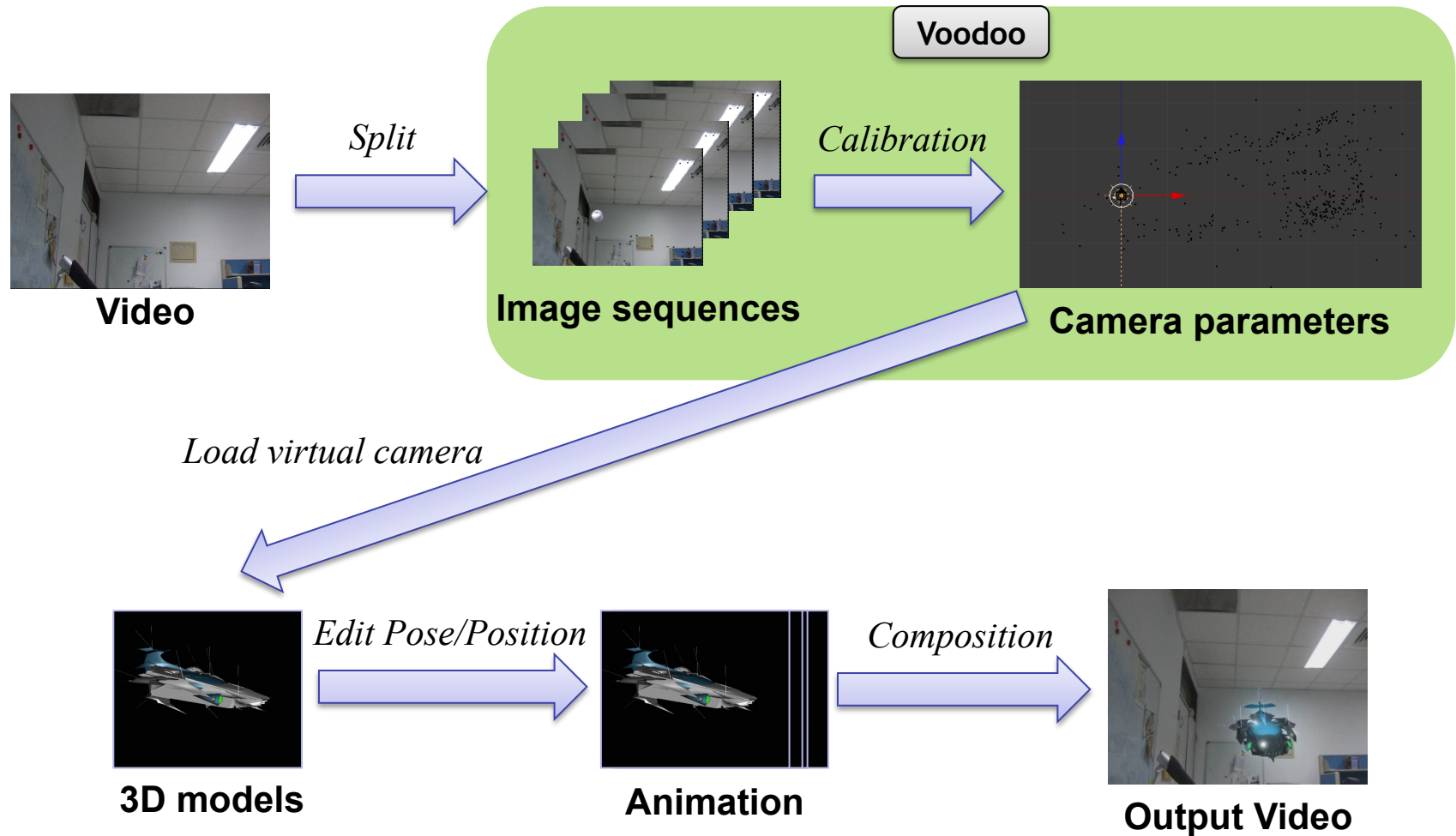
**Finish!**  
You can find the image sequences in output directory

**Click Animation**



**Render image sequence**

# Stage 2: Camera Calibration



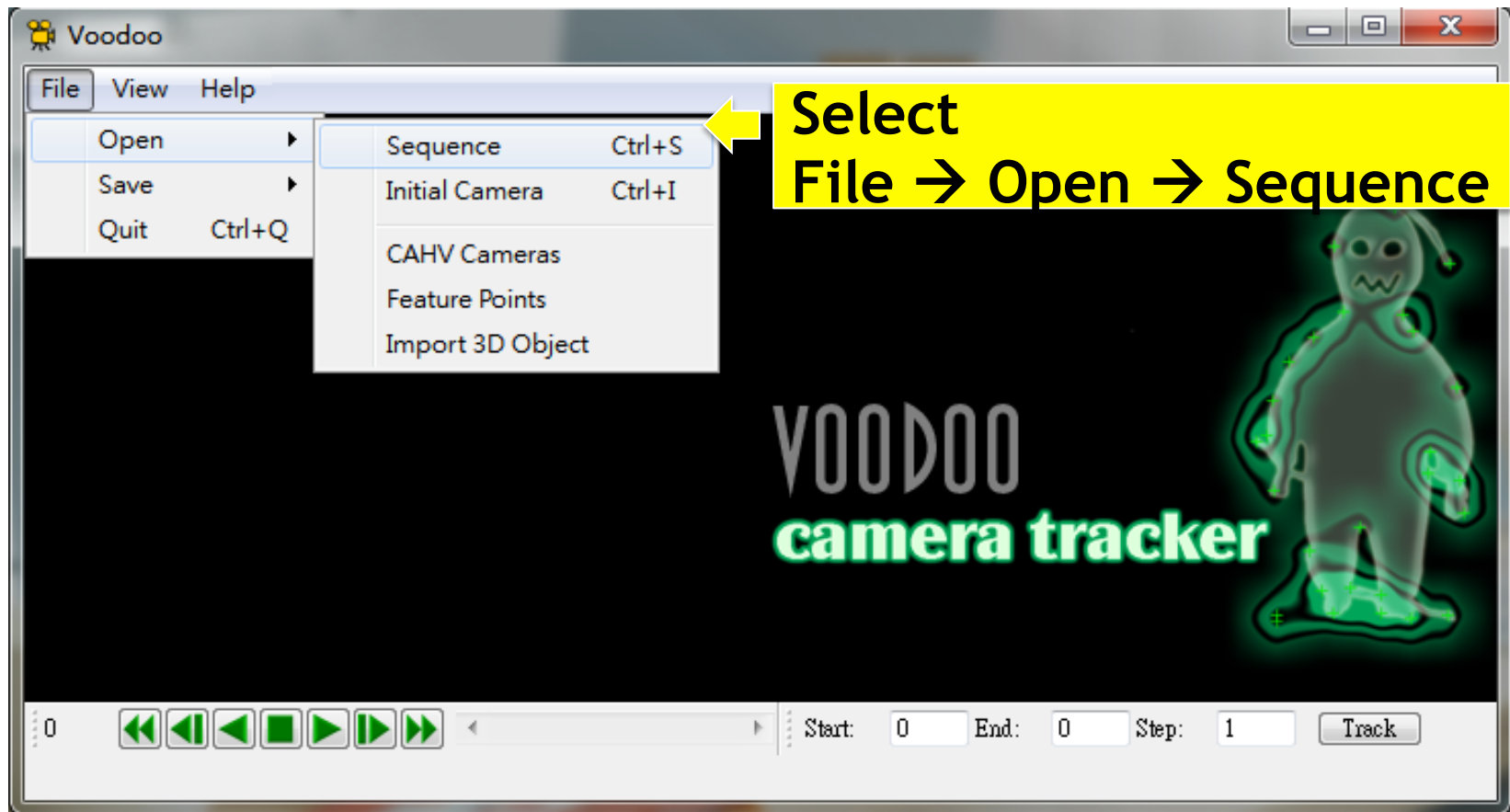
# Stage 2: Camera Calibration

---

1. Open Voodoo
2. Open image sequence:
  - Select File → Open → Sequence
  - Select the first frame
  - Set Move Type to “**free move**”
3. Track:
  - Click Track button
4. Export Python script:
  - Select File → Save → Blender Python Script
  - Save .py file (Blender 2.5x and higher)
  - Export all

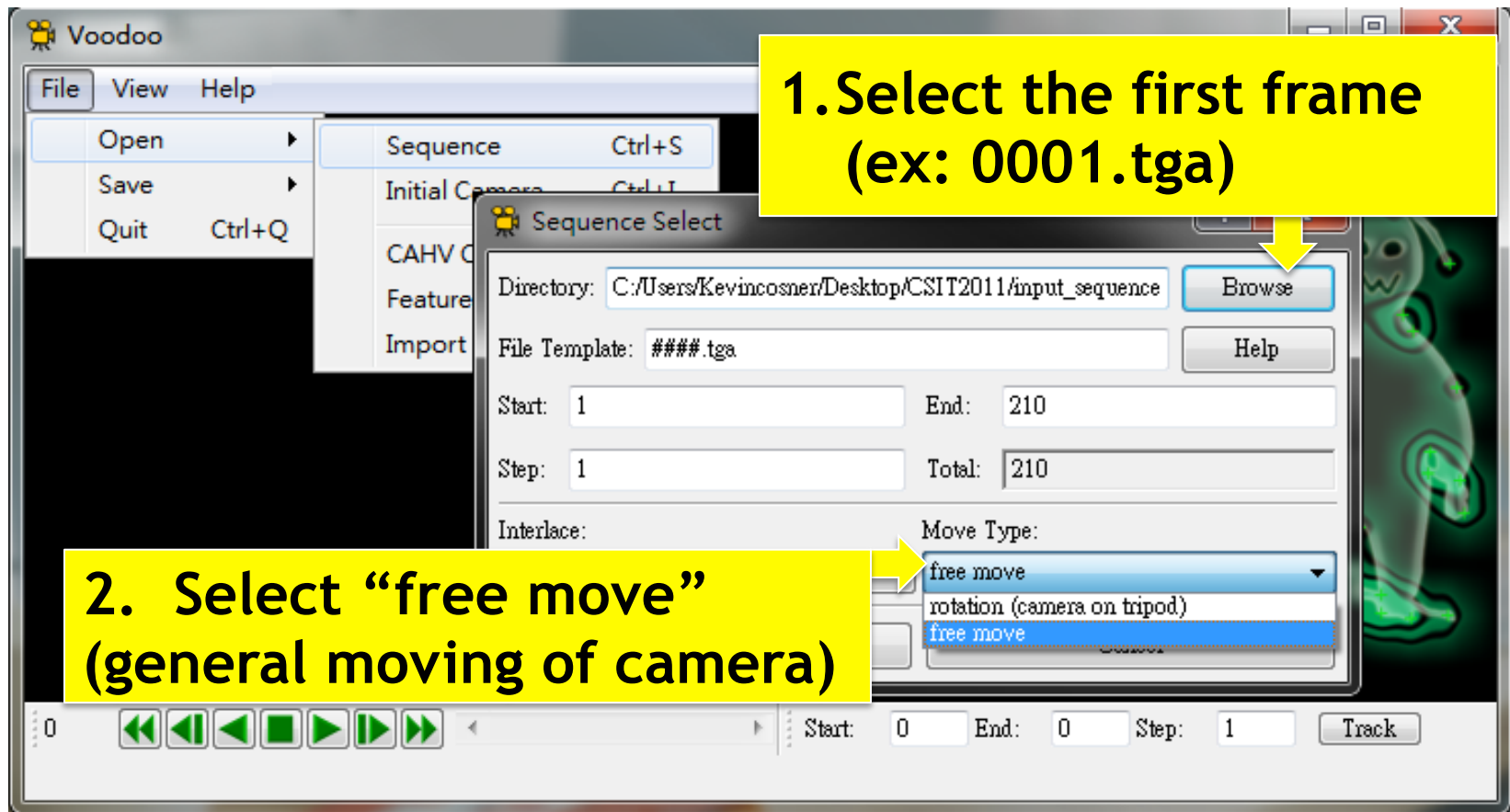


# Stage 2: Camera Calibration



Use Voodoo to load image sequence

# Stage 2: Camera Calibration



Choose and set sequence

# Stage 2: Camera Calibration

The screenshot displays the Voodoo camera tracker software interface. On the left, a terminal window titled "voodoo camera tracker 1.2.0 beta" shows the following log output:

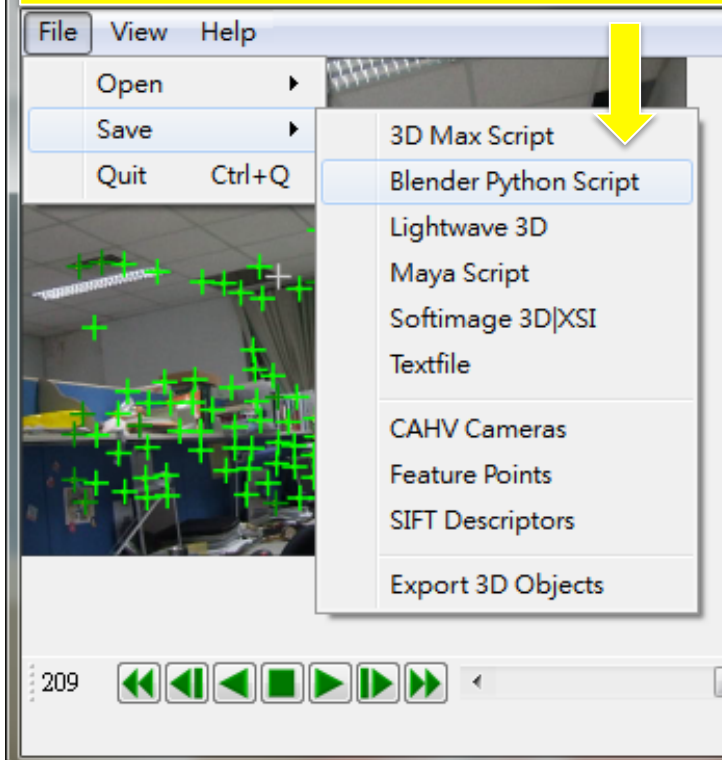
```
Notice: o_RandSampling::FindParameterSet: SUCCESSFUL
Notice: after 1000 searches, select best one, ratio (supported/input correspondences): 1.000000 (48/48)
Notice: o_RandSampling::MarkSet: 48 corrs, 48 supported, 0 not supported
Notice: ***** o_CTrackMgr::ComputeDetection *****
*****
Notice: ***** o_CTrackMgr::ComputeCorrespondence *****
*****
Notice: o_FCorrelatorKLT::Compute: Tracking 68 features in a 32
Notice: o_FCorrelatorKLT::Compute: 65 features successfully tracked
Notice: o_FCorrelatorKLT::Compute: Attempting to replace 935 features
by 240 image...
Notice: o_FCorrelatorKLT::Compute: 4 features replaced.
Notice: o_FCorrelatorKLT::Compute: found 65 corrs. (1000 fp of
000 fp of img no. 34)
Notice: ***** o_CTrackMgr::ComputeOutlierElimination *****
*****
Notice: o_RandSampling::FindParameterSet: SUCCESSFUL
Notice: after 1000 searches, select best one, ratio (supported/input correspondences): 1.000000 (65/65)
Notice: o_RandSampling::MarkSet: 65 corrs, 65 supported, 0 not supported
Notice: ***** o_CTrackMgr::ComputeCameraEstimation *****
*****
```

On the right, the main Voodoo window shows a video frame with green tracking markers. A "Progress of tracking" dialog box is open, displaying a progress bar at 15% and a "Stop tracking" button. A yellow callout box with the text "Click 'Track' button" and a yellow arrow points to the "Track" button in the software's playback controls at the bottom right.

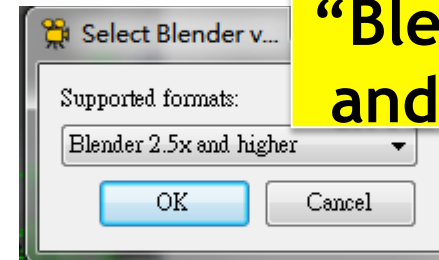
Tracking features

# Stage 2: Camera Calibration

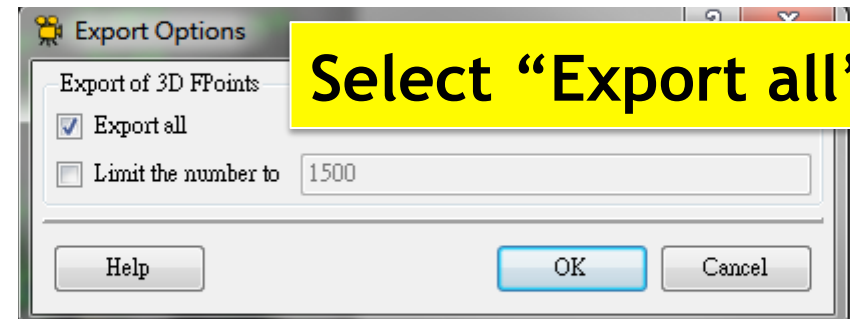
Select  
File → Save → Blender Python Script



Select  
“Blender 2.5x  
and higher”

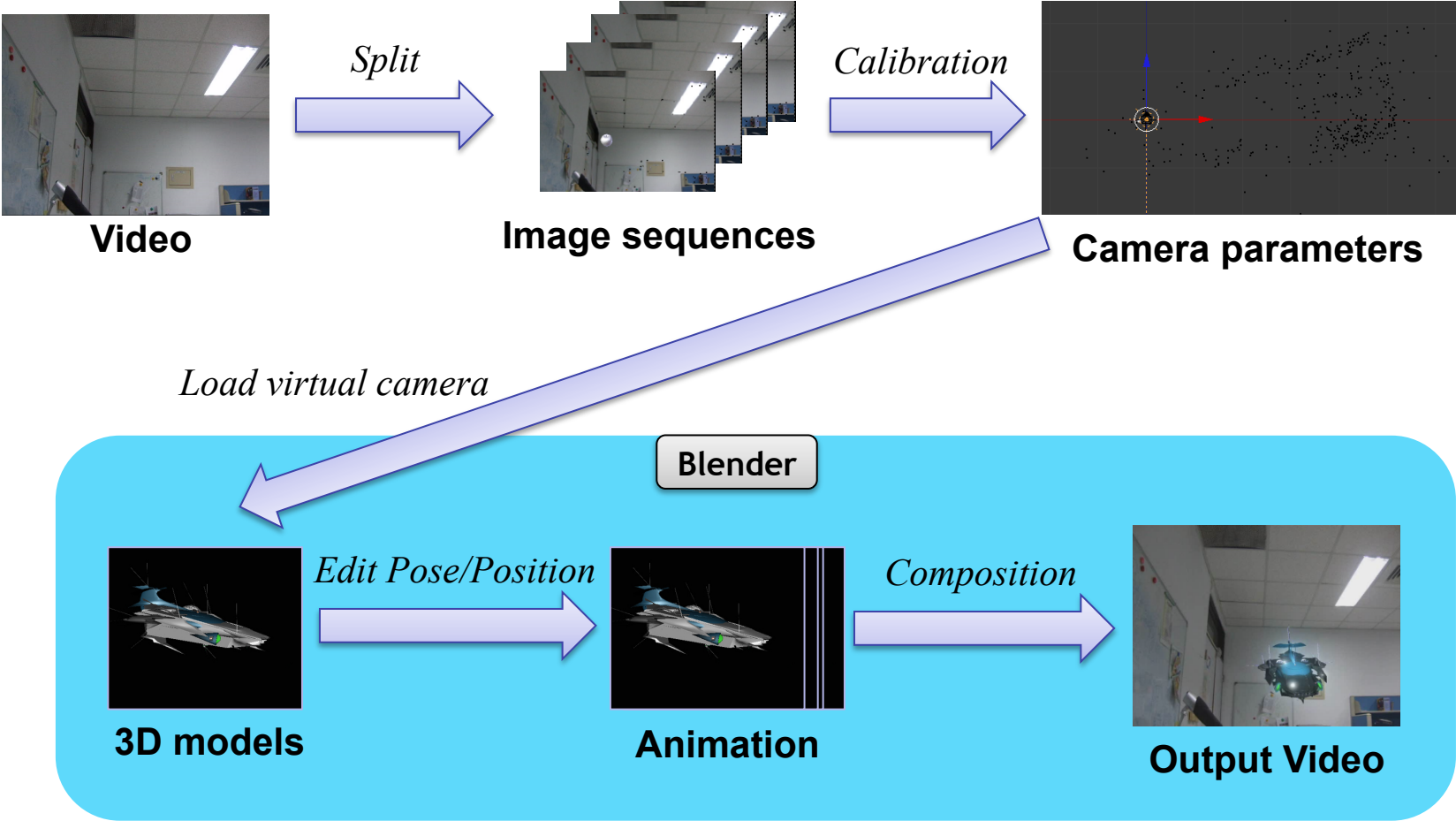


Select “Export all”



Save results to “Blender Python Script”

# Stage 3: Combine Video and 3D Model



# Stage 3: Combine Video and 3D Model

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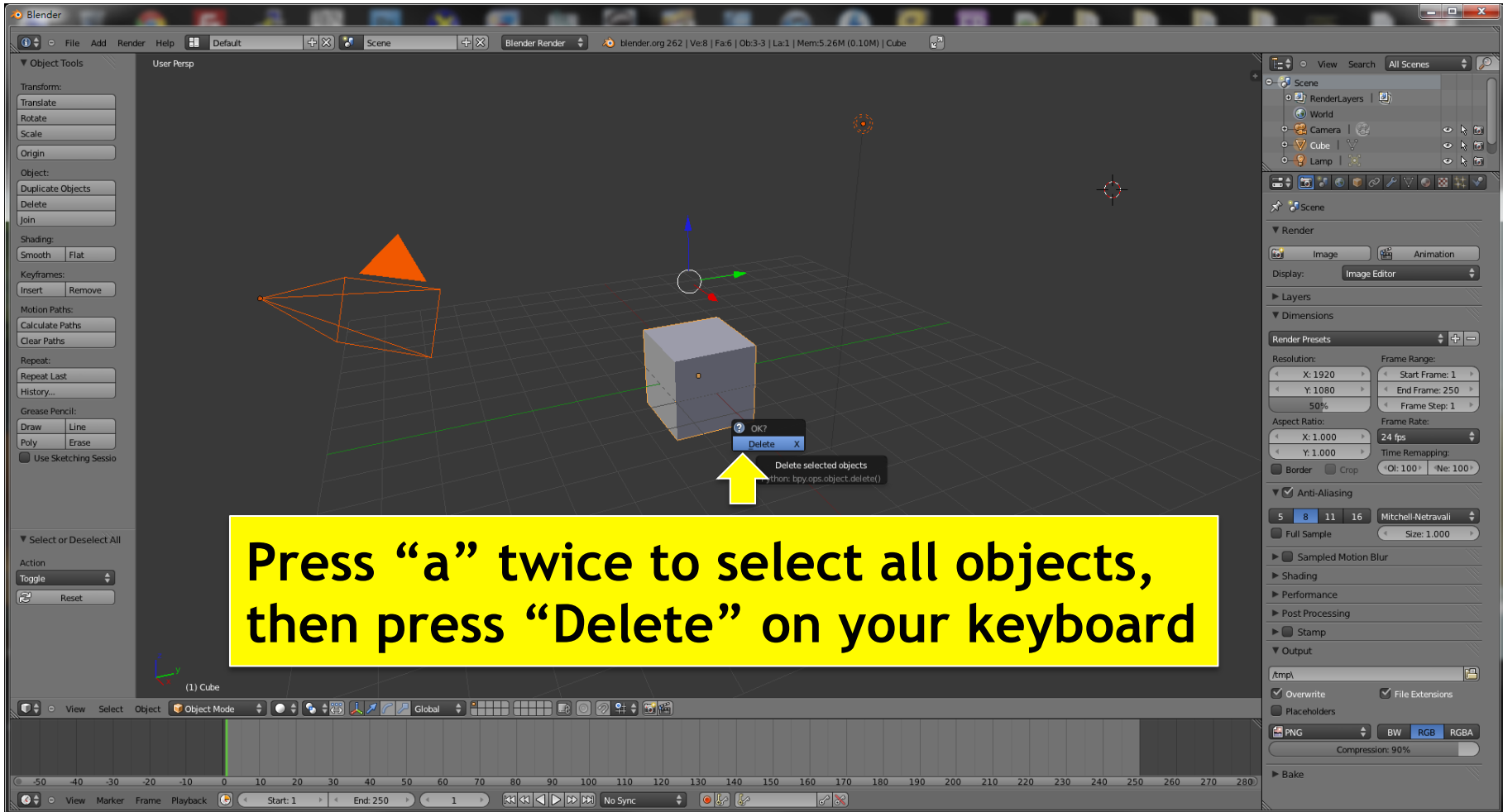
- Stage 3-1: Load virtual camera (python script from voodoo)
- Stage 3-2: Show background images
- Stage 3-3: Load 3D model
- Stage 3-4: Set model animation
- Stage 3-5: Render video

# Stage 3-1 ~ 3-2

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1. Open Blender
2. Delete default objects
3. Load Python Script
  - Change Window Type to “**Text Editor**”
  - Select Text → Open Text Block
  - Select the \*.py file (exported from Voodoo)
  - Click “**Run Script**”
4. Load Background Images
  - Change window type to “**3D View**”
  - Select View → Cameras → Set Active Object as Active Camera
  - Load background images
  - Set the parameters of background images

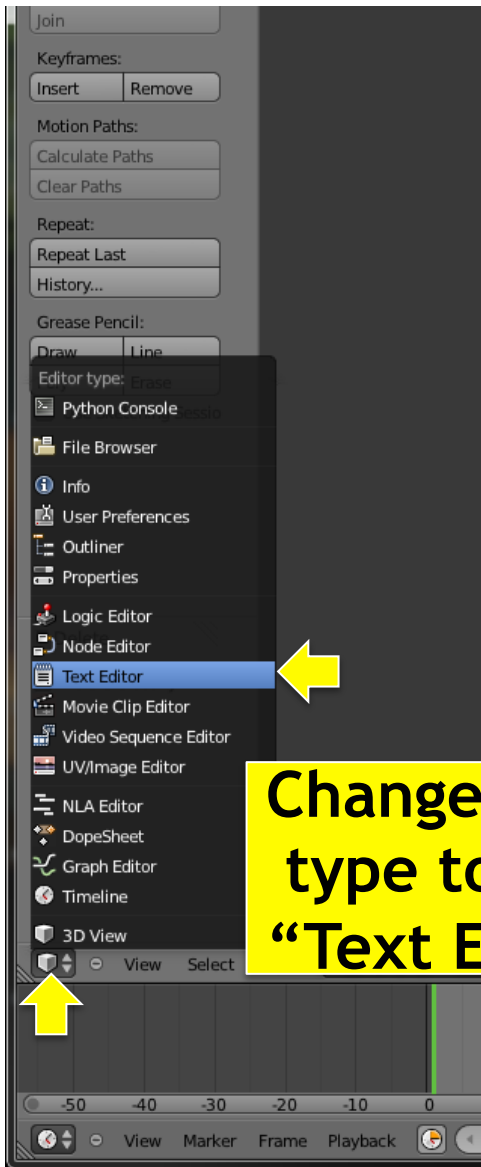
# Stage 3-1: Load Virtual Camera



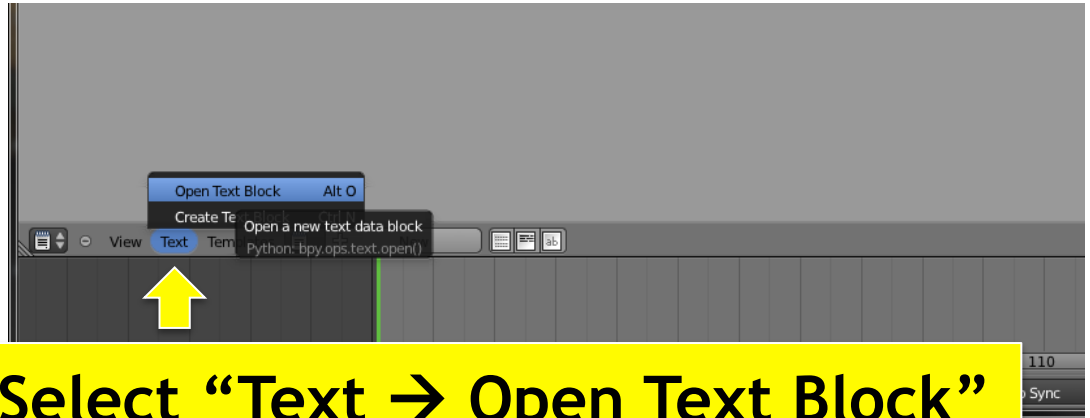
**Delete default objects**



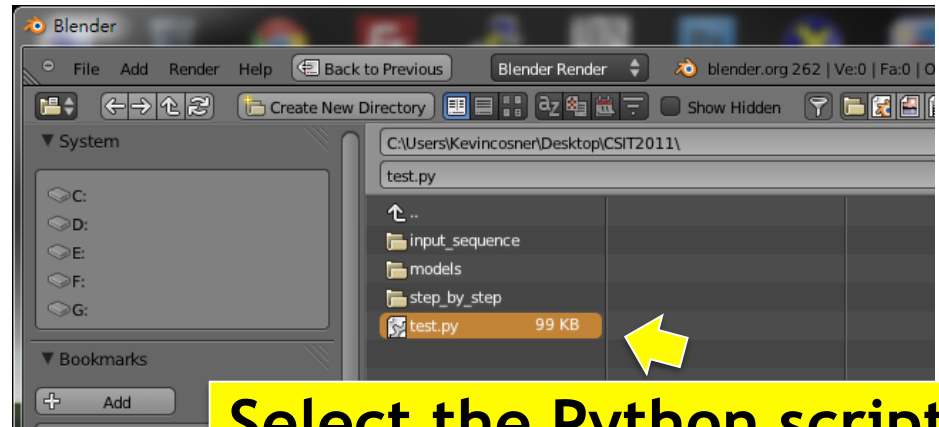
# Stage 3-1: Load Virtual Camera



**Change window type to "Text Editor"**



**Select "Text → Open Text Block"**



**Select the Python script exported by Voodoo**

**Load python script**

# Stage 3-1: Load Virtual Camera

The image shows the Blender 2.5x interface with a Python script loaded in the Text Editor. The script configures a virtual camera and a mesh. Two yellow callout boxes provide instructions:

- 1. Press "Run Script"**: An arrow points to the 'Run Script' button in the bottom toolbar.
- 2. Return to "3D View"**: An arrow points to the '3D Viewport' area, which is currently in 'Text' mode.

```

blender export (blender version 2.5x and higher)
# created by voodoo camera tracker - www.digilab.uni-hannover.de
# Creation date: Thu May 31 00:38:03 2012
# USAGE: load this python script into Blender's text editor and execute the script with ALT-P
# use the 'voodoo_render_cam' for rendering your scene
# use the helper object 'voodoo_scene' to rotate, translate and scale the scene

import bpy
import mathutils
import string
import math
scene = bpy.context.scene
dummy = bpy.data.objects.new('voodoo_scene', None)
dummy.location = (0.0, 0.0, 0.0)
dummy.rotation_euler = (-3.141593/2, 0.0, 0.0)
dummy.scale = (0.2, 0.2, 0.2)
scene.objects.link(dummy)
data = bpy.data.cameras.new('voodoo_render_cam')
data.lens unit = 'DEGREES'
vcam = bpy.data.objects.new('voodoo_render_cam', data)
vcam.location = (0.0, 0.0, 0.0)
vcam.rotation_euler = (0.0, 0.0, 0.0)
vcam.scale = (1.0, 1.0, 1.0)
data.lens = 35.0
data.shift_x = 0.0
data.shift_y = 0.0
data.dof_distance = 0.0
data.clip_start = 0.1
data.clip_end = 1000.0
data.draw_size = 0.5
scene.objects.link(vcam)
vcam.parent = dummy
data = bpy.data.meshes.new('voodoo_FP3D_cloud')
mesh = bpy.data.objects.new('voodoo_FP3D_cloud', data)
mesh.location = (0.0, 0.0, 0.0)
mesh.rotation_euler = (0.0, 0.0, 0.0)
mesh.scale = (1.0, 1.0, 1.0)
scene.objects.link(mesh)
mesh.parent = dummy

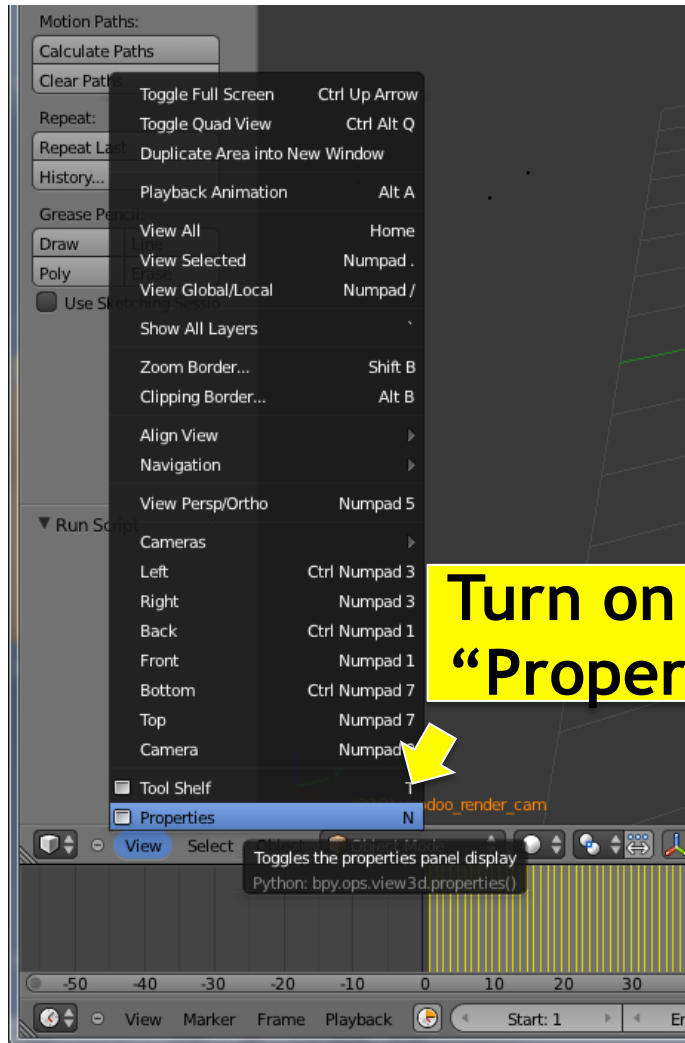
#Camera Parameters
scene.frame_current = 1
vcam.data.lens = 54.088324
vcam.matrix_world = (((0.999989, -0.000551, 0.004552, 0.000000), [-0.000416, -0.999563, -0.029551, 0.000000]), [0.004566, 0.029549, -0.999553, 0.000000]), [0.062943, -0.024483, -0.433771, 1.000000]))
vcam.keyframe_insert('location')
vcam.keyframe_insert('scale')
vcam.keyframe_insert('rotation_euler')
vcam.data.keyframe_insert('lens')

scene.frame_current = 2
vcam.data.lens = 54.088324
vcam.matrix_world = (((0.999988, -0.000251, 0.004864, 0.000000), [-0.000107, -0.999562, -0.029604, 0.000000]), [0.004870, 0.029603, -0.999550, 0.000000]), [0.064143, -0.024497, -0.438955, 1.000000]))
vcam.keyframe_insert('scale')
vcam.keyframe_insert('rotation_euler')
vcam.data.keyframe_insert('lens')

scene.frame_current = 4
vcam.data.lens = 54.088324
vcam.matrix_world = (((0.999990, -0.000268, 0.004483, 0.000000), [-0.000137, -0.999571, -0.029271, 0.000000]), [0.004483, 0.029271, -0.999553, 0.000000]), [0.061696, -0.025573, -0.429861, 1.000000]))
    
```

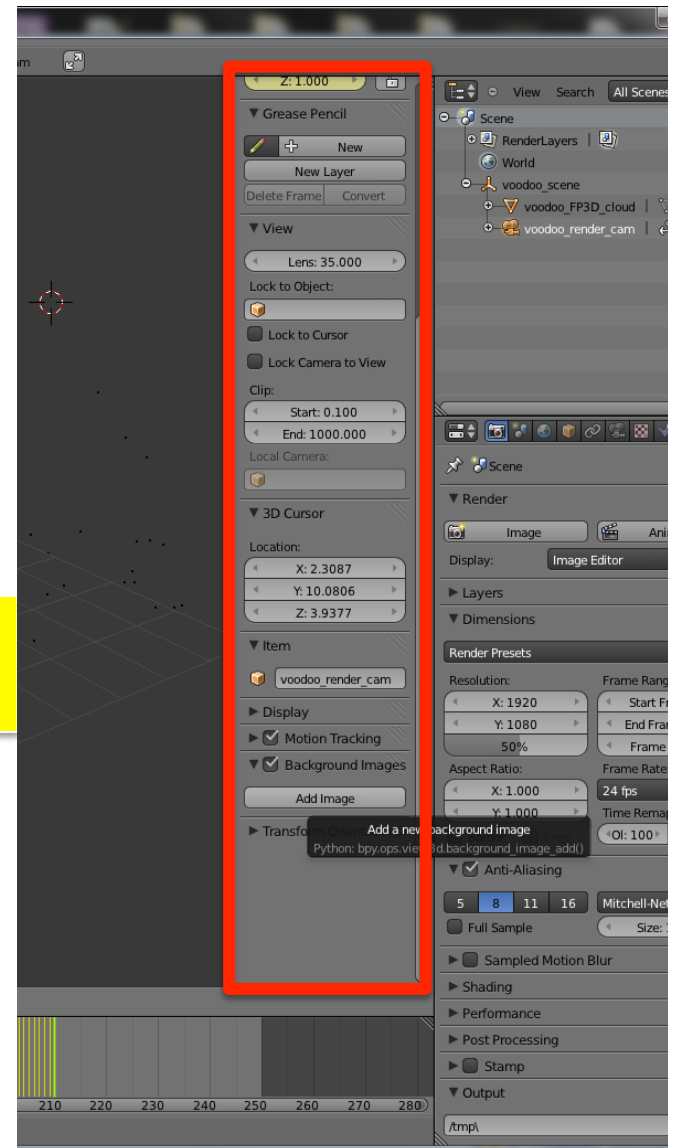
Run script

# Stage 3-2: Show Background Images

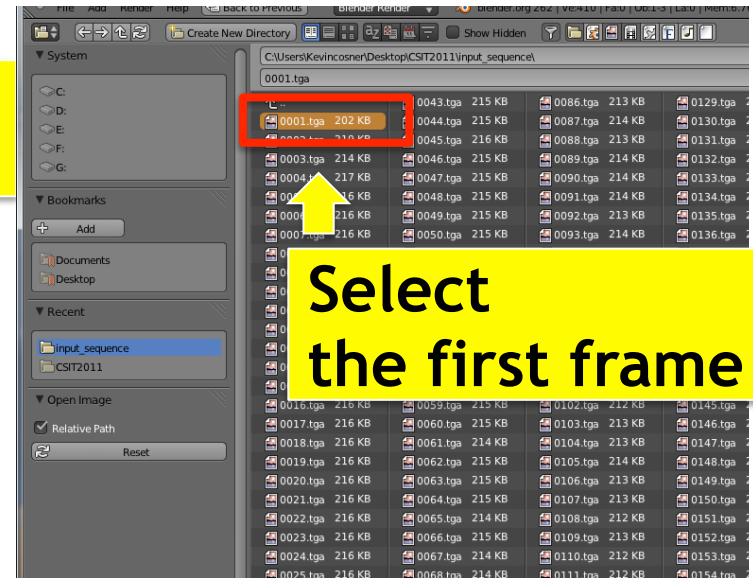
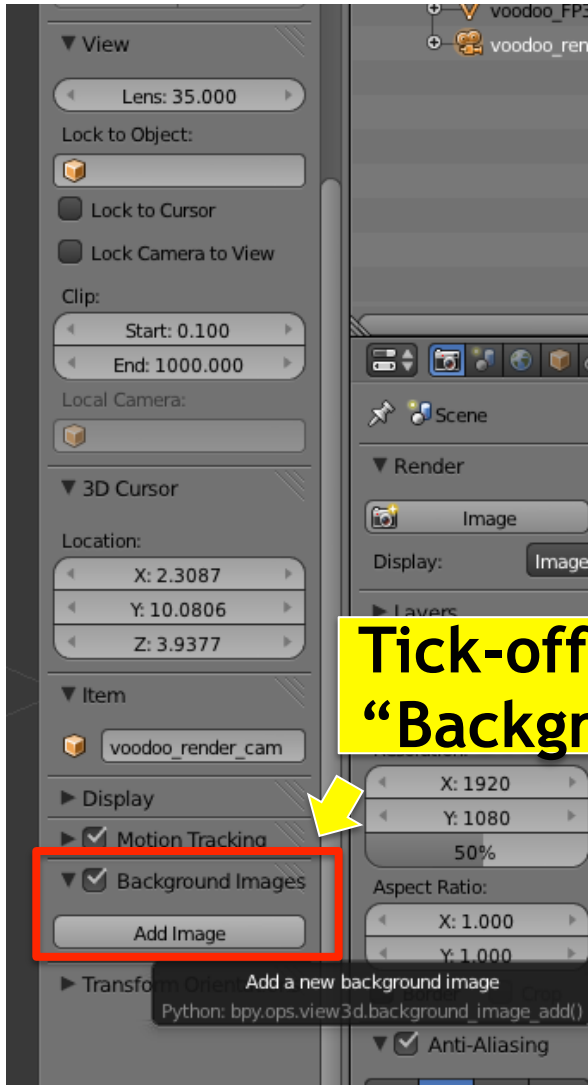


Turn on  
"Properties" Panel

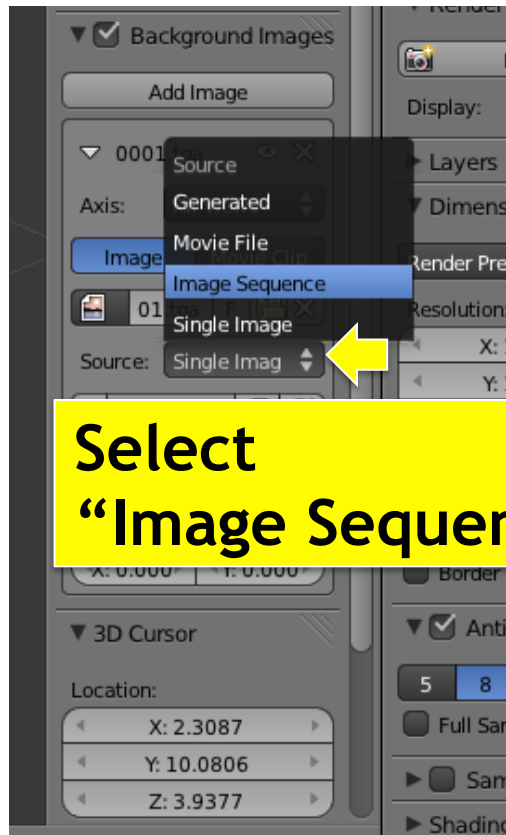
Show Property Panel



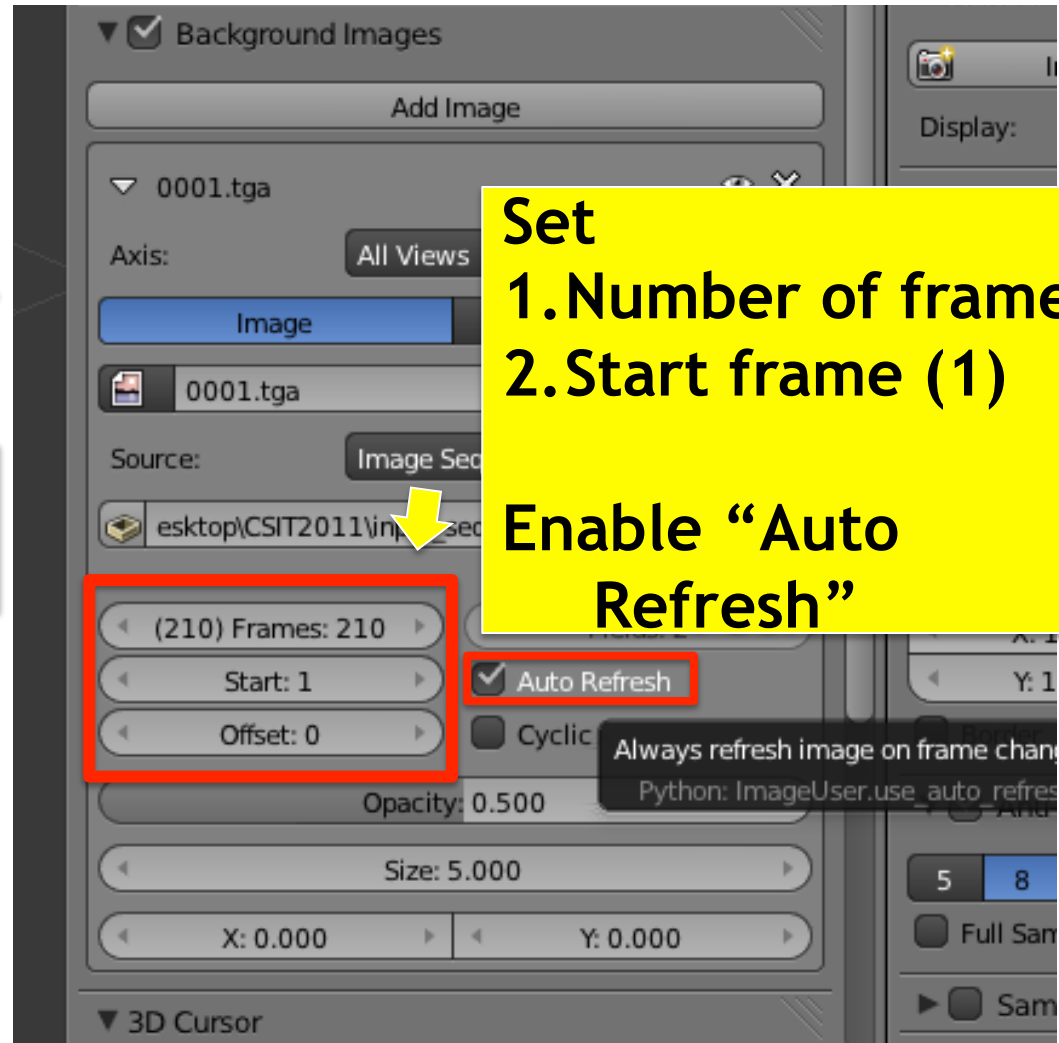
# Stage 3-2: Show Background Images



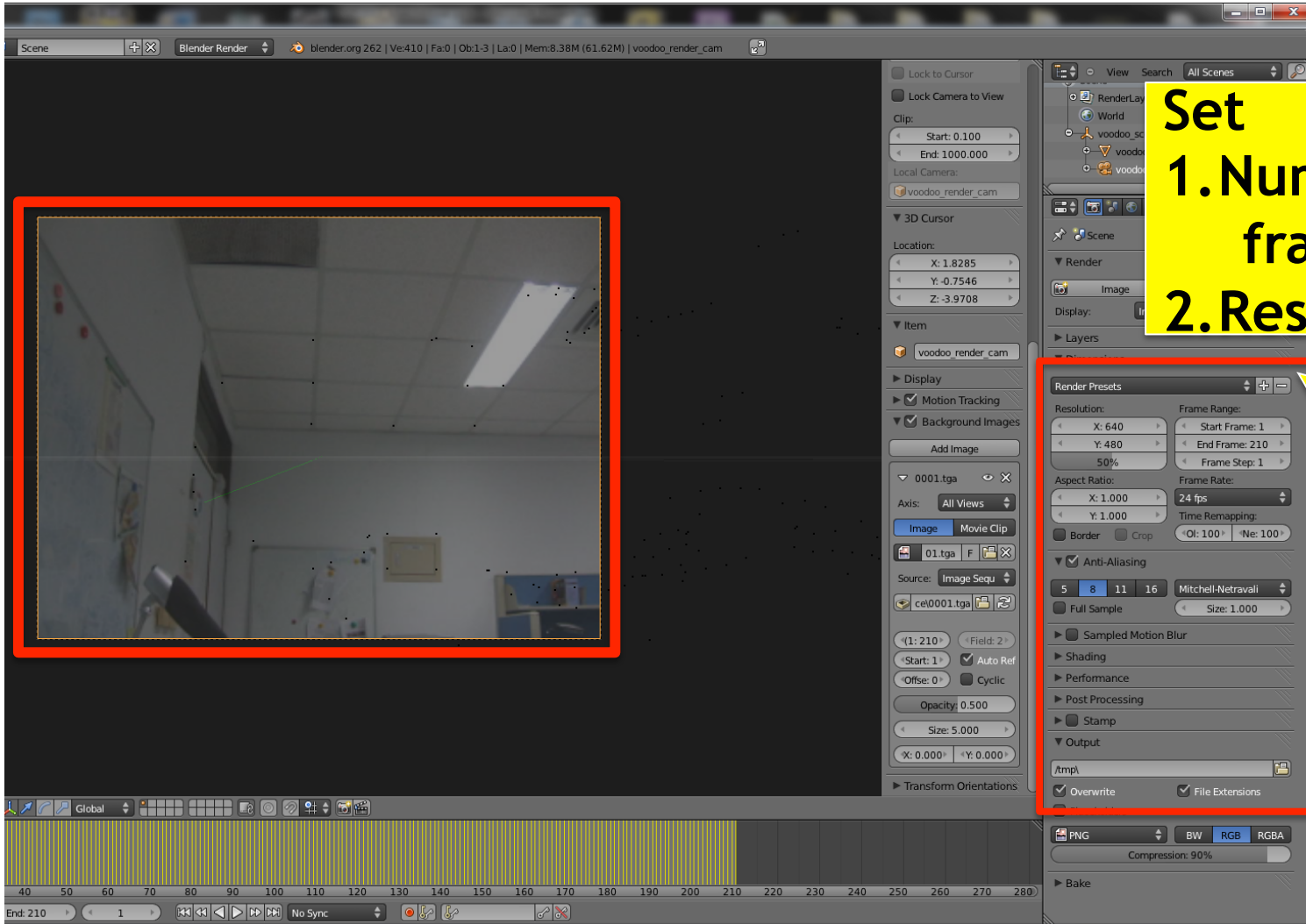
# Stage 3-2: Show Background Images



**Change background type**



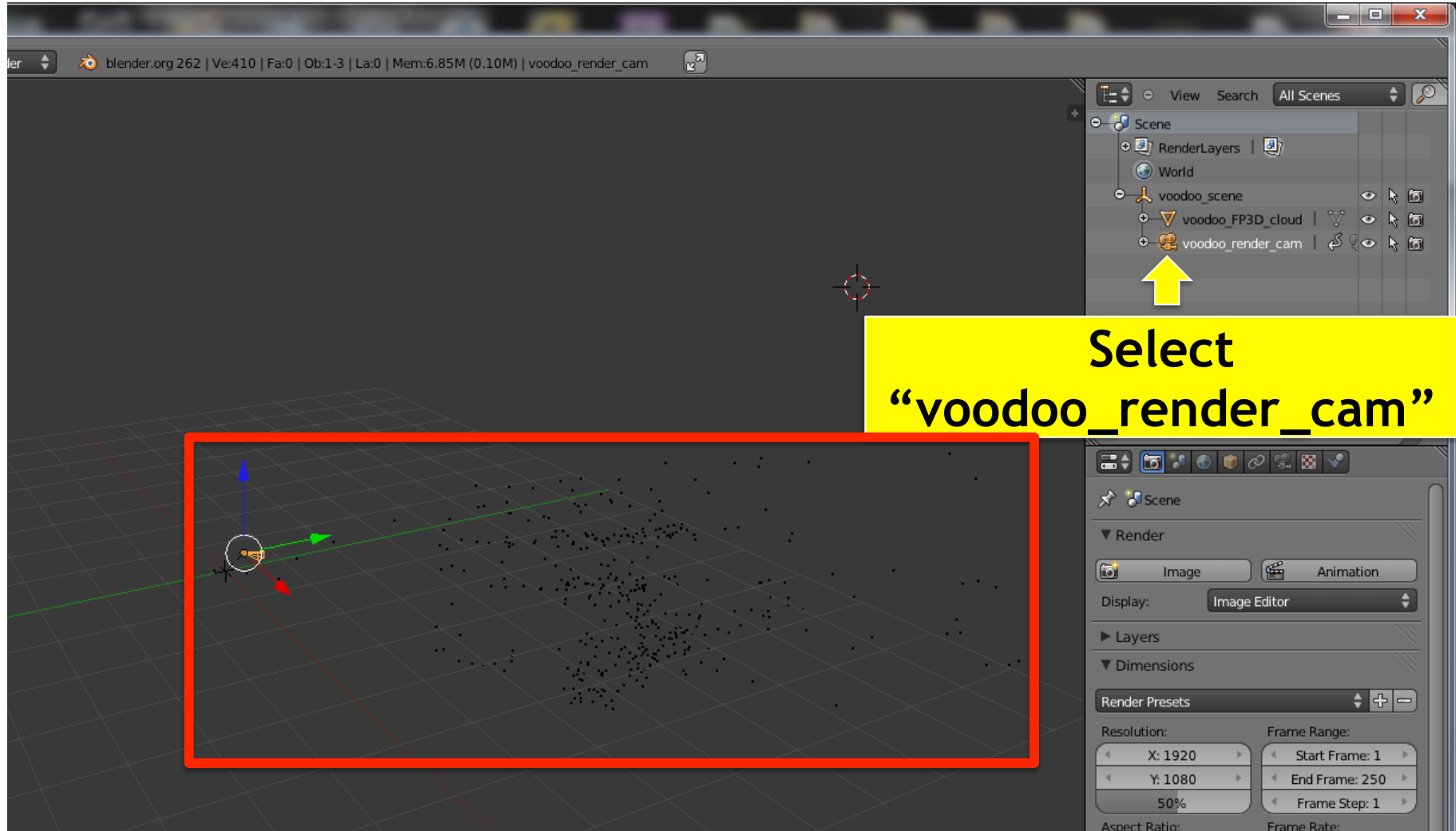
# Stage 3-2: Show Background Images



**Set**  
**1. Number of frames**  
**2. Resolution**

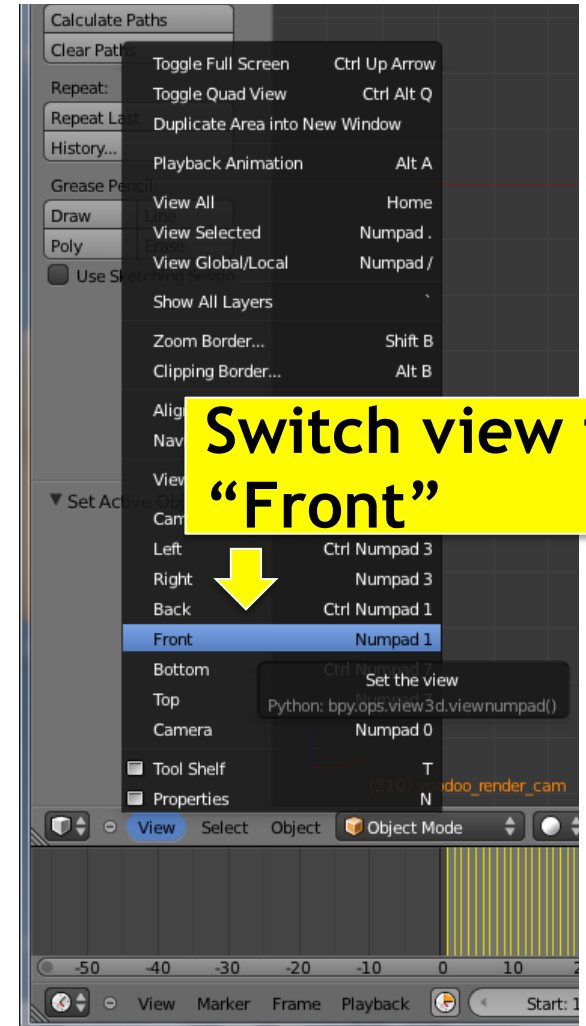
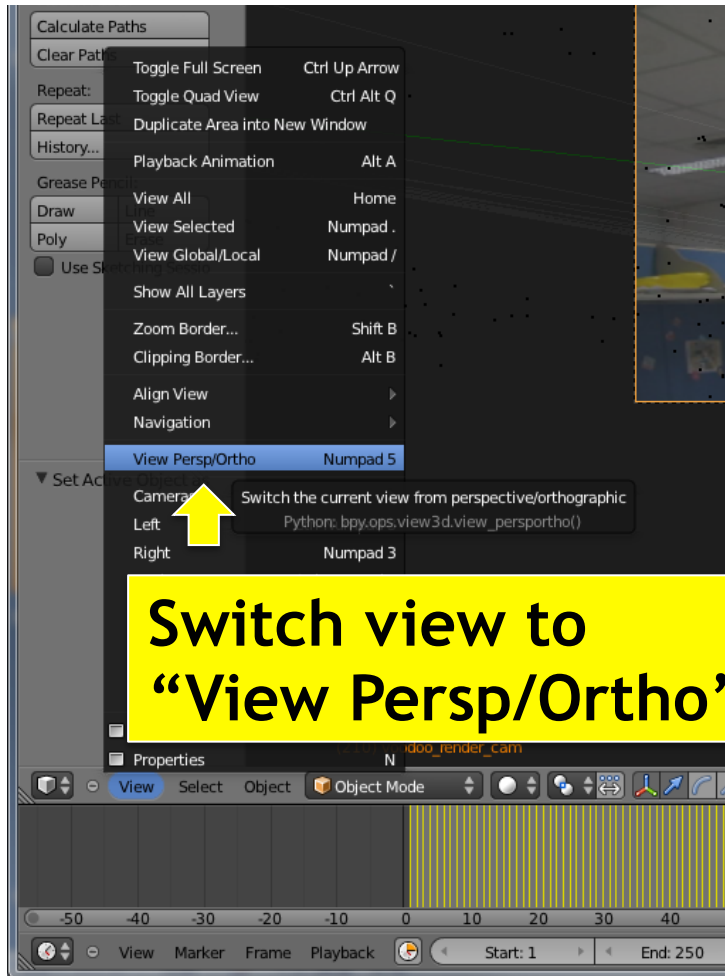
**Set resolution**

# Stage 3-2: Show Background Images



Select Voodoo camera

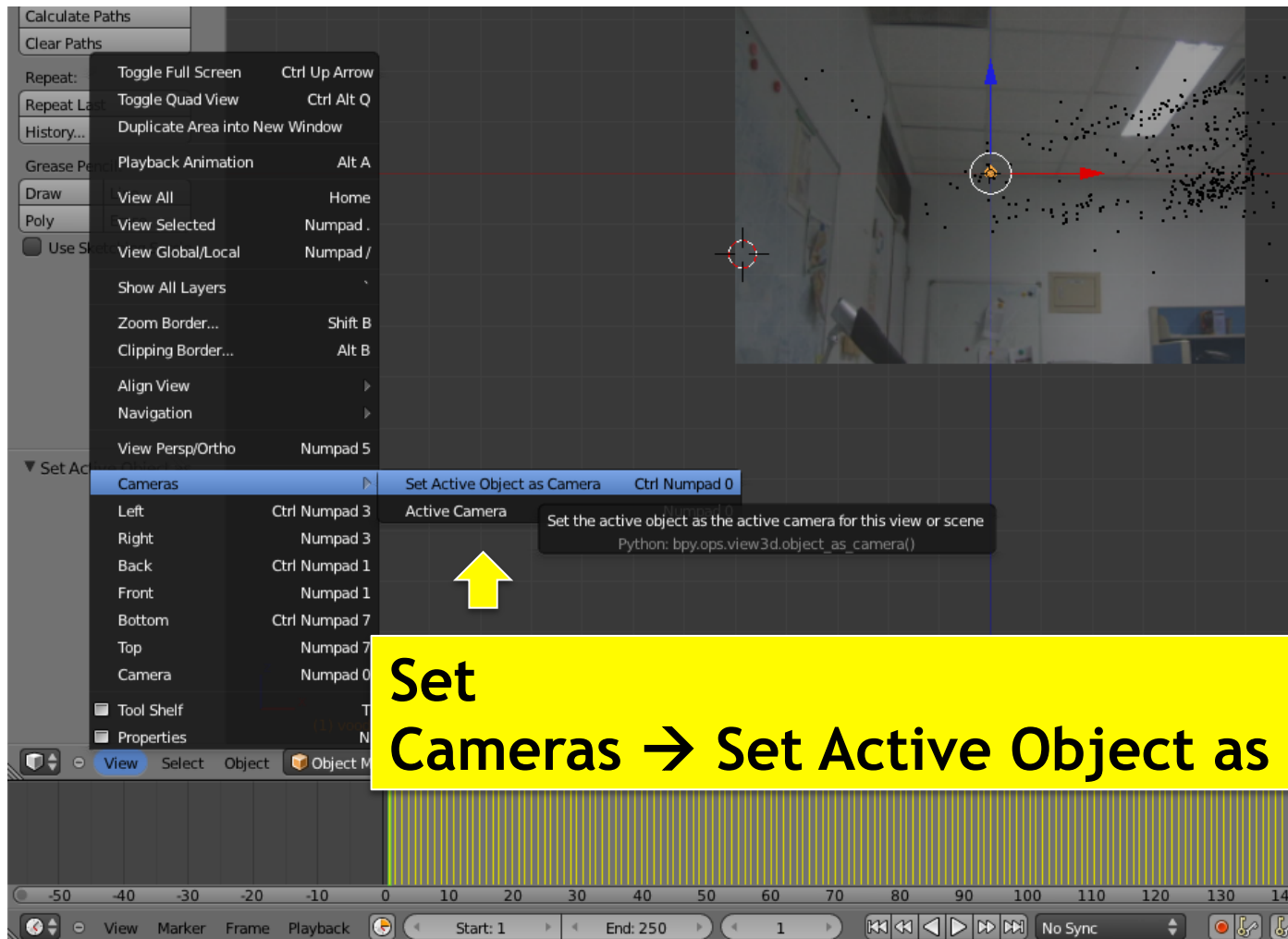
# Stage 3-2: Show Background Images



**Set view**



# Stage 3-2: Show Background Images



**Set  
Cameras → Set Active Object as Camera**

**Set active camera**

# Stage 3-2: Show Background Images

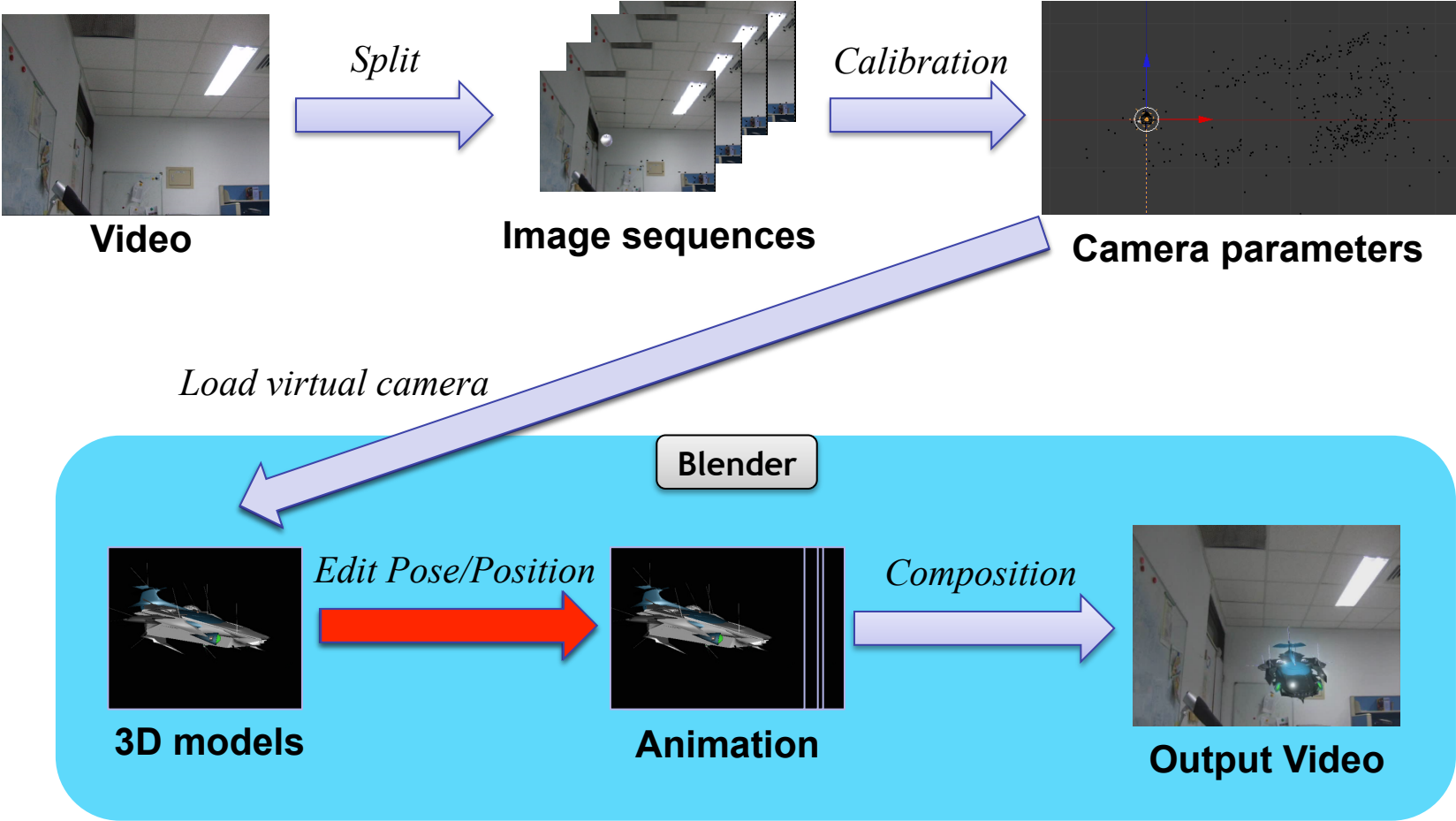
**Make sure “voodoo render cam” is selected**

**You can drag here to see the camera motions**

Blender interface showing the 3D viewport, Outliner, Properties panel, and Timeline. The camera 'voodoo\_render\_cam' is selected in the Outliner. The 3D viewport shows a scene with a camera and background images. The Properties panel shows the camera's settings, including the Background Images section. The Timeline shows the camera's motion path.

**Check background**

# Stage 3: Combine Video and 3D Model

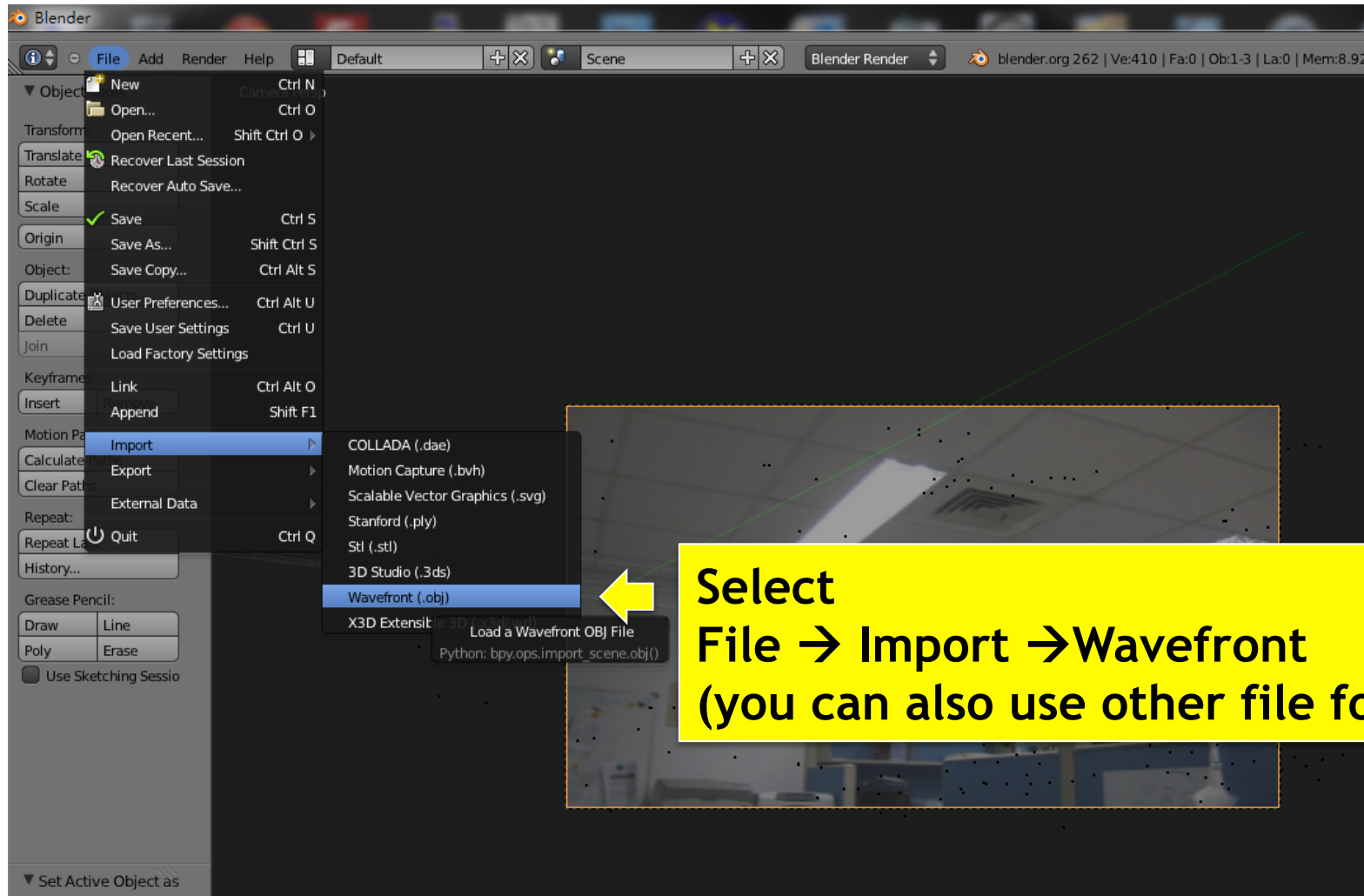


# Stage 3-3 ~ 3-4

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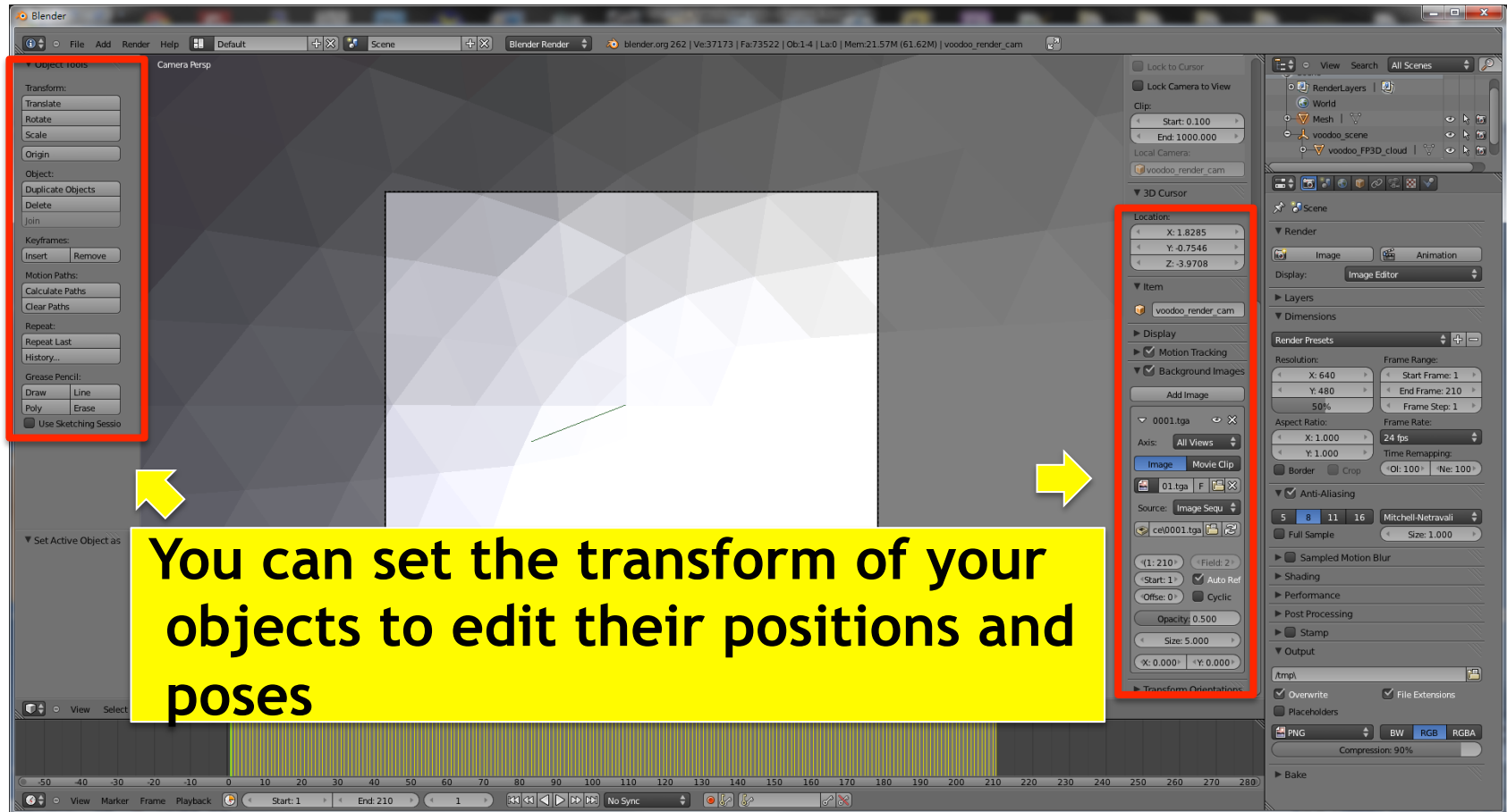
- Load models
  - File → Import → \*.obj
- Edit model poses/motions in the video
  - Object → Animation → Insert keyframe (or press “I”)
  - Fine tuning

# Stage 3-3: Load 3D Model



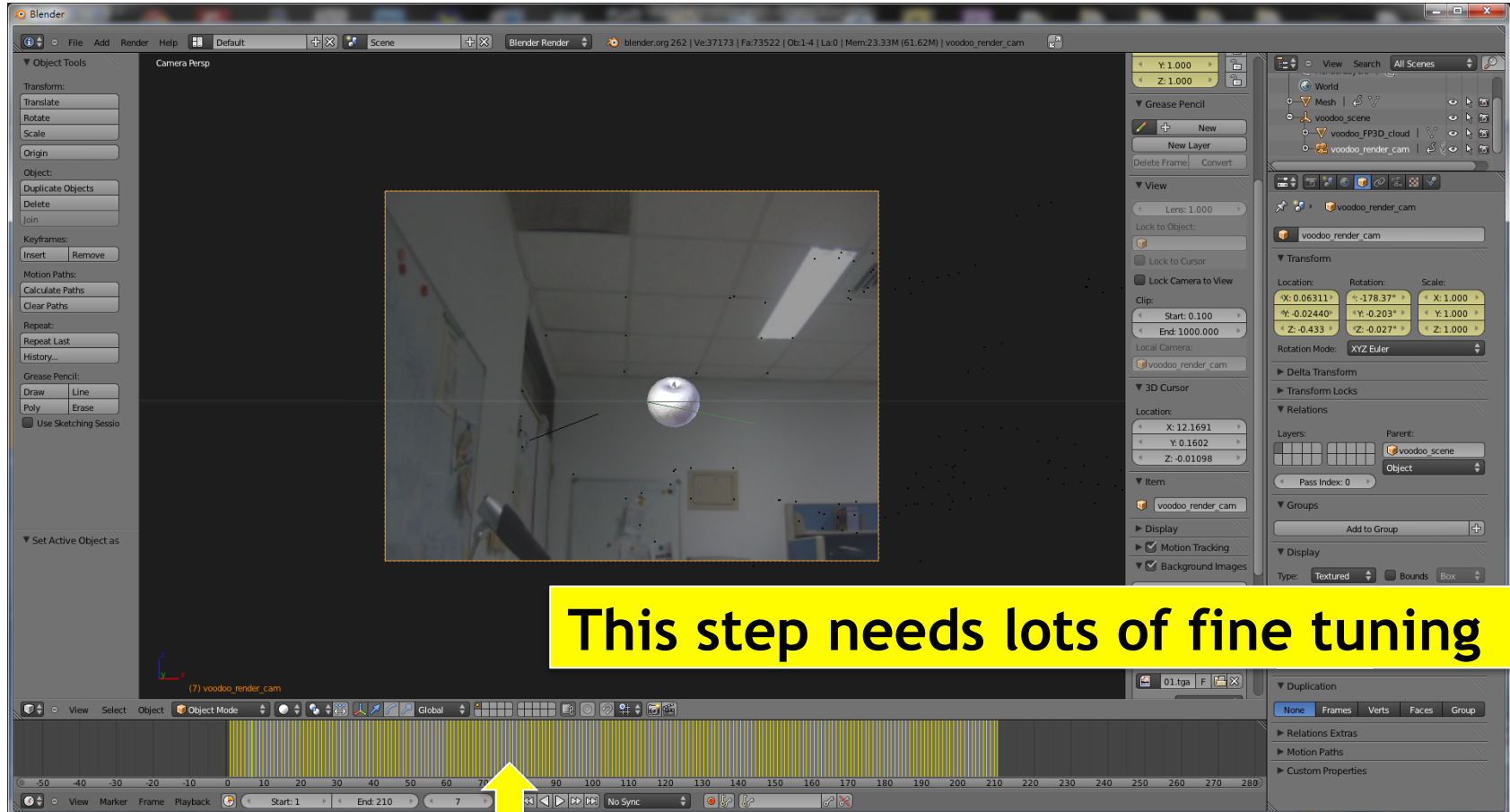
**Load models**

# Stage 3-3: Load 3D Model



**Set poses / positions for models**

# Stage 3-3: Load 3D Model



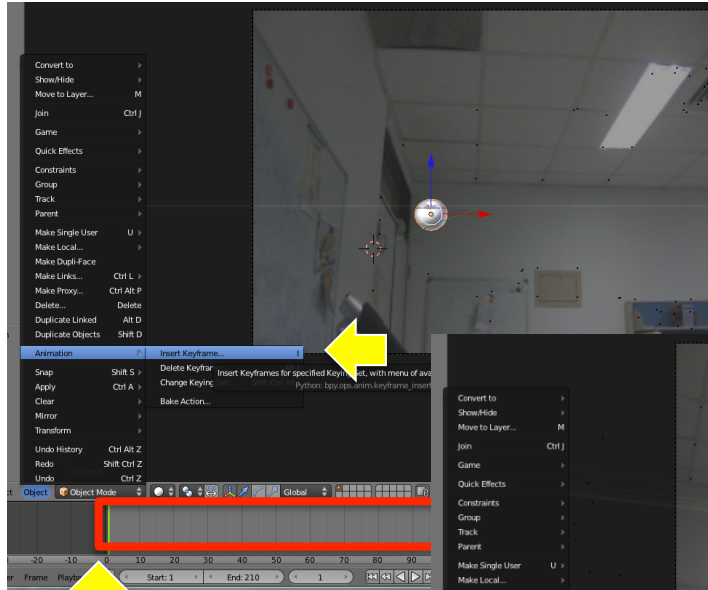
**This step needs lots of fine tuning**

**Fine tuning**

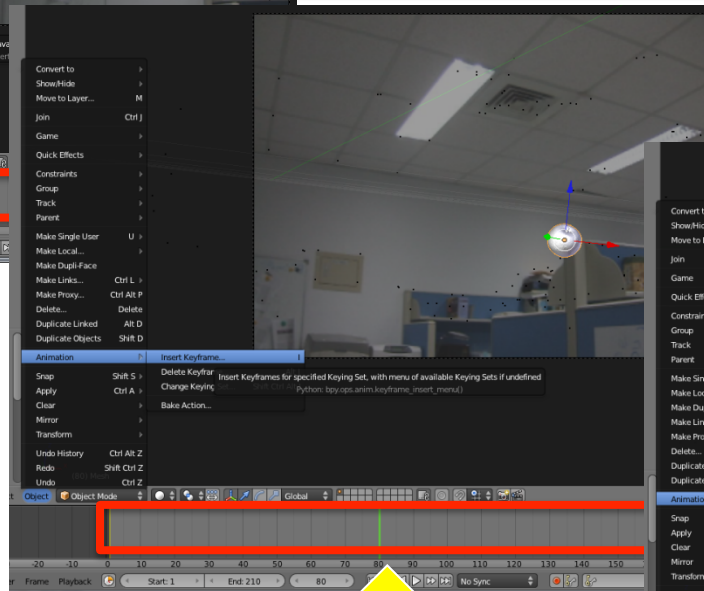
**You can drag here to see whether your tuning is correct or not (is the object located at the correct position?)**

# Stage 3-4: Set Model Animation

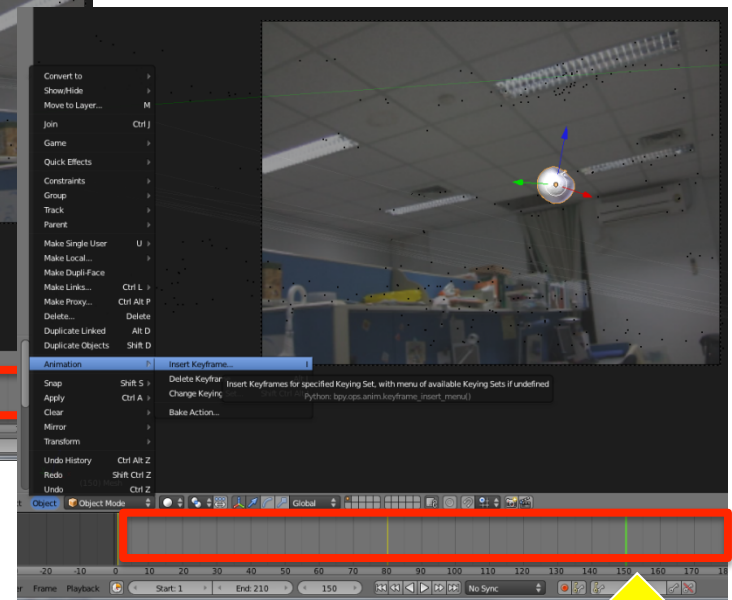
1. Select the frame that you want to insert a key frame
2. Select Object → Animation → Insert Keyframe..
3. Repeat multiple times



Frame 1



Frame 80

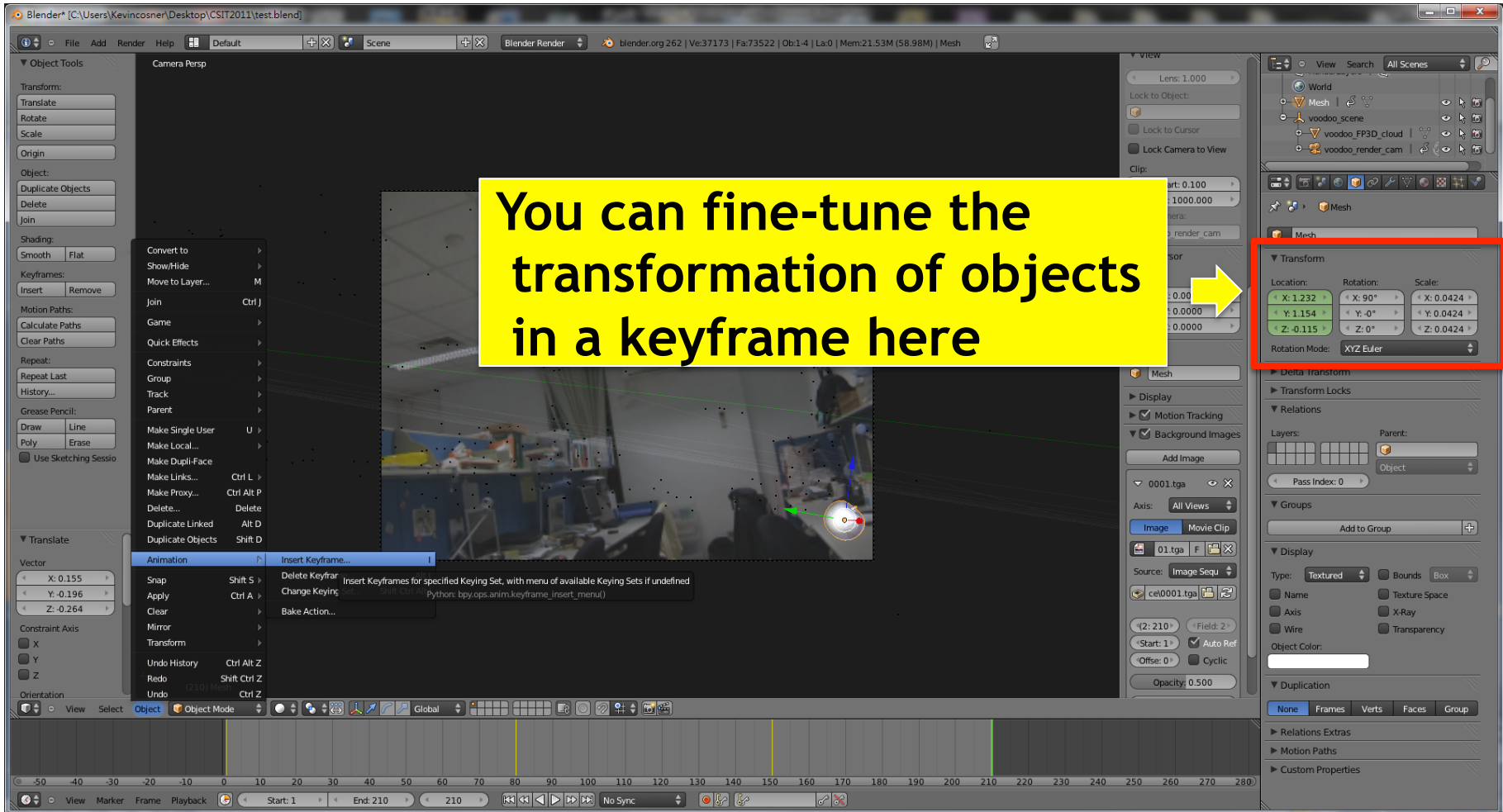


Frame 150

Set keyframes

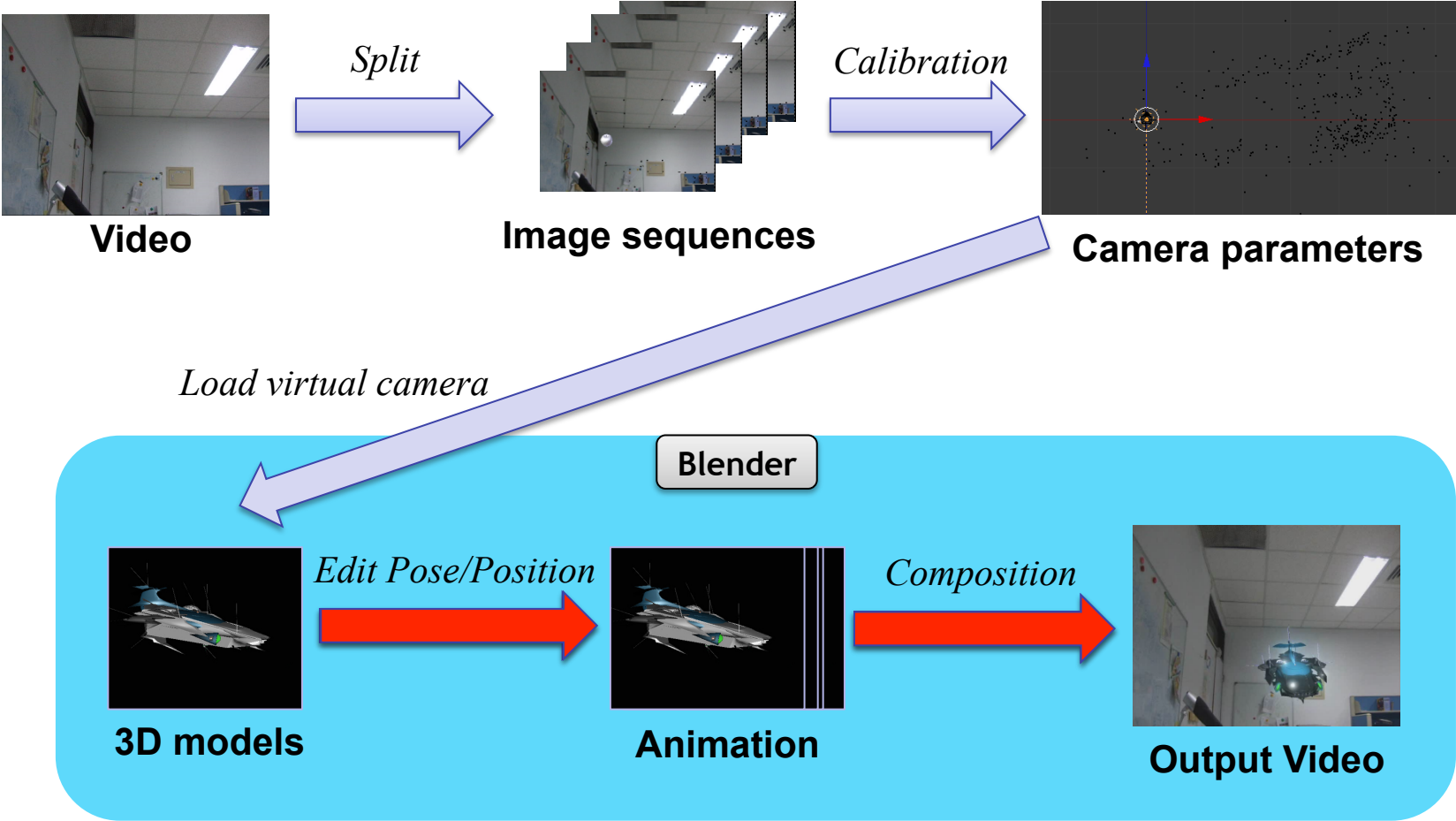


# Stage 3-4: Set Model Animation



**Fine tuning**

# Stage 3: Combine Video and 3D Model

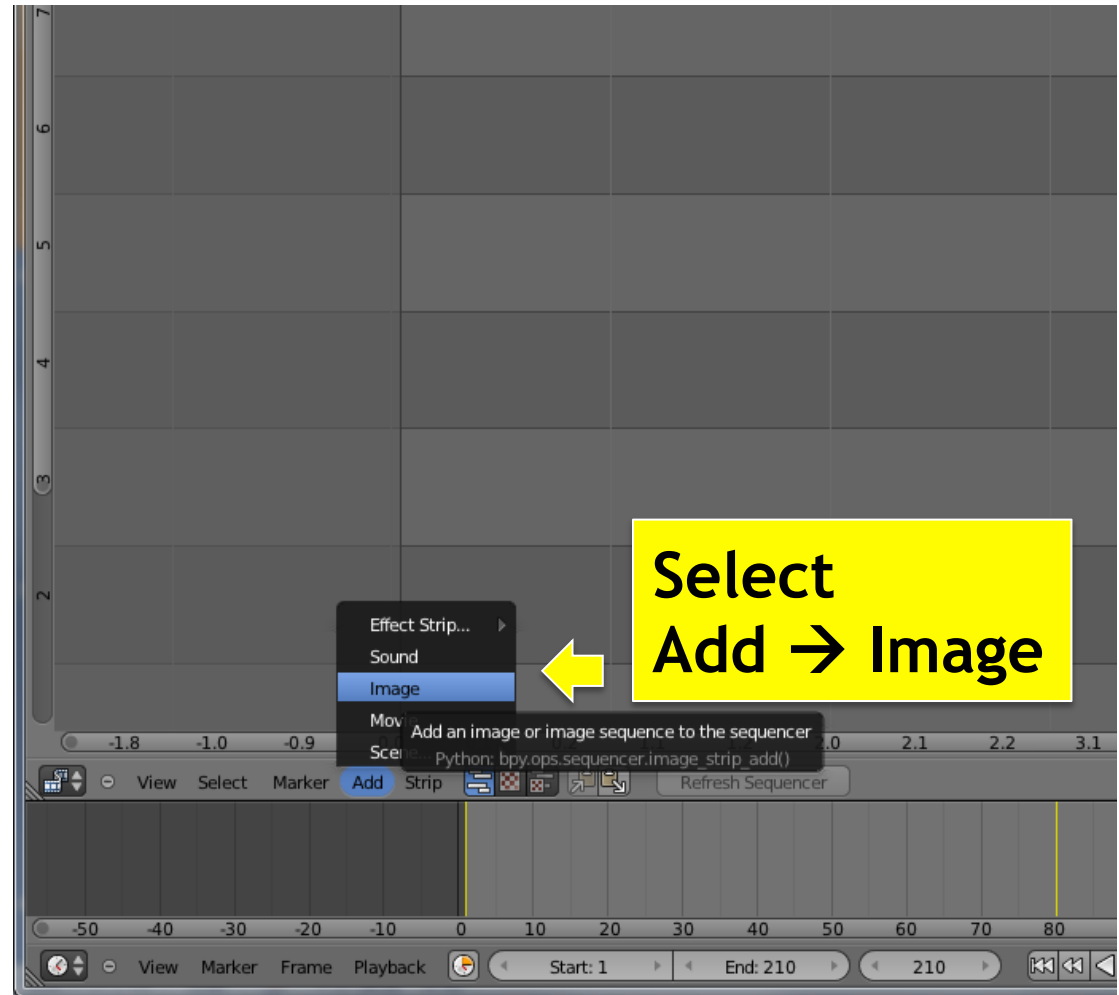
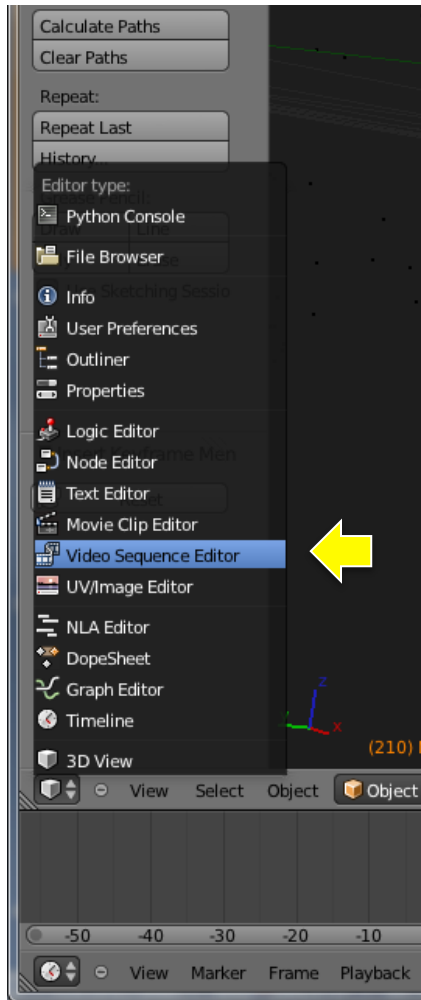


# Stage 3-5

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- Add image sequence
  - Change window type to “Video Sequence Editor”
  - Select Add → Images and select all images
  - Drag the strip to the “1<sup>st</sup> Frame” in Layer 1
- Add scene
  - Select Add → Scene
  - Drag the scene strip to the “1<sup>st</sup> Frame” in Layer 2
  - Change scene property to “Alpha Over”
  - Set parameters of output video
- Click “Animation”

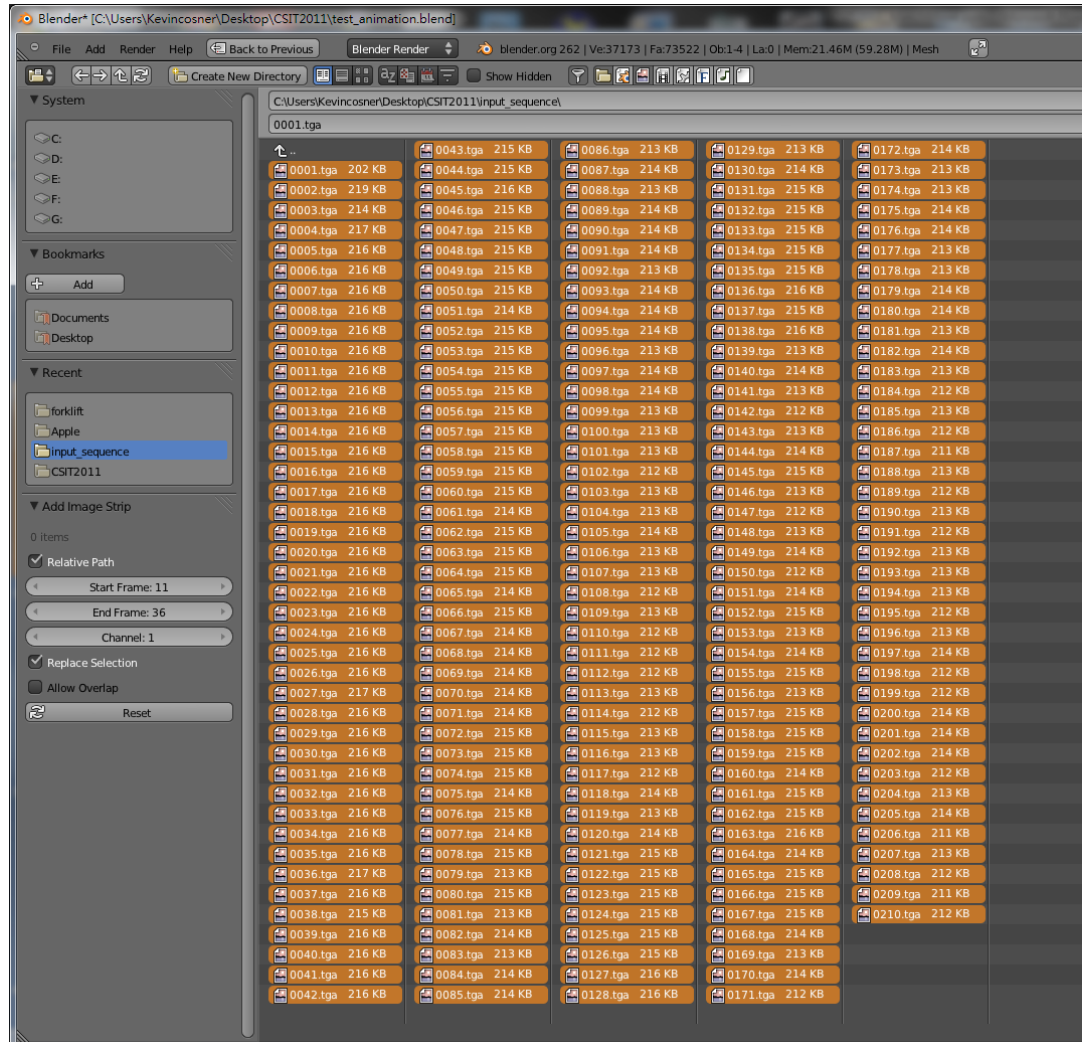
# Stage 3-5: Render Video



**Set to Video Sequence Editor**

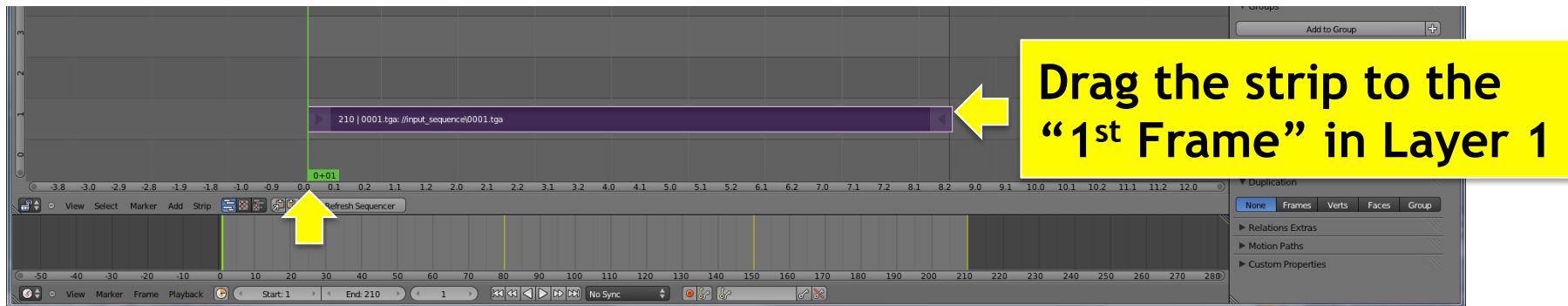
**Add image sequence (Video Channel)**

# Stage 3-5: Render Video



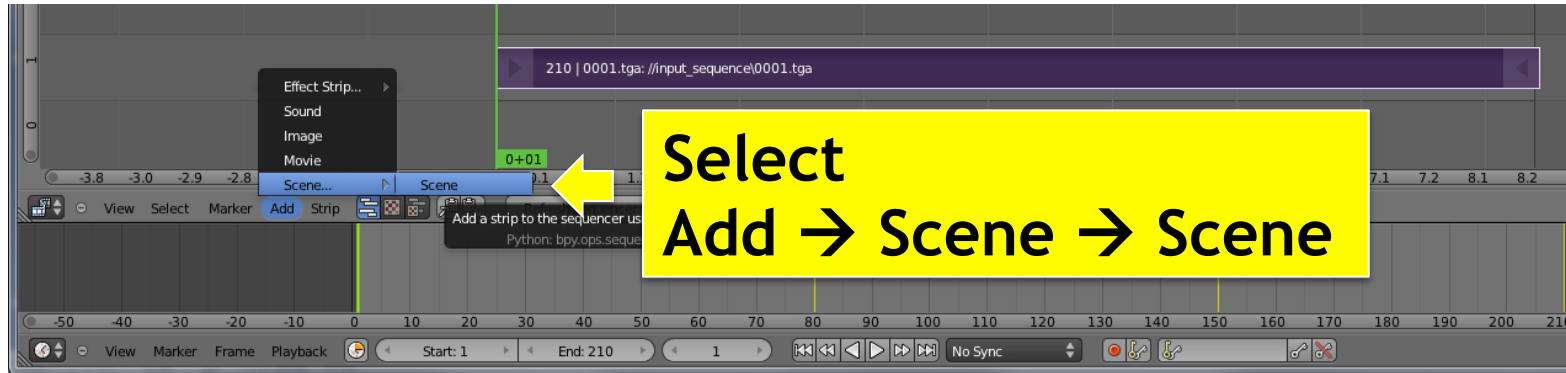
**This time, select all frames (Press A)**

# Stage 3-5: Render Video

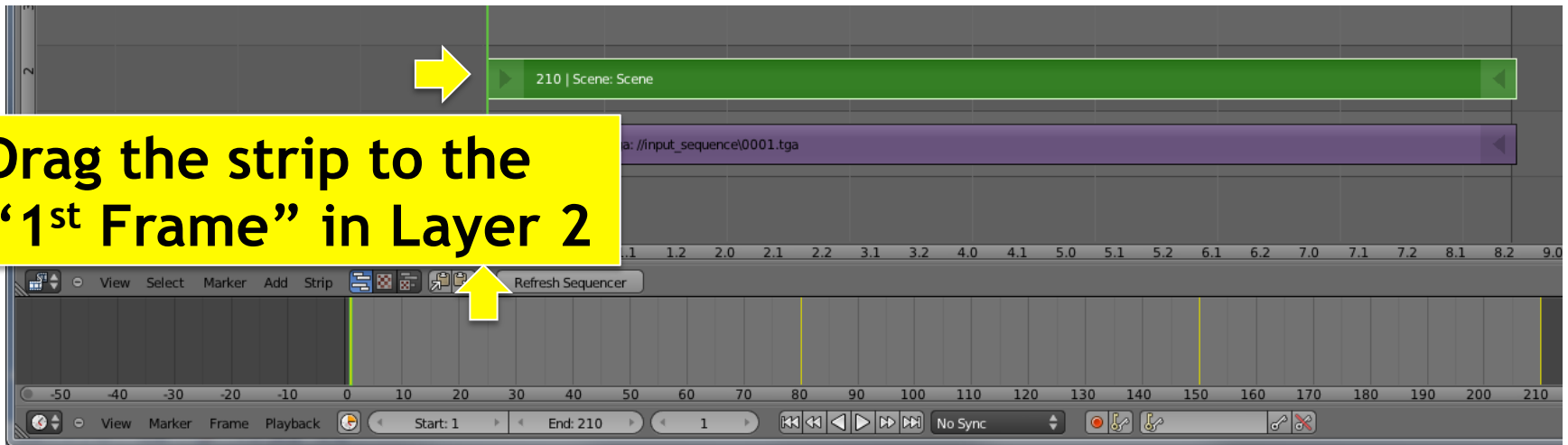


**Edit Video Layer (Right click and drag, left click to set)**

# Stage 3-5: Render Video

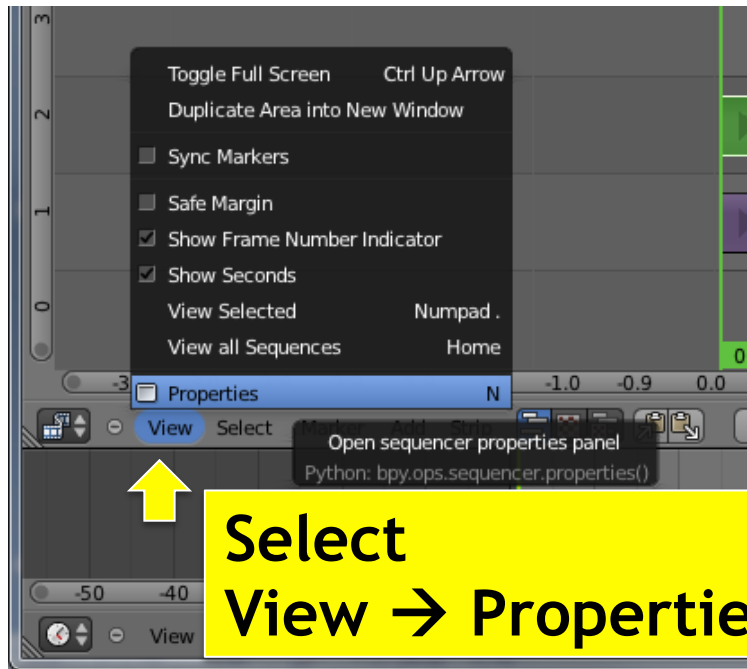


**Add scene layer**



**Edit scene layer (Right click and drag, left click to set)**

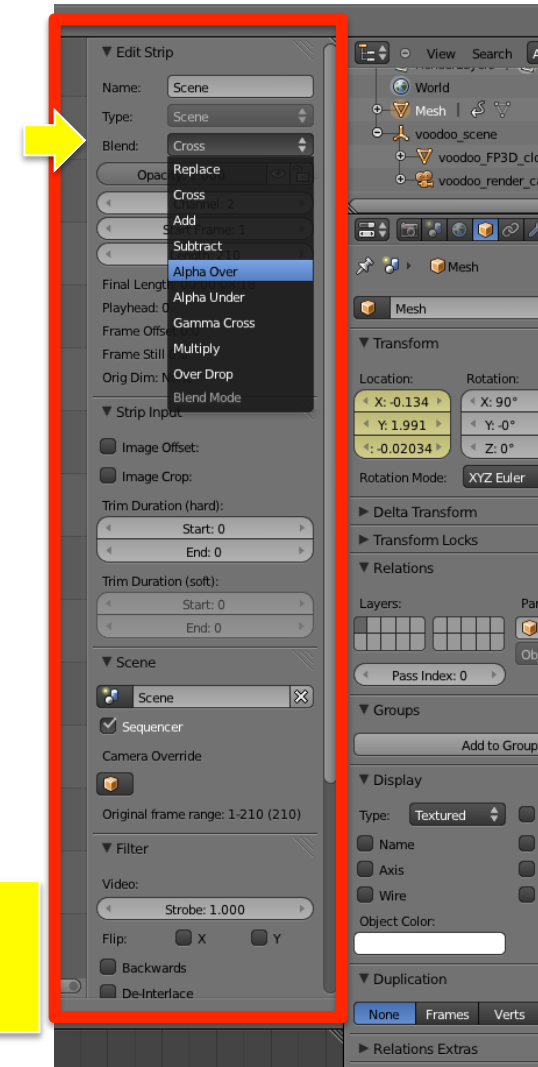
# Stage 3-5: Render Video



**Show Properties Panel**

**You will see the  
Properties Panel**

**Select  
Blend → Alpha Over**



**Set Blend Type**



# Stage 3-5: Render Video

Frame Offset 0:0  
Frame Still 0:0  
Orig Dim: None

▼ Strip Input

Image Offset:  
 Image Crop:

Trim Duration (hard):  
Start: 0  
End: 0

Trim Duration (soft):  
Start: 0  
End: 0

▼ Scene

Scene

Sequencer

Camera Override

Original frame range: 1-210 (210)

▼ Filter

Video:  
Strobe: 1.000

Flip:  X  Y

Backwards  
 De-Interlace

Colors:  
Saturation: 1.000  
Multiply: 1.000

Premultiply  
 Convert Float  
 Use Color Balance

▼ Proxy / Timecode

Proxy Custom Directory  
 Proxy Custom File

Frame Still 0:0  
Orig Dim: None

▼ Strip Input

Image Offset:  
 Image Crop:

Trim Duration (hard):  
Start: 0  
End: 0

Trim Duration (soft):  
Start: 0  
End: 0

▼ Scene

Scene

Sequencer

Camera Override

voodoo\_render\_cam

▼ Filter

Video:  
Strobe: 1.000

Flip:  X  Y

Backwards  
 De-Interlace

Colors:  
Saturation: 1.000  
Multiply: 1.000

Premultiply  
 Convert Float  
 Use Color Balance

▼ Proxy / Timecode

Proxy Custom Directory  
 Proxy Custom File

World  
Mesh  
voodoo\_scene  
voodoo\_FP3D\_cloud  
voodoo\_render\_cam

Mesh

▼ Transform

Location: X: -0.134 Y: 1.991 Z: -0.02034  
Rotation: X: 90° Y: -0° Z: 0°  
Scale: X: 0.0424 Y: 0.0424 Z: 0.0424

Rotation Mode: XYZ Euler

► Delta Transform

► Transform Locks

▼ Relations

Layers: Parent: Object

Pass Index: 0

▼ Groups

Add to Group

▼ Display

Type: Textured  
Bounds: Box

Name  
 Axis  
 Wire  
Object Color:

Texture Space  
 X-Ray  
 Transparency

► Duplication

10.2 11.2

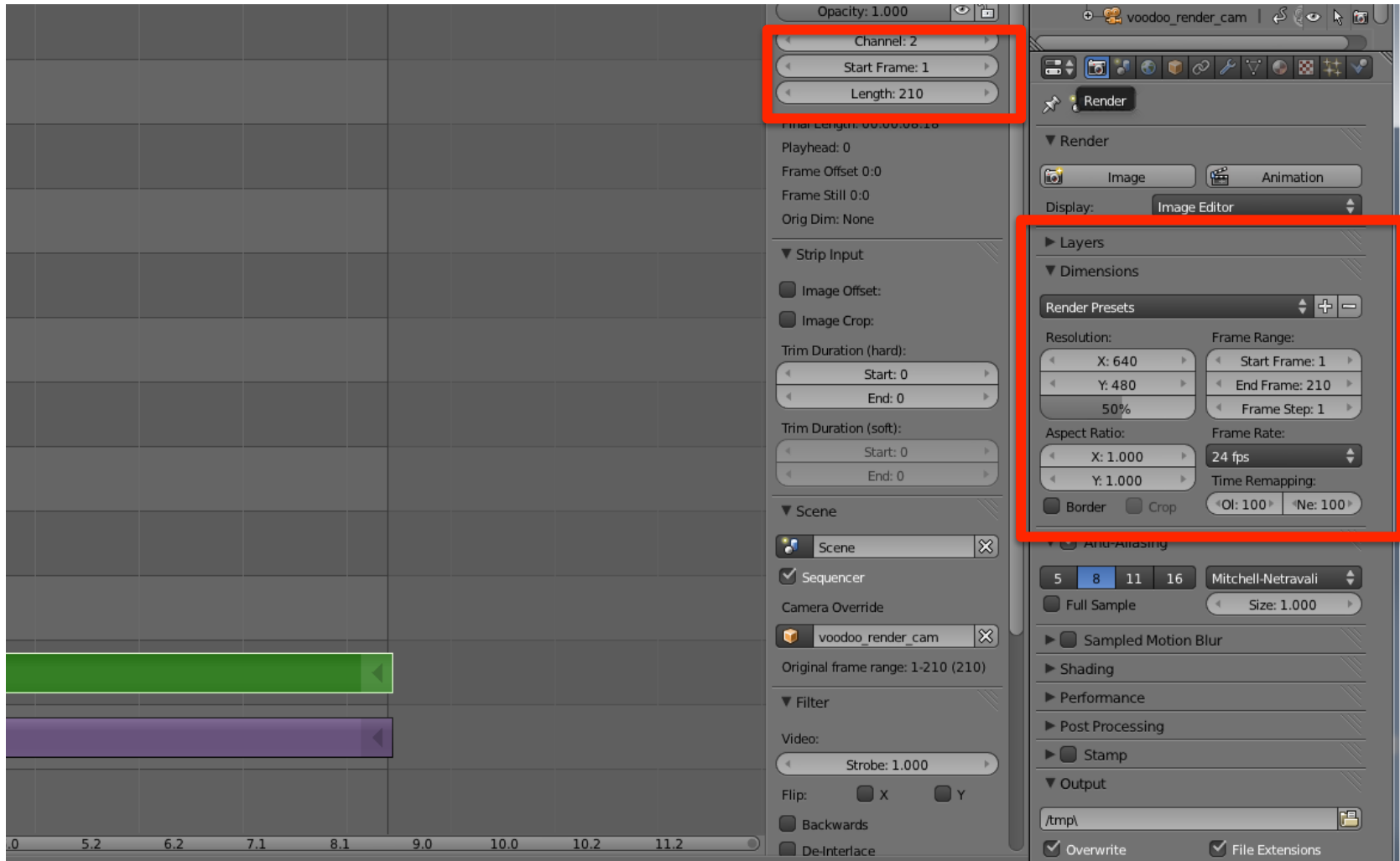
Set scene camera to "voodoo\_render\_cam"

Enable!

Select Premultiply

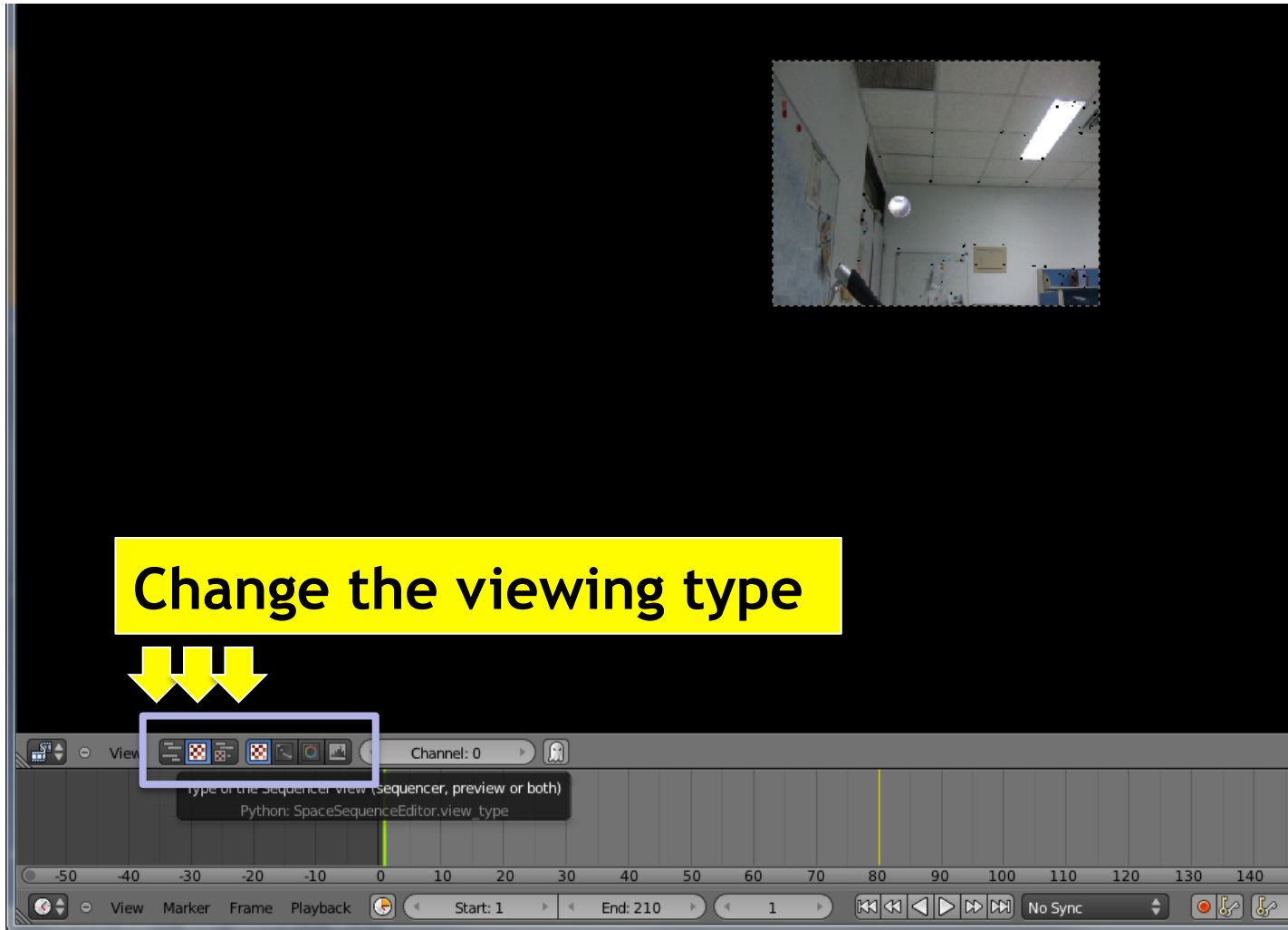
Set scene camera

# Stage 3-5: Render Video



**Check output setting again!**

# Stage 3-5: Render Video

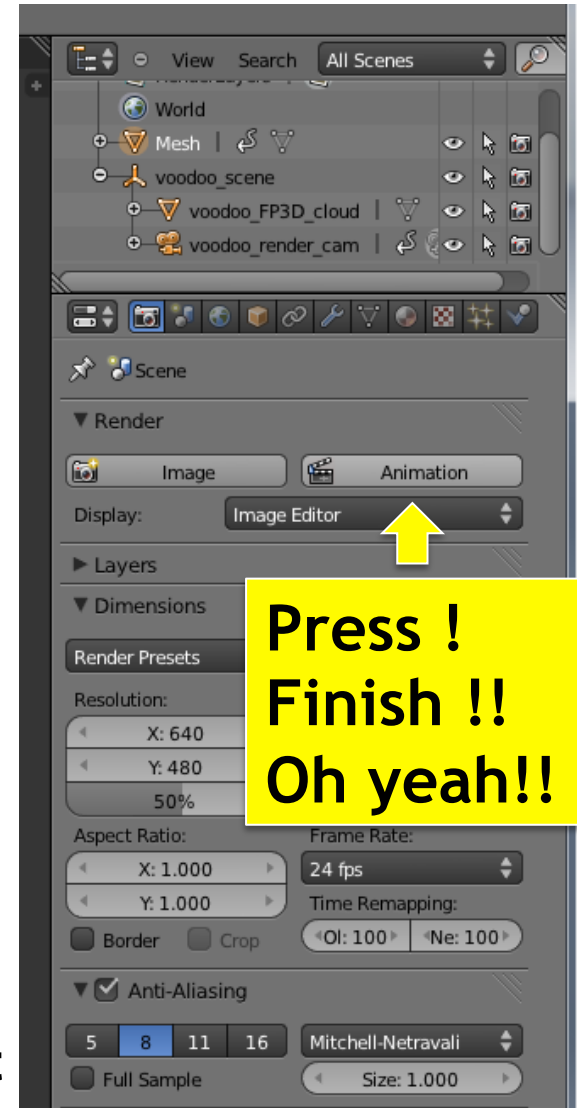


Preview your video

# Stage 3-5: Render Video



Select output format



Final Output

# Demo

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- <https://www.youtube.com/watch?v=DzTiVhdxJk0>
- <https://www.youtube.com/watch?v=QU4pPnsqbeM>
- <https://www.youtube.com/watch?v=1f3fMV3v7Xg>
  
- More examples:
  - <http://ntuvfx.csie.org/vfx/2017/>
  - <http://192.168.1.110/vfx/2017/>

# Submission

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- You need to submit:
  1. **Artifact video:** final video with CGI
  2. **Raw video:** video without CGI
  3. **Report** in html/pdf format
- Upload a compressed file (including raw video and report) and your artifact to the submission website.
  - [http://ntuvfx.csie.org/vfx/2017/proj3\\_submit.php](http://ntuvfx.csie.org/vfx/2017/proj3_submit.php)
  - [http://192.168.1.110/vfx/2017/proj3\\_submit.php](http://192.168.1.110/vfx/2017/proj3_submit.php)

# Grading Criterion

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- Camera motion
- Model motion: ex. moving on the ground vs. flying
- Video completeness: ex. story
- Creativity
- Bonus: voting

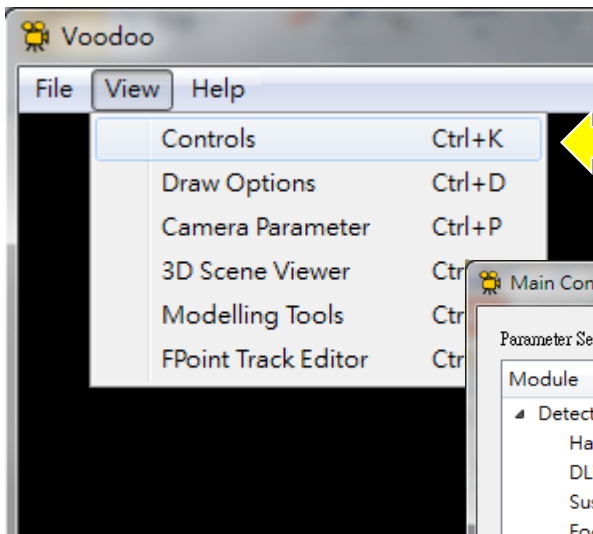
# FAQ

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- Voodoo會當掉！
  - 拍攝的影片內容差異太大
  - 調整tracking的方式
- 為什麼我在Blender中的Background和Feature沒辦法配合？
  - 記得要先選取 voodoo\_render\_cam
  - 設定 **Cameras → Set Active Object as Camera**
- 3D models的位置/動作好難調整...
  - 多利用座標系相對位置以及不同視角會有幫助, 不過還是需要一些時間
  - 設定動作時, 盡量避免大角度或大範圍的interpolation, **多設一些 key frames**
- 為什麼最後做出來的動畫Model是黑的？
  - 記得在場景裡**加盞燈**
- 我該去哪裡找3D models？
  - 網路上免費資源非常多!
  - 例如: <http://www.3dm3.com/modelsbank/>  
<http://www.sharecg.com/>

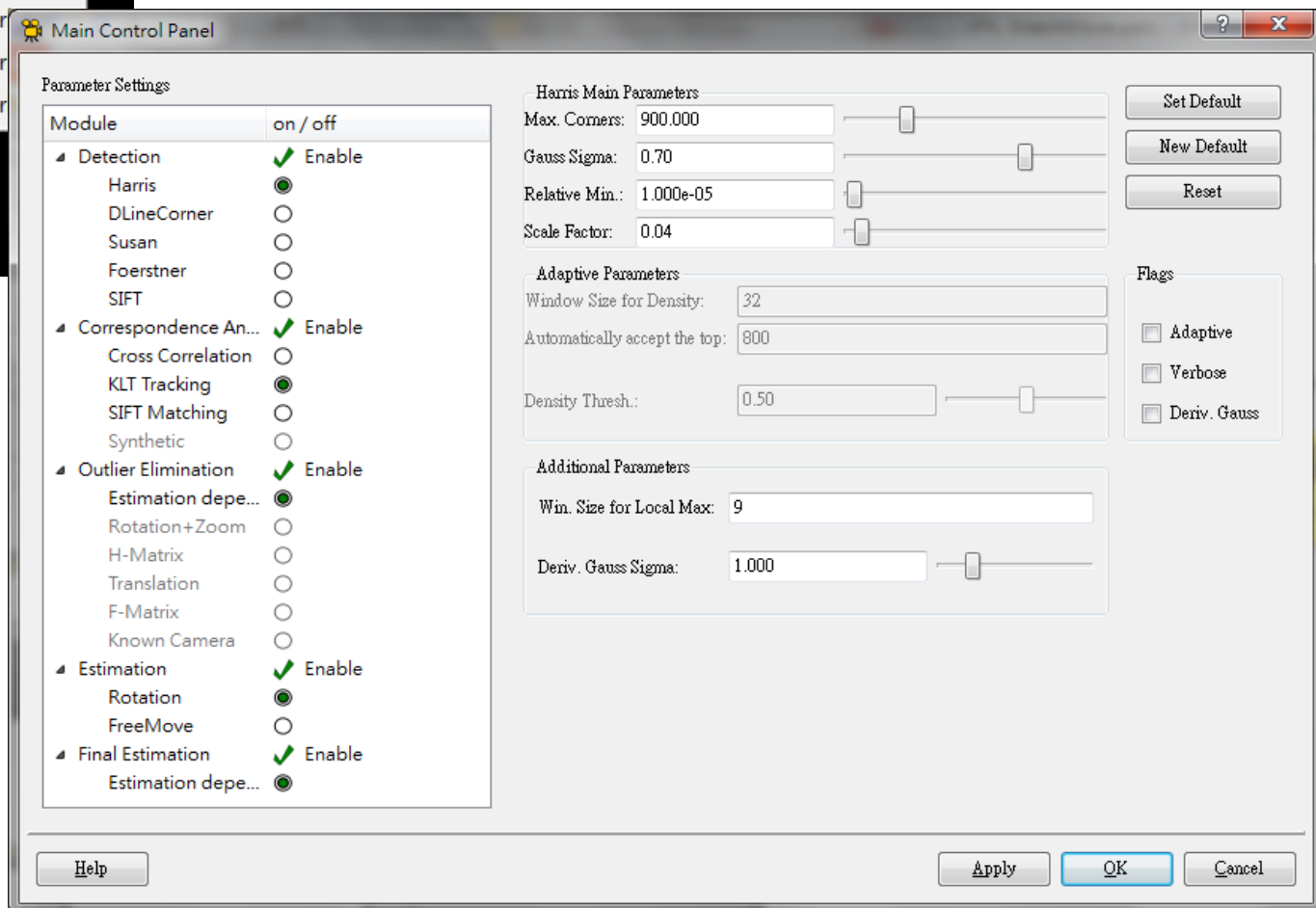


# FAQ



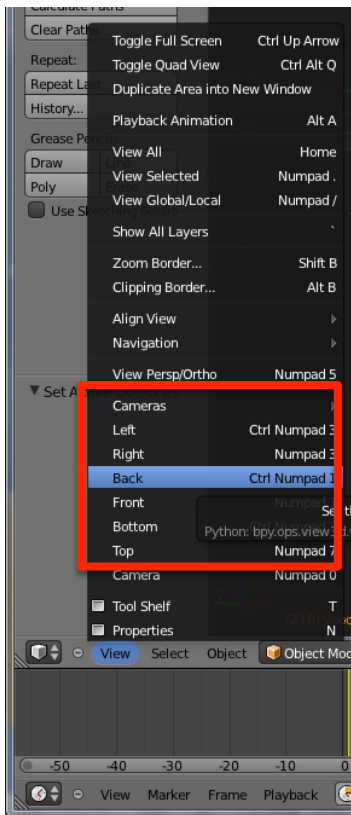
調整設定

View → controls

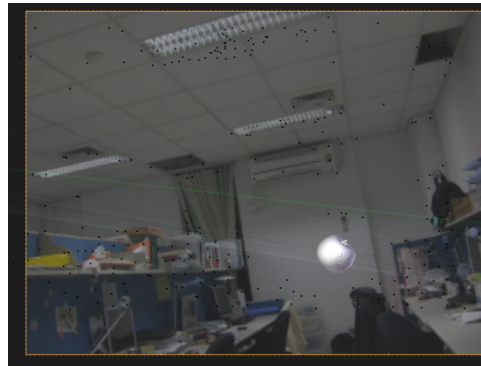


# FAQ

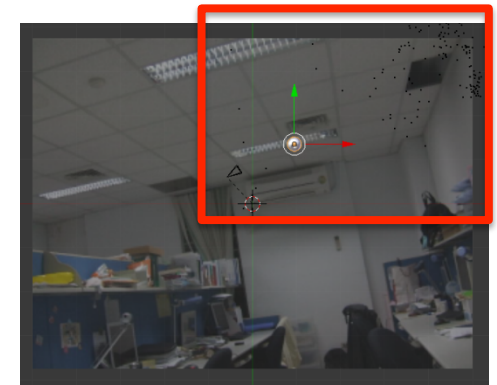
- Use different views to adjust the positions and poses of objects



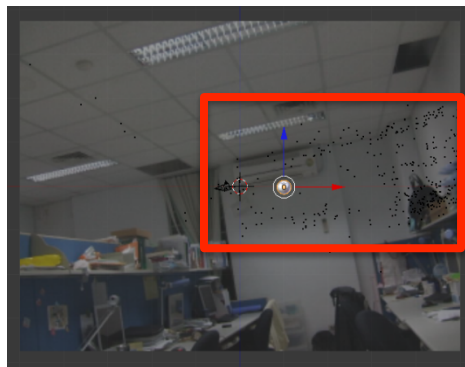
**Set  
view**



**Camera  
view**



**Top  
view**

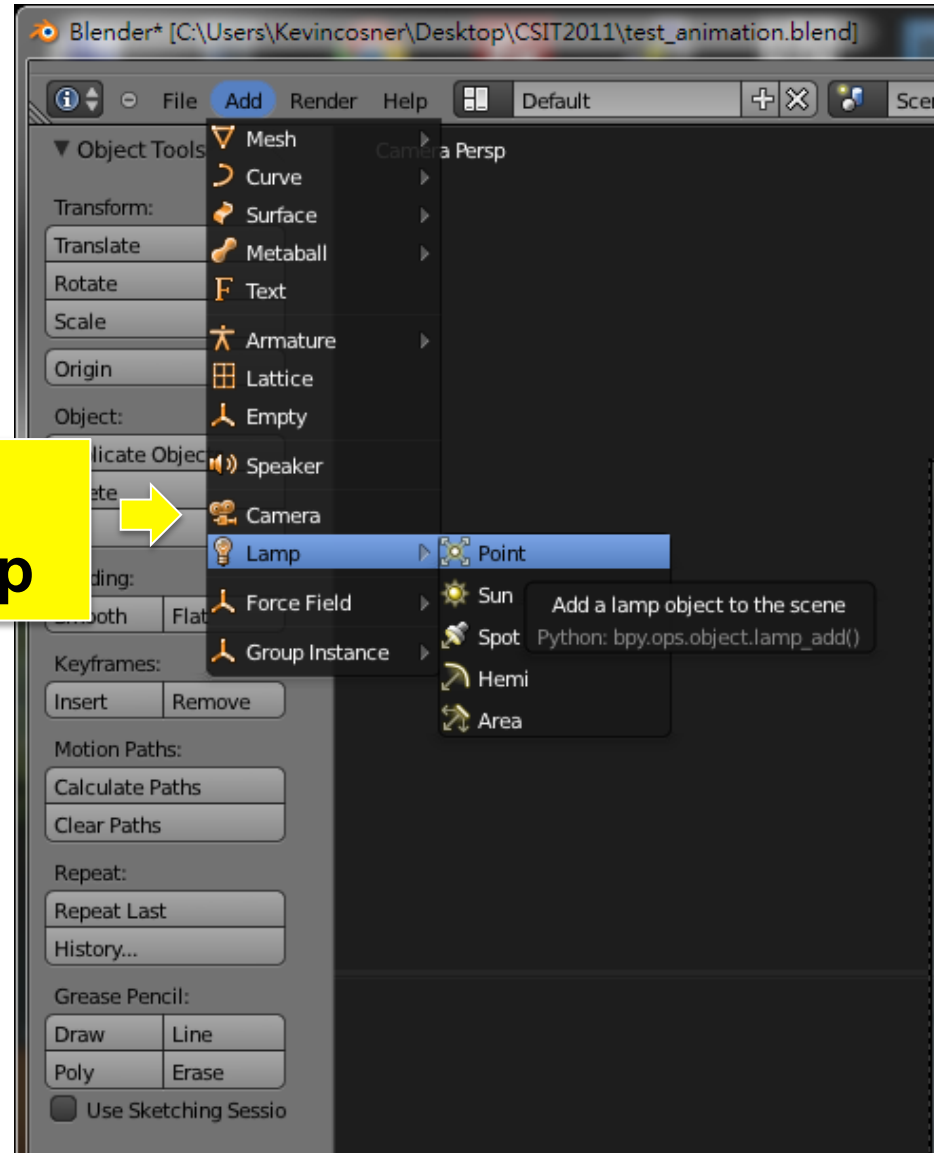


**Front  
view**

# FAQ

- Add lights

記得開燈!  
Add → Lamp



# Document

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- Blender official website
  - <http://www.blender.org/education-help/>
- Voodoo document website
  - <http://www.viscoda.com/index.php/en/voodoo-manual>