



Matchmove

Multimedia Techniques & Applications

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(with slides borrowed from Prof. Yung-Yu Chuang)

Jurassic Park (1993)

How to Composite Virtual and Real?

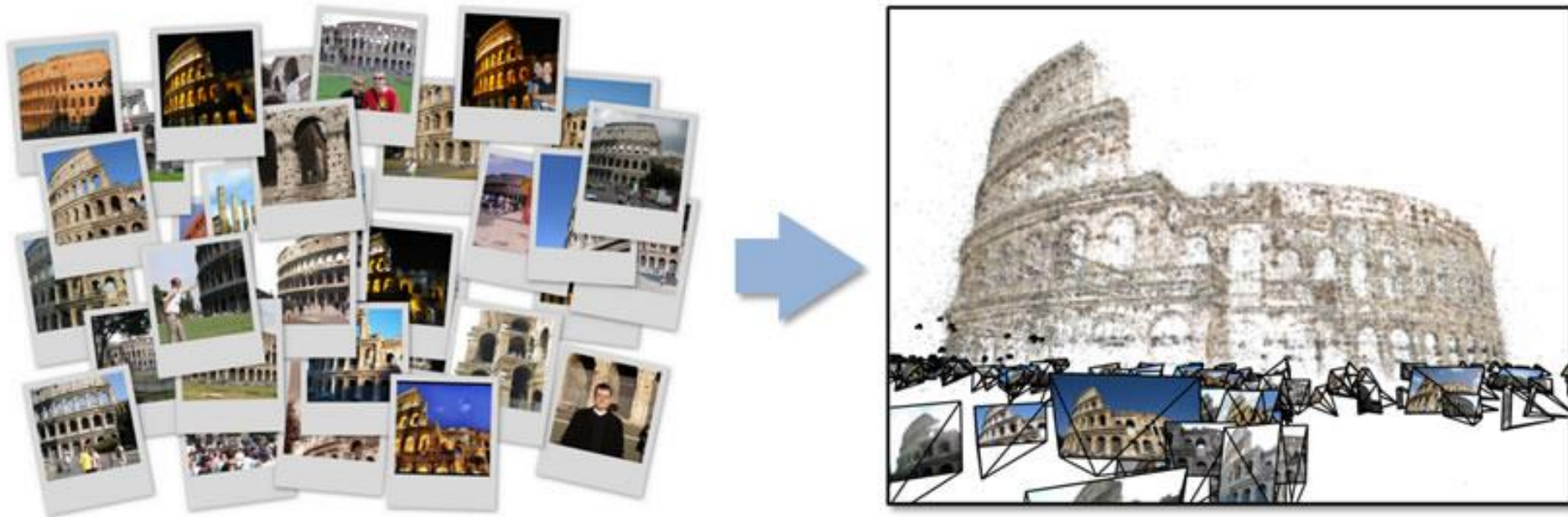
- In the real world, we use a **camera** to record the information of the real scene
- In a virtual world, we use a **virtual camera** to record the information of the virtual scene
- **Idea:** make the virtual camera **sync** with the real-world camera and **put the virtual objects in the right places**

How to Composite Virtual and Real? (cont.)



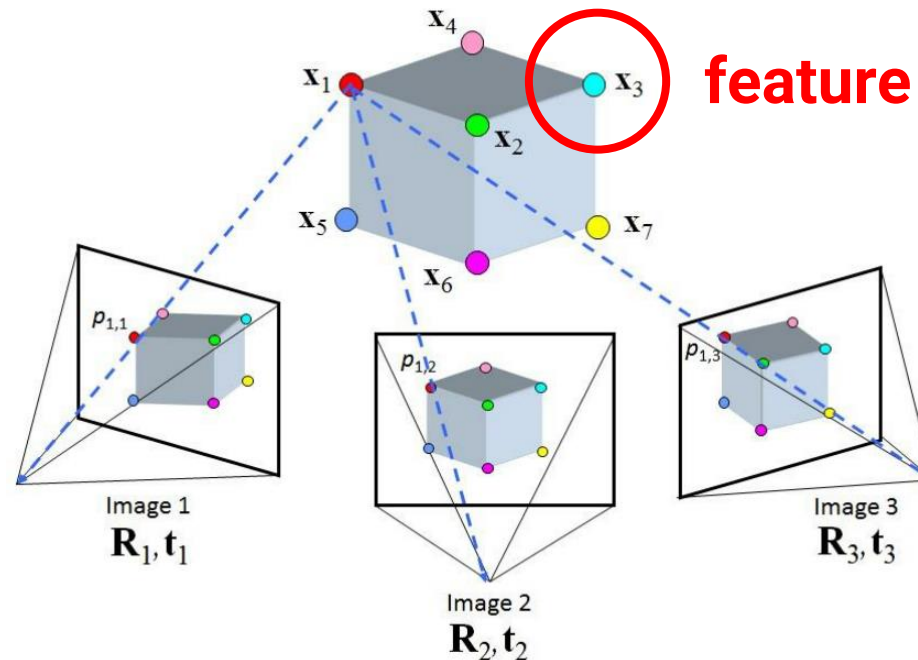
Matchmove (Structure from Motion)

- **Structure from Motion:** automatic recovery of camera motion and scene structure from two or more images
- Also called **matchmove** in film production



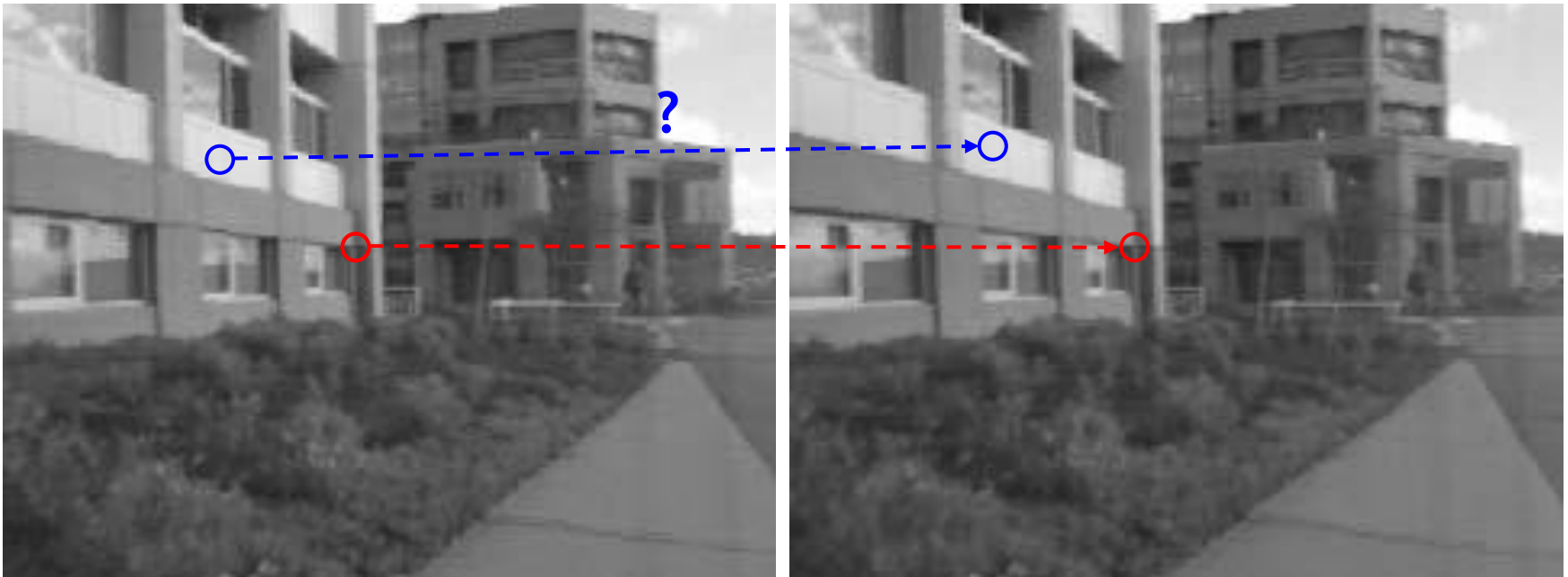
Matchmove (Structure from Motion)

- **Structure from Motion:** automatic recovery of camera motion and scene structure from two or more images
- Also called **matchmove** in film production



Features

- Also known as **interesting points**, **salient points**, or **keypoints**
- Points that you can easily point out their **correspondences** in **multiple images** using only **local information**



Desired Properties for Features

- **Distinctive**

- A single feature can be correctly matched with high probability

- **Invariant**

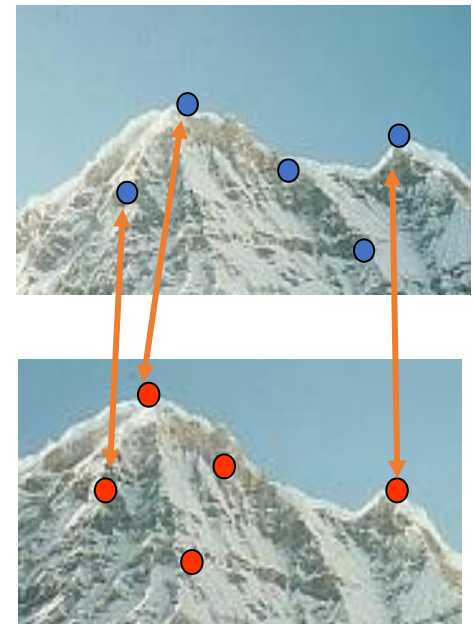
- Invariant to scale, rotation, illumination and noise for robust matching across a substantial range of distortion, viewpoint change and so on

Applications

- **Object or scene recognition**
- **Matchmove (structure from motion)**
- **Stereo**
- **Motion tracking**
- ...

Components

- **Feature detection** locates where they are
- **Feature description** describes what they are
- **Feature matching** decides whether two are the same one

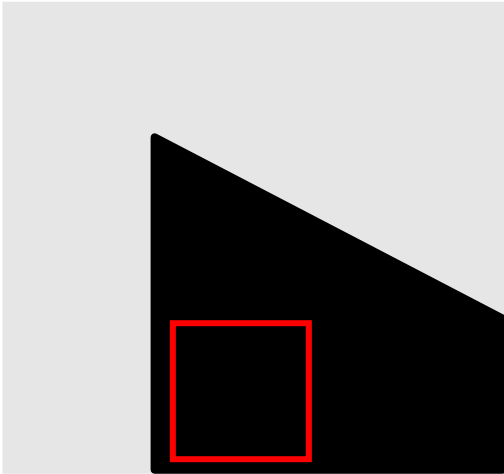


Moravec Corner Detector

- We should easily recognize the point by looking through a **small window**
- Shifting a window in any direction should give a large change in **intensity**

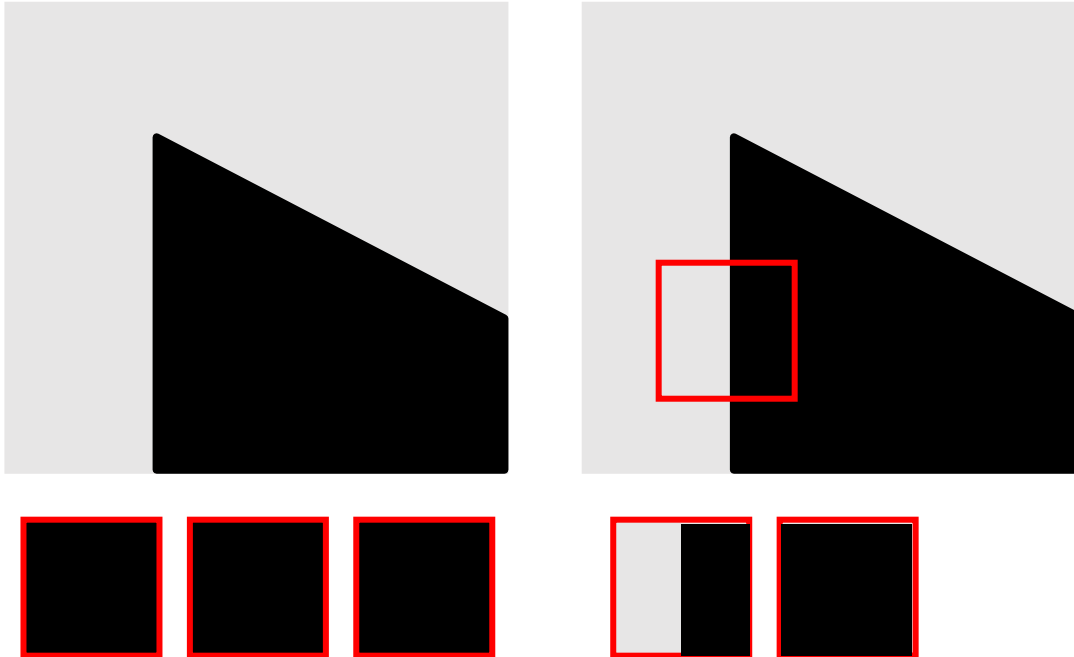


Moravec Corner Detector (cont.)



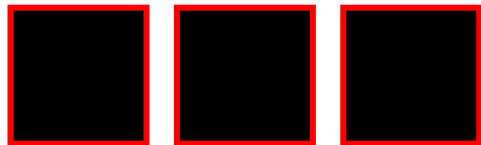
flat

Moravec Corner Detector (cont.)

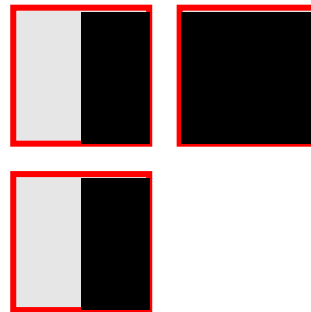
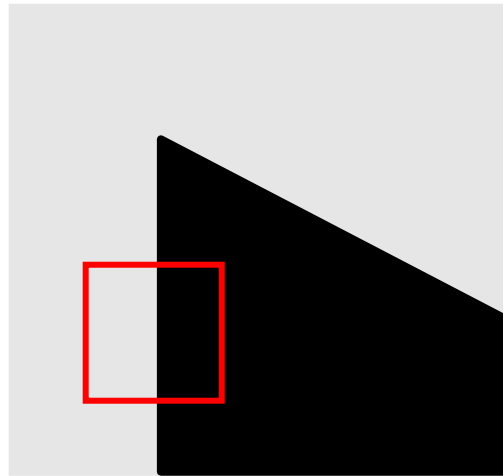


flat

Moravec Corner Detector (cont.)

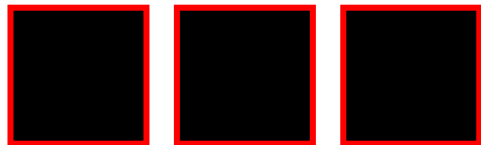


flat

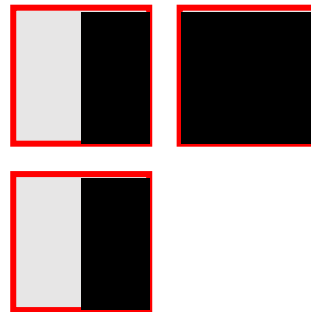


edge

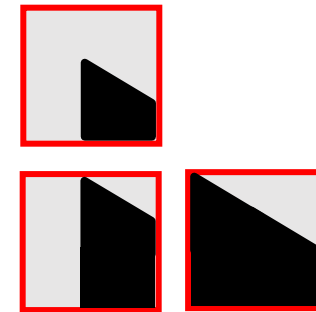
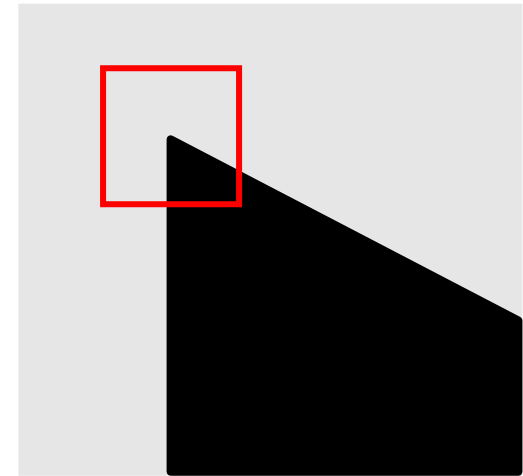
Moravec Corner Detector (cont.)



flat



edge

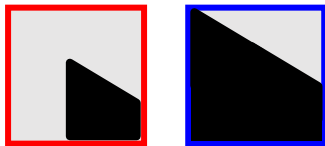
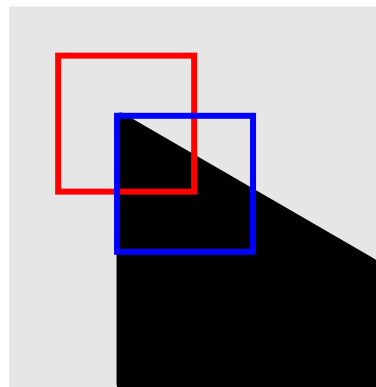


corner
isolated point

Moravec Corner Detector (cont.)

- Change of intensity for the shift $[u, v]$

$$E(u, v) = \sum_{x, y} w(x, y) [I(x + u, y + v) - I(x, y)]^2$$



window
function

shifted
intensity

intensity

Window function $w(x, y) =$



1 in window, 0 outside

Four shifts: $(u, v) = (1, 0), (1, 1), (0, 1), (-1, 1)$

Look for local maxima in $\min\{E\}$

Problems of Moravec Detector

- Noisy response due to a binary window function
- Only a set of shifts at every 45 degree is considered
- Only minimum of E is taken into account

➔ **Harris corner detector solves these problems**

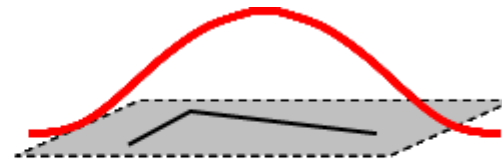
Harris Corner Detector

- Noisy response due to a binary window function

→ Use a Gaussian function

$$w(x, y) = \exp\left(-\frac{(x^2 + y^2)}{2\sigma^2}\right)$$

Window function $w(x, y) =$



Gaussian

Harris Corner Detector (cont.)

- Only a set of shifts at every 45 degree is considered

➔ Consider all small shifts by Taylor's expansion

$$\begin{aligned}
 E(u, v) &= \sum_{x, y} w(x, y) [I(x+u, y+v) - I(x, y)]^2 \\
 &= \sum_{x, y} w(x, y) [I_x u + I_y v + O(u^2, v^2)]^2
 \end{aligned}$$

➔ $E(u, v) = Au^2 + 2Cuv + Bv^2$

We can obtain a new measurement by investigating the shape of the error function

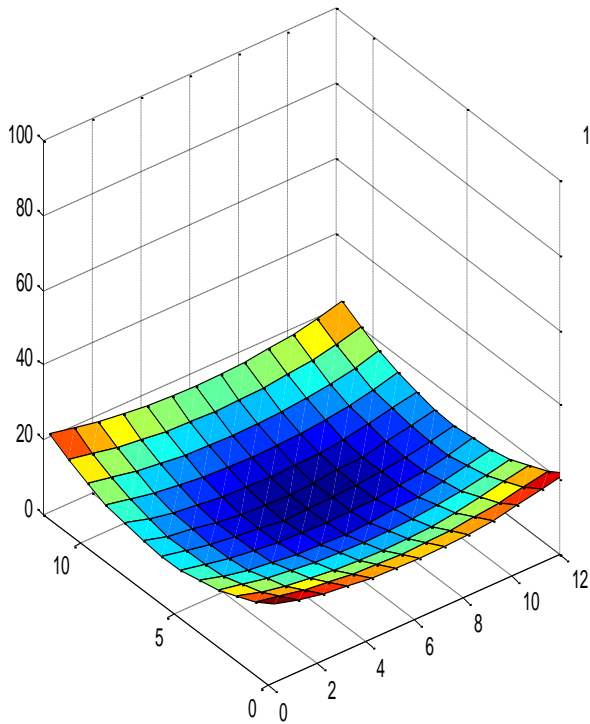
$$A = \sum_{x, y} w(x, y) I_x^2(x, y)$$

$$B = \sum_{x, y} w(x, y) I_y^2(x, y)$$

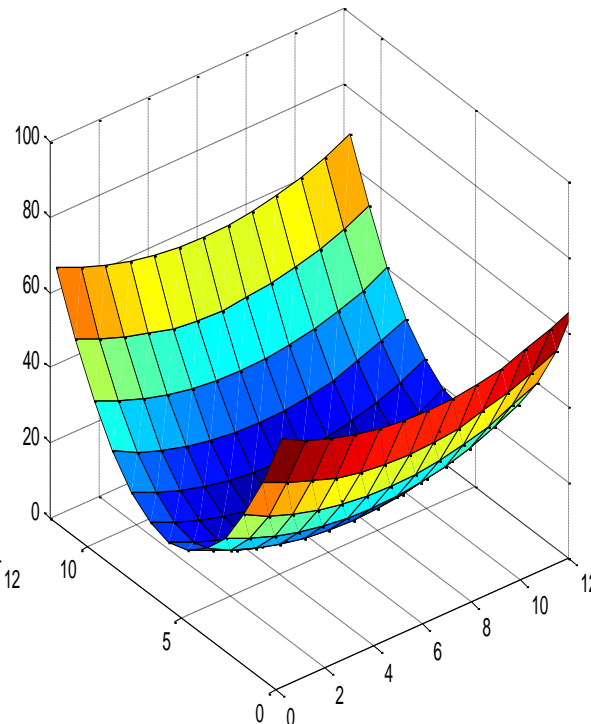
$$C = \sum_{x, y} w(x, y) I_x(x, y) I_y(x, y)$$

Harris Corner Detector (cont.)

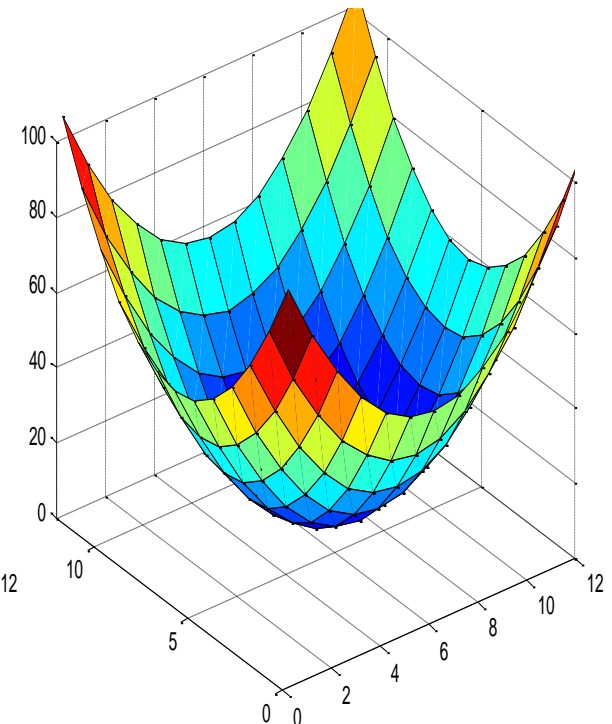
- High-level idea: what shape of the error function will we prefer for features?



flat



edge

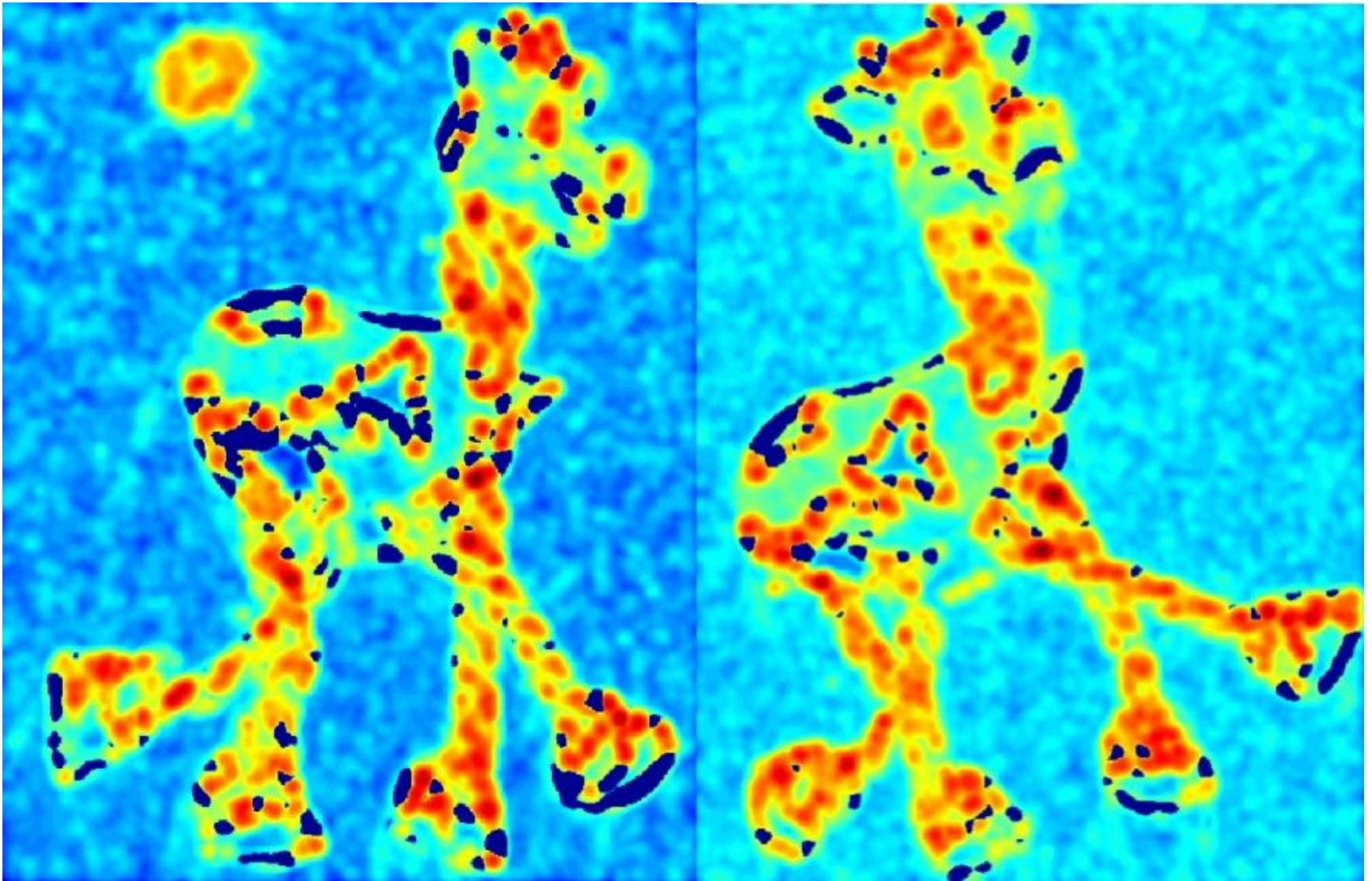


corner

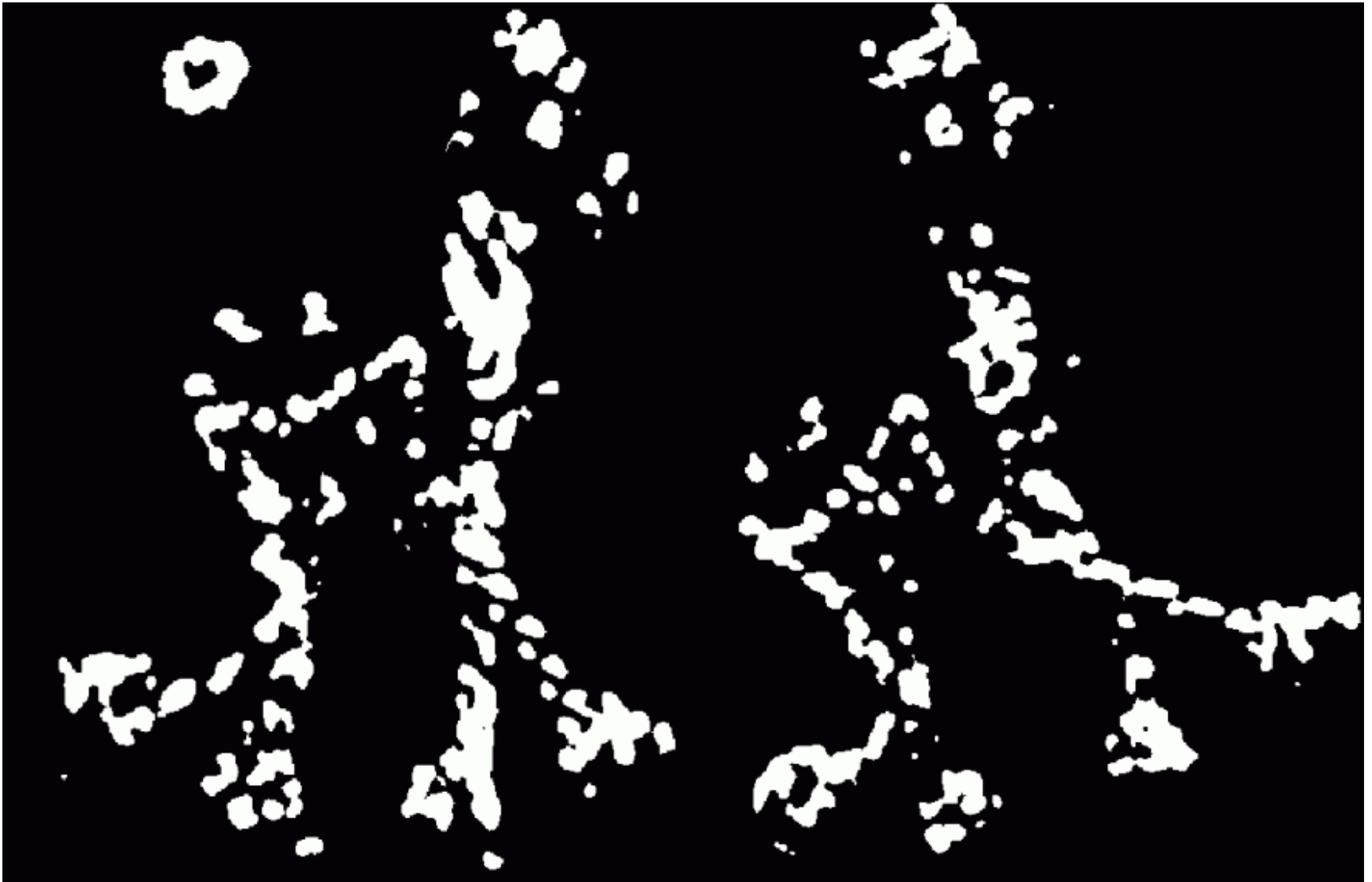
Harris Corner Detector (Input)



Harris Corner Detector (Response)



Harris Corner Detector (Theshold)



Harris Corner Detector (Local Maximum)

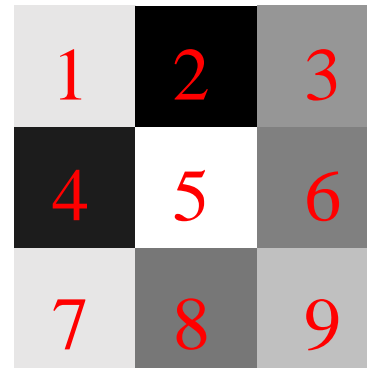


Harris Corner Detector (Output)



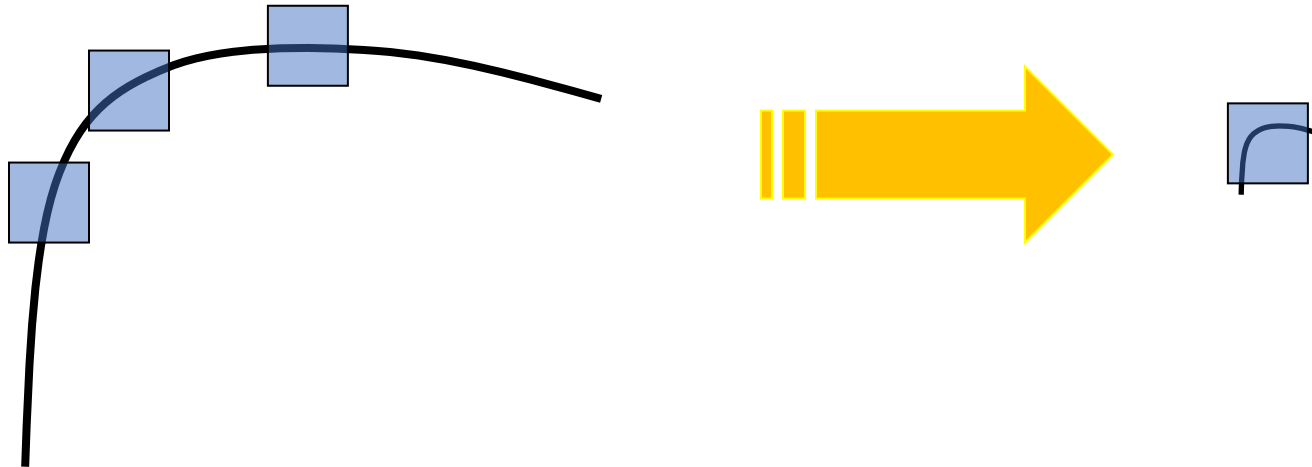
Feature Description

- Now we know where the features are
- But how to match them?
- What is the descriptor for a feature? The simplest solution is the intensities of its spatial neighbors
- This might not be robust to brightness change or small shift/rotation



Problems of Harris Detector

- Not invariant to image scale

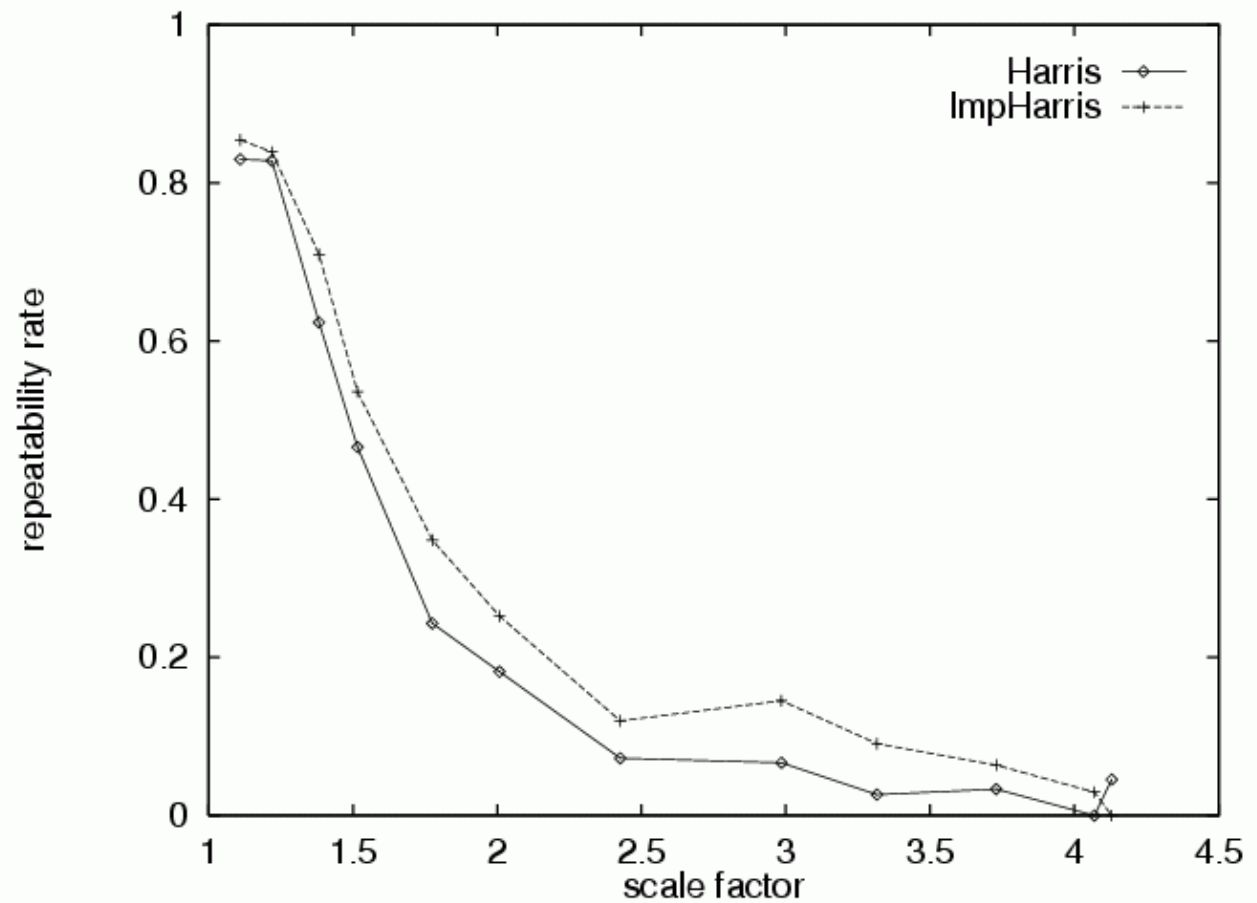


All points will be classified as **edges**

Corner !

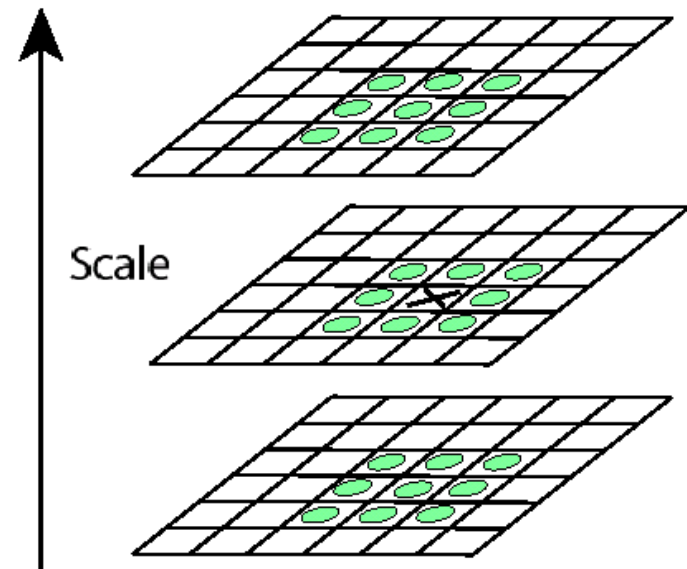
Problems of Harris Detector (cont.)

- Not invariant to image scale



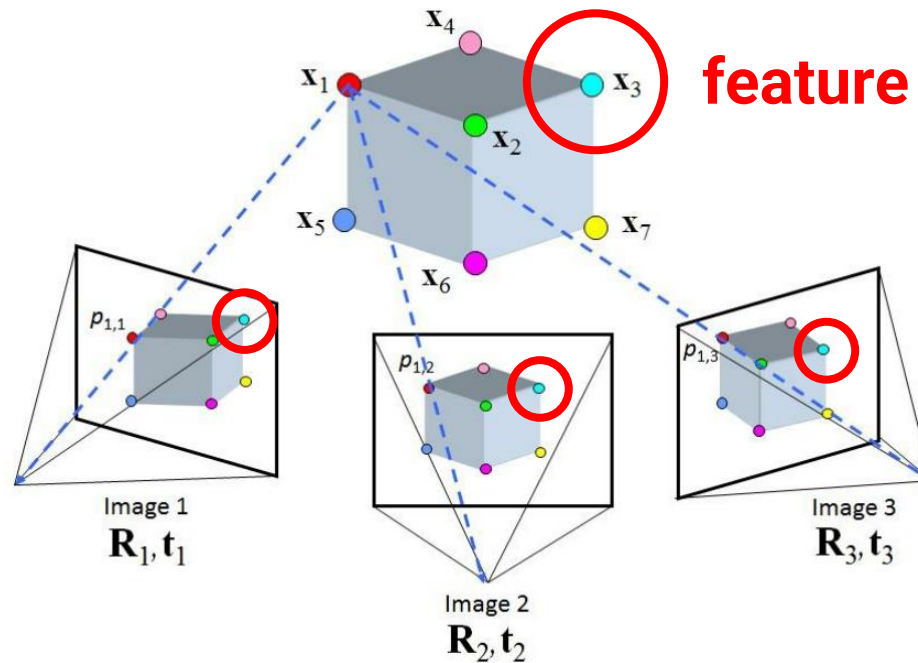
SIFT

- Stands for **Scaled Invariant Feature Transform**
- For **scale invariance**, search for stable features **across all possible scales** using a continuous function of scale, scale space.

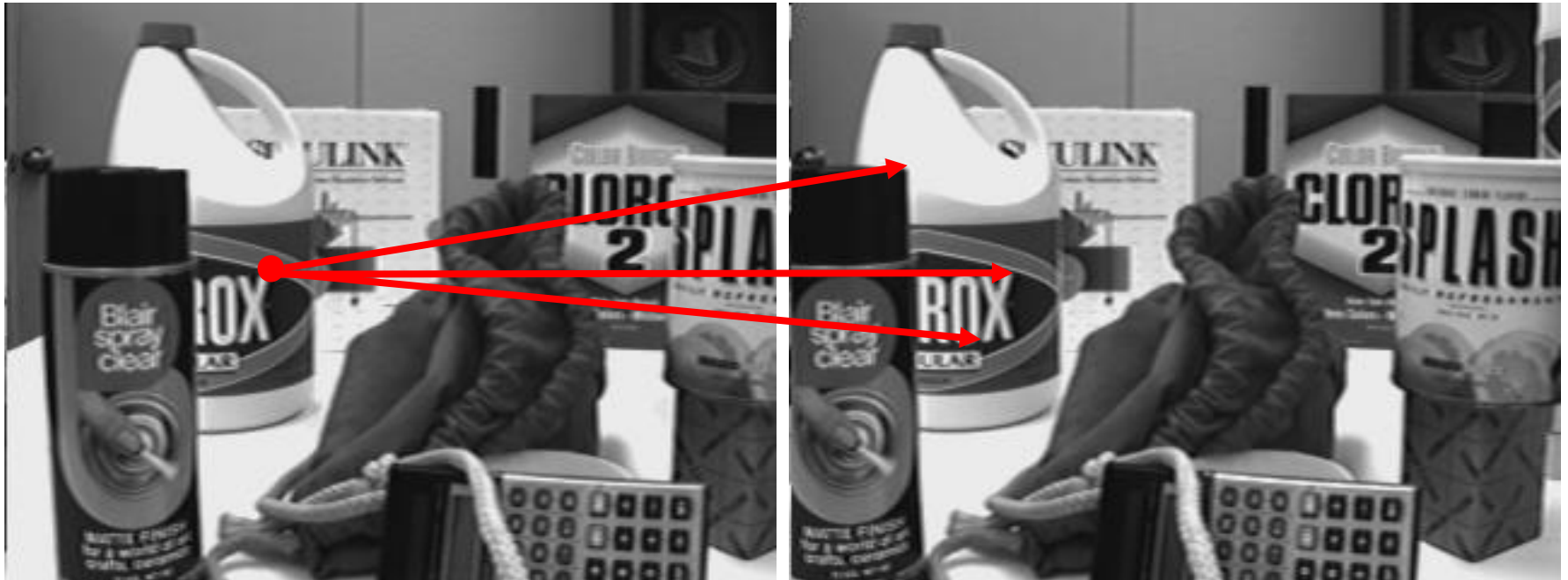


Tracking

- If we detect a feature point in one frame, how do we keep tracks of it in other frames?



Tracking (cont.)

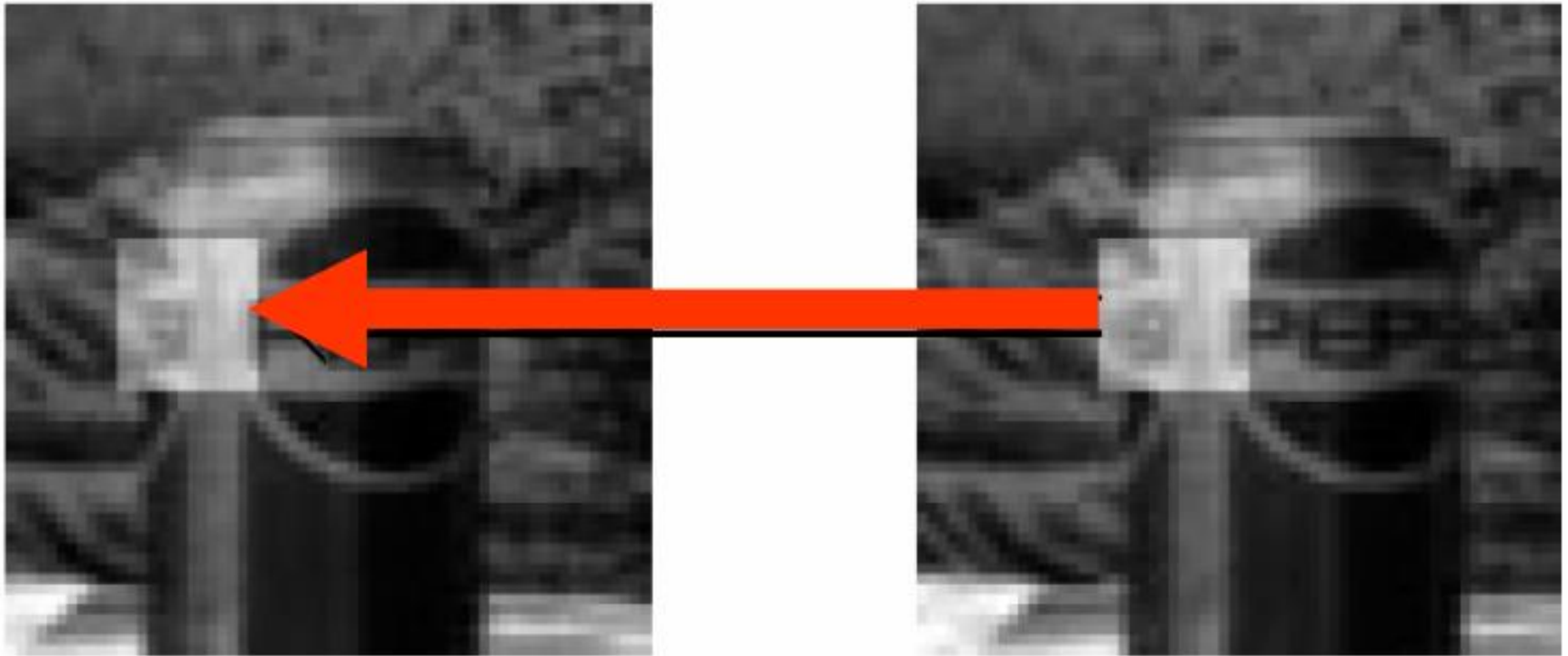


Three Assumptions of Tracking

- **Brightness consistency**
- **Spatial coherence**
- **Temporal persistence**

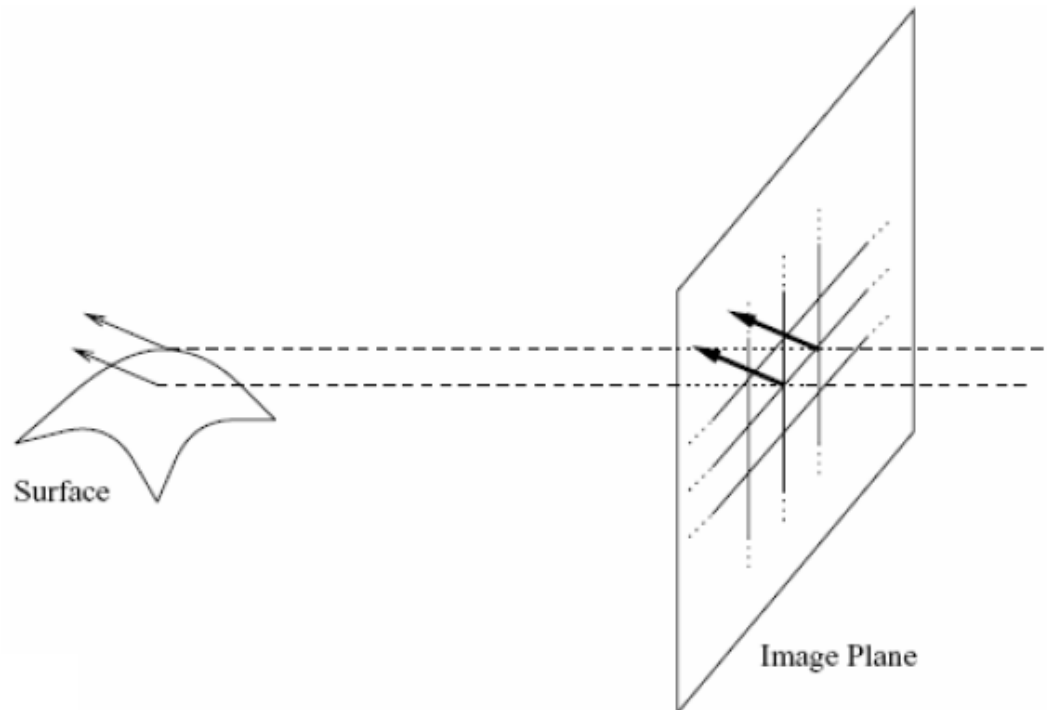
Brightness Consistency

- Image measurement (e.g. brightness) in a small region remain the same although their location may change



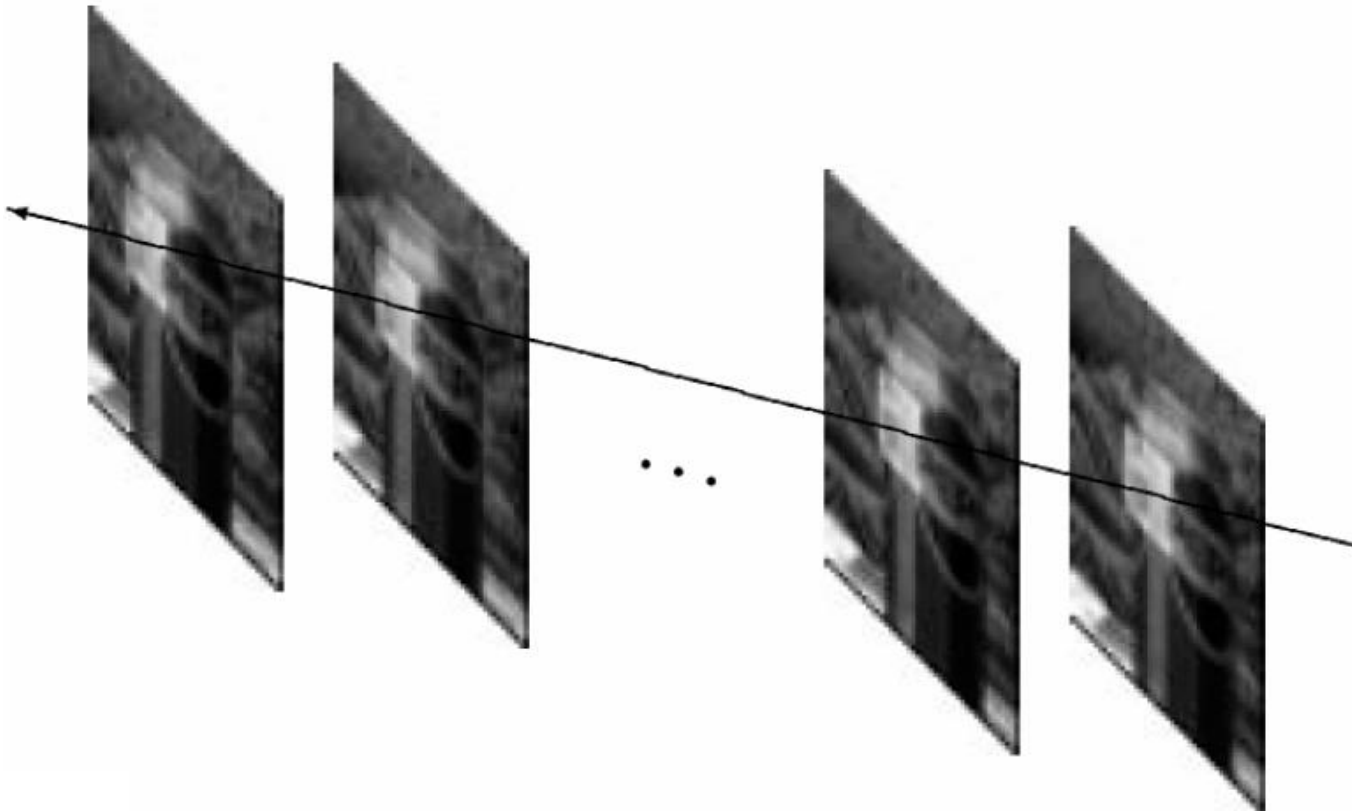
Spatial Coherence

- Neighboring points in the scene typically belong to the same surface and hence typically have similar motions.
- Since they also project to nearby pixels in the image, we expect spatial coherence in image flow.



Temporal Persistence

- The image motion of a surface patch changes gradually over time



Simple Tracking Approach

- Minimize brightness difference

$$E(u, v) = \sum_{x, y} (I(x + u, y + v) - T(x, y))^2$$

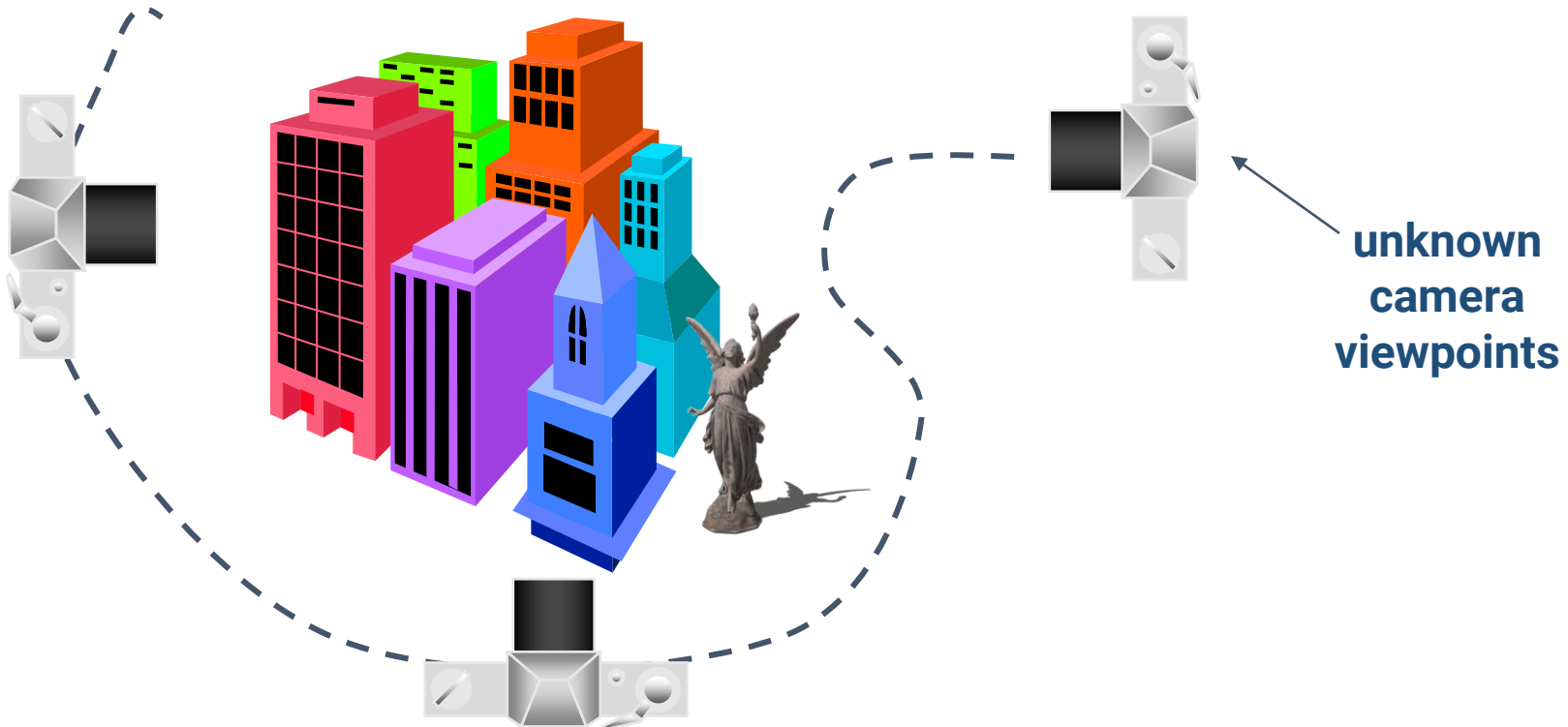
- For each offset (u, v) compute E(u, v)
- Choose (u, v) which minimizes E(u, v)
- Problems:
 - Not efficient
 - Only sub-pixel accuracy

There are more efficient algorithms (e.g. Lucas-Kanade) for tracking

Back to the Matchmove Problem

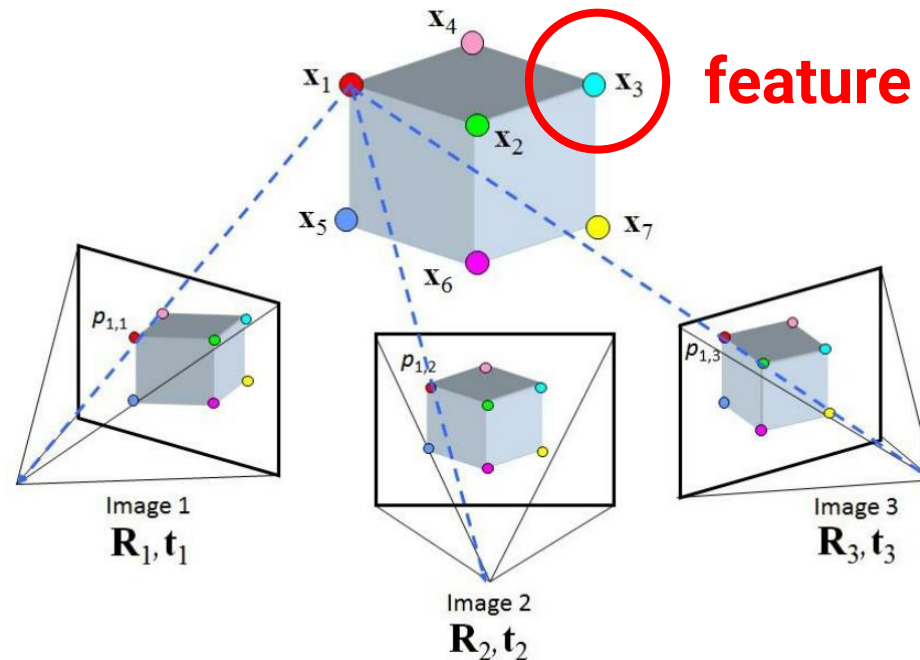
We need to reconstruct the **camera path**

We also need to reconstruct the **(partial) scene geometry**

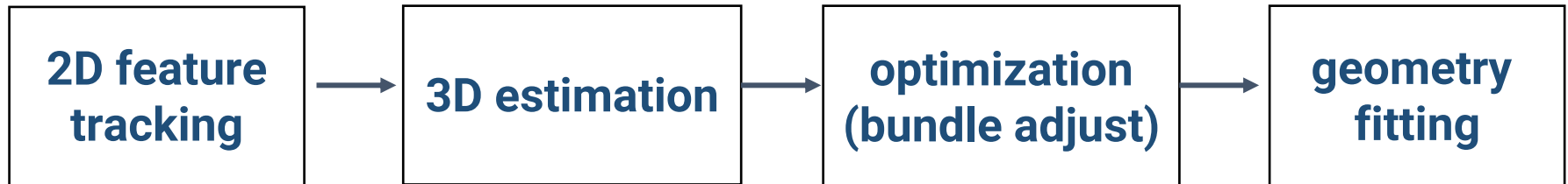


Back to the Matchmove Problem (cont.)

- For the scene geometry, we only recover the 3D position of **feature points**

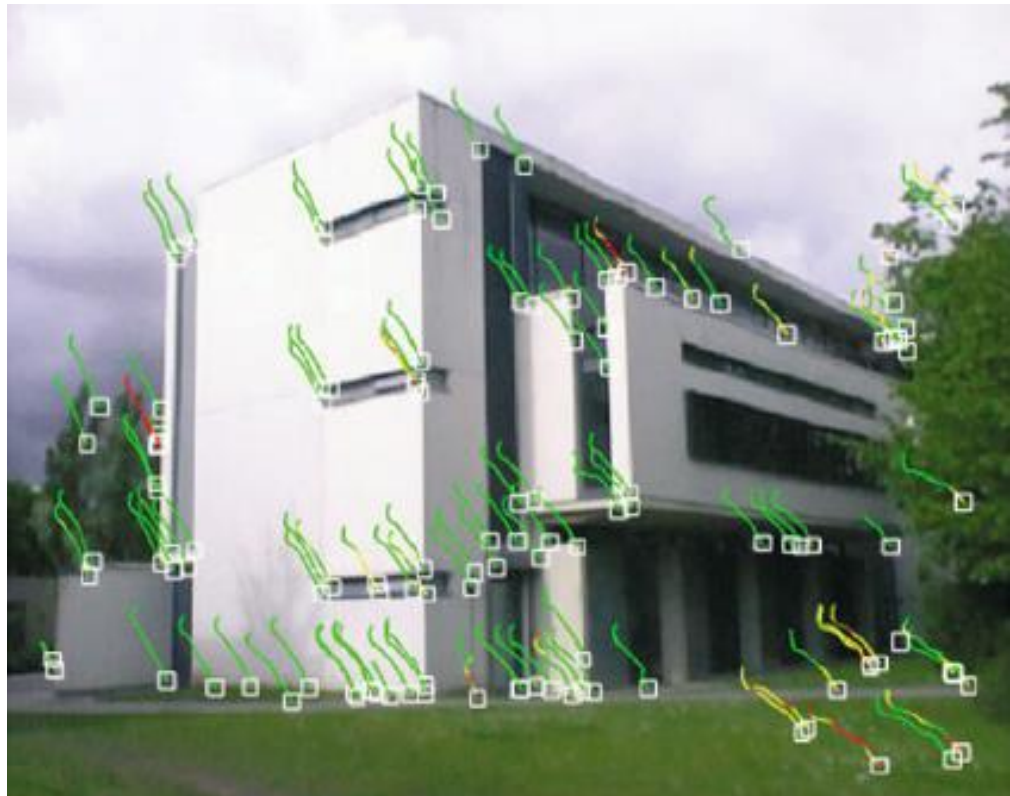


Matchmove Pipeline



2D Feature Tracking

- Detect good features (e.g. by SIFT)
- Find correspondences between frames



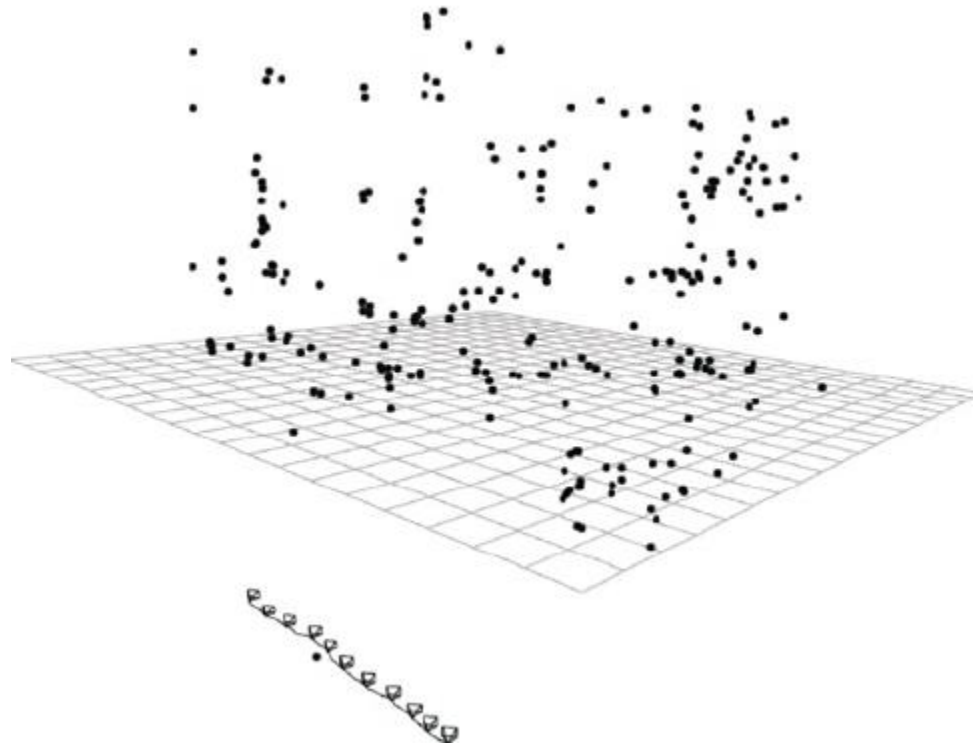
3D Estimation

- Use 2 or 3 views at a time
- Solve an optimization problem



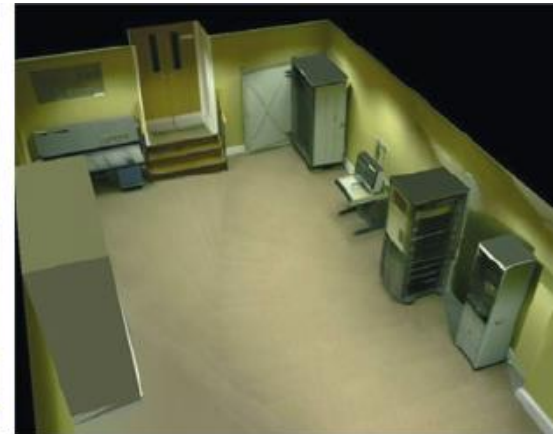
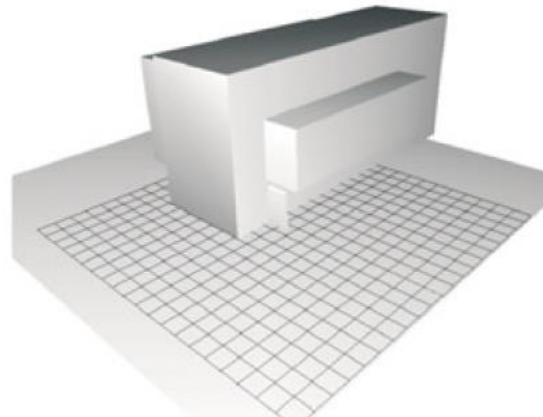
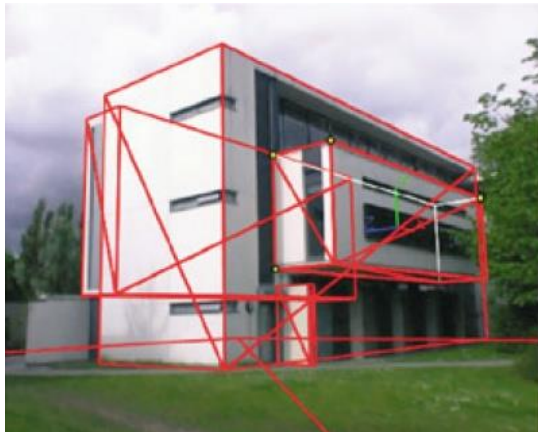
Optimization

- Iterative refine estimates



Geometry Fitting

- Recover surface by image-based triangulation, silhouettes, or stereo



Matchmove in Blender

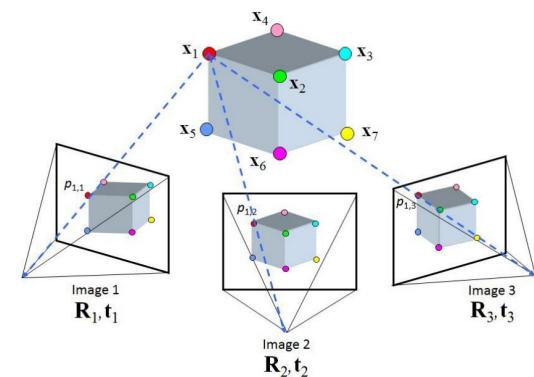
Steps

- **Prepare a video**
- **Extract image sequence (optional)**
- **3D estimation: solve and optimize camera motion and scene geometry**
- **Import 3D models and edit their animations**
- **Output video**

Prepare a Video

Prepare a Video

- You can either capture your video (suggested) or download ones from the internet
- **Some useful tips**
 - It is better to have **many features** in your video
 - And the features should exist in the entire video (**especially for the ground**)
 - Not too long (if it is, subdivide it and edit each part separately)
 - Your camera should have both **translation** and **rotation**
 - Your video should have **large parallax**



Bad example



Good example

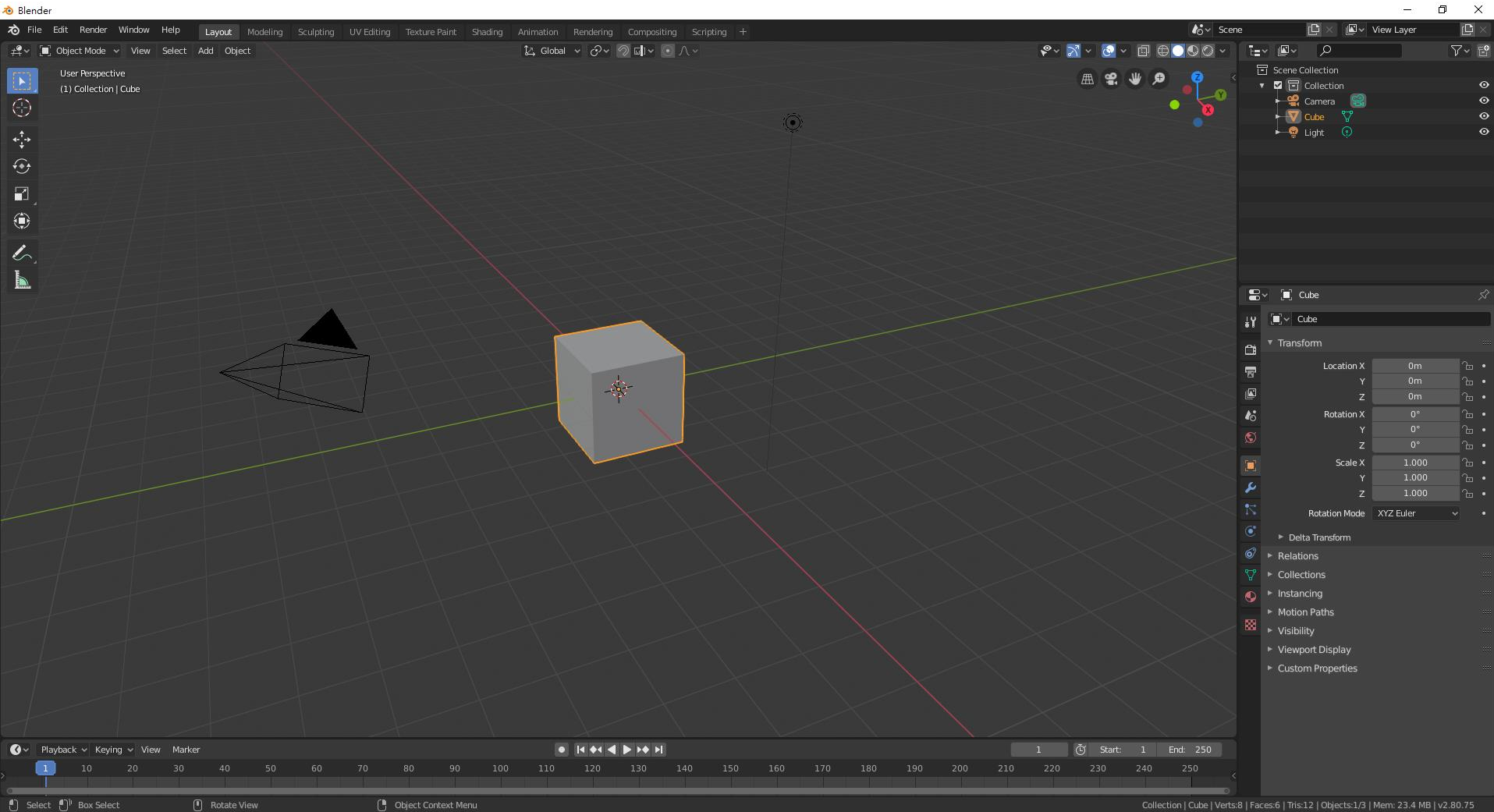


Extract Image Sequence (Optional)

Convert a Video into Image Sequence

- **Why?**
 - Video files have compression built-in
 - Using image sequence leads to better run-time performance

Delete unused objects



Load Your Video (1)

The screenshot displays the Blender 2.80.75 interface. The top menu bar includes File, Edit, Render, Window, Help, Layout, Modeling, Sculpting, UV Editing, Texture Paint, Shading, Animation, Rendering, Compositing, and Scripting. The 'Editor Type' menu is open, showing various editor options. The 'Movie Clip Editor' is highlighted with a red box. A yellow text overlay with a black outline reads 'Change to 'Movie Clip Editor'' and points to the selected option. The 3D Viewport shows a wireframe cube on a grid. The right sidebar shows the 'Scene' collection with 'Camera' and 'Light' objects. The bottom status bar shows 'Collection | Verts:0 | Faces:0 | Tris:0 | Objects:0/2 | Mem: 23.7 MB | v2.80.75'.

Blender

File Edit Render Window Help Layout Modeling Sculpting UV Editing Texture Paint Shading Animation Rendering Compositing Scripting +

Scene View Layer

Editor Type

General	Animation	Scripting	Data
3D Viewport (Shift F5)	Dope Sheet (Shift F12)	Text Editor (Shift F11)	Outliner (Shift F9)
Image Editor (Shift F10)	Timeline (Shift F12)	Python Console (Shift F4)	Properties (Shift F7)
UV Editor (Shift F10)	Graph Editor (Shift F6)	Info (F1)	File Browser (Shift F1)
Shader Editor (Shift F3)	Drivers (Shift F6)	Preferences	
Compositor (Shift F3)	Nonlinear Animation		
Texture Node Editor (Shift F3)			
Video Sequencer (Shift F8)			
Movie Clip Editor (Shift F2)			

Motion tracking tools.
Shift F2

Change to 'Movie Clip Editor'

Scene View Layer

Scene

- Camera
- Background Scene
- Active Movie Clip
- Units
- Gravity
- Keying Sets
- Audio
- Rigid Body World
- Custom Properties

Playback Keying View Marker

1 Start: 1 End: 250

1 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250

Select Box Select Rotate View Object Context Menu

Collection | Verts:0 | Faces:0 | Tris:0 | Objects:0/2 | Mem: 23.7 MB | v2.80.75

Load Your Video (2)

Blender

File Edit Render Window Help Layout Modeling Sculpting UV Editing Texture Paint Shading Animation Rendering Compositing Scripting +

Scene View Layer

Tracking Clip View Clip

Annotation

Draw:

Draw Erase
Line Poly

Insert Blank Frame
Delete Frame(s)

Data Source:

Clip Track

Stroke Placement:

View Cursor

Open

Load a sequence of frames or a movie file.

2. Press the 'Open' button

1. Make sure you choose the 'Clip' type

Scene View Layer

Scene

Camera Camera

Background Scene

Active Movie Clip

Units

Gravity

Keying Sets

Audio

Rigid Body World

Custom Properties

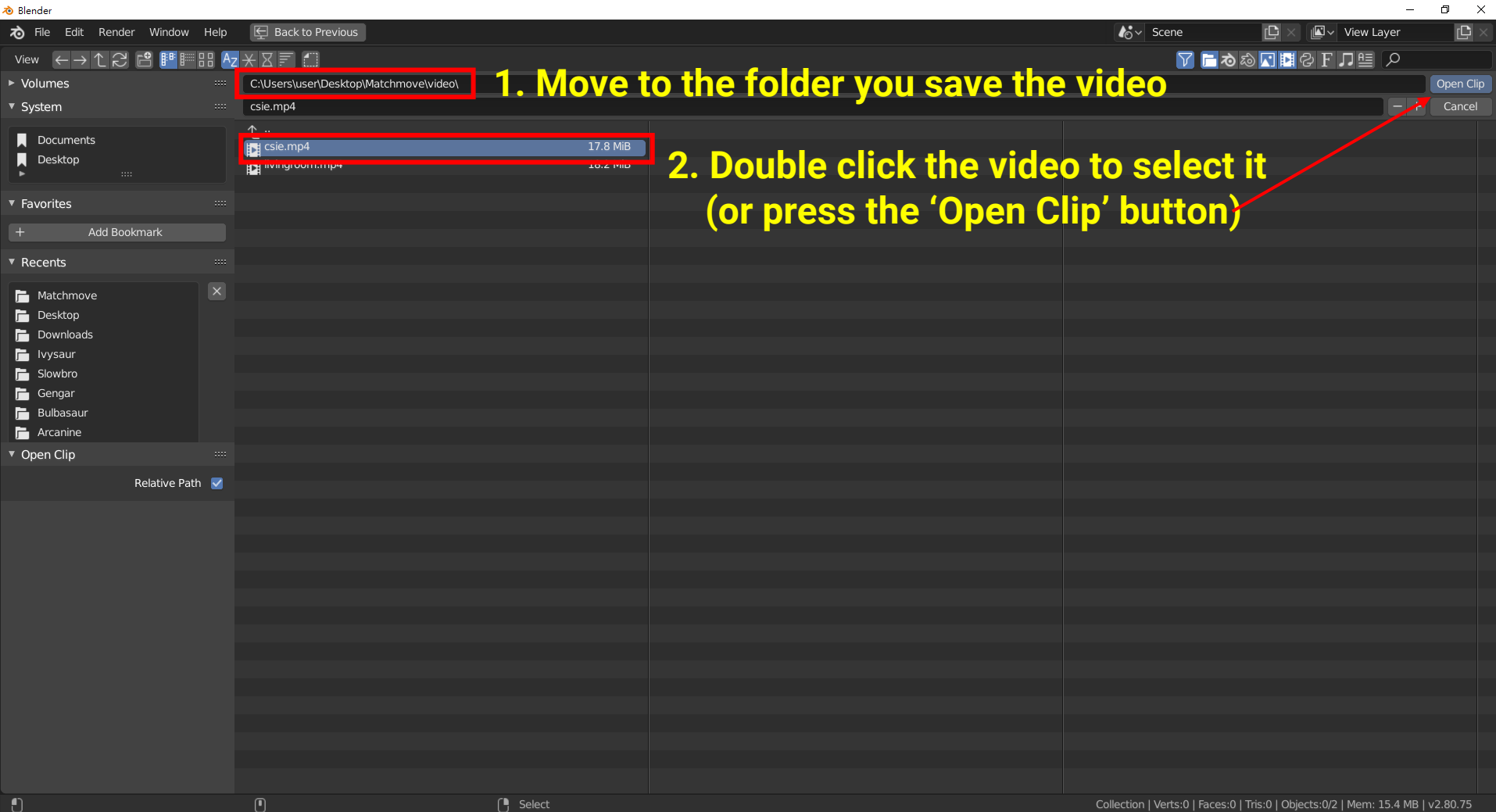
Playback Keying View Marker

1 Start: 1 End: 250

1 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250

Collection | Verts:0 | Faces:0 | Tris:0 | Objects:0/2 | Mem: 15.3 MB | v2.80.75

Load Your Video (3)



The screenshot shows the Blender File dialog box. The address bar at the top displays the path `C:\Users\User\Desktop\Matchmove\video\`, which is highlighted with a red box. Below the address bar, the file list shows `csie.mp4` (17.8 MiB) selected, also highlighted with a red box. A red arrow points from the text 'Open Clip' to the 'Open Clip' button in the top right corner of the dialog. The 'Open Clip' button is also highlighted with a red box. The 'Recents' list on the left shows the 'Matchmove' folder selected. The status bar at the bottom right displays 'Collection | Verts:0 | Faces:0 | Tris:0 | Objects:0/2 | Mem: 15.4 MB | v2.80.75'.

1. Move to the folder you save the video

2. Double click the video to select it (or press the 'Open Clip' button)

Load Your Video (4)

3. Press the 'Set Scene Frames' button (set the video length)

2. Switch to the 'Output' panel

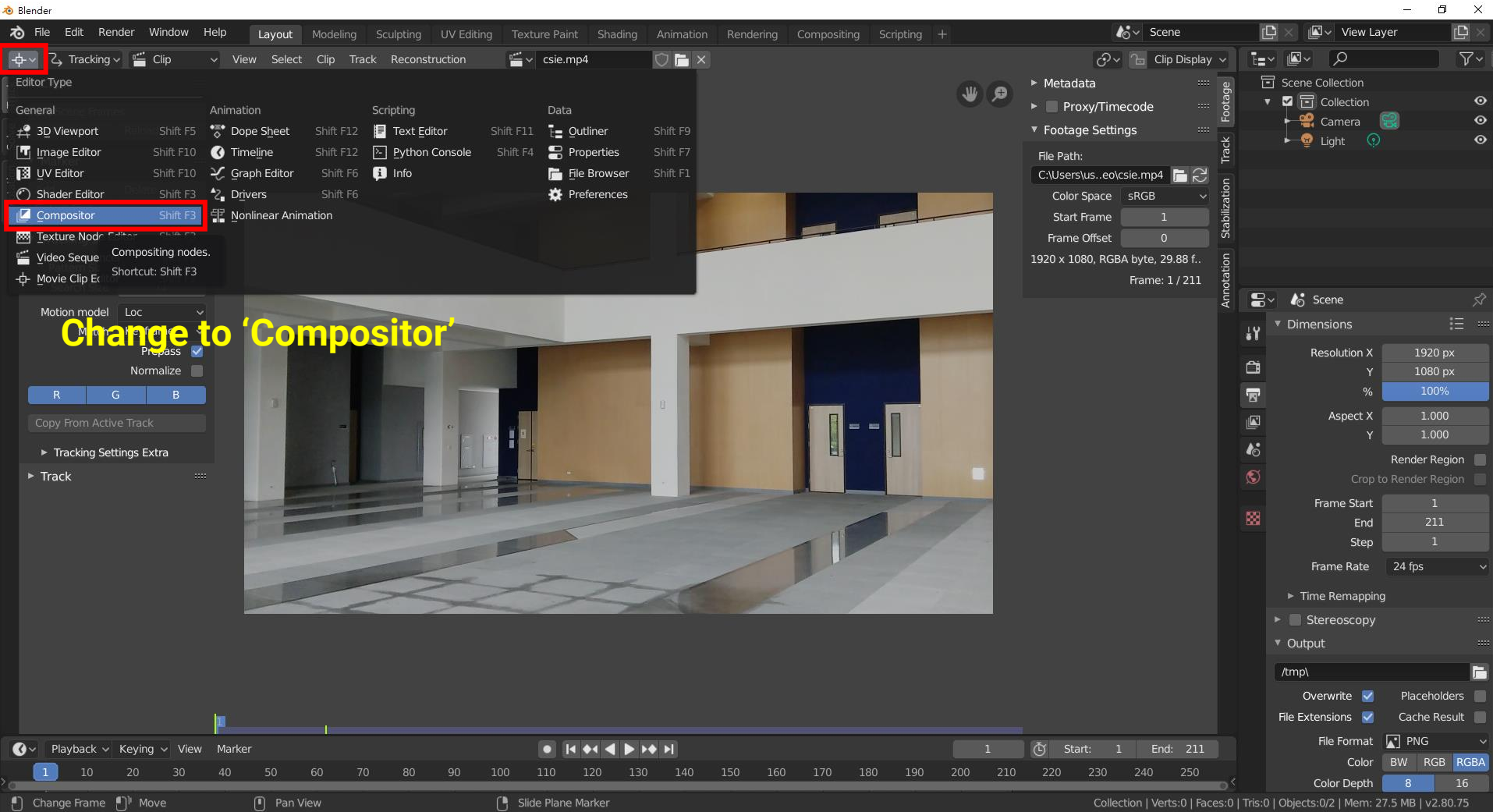
1. You will see your video is loaded

Blender interface showing the video loading process. The central viewport displays a video of a modern building interior. The left sidebar shows the 'Track' panel with 'Set Scene Frames' highlighted. The right sidebar shows the 'Output' panel with 'End' frame set to 250. A timeline at the bottom shows the video duration from 1 to 250 frames.

Load Your Video (5)

Blender 2.80.75 interface showing video clip loading settings. The central viewport displays a video of a modern interior space. The 'Clip Display' panel on the right shows 'File Path: C:\Users\lus...eo\csie.mp4' and 'Frame: 1 / 211'. The 'Dimensions' panel on the right shows 'Resolution X: 1920 px', 'Resolution Y: 1080 px', and 'Aspect X: 1.000'. The 'Frame Start' is 1, 'End' is 211, and 'Step' is 1. The 'Timeline' at the bottom shows the current frame at 1, with 'Start: 1' and 'End: 211' highlighted in red. A yellow text overlay reads 'You will see the number of frames has been changed' with a red arrow pointing to the 'End' field in the 'Dimensions' panel.

Generate Image Sequence (1)



The screenshot shows the Blender 2.80.75 interface. The top menu bar includes File, Edit, Render, Window, Help, Layout, Modeling, Sculpting, UV Editing, Texture Paint, Shading, Animation, Rendering, Compositing, and Scripting. The Editor Type menu is open, with 'Compositor' highlighted in red. The main viewport shows a 3D render of a modern interior space. The right sidebar shows the Properties panel for the active clip, with the 'Footage Settings' section expanded. The bottom status bar shows the current frame (1) and total frames (211).

Change to 'Compositor'

Resolution X: 1920 px
Resolution Y: 1080 px
Aspect X: 1.000
Aspect Y: 1.000
Frame Start: 1
End: 211
Step: 1
Frame Rate: 24 fps
File Format: PNG
Color: RGB
Color Depth: 8

Generate Image Sequence (2)

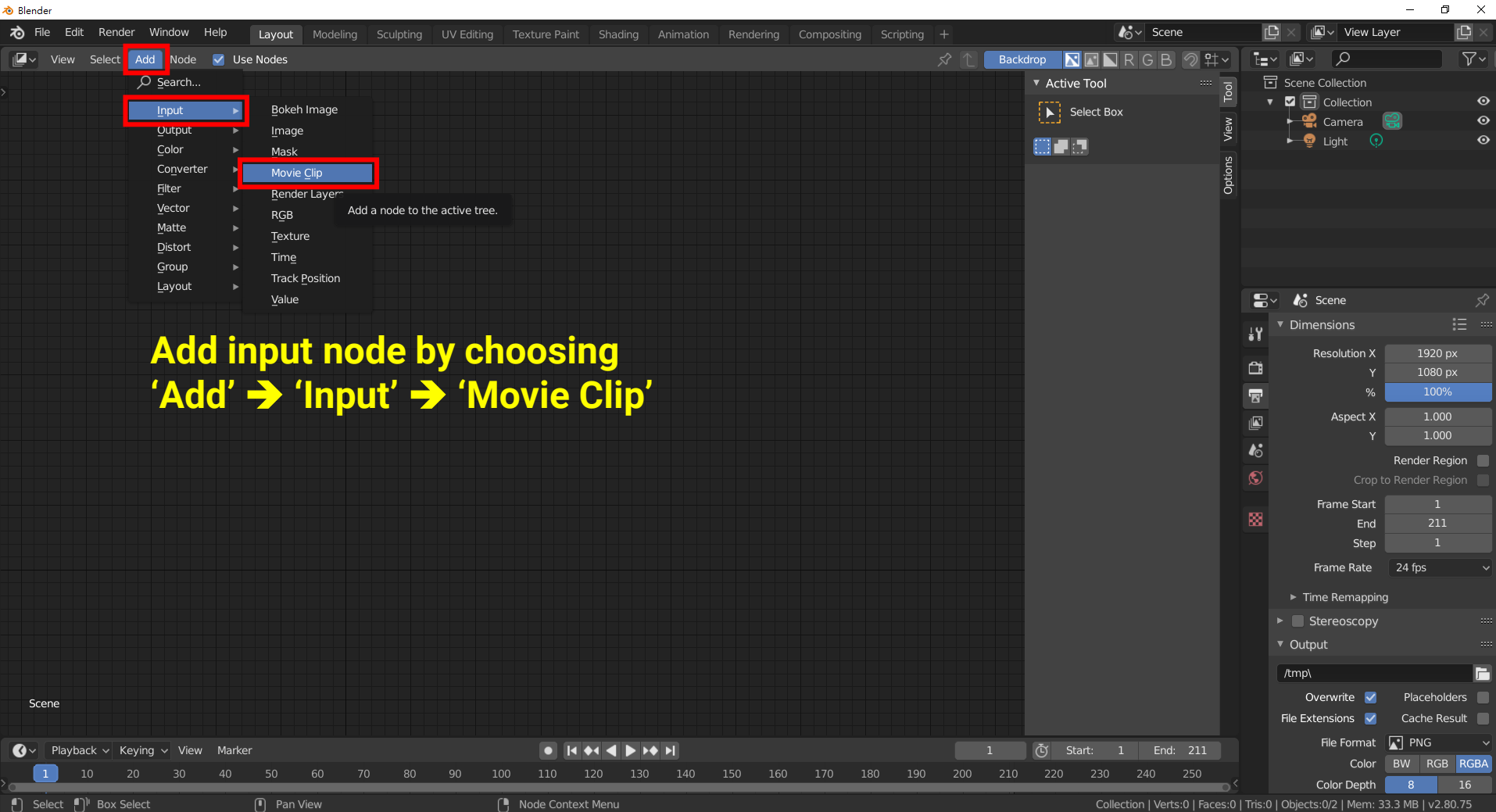
1. Check 'Use Nodes'

2. Delete the default nodes

3. Tick the 'Backdrop' button

The screenshot shows the Blender 2.80.75 interface. The top bar has 'Use Nodes' checked and 'Backdrop' highlighted. The Node Editor shows the 'Render Layers' and 'Composite' nodes. The Properties panel on the right shows the 'Output' settings for the scene, including 'File Format' set to PNG and 'Color Depth' set to 8.

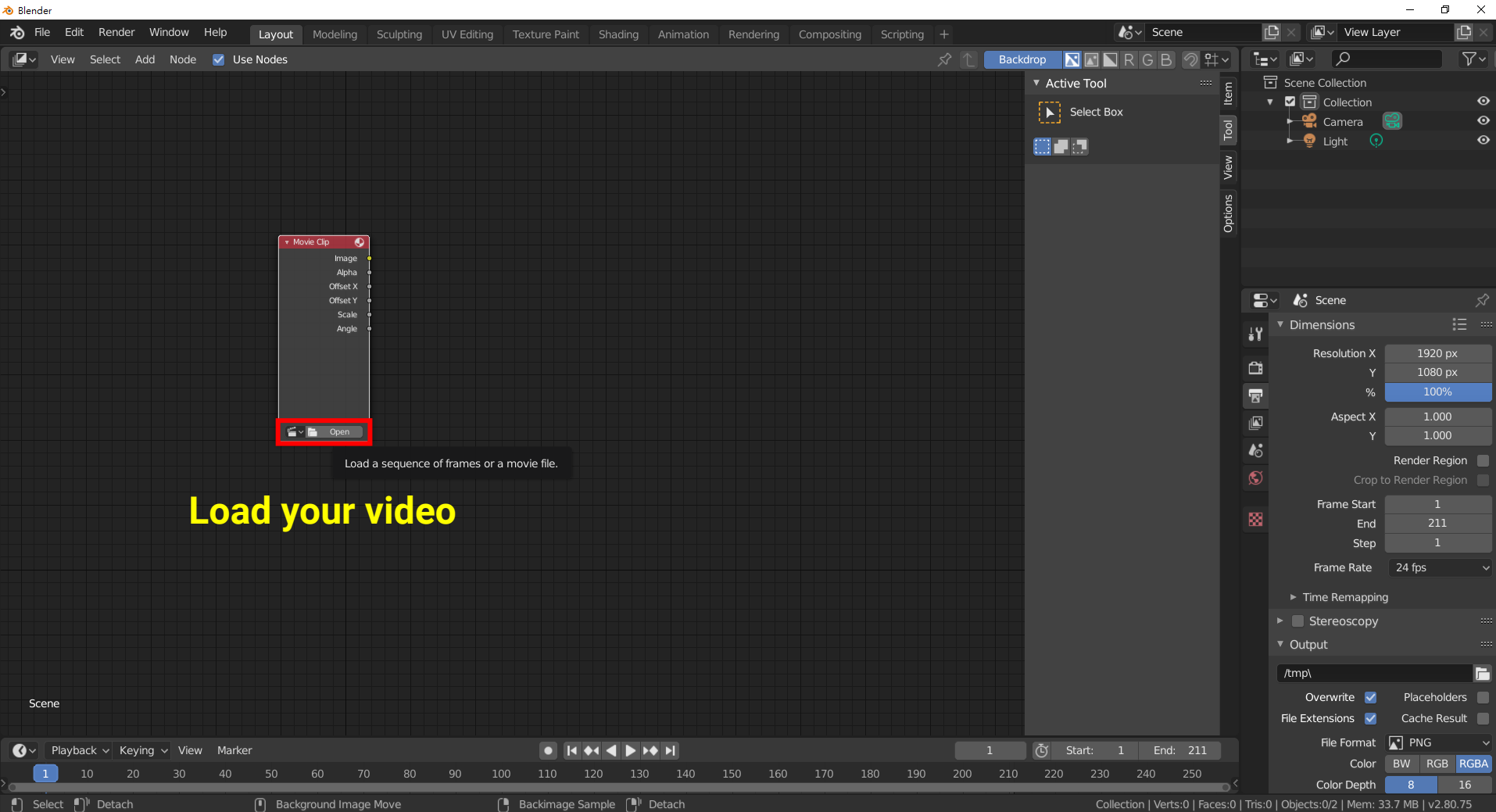
Generate Image Sequence (3)



The image shows the Blender 2.80.75 interface. The 'Add' menu is open, and the 'Input' category is selected. The 'Movie Clip' node is highlighted. The 'Active Tool' panel shows 'Select Box'. The 'Scene' properties panel is visible on the right, showing dimensions and output settings. The timeline at the bottom shows frame 1 selected.

**Add input node by choosing
'Add' → 'Input' → 'Movie Clip'**

Generate Image Sequence (4)



The image shows the Blender 2.80.75 interface. The main 3D viewport is in the center, displaying a dark grid. A 'Movie Clip' node is visible in the Outliner on the right, with its properties panel open. The 'Open' button at the bottom of the properties panel is highlighted with a red rectangle. Below the 'Open' button, the text 'Load a sequence of frames or a movie file.' is displayed. The 'Dimensions' panel on the right shows the following settings:

Property	Value
Resolution X	1920 px
Resolution Y	1080 px
%	100%
Aspect X	1.000
Aspect Y	1.000
Render Region	<input type="checkbox"/>
Crop to Render Region	<input type="checkbox"/>
Frame Start	1
End	211
Step	1
Frame Rate	24 fps

The 'Output' panel shows the following settings:

Property	Value
File Format	PNG
Color	RGB (selected)
Color Depth	8

The 'Dimensions' panel also shows 'Frame Start' set to 1 and 'End' set to 211. The 'Output' panel shows 'File Format' set to PNG, 'Color' set to RGB, and 'Color Depth' set to 8. The 'Dimensions' panel shows 'Resolution X' set to 1920 px, 'Resolution Y' set to 1080 px, and 'Frame Rate' set to 24 fps.

Load your video

Generate Image Sequence (5)

The image shows the Blender 2.80.75 interface. The 'Add' button in the top-left corner is highlighted with a red box. A dropdown menu is open, showing the 'Output' category selected, with the 'Composite' node highlighted in blue. A yellow text overlay reads: "Add input node by choosing 'Add' → 'Output' → 'Composite'". The Outliner on the right shows a 'Scene Collection' containing a 'Collection', 'Camera', and 'Light'. The Properties panel on the right shows the 'Scene' properties, including 'Dimensions' (Resolution X: 1920 px, Y: 1080 px, Aspect X: 1.000, Y: 1.000) and 'Output' (File Format: PNG, Color: RGB, Color Depth: 8). The timeline at the bottom shows frame 1 selected, with a range from 1 to 211.

Blender

File Edit Render Window Help Layout Modeling Sculpting UV Editing Texture Paint Shading Animation Rendering Compositing Scripting +

Scene

View Layer

View Select Add Node Use Nodes

Search...

Input

Output Composite

Color File Output

Converter Levels

Filter Split Viewer

Vector Viewer

Matte

Distort

Group

Layout

movie Clip

Image

Alpha

Offset X

Offset Y

Scale

Angle

Active Tool

Select Box

Scene Collection

Collection

Camera

Light

Dimensions

Resolution X 1920 px

Y 1080 px

% 100%

Aspect X 1.000

Y 1.000

Render Region

Crop to Render Region

Frame Start 1

End 211

Step 1

Frame Rate 24 fps

Time Remapping

Stereoscopy

Output

/tmp/

Override Placeholders

File Extensions Cache Result

File Format PNG

Color BW RGB RGBA

Color Depth 8 16

Scene

Playback Keying View Marker

1 Start: 1 End: 211

1 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250

Select Box Select Pan View Node Context Menu

Collection | Verts:0 | Faces:0 | Tris:0 | Objects:0/2 | Mem: 34.4 MB | v2.80.75

Generate Image Sequence (6)

The image shows the Blender 2.80.75 interface during the process of generating an image sequence. The 'Add' button in the top-left corner is highlighted with a red box. A dropdown menu is open, showing the 'Output' category selected, with the 'Viewer' node highlighted in blue. A yellow text overlay reads: "Add input node by choosing 'Add' → 'Output' → 'Viewer'". The active tree shows a 'Composite' node with a 'Use Alpha' property set to 1.000. The 'Dimensions' panel on the right shows the resolution set to 1920 x 1080 px, 100% scale, and the frame range from 1 to 211. The 'Output' panel shows the file format set to PNG and the color depth set to 8 bits.

Blender

File Edit Render Window Help Layout Modeling Sculpting UV Editing Texture Paint Shading Animation Rendering Compositing Scripting +

Scene View Layer

Backdrop R G B

Active Tool: Select Box

Scene Collection: Collection, Camera, Light

Dimensions: Resolution X: 1920 px, Y: 1080 px, %: 100%, Aspect X: 1.000, Y: 1.000, Render Region: Crop to Render Region, Frame Start: 1, End: 211, Step: 1, Frame Rate: 24 fps

Time Remapping: Stereoscopy

Output: /tmp/, Overwrite, Placeholders, File Extensions, Cache Result, File Format: PNG, Color: BW, RGB, RGBA, Color Depth: 8, 16

Scene

Playback Keying View Marker: 1, Start: 1, End: 211

1 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250

Select Box Select Pan View Node Context Menu Collection | Verts:0 | Faces:0 | Tris:0 | Objects:0/2 | Mem: 34.7 MB | v2.80.75

Generate Image Sequence (7)

Blender

File Edit Render Window Help Layout Modeling Sculpting UV Editing Texture Paint Shading Animation Rendering Compositing Scripting +

Scene View Layer

View Select Add Node Use Nodes

Backdrop R G B

Active Tool: Select Box

Scene Collection: Collection, Camera, Light

Scene Dimensions: Resolution X: 1920 px, Y: 1080 px, %: 100%, Aspect X: 1.000, Y: 1.000, Render Region, Frame Start: 1, End: 211, Step: 1, Frame Rate: 24 fps

Time Remapping: Stereoscopy, Output: /tmp/

Overwrite, Placeholders, File Extensions, Cache Result, File Format: PNG, Color: BW, RGB, RGBA, Color Depth: 8, 16

Collection | Verts:0 | Faces:0 | Tris:0 | Objects:0/2 | Mem: 75.6 MB | v2.80.75

Scene

Movie Clip: Image, Alpha, Offset X, Offset Y, Scale, Angle

Composite: Use Alpha, Image, Alpha: 1.000, Z: 1.000

Viewer: Use Alpha, Image, Alpha: 1.000, Z: 1.000

Playback Keying View Marker

1 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250

Select Detach Background Image Move Backimage Sample Detach

1 Start: 1 End: 211

Link 'Image' (Movie Clip) to 'Image' (Composite) and
Link 'Image' (Movie Clip) to 'Image' (Viewer)

You will see your video shown in the background

Generate Image Sequence (8)

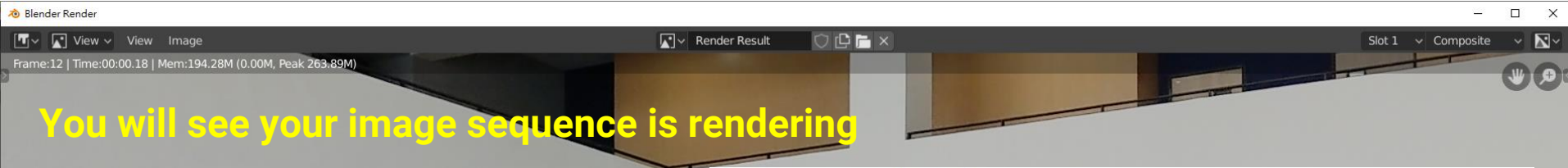
3. Press 'Render' → 'Render Animation'

1. Set the folder to store the image sequence

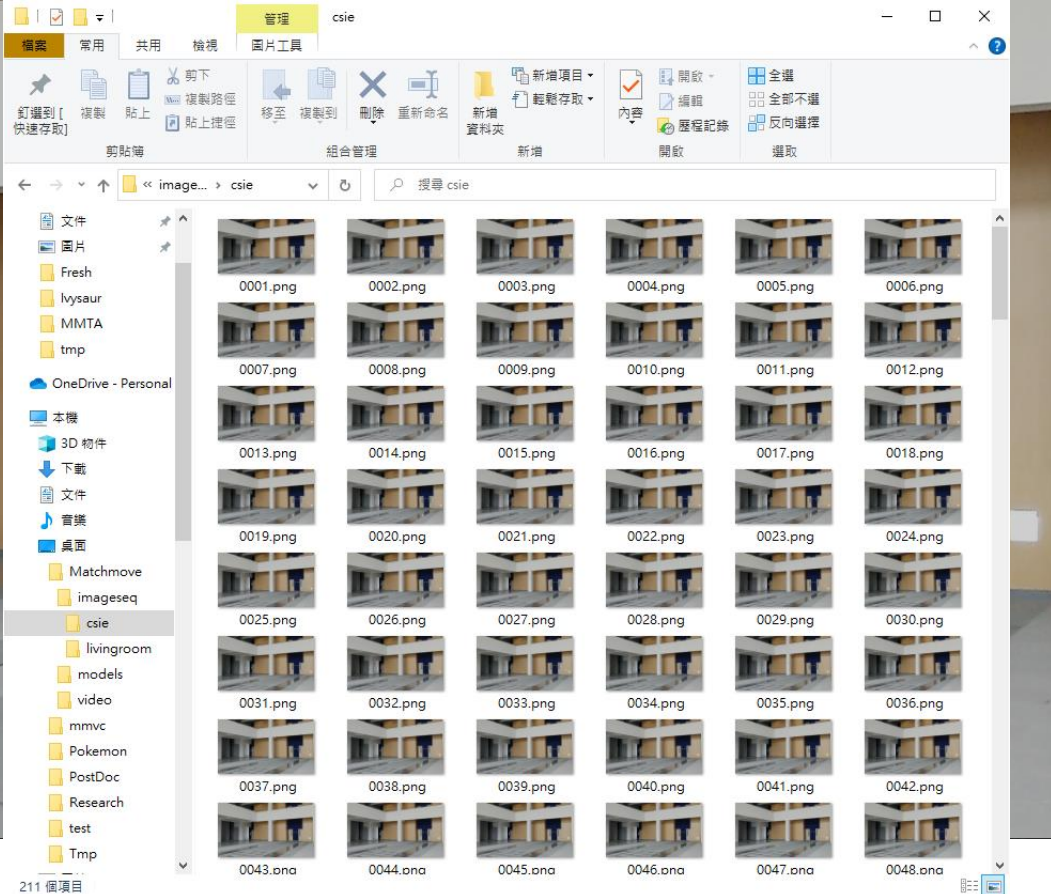
2. Make sure the output type is 'PNG'

The screenshot shows the Blender 2.80.75 interface. The 'Render' menu is open, with 'Render Animation' (Ctrl F12) highlighted. The 'Output' panel in the Properties editor is also highlighted, showing the file format set to PNG. The 3D scene in the background is a hallway with a door and a window.

Generate Image Sequence (9)

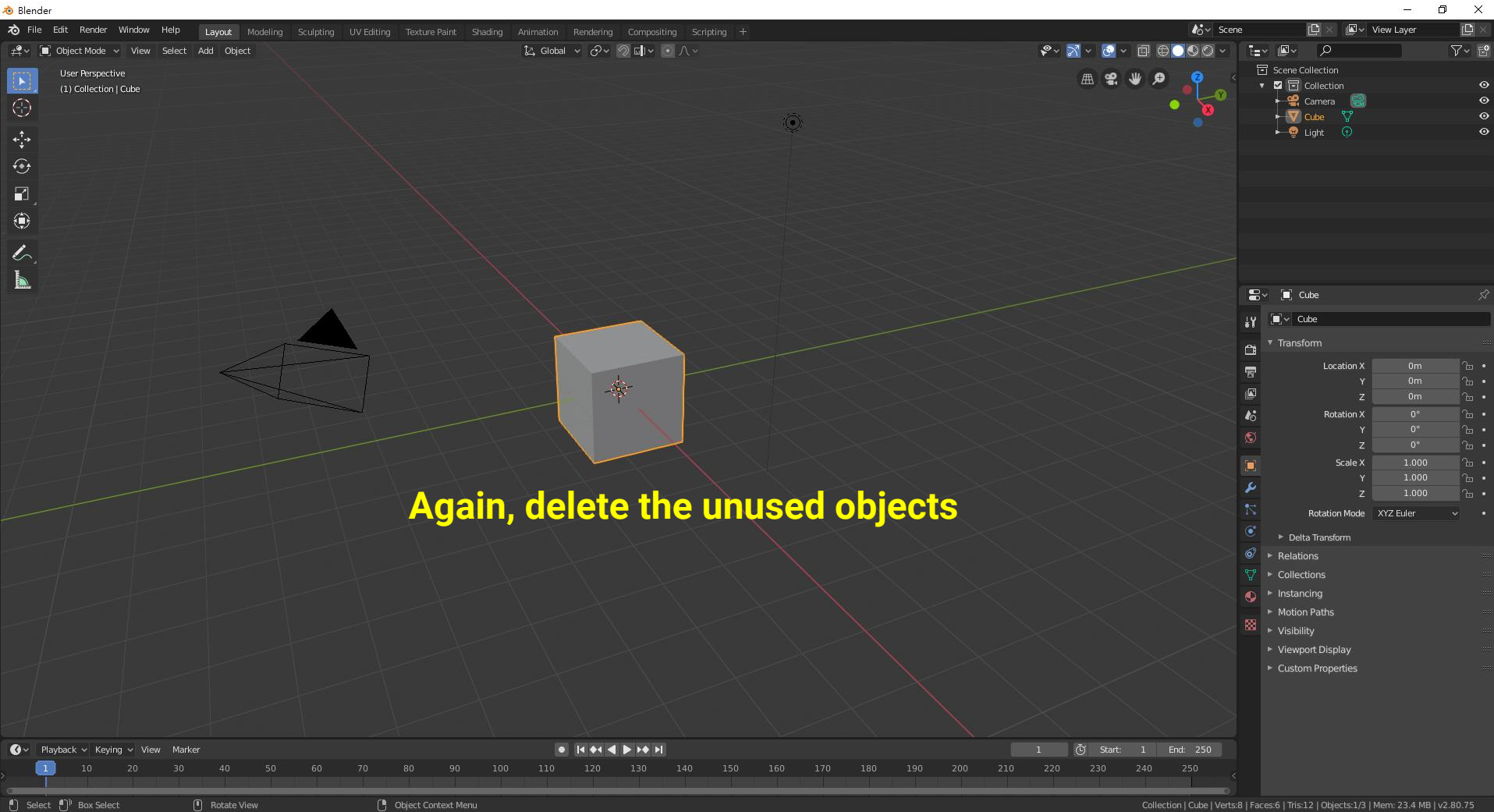


You will see your image sequence is rendering



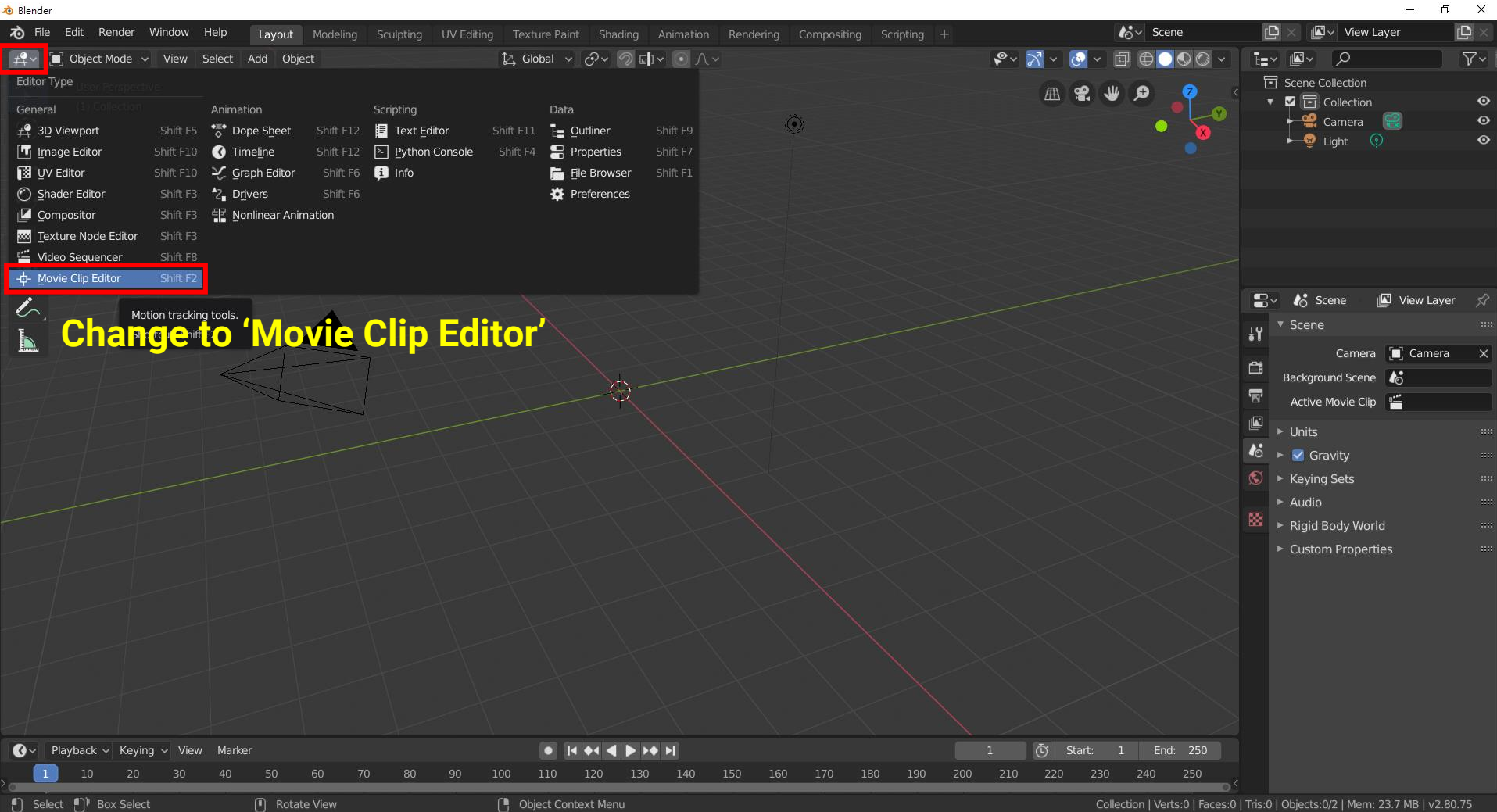
And you can find your image files in the folder

Close your Blender and Reopen It



3D Estimation

Load the Image Sequence (1)



Load the Image Sequence (2)

Blender

File Edit Render Window Help Layout Modeling Sculpting UV Editing Texture Paint Shading Animation Rendering Compositing Scripting +

Scene View Layer

Tracking Clip View Clip

Annotation

Draw:

Draw Erase
Line Poly

Insert Blank Frame
Delete Frame(s)

Data Source:

Clip Track

Stroke Placement:

View Cursor

Open

Load a sequence of frames or a movie file.

2. Press the 'Open' button

1. Make sure you choose the 'Clip' type

Scene View Layer

Scene

Camera Camera

Background Scene

Active Movie Clip

Units

Gravity

Keying Sets

Audio

Rigid Body World

Custom Properties

Playback Keying View Marker

1 Start: 1 End: 250

1 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250

Collection | Verts:0 | Faces:0 | Tris:0 | Objects:0/2 | Mem: 15.3 MB | v2.80.75

Load the Image Sequence (3)

Blender 2.80.7 File Explorer

Path: C:\Users\User\Desktop\Matchmove\imageseq\csie1

1. Move to the folder you save your image sequence

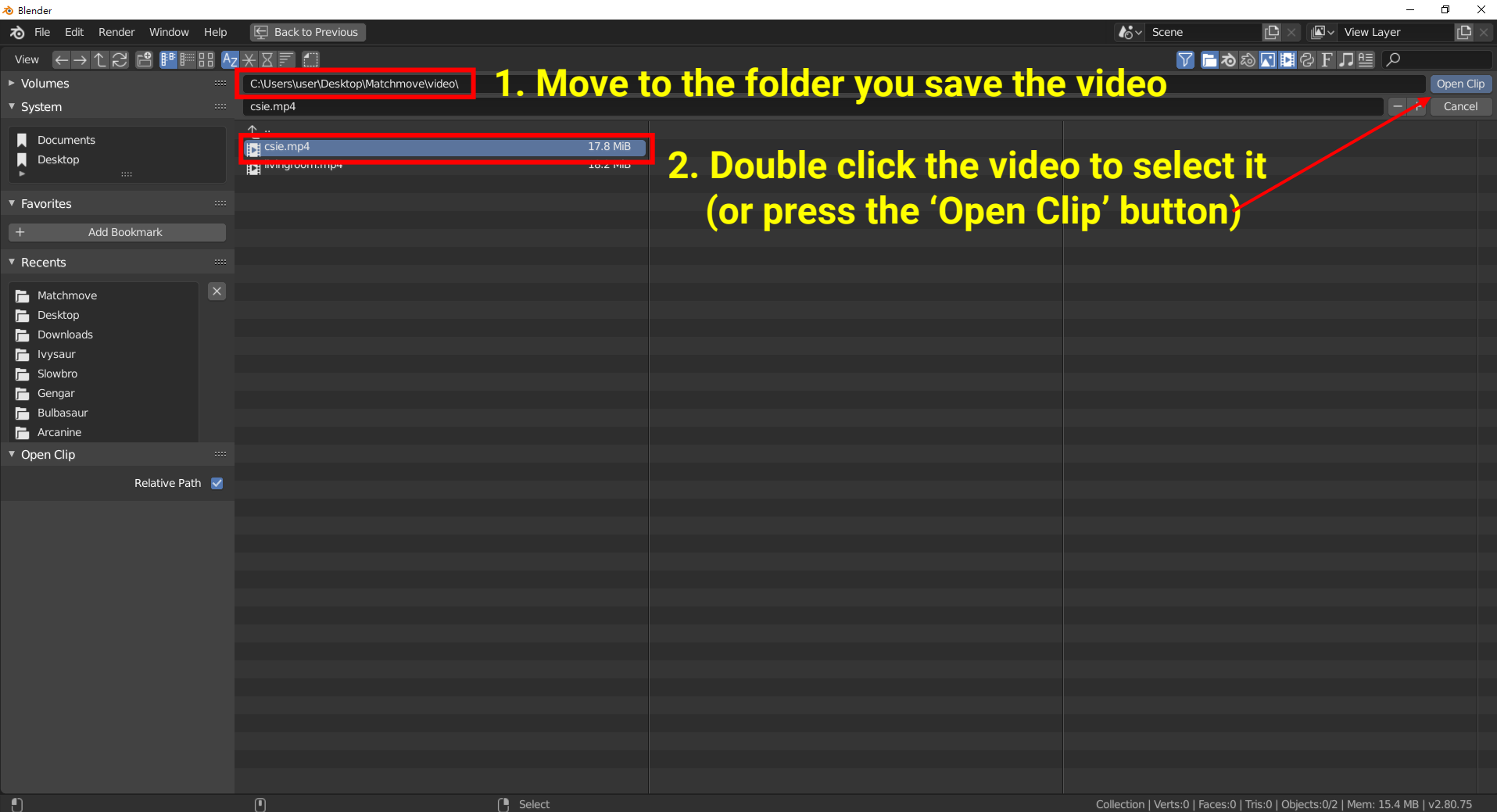
2. Press 'a' to select all image files

3. Press the 'Open Clip' button

File Name	Size	File Name	Size	File Name	Size
0001.png	2.39 MiB	0036.png	2.69 MiB	0072.png	2.66 MiB
0002.png	2.40 MiB	0037.png	2.68 MiB	0073.png	2.66 MiB
0003.png	2.44 MiB	0038.png	2.70 MiB	0074.png	2.66 MiB
0004.png	2.51 MiB	0039.png	2.70 MiB	0075.png	2.66 MiB
0005.png	2.56 MiB	0040.png	2.70 MiB	0076.png	2.66 MiB
0006.png	2.63 MiB	0041.png	2.71 MiB	0077.png	2.66 MiB
0007.png	2.64 MiB	0042.png	2.68 MiB	0078.png	2.66 MiB
0008.png	2.66 MiB	0043.png	2.68 MiB	0079.png	2.67 MiB
0009.png	2.66 MiB	0044.png	2.69 MiB	0080.png	2.67 MiB
0010.png	2.67 MiB	0045.png	2.69 MiB	0081.png	2.67 MiB
0011.png	2.68 MiB	0046.png	2.69 MiB	0082.png	2.67 MiB
0012.png	2.69 MiB	0047.png	2.70 MiB	0083.png	2.67 MiB
0013.png	2.72 MiB	0048.png	2.70 MiB	0084.png	2.67 MiB
0014.png	2.71 MiB	0049.png	2.70 MiB	0085.png	2.68 MiB
0015.png	2.70 MiB	0050.png	2.69 MiB	0086.png	2.67 MiB
0016.png	2.70 MiB	0051.png	2.70 MiB	0087.png	2.67 MiB
0017.png	2.70 MiB	0052.png	2.70 MiB	0088.png	2.67 MiB
0018.png	2.70 MiB	0053.png	2.71 MiB	0089.png	2.69 MiB
0019.png	2.70 MiB	0054.png	2.69 MiB	0090.png	2.55 MiB
0020.png	2.70 MiB	0055.png	2.69 MiB	0091.png	2.59 MiB
0021.png	2.71 MiB	0056.png	2.68 MiB	0092.png	2.60 MiB
0022.png	2.71 MiB	0057.png	2.68 MiB	0093.png	2.63 MiB
0023.png	2.70 MiB	0058.png	2.69 MiB	0094.png	2.62 MiB
0024.png	2.69 MiB	0059.png	2.60 MiB	0095.png	2.64 MiB
0025.png	2.69 MiB	0060.png	2.62 MiB	0096.png	2.66 MiB
0026.png	2.69 MiB	0061.png	2.63 MiB	0097.png	2.65 MiB
0027.png	2.70 MiB	0062.png	2.65 MiB	0098.png	2.65 MiB
0028.png	2.69 MiB	0063.png	2.66 MiB	0099.png	2.66 MiB
0029.png	2.69 MiB	0064.png	2.66 MiB	0100.png	2.66 MiB
0030.png	2.69 MiB	0065.png	2.66 MiB	0101.png	2.65 MiB
0031.png	2.69 MiB	0066.png	2.66 MiB	0102.png	2.65 MiB
0032.png	2.69 MiB	0067.png	2.66 MiB	0103.png	2.65 MiB
0033.png	2.69 MiB	0068.png	2.66 MiB	0104.png	2.66 MiB
0034.png	2.69 MiB	0069.png	2.66 MiB	0105.png	2.66 MiB
0035.png	2.69 MiB	0070.png	2.66 MiB	0106.png	2.66 MiB
		0071.png	2.65 MiB	0107.png	2.66 MiB

Collection | Verts:0 | Faces:0 | Tris:0 | Objects:0/2 | Mem: 15.4 MB | v2.80.75

Or Load Your Video (If you skip step 1)



Set Input Data (1)

The image shows the Blender 2.80.75 interface with the 'Clip' panel selected. The 'Output' panel is also visible, showing the 'End' frame set to 211. The 'Set Scene Frames' button is highlighted in the 'Clip' panel. The 'Output' panel is also highlighted.

1. Switch to the 'Output' panel

2. Press the 'Set Scene Frames' button (set the images/video length)

The 'Output' panel settings are as follows:

Property	Value
Resolution X	1920 px
Resolution Y	1080 px
%	100%
Aspect X	1.000
Aspect Y	1.000
Render Region	<input type="checkbox"/>
Crop to Render Region	<input type="checkbox"/>
Frame Start	1
End	211
Step	1
Frame Rate	24 fps

The 'Clip' panel settings are as follows:

Property	Value
File Path	C:\Users\us...ie\0001.png
Color Space	sRGB
Start Frame	1
Frame Offset	0
Resolution	1920 x 1080, RGBA byte
Frame	1 / 211
File	\0001.png

Set Input Data (2)

Blender

File Edit Render Window Help Layout Modeling Sculpting UV Editing Texture Paint Shading Animation Rendering Compositing Scripting +

Scene View Layer

Tracking Clip View Select Clip Track Reconstruction 0001.png

Clip

Set Scene Frames

Prefetch Reload

Mar Prefetch frames from disk for faster playback/tracking.

Add Shortcut: P

Detect Features

Tracking Settings

Pattern Size 21

Search Size 71

Motion model Loc

Match Keyframe

Prepass

Normalize

R G B

Copy From Active Track

Tracking Settings Extra

Track

Clip Display

Metadata

Proxy/Timecode

Footage Settings

File Path: C:\Users\us...sie\0001.png

Color Space sRGB

Start Frame 1

Frame Offset 0

1920 x 1080, RGBA byte

Frame: 1 / 211

File: \0001.png

Scene Collection

Collection

Camera

Light

Scene

Dimensions

Resolution X 1920 px

Y 1080 px

% 100%

Aspect X 1.000

Y 1.000

Render Region

Crop to Render Region

Frame Start 1

End 211

Step 1

Frame Rate 24 fps

Time Remapping

Stereoscopy

Output

Overwrite Placeholders

File Extensions Cache Result

File Format PNG

Color BW RGB **RGBA**

Color Depth 8 16

Collection | Verts:0 | Faces:0 | Tris:0 | Objects:0/2 | Mem: 1.77 GB | v2.80.75

Playback Keying View marker Start: 1 End: 211

1 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250

**Press the 'Prefetch' button
(load the entire images/video into memory)**

**You will notice the color of the frame bar become lighter
(If your video is too large, you may fail to load the entire video into memory)**

Feature Detection (1)

Blender 2.80.75 interface showing the Clip Tracking settings for a video clip. The 'Motion model' dropdown is set to 'LocRotScale', which is highlighted with a red box. A tooltip explains that this model searches for markers that are translated, rotated, and scaled between frames. Other options like 'Perspective', 'Affine', and 'LocScale' are also visible. The background shows a 3D render of a modern building interior.

Change the Motion model to 'LocRotScale' (you can also try 'Affine' or 'Perspective')

Feature Detection (2)

Blender 2.80.75 interface showing feature detection steps:

1. Make sure you are at the first frame
2. Find a feature point in the scene
3. Press 'Ctrl' and 'left click' to add a feature
(You can scroll your middle mouse button to enlarge the view)

The interface includes the following panels and settings:

- Left Sidebar (Tracking Settings):**
 - Pattern Size: 21
 - Search Size: 71
 - Motion model: LocRotScale
 - Match: Keyframe
 - Prepass:
 - Normalize:
 - Buttons: R, G, B
- Right Sidebar (Clip Display):**
 - File Path: C:\Users\lus...ie\0001.png
 - Color Space: sRGB
 - Start Frame: 1
 - Frame Offset: 0
 - Resolution: 1920 x 1080, RGBA byte
 - Frame: 1 / 211
 - File: \0001.png
- Right Sidebar (Scene Dimensions):**
 - Resolution X: 1920 px
 - Resolution Y: 1080 px
 - %: 100%
 - Aspect X: 1.000
 - Aspect Y: 1.000
 - Render Region:
 - Frame Start: 1
 - End: 250
 - Step: 1
 - Frame Rate: 24 fps
- Timeline (Bottom):**
 - Current frame: 1
 - Start: 1, End: 250

Feature Detection (3)

The image shows the Blender 2.80.75 interface with the 'Track' panel open. The central viewport displays a 3D render of a modern building interior. A yellow text overlay reads: "Press 'Track Markers (forward)' because we are at the first frame". The 'Track' panel is highlighted with a red box, and the 'Track Markers (forward)' button is also highlighted with a red box. A tooltip for this button is visible, stating: "Track Markers. Track selected markers. Shortcut: Ctrl T". The 'Tracking Settings' panel shows the following values: Pattern Size: 21, Search Size: 71, Motion model: LocRotScale, Match: Keyframe, Prepass: checked, Normalize: unchecked, and Copy From Active Track: unchecked. The 'Clip Display' panel shows the file path: C:\Users\lus...ie\0001.png, Color Space: sRGB, Start Frame: 1, Frame Offset: 0, and File: \0001.png. The 'Dimensions' panel shows Resolution X: 1920 px, Y: 1080 px, Aspect X: 1.000, Y: 1.000, Frame Start: 1, End: 250, Step: 1, and Frame Rate: 24 fps. The 'Output' panel shows File Format: PNG, Color: RGB, and Color Depth: 8. The timeline at the bottom shows the current frame is 1, with a total of 250 frames.

Blender 2.80.75

File Edit Render Window Help Layout Modeling Sculpting UV Editing Texture Paint Shading Animation Rendering Compositing Scripting +

Scene View Layer

Tracking

Clip

Set Scene Frames

Prefetch Reload

Marker

Add Delete

Detect Features

Tracking Settings

Pattern Size: 21

Search Size: 71

Motion model: LocRotScale

Match: Keyframe

Prepass:

Normalize:

R G B

Copy From Active Track

Tracking Settings Extra

Track

Clear

Refine

Merge

Track Markers. Track selected markers. Shortcut: Ctrl T

Clip Display

Metadata

Proxy/Timecode

Footage Settings

File Path: C:\Users\lus...ie\0001.png

Color Space: sRGB

Start Frame: 1

Frame Offset: 0

1920 x 1080, RGBA byte

Frame: 1 / 211

File: \0001.png

Scene

Dimensions

Resolution X: 1920 px

Y: 1080 px

%: 100%

Aspect X: 1.000

Y: 1.000

Render Region

Crop to Render Region

Frame Start: 1

End: 250

Step: 1

Frame Rate: 24 fps

Time Remapping

Stereoscopy

Output

/tmp/

Overwrite: Placeholders:

File Extensions: Cache Result:

File Format: PNG

Color: BW RGB **RGBA**

Color Depth: 8 16

Collection | Verts:0 | Faces:0 | Tris:0 | Objects:0/2 | Mem: 1.77 GB | v2.80.75

Press 'Track Markers (forward)' because we are at the first frame

Track Markers. Track selected markers. Shortcut: Ctrl T

Move

Playback Keying View Marker

1 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250

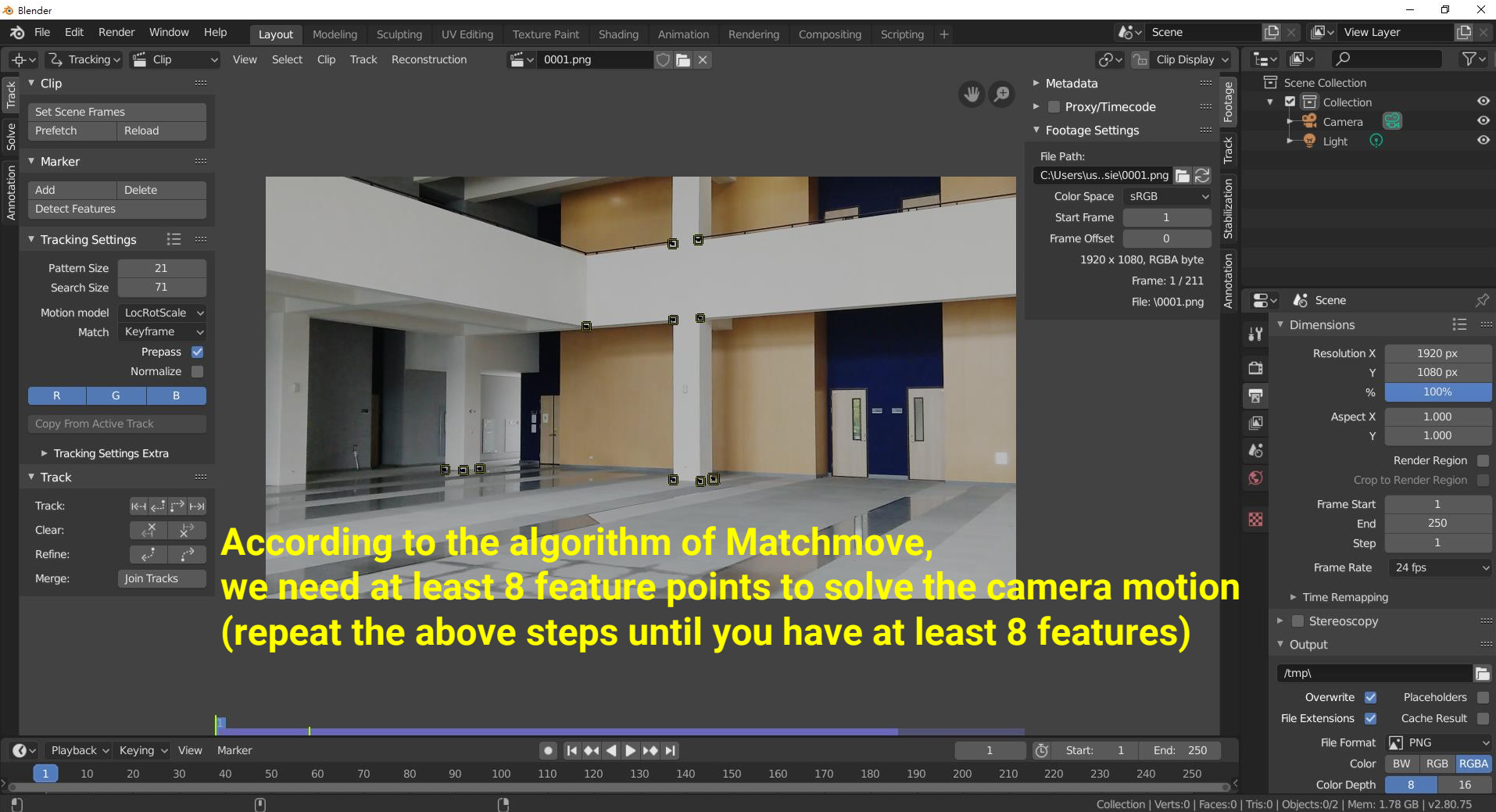
1 Start: 1 End: 250

Feature Detection (4)

The image shows the Blender 2.80.75 interface with the 'Tracking' workspace active. The central 3D viewport displays a scene of a hallway with a white floor and yellow walls. A red square with a crosshair is positioned on the floor, tracking a feature. A red arrow points from the square to the timeline at frame 184. The timeline is highlighted with a red box, and the frame number '184' is visible. The left sidebar shows the 'Tracking' panel with various settings like 'Pattern Size', 'Search Size', and 'Motion model'. The right sidebar shows the 'Clip Display' and 'Scene' properties.

**Drag the timeline to ensure the feature is tracked correctly for all frames
The feature (center of the square) should stick to the same scene point**

Feature Detection (5)



The screenshot displays the Blender 2.80.75 interface with the Video Sequencer editor active. The central 3D viewport shows a modern interior space with a white ceiling, yellow walls, and a blue door. Several feature points are visible on the walls and ceiling. The interface includes various panels and settings:

- Track Panel:** Shows tracking settings such as Pattern Size (21), Search Size (71), Motion model (LocRotScale), Match (Keyframe), Prepass (checked), and Normalize (unchecked). It also includes buttons for R, G, and B, and a Copy From Active Track button.
- Tracking Settings Extra:** Includes buttons for Track, Clear, Refine, and Merge.
- Metadata Panel:** Shows File Path (C:\Users\us...ie\0001.png), Color Space (sRGB), Start Frame (1), Frame Offset (0), Resolution (1920 x 1080, RGBA byte), Frame (1 / 211), and File (\0001.png).
- Dimensions Panel:** Shows Resolution X (1920 px), Y (1080 px), Aspect X (1.000), Y (1.000), Frame Start (1), End (250), Step (1), and Frame Rate (24 fps).
- Output Panel:** Shows File Format (PNG), Color (RGB), and Color Depth (8).

According to the algorithm of Matchmove, we need at least 8 feature points to solve the camera motion (repeat the above steps until you have at least 8 features)

Feature Detection (7)

Blender 2.80.75 interface showing feature tracking on a video clip. The central viewport displays a hallway scene with tracking points and lines. A red square highlights a tracking failure on a floor tile at frame 140. The timeline at the bottom also highlights frame 140. The left sidebar shows tracking settings, and the right sidebar shows clip and scene properties.

Sometimes your tracking will fail in the middle frame

Tracking Settings:

- Pattern Size: 21
- Search Size: 71
- Motion model: LocRotScale
- Match: Keyframe
- Prepass:
- Normalize:
- Buttons: R, G, B
- Copy From Active Track
- Tracking Settings Extra

Track:

- Track: [Left Arrow] [Right Arrow]
- Clear: [X] [X]
- Refine: [Left Arrow] [Right Arrow]
- Merge: Join Tracks

Clip Display:

- File Path: C:\Users\us...sie\0001.png
- Color Space: sRGB
- Start Frame: 1
- Frame Offset: 0
- Resolution: 1920 x 1080, RGBA byte
- Frame: 140 / 211
- File: \0140.png

Scene Dimensions:

- Resolution X: 1920 px
- Resolution Y: 1080 px
- %: 100%
- Aspect X: 1.000
- Aspect Y: 1.000
- Render Region:
- Crop to Render Region:
- Frame Start: 1
- End: 250
- Step: 1
- Frame Rate: 24 fps

Timeline: 140

Collection | Verts:0 | Faces:0 | Tris:0 | Objects:0/2 | Mem: 1.78 GB | v2.80.75

Feature Detection (8)

The image shows the Blender 2.80.75 interface with the following components:

- Top Bar:** File, Edit, Render, Window, Help, Layout, Modeling, Sculpting, UV Editing, Texture Paint, Shading, Animation, Rendering, Compositing, Scripting.
- Left Sidebar (Track):**
 - Clip: Set Scene Frames, Prefetch, Reload.
 - Marker: Add, Delete, Detect Features.
 - Tracking Settings: Pattern Size (21), Search Size (71), Motion model (LocRotScale), Match (Keyframe), Prepass (checked), Normalize (unchecked), R, G, B buttons, Copy From Active Track, Tracking Settings Extra.
 - Track: Navigation and control buttons (Clear, Refine, Merge).
- Center Viewport:** A 3D render of a hallway with tracking points (red and blue) and motion paths. A yellow text overlay reads "Just go back to the frame with the correct tracking".
- Right Sidebar (Clip Display):**
 - Metadata: Proxy/Timecode.
 - Footage Settings: File Path (C:\Users\us...ie\0001.png), Color Space (sRGB), Start Frame (1), Frame Offset (0), 1920 x 1080, RGBA byte, Frame: 139 / 211, File: \0139.png.
 - Dimensions: Resolution X (1920 px), Y (1080 px), % (100%), Aspect X (1.000), Y (1.000), Render Region (unchecked), Crop to Render Region (unchecked), Frame Start (1), End (250), Step (1), Frame Rate (24 fps).
 - Time Remapping: Stereoscopy (unchecked).
 - Output: /tmp/, Overwrite (checked), Placeholders (unchecked), File Extensions (checked), Cache Result (unchecked), File Format (PNG), Color (BW, RGB, RGBA), Color Depth (8, 16).
- Bottom Bar:** Playback, Keying, View, Marker, Timeline (0 to 250), 139 (highlighted in a red box), Start: 1, End: 250.

Feature Detection (9)

The image shows the Blender 2.80.75 interface with the 'Track' workspace active. The central viewport displays a video clip of a hallway with tracked features (red lines) and a search range (red box) highlighted. A yellow text overlay reads: "You can press 'Alt' + 's' for showing the search range".

Left Sidebar (Track Panel):

- Clip: Set Scene Frames, Prefetch, Reload
- Marker: Add, Delete, Detect Features
- Tracking Settings:
 - Pattern Size: 21
 - Search Size: 71
 - Motion model: LocRotScale
 - Match: Keyframe
 - Prepass:
 - Normalize:
 - Buttons: R, G, B
 - Copy From Active Track
 - Tracking Settings Extra
- Track:
 - Track: [Left Arrow], [Right Arrow], [Home], [End]
 - Clear: [X], [X]
 - Refine: [Left Arrow], [Right Arrow]
 - Merge: Join Tracks

Right Sidebar (Clip Display Panel):

- Metadata
- Proxy/Timecode
- Footage Settings:
 - File Path: C:\Users\us...sie\0001.png
 - Color Space: sRGB
 - Start Frame: 1
 - Frame Offset: 0
 - Resolution: 1920 x 1080, RGBA byte
 - Frame: 139 / 211
 - File: \0139.png

Right Sidebar (Scene Panel):

- Dimensions:
 - Resolution X: 1920 px
 - Resolution Y: 1080 px
 - %: 100%
 - Aspect X: 1.000
 - Aspect Y: 1.000
 - Render Region:
 - Crop to Render Region:
 - Frame Start: 1
 - End: 250
 - Step: 1
 - Frame Rate: 24 fps
- Time Remapping
- Stereoscopy:
- Output:
 - Path: /tmp/
 - Overwrite:
 - Placeholders:
 - File Extensions:
 - Cache Result:
 - File Format: PNG
 - Color: BW, RGB, **RGBA**
 - Color Depth: 8, 16

Timeline: 139, Start: 1, End: 250

Bottom Status Bar: Collection | Verts:0 | Faces:0 | Tris:0 | Objects:0/2 | Mem: 1.78 GB | v2.80.75

Feature Detection (10)

Blender 2.80.75 interface showing feature detection in a video clip. The central viewport displays a hallway scene with tracked features (red and blue lines) and a feature pattern (a square with four points). The left sidebar shows the 'Track' panel with 'Tracking Settings' and 'Track' sections. The right sidebar shows 'Clip Display' and 'Scene' properties. A yellow text overlay reads: "Press 's' to scale the feature pattern size and search size. Adjust them to improve the uniqueness of the feature point".

Tracking Settings:

- Pattern Size: 21
- Search Size: 71
- Motion model: LocRotScale
- Match: Keyframe
- Prepass:
- Normalize:
- Buttons: R, G, B
- Copy From Active Track
- Tracking Settings Extra

Track:

- Track: [Left Arrow] [Right Arrow]
- Clear: [X] [X]
- Refine: [Left Arrow] [Right Arrow]
- Merge: Join Tracks

Clip Display:

- File Path: C:\Users\us...ie\0001.png
- Color Space: sRGB
- Start Frame: 1
- Frame Offset: 0
- Resolution: 1920 x 1080, RGBA byte
- Frame: 139 / 211
- File: \0139.png

Scene Dimensions:

- Resolution X: 1920 px
- Resolution Y: 1080 px
- %: 100%
- Aspect X: 1.000
- Aspect Y: 1.000
- Render Region:
- Frame Start: 1
- End: 250
- Step: 1
- Frame Rate: 24 fps

Scene Output:

- File Format: PNG
- Color: BW, RGB, **RGBA**
- Color Depth: 8, 16

Collection | Verts:0 | Faces:0 | Tris:0 | Objects:0/2 | Mem: 1.78 GB | v2.80.75

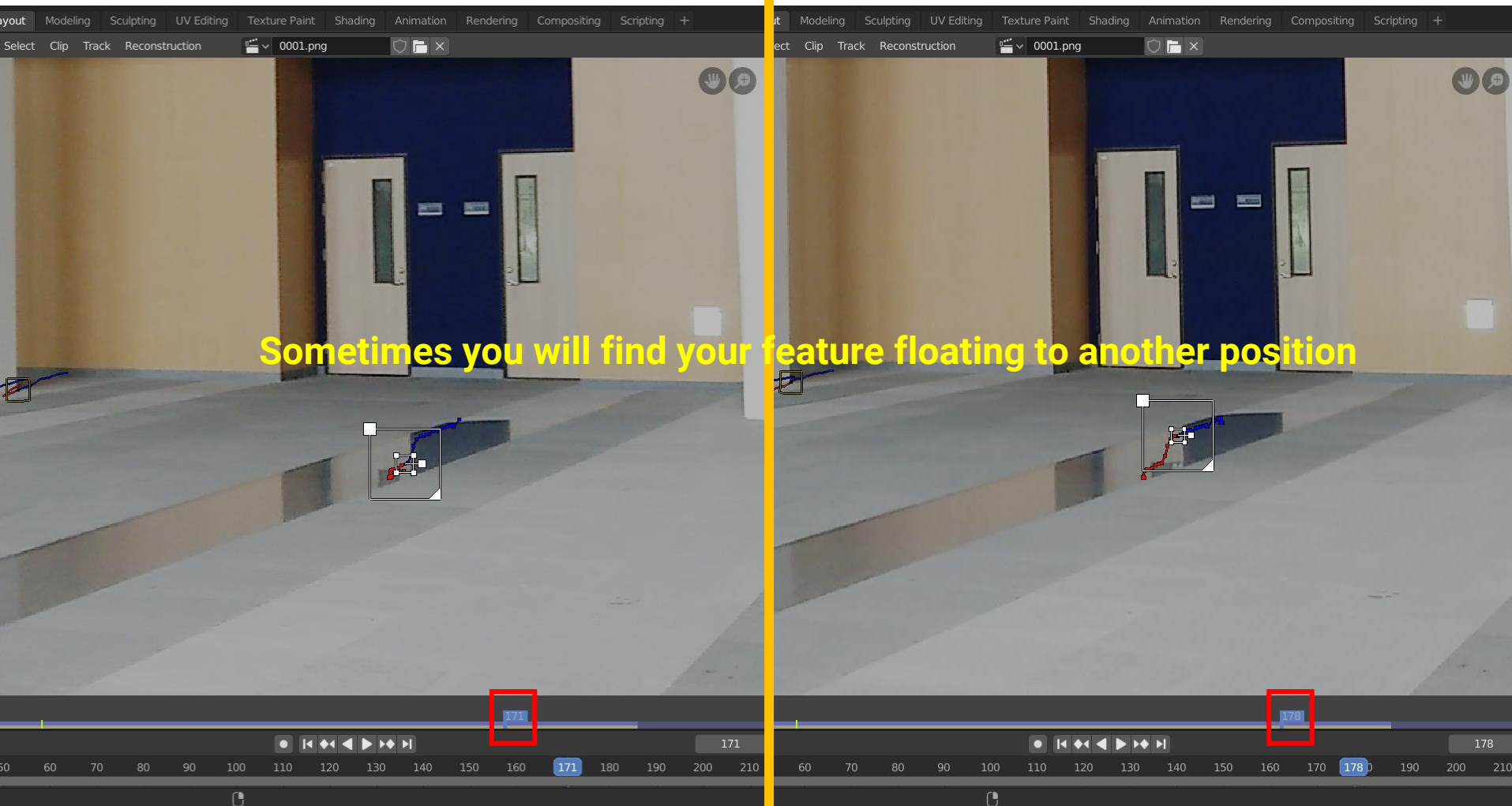
Feature Detection (11)

Blender 2.80.75 interface showing feature detection in a video clip. The main viewport displays a hallway scene with tracking markers on the floor. The left sidebar shows the 'Track' panel with 'Track Markers' selected. The right sidebar shows 'Clip Display' and 'Dimensions' panels. The timeline at the bottom shows frame 211 selected.

**Press 'Track Markers (forward)' again
It might work
(If it is not, repeat the last step and keep trying)**

Keyframes for Track Markers are visible on the timeline at frame 211.

Feature Detection (12)



Feature Detection (13)

Blender 2.80.75

File Path: C:\Users\us...sie\0001.png

Color Space: sRGB

Start Frame: 1

Frame Offset: 0

1920 x 1080, RGBA byte

Frame: 172 / 211

File: \0172.png

Resolution X: 1920 px

Resolution Y: 1080 px

%: 100%

Aspect X: 1.000

Aspect Y: 1.000

Frame Start: 1

Step: 1

Frame Rate: 24 fps

172

Start: 1 End: 250

Collection | Verts:0 | Faces:0 | Tris:0 | Objects:0/2 | Mem: 1.78 GB | v2.80.75

**2. First press 'Clear Track Path (Forward)' to clear tracking data (important!)
If you are tracking backward, press 'Clear Track Path (Backward)' instead**

1. Just go back to the last frame with correct tracking

3. You will find the green color (tracking) disappear

Feature Detection (14)

Blender 2.80.75 interface showing the tracking process. The central viewport displays a 3D scene of a hallway with a blue door and a white door. A red feature is being tracked, and a bounding box is visible around it. The left sidebar shows the 'Track' panel with various settings and a 'Track' button highlighted in red. The right sidebar shows the 'Dimensions' panel with resolution settings. The bottom status bar shows the current frame as 211.

**Press 'Track Markers (forward)' again
It might work
(If it is not, repeat the last step and keep trying)
(If it keeps failing, delete the feature and choose another one)**

Feature Detection (15)

You can also try the automatic "Feature Detection" of Blender by pressing the "Detect Features" button (but in my experience, it is not faster)

The image shows the Blender 2.80.75 interface with the following details:

- Top Bar:** File, Edit, Render, Window, Help, Layout, Modeling, Sculpting, UV Editing, Texture Paint, Shading, Animation, Rendering, Compositing, Scripting.
- Left Panel (Tools Shelf):** Track, Annotation, Solve. The 'Track' panel is active, showing 'Detect Features' highlighted with a red box. Other options include 'Set Scene Frames', 'Prefetch', 'Reload', 'Add', 'Delete', 'Tracking Settings', and 'Track'.
- Center Viewport:** A 3D scene of a modern hallway with yellow feature markers placed on various surfaces. A tooltip above the markers reads: 'Automatically detect features and place markers to track.'
- Right Panel (Properties):** Metadata, Proxy/Timecode, Footage Settings. The 'Footage Settings' section is expanded, showing: File Path: C:\Users\lus...sie\0001.png, Color Space: sRGB, Start Frame: 1, Frame Offset: 0, Resolution: 1920 x 1080, Frame: 1 / 211, File: \0001.png.
- Bottom Panel (Timeline):** Playback, Keying, View, Marker. A 'Detect Features' action is visible at frame 1.
- Bottom Right Panel (Scene Properties):** Dimensions, Time Remapping, Stereoscopic, Output. The 'Output' section shows: /tmp/, Overwrite, Placeholders, File Extensions, Cache Result, File Format: PNG, Color: BW, RGB, **RGBA**, Color Depth: 8, 16.

Feature Detection (16)

Blender 2.80.75 interface showing feature tracking in a 3D scene. The central viewport displays a hallway with several yellow feature points tracked on the walls and ceiling. The left sidebar shows the 'Track' panel with various settings like Pattern Size (21), Search Size (71), and Motion model (LocRotScale). The right sidebar shows the 'Clip Display' and 'Scene' properties. The bottom status bar indicates the current frame is 211 out of 250.

Once we have more than 8 tracked feature points, we are ready for camera estimation

Also, keep at least 3 points on the ground (important!)

Setting Camera Parameters (1)

The image shows the Blender 2.80.75 interface with the 'Track' panel selected. The central viewport displays a 3D scene of a modern interior with several yellow tracking markers. The 'Track' panel on the right is expanded to the 'Camera' section, where the 'Sensor Width' field is highlighted with a red box and contains the value '4.800'. A yellow text annotation '1. Switch to 'Track' panel' points to the 'Track' tab in the panel header. Another yellow text annotation '2. Type in the sensor width information of your camera' points to the 'Sensor Width' field. The 'Dimensions' panel on the right shows a resolution of 1920x1080 px and an aspect ratio of 1.000. The bottom status bar indicates 'Collection | Verts:0 | Faces:0 | Tris:0 | Objects:0/2 | Mem: 1.78 GB | v2.80.75'.

1. Switch to 'Track' panel

2. Type in the sensor width information of your camera

Camera Parameters

- How do we know the camera parameters?
 - Google it on the internet
 - <https://www.photocounter.com.au/wp-content/uploads/2013/01/sensor-size-table.pdf>
 - You can also use Blender's preset

Google search results for "iphone 8 sensor width mm".

約有 19,500,000 項結果 (搜尋時間 : 0.63 秒)

4.8mm x 3.5mm

Apple iPhone 8 Plus Review

Basic Specifications

Resolution:	12.00 Megapixels
Sensor size:	1/3 inch (4.8mm x 3.5mm)
Lens:	2.00x zoom (29-57mm eq.)
Viewfinder:	No / LCD

Sensor "Type"	Imaging Area Dimensions			
	Diagonal (mm)	Width (mm)	Height (mm)	Area (mm ²)
1/6"	2.7	2.46	1.8	4.43
1/4"	4.5	3.6	2.7	9.72
1/3.6"	5.0	4.0	3.0	12.0
1/3.2"	5.68	4.54	3.42	15.53
1/3"	6.0	4.8	3.6	17.28
1/2.7"	6.72	5.37	4.04	21.69
1/2.5"	7.18	5.76	4.29	24.71
1/2.4"	7.66	5.92	4.57	27.05
1/2.33"	7.7	6.12	4.51	27.60
1/2.3"	7.8	6.17	4.55	28.07
1/2"	8.0	6.4	4.8	30.72
1/1.8"	8.93	7.18	5.32	38.20
1/1.75"	9.23	7.38	5.54	40.89
1/1.72"	9.25	7.40	5.55	41.07
1/1.7"	9.5	7.6	5.7	43.32
1/1.6"	10.07	8.08	6.01	48.56
2/3"	11.07	8.8	6.6	58.08
1"	16.0	12.8	9.6	122.88
4/3"	22.5	17.3	13.0	243.00

Setting Camera Parameters (2)

The image shows the Blender 2.80.75 interface during a camera tracking session. The main 3D viewport displays a scene of a modern interior with several camera tracks overlaid. The left sidebar shows tracking settings, including Pattern Size (21) and Search Size (71). The right sidebar shows the Camera properties panel, with a 'New Preset' button highlighted in red. The bottom status bar shows 'Collection | Verts:0 | Faces:0 | Tris:0 | Objects:0/2 | Mem: 1.78 GB | v2.80.75'.

Tracking Settings (Left Sidebar):

- Pattern Size: 21
- Search Size: 71
- Motion model: LocRotScale
- Match: Keyframe
- Prepass:
- Normalize:
- Buttons: R, G, B
- Copy From Active Track
- Tracking Settings Extra

Camera Properties (Right Sidebar):

- Sensor Width: 4.800
- Pixel Aspect: 1.00
- Optical Center: 960.000 px (X), 540.000 px (Y)
- Buttons: Set Center
- Lens:
- Marker:

Dimensions (Right Sidebar):

- Resolution X: 1920 px
- Resolution Y: 1080 px
- Aspect X: 1.000
- Aspect Y: 1.000
- Render Region:
- Crop to Render Region:
- Frame Start: 1
- End: 250
- Step: 1
- Frame Rate: 24 fps

Output (Right Sidebar):

- File Format: PNG
- Color: RGB RGBA
- Color Depth: 8

Solving Camera Motion (1)

The image shows the Blender 2.80.75 interface with the 'Solve' panel active. The interface is annotated with yellow text and red boxes highlighting key steps in the camera motion solving process.

- 1. Make sure you are at the first frame**: The timeline at the bottom shows frame 1 selected.
- 2. Make sure all features are selected**: A red box highlights the 3D viewport where several yellow feature markers are placed on the scene.
- 3. Switch to 'Solve' panel**: The 'Solve' panel is selected in the left sidebar.
- 4. Tick Keyframe**: The 'Keyframe' checkbox is checked in the 'Solve' panel.
- 5. Change 'Refine' to 'Focal Length, K1, K2'**: The 'Refine' dropdown menu is set to 'Focal length...'. The 'Solve Camera Motion' button is also highlighted.
- 6. Press 'Solve Camera Motion'**: The 'Solve Camera Motion' button is highlighted in the 'Solve' panel.

The right sidebar shows the 'Track' panel with 'Track.012' selected, and the 'Scene' panel with dimensions set to 1920x1080px and 24 fps. The bottom status bar shows 'Average re-projection error: 1.150'.

Solving Camera Motion (2)

You will see the error here
It is suggest to have an error lower than 1
(better to have one lower than 0.5)

Solve error: 1.1495

Average Error: 2.8563

Solve error: 1.1495

Resolution X: 1920 px
Resolution Y: 1080 px
Aspect X: 1.000
Aspect Y: 1.000

Frame Start: 1
End: 250
Step: 1
Frame Rate: 24 fps

File Format: PNG
Color: RGB
Color Depth: 8

Collection | Verts:0 | Faces:0 | Tris:0 | Objects:0/2 | Mem: 1.78 GB | v2.80.75

Solving Camera Motion (4)

The image shows the Blender 2.80.75 interface during the 'Solve Camera Motion' process. The main viewport displays a scene with a hallway and two doors. A track labeled 'Track 012: keyframed' is highlighted in the 'Track' panel, showing an 'Average error: 2.856'. A context menu is open over this track, with the 'Delete Track' option highlighted in red. A yellow text overlay reads: 'Select and delete (right click) the feature with large error'. The interface includes various panels for solving motion, such as 'Solve', 'Clean up', 'Geometry', 'Orientation', and 'Scene Setup'. The timeline at the bottom shows the current frame is 1 out of 250.

Select and delete (right click) the feature with large error

Context Menu

- Copy Track Settings
- Track Settings As Default
- Copy Color
- Copy Tracks Ctrl C
- Paste Tracks Ctrl V
- Disable Markers
- Enable Markers
- Hide Tracks
- Show Tracks Alt H
- Lock Tracks Ctrl L
- Unlock Tracks Alt L
- Join Tracks Ctrl J
- Delete Track X**

Track 012: keyframed
Average error: 2.856

Delete selected tracks.

Solving Camera Motion (5)

Blender

File Edit Render Window Help Layout Modeling Sculpting UV Editing Texture Paint Shading Animation Rendering Compositing Scripting +

Scene View Layer

Tracking Clip View Select Clip Track Reconstruction 0001.png

Solve error: 0.3070

Browse Scene to be linked.

Track

Plane Track

Solve

Tripod

Keyframe

Keyframe A 1

Keyframe B 209

Refine Focal length...

Solve Camera Motion

Clean up

Geometry

Orientation

Floor Wall

Set Origin

Set X Axis Set Y Axis

Set Scale Apply Scale

Distance 1.000

Scene Setup

Set as Background

Setup Tracking Scene

Track

Objects

Plane Track

Tracking Settings

Camera

Sensor Width 4.800

Pixel Aspect 1.00

Optical Center 960.000 px 540.000 px

Set Center

Lens

Marker

Scene

Dimensions

Resolution X 1920 px

Y 1080 px

% 100%

Aspect X 1.000

Y 1.000

Render Region

Crop to Render Region

Frame Start 1

End 250

Step 1

Frame Rate 24 fps

Time Remapping

Stereoscopy

Output

/tmp/

Overwrite Placeholders

File Extensions Cache Result

File Format PNG

Color BW RGB RGBA

Color Depth 8 16

Annotation Stabilization

Annotation

Scene Collection

Collection

Camera

Light

Track

Track.008: keyframed
Average error: 0.256

Track.009: keyframed
Average error: 0.302

Track.003: keyframed
Average error: 0.316

Track.006: keyframed
Average error: 0.427

Track.004: tracked
Average error: 0.370

Track.005: tracked
Average error: 0.375

Track.011: keyframed
Average error: 0.155

Select all features and press 'Solve Camera Motion' again,
You may see the error drops

Playback Keying View Marker

1 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250

Pan View

Average re-projection error: 0.307

Collection | Verts:0 | Faces:0 | Tris:0 | Objects:0/2 | Mem: 1.78 GB | v2.80.75

Solving Camera Motion (6)

Solve error: 0.2560

Track

Track.011

Weight: 1.000

Stab Weight: 1.000

Average Error: 0.1125

Objects

Plane Track

Tracking Settings

Camera

Sensor Width: 4.800

Pixel Aspect: 1.00

Optical Center: 960.000 px, 540.000 px

Set Center

Lens

Track.008: keyframed, Average error: 0.236

Track.009: keyframed, Average error: 0.236

Track.003: keyframed, Average error: 0.319

Track.004: tracked, Average error: 0.308

Track.006: keyframed, Average error: 0.188

Track.007: tracked, Average error: 0.387

Track.011: keyframed, Average error: 0.113

You can delete more features with large error to obtain a better estimation of camera motion (but need to have more than 8)

Playback: 1 | Start: 1 | End: 250

Average re-projection error: 0.256

Collection | Verts:0 | Faces:0 | Tris:0 | Objects:0/2 | Mem: 1.78 GB | v2.80.75

Setup Tracking Scene (1)

The image displays the Blender 2.80.75 interface for setting up a tracking scene. The main viewport shows a 3D scene of a modern interior with tracking markers on the floor and walls. The 'Scene Setup' panel on the left has the 'Setup Tracking Scene' button highlighted in red. A yellow text overlay reads 'Press the 'Setup Tracing Scene' button'. The 'Track' panel on the right shows the 'Track.011' clip with various tracking parameters. The 'Dimensions' panel on the right shows the resolution and aspect ratio settings. The bottom status bar indicates the current frame is 1 out of 250.

Prepare scene for compositing 3D objects into this footage.

Press the 'Setup Tracing Scene' button

Blender 2.80.75

File Edit Render Window Help Layout Modeling Sculpting UV Editing Texture Paint Shading Animation Rendering Compositing Scripting +

Scene

Solve error: 0.2560

Clip Display

Track

Track.011

R G B B/W

Weight 1.000

Stab Weight 1.000

Average Error: 0.1125

Custom Color Pres...

Objects

Plane Track

Tracking Settings

Camera

Sensor Width 4.800

Pixel Aspect 1.00

Optical Center 960.000 px 540.000 px

Set Center

Lens

Marker

Scene

Dimensions

Resolution X 1920 px

Y 1080 px

% 100%

Aspect X 1.000

Y 1.000

Render Region

Crop to Render Region

Frame Start 1

End 250

Step 1

Frame Rate 24 fps

Time Remapping

Stereoscopy

Output

/tmp/

Overwrite Placeholders

File Extensions Cache Result

File Format PNG

Color BW RGB RGBA

Color Depth 8 16

Collection | Verts:0 | Faces:0 | Tris:0 | Objects:0/2 | Mem: 1.78 GB | v2.80.75

Setup Tracking Scene (2)

The image shows the Blender 2.80.75 interface during the setup of a tracking scene. The 3D Viewport is highlighted in yellow with the text "Change to '3D Viewport'". The interface includes the top menu bar, a left sidebar with the "Tracking" panel, a central 3D viewport showing a hallway scene, and a right sidebar with the "Track" and "Scene" panels.

Tracking Panel (Left Sidebar):

- Tracking: Track, Clip, View, Select, Clip, Track, Reconstruction
- 0001.png
- Solve error: 0.2560
- Clip Display
- Track: Track.011
- Weight: 1.000
- Stab Weight: 1.000
- Average Error: 0.1125
- Custom Color Pres...
- Objects: Plane Track, Tracking Settings
- Camera: Sensor Width: 4.800, Pixel Aspect: 1.00, Optical Center: 960.000 px, 540.000 px, Set Center
- Lens, Marker

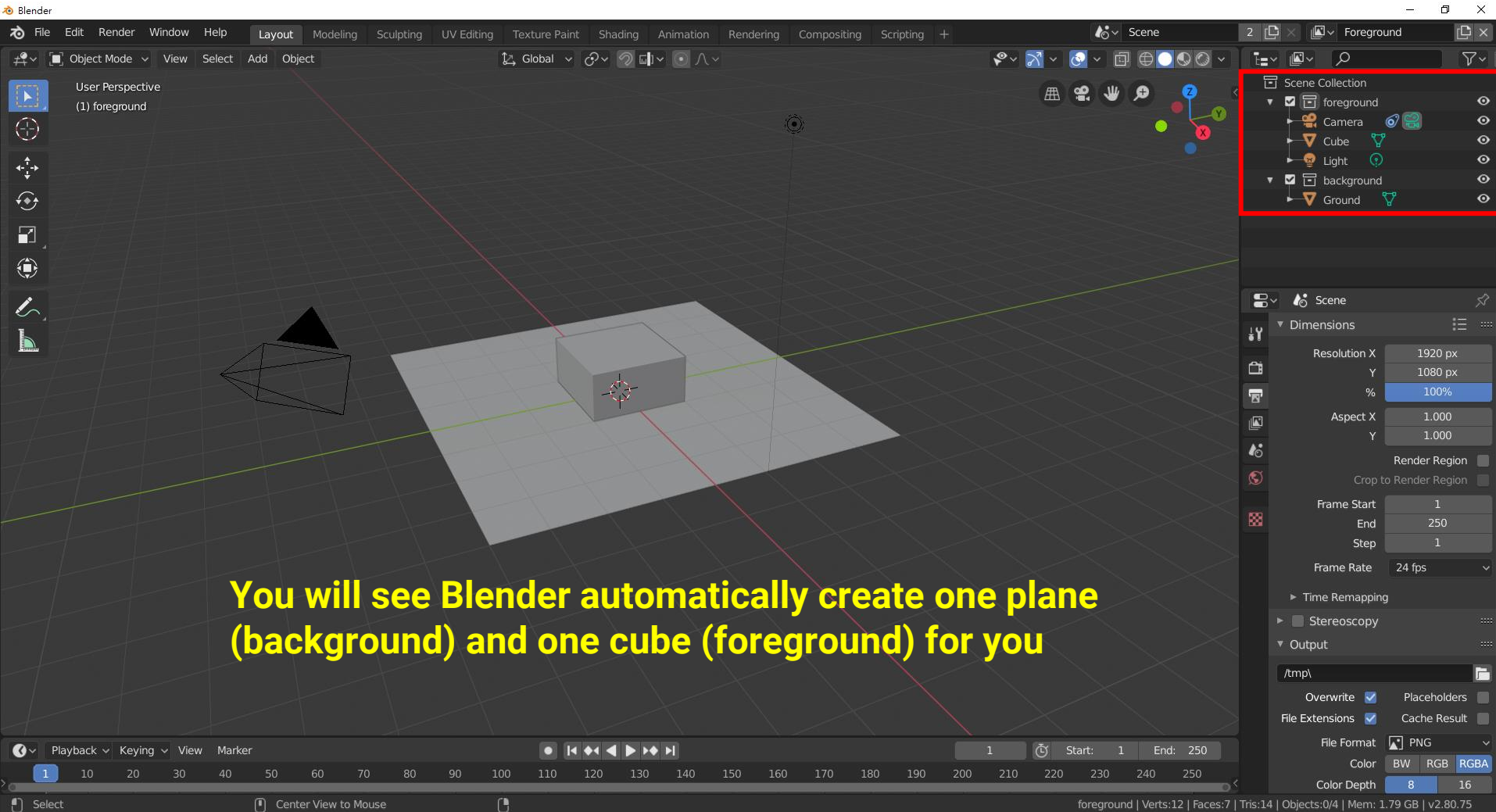
Scene Panel (Right Sidebar):

- Scene Collection: foreground (Camera, Cube, Light), background (Ground)
- Scene: Dimensions: Resolution X: 1920 px, Y: 1080 px, Aspect X: 1.000, Y: 1.000, Render Region, Crop to Render Region, Frame Start: 1, End: 250, Step: 1, Frame Rate: 24 fps, Time Remapping, Stereoscopy, Output: /tmp, Overwrite, Placeholders, File Extensions, Cache Result, File Format: PNG, Color: BW, RGB, RGBA, Color Depth: 8, 16

Bottom Panel:

- Playback, Keying, View, Marker
- 1, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, 120, 130, 140, 150, 160, 170, 180, 190, 200, 210, 220, 230, 240, 250
- Change Frame, Move, Pan View, Slide Plane Marker
- foreground | Verts:12 | Faces:7 | Tris:14 | Objects:0/4 | Mem: 1.78 GB | v2.80.75

Setup Tracking Scene (3)



The image shows the Blender 2.80.75 interface in Object Mode. The 3D viewport displays a camera, a cube, and a ground plane. The Outliner panel on the right shows the scene collection with 'foreground' and 'background' collections. The Properties panel on the right shows the scene dimensions and output settings.

You will see Blender automatically create one plane (background) and one cube (foreground) for you

Resolution X: 1920 px
Resolution Y: 1080 px
Aspect X: 1.000
Aspect Y: 1.000
Frame Start: 1
End: 250
Step: 1
Frame Rate: 24 fps
File Format: PNG
Color: BW, RGB, **RGBA**
Color Depth: 8, 16

Setup Tracking Scene (4)

1. Select Camera

2. Press 'Overlay' setting

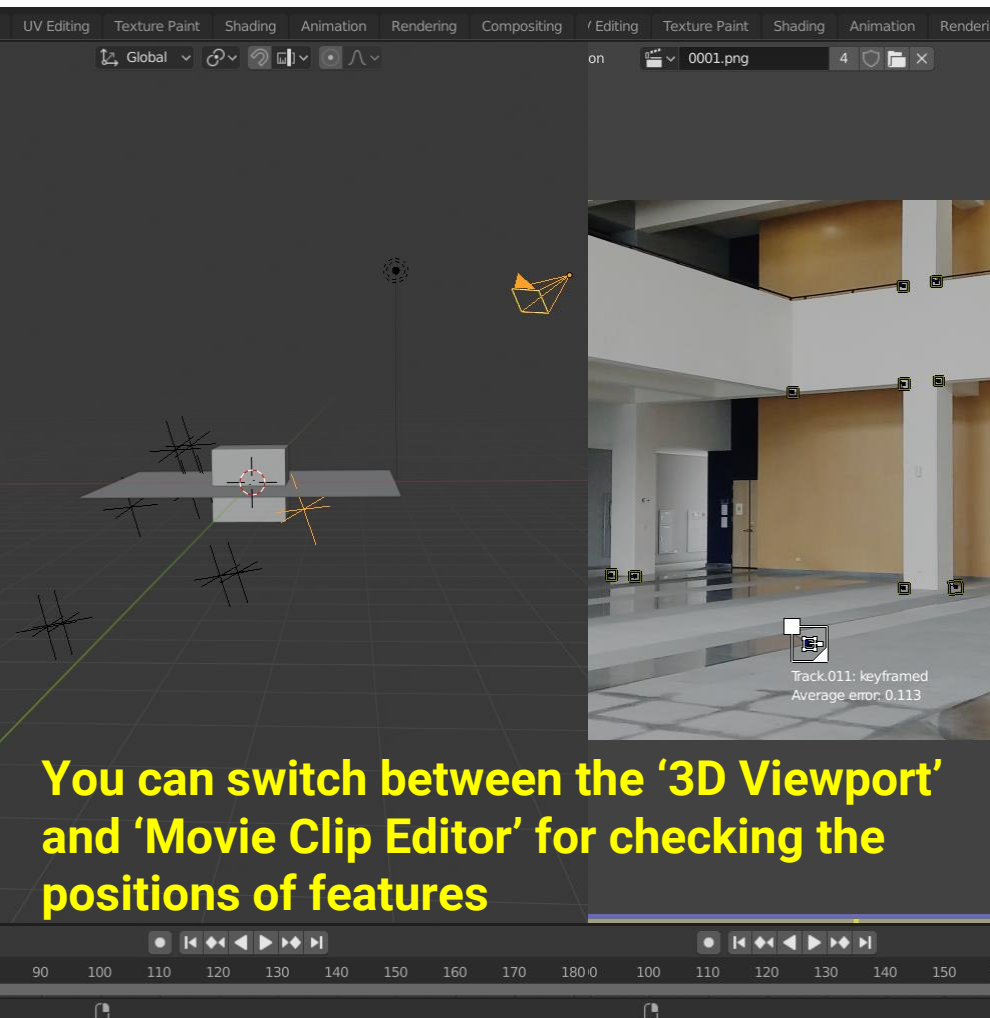
3. Tick 'Motion Tracking'

4. Enlarge the track vis. size

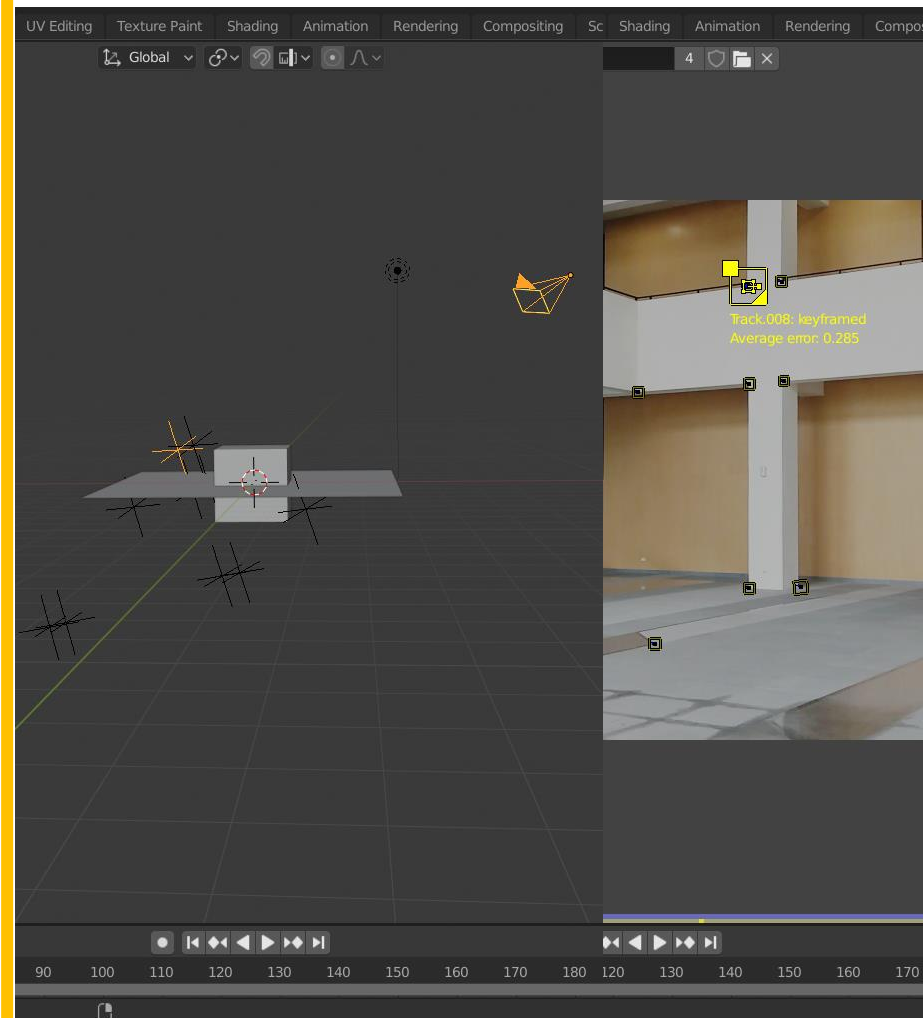
5. These are the estimated 3D location of our feature points

The image shows the Blender 2.80.75 interface in Object Mode. A camera is selected in the foreground, and a cube is positioned on a plane. The 'Motion Tracking' panel is open, showing the 'Motion Tracking' checkbox checked and the 'Size' set to 1.000. The 'Viewports Overlays' panel is also open, showing the 'Grid' and 'Floor' checkboxes checked. The 'Dimensions' panel shows a resolution of 1920x1080 pixels and a frame rate of 24 fps. The timeline at the bottom shows a duration of 250 frames.

Setup Tracking Scene (5)



You can switch between the '3D Viewport' and 'Movie Clip Editor' for checking the positions of features



Setup Tracking Scene (6)

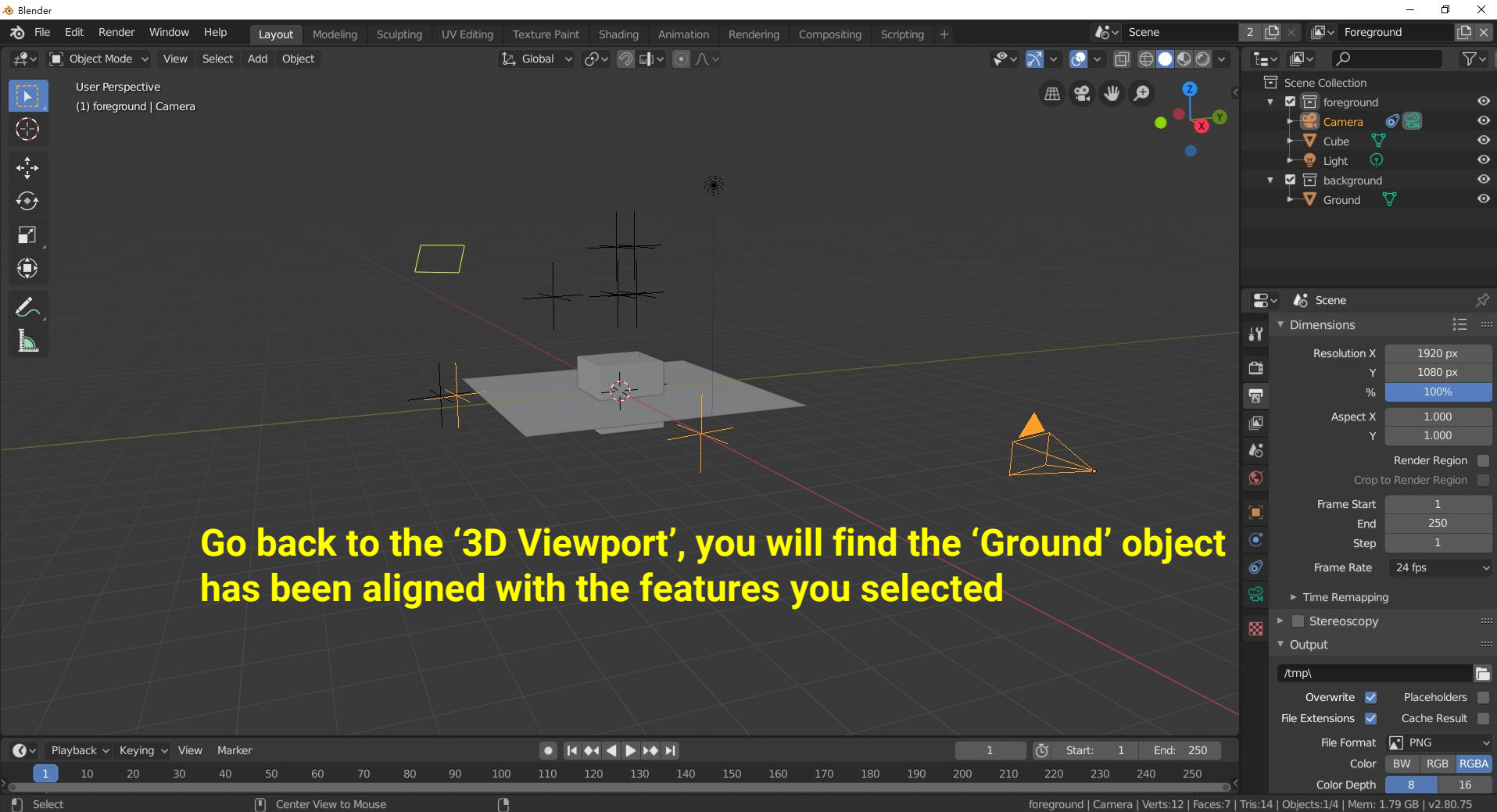
Blender 2.80.75 interface showing the tracking setup process. The main viewport displays a 3D scene of a modern building interior with tracking markers on the floor. The 'Track' panel on the right shows the 'Ground' object selected in the 'Track' list. The 'Scene Setup' panel on the left has the 'Floor' button highlighted. A red box highlights three tracking markers on the floor in the viewport. A red arrow points from the 'Ground' object in the 'Track' panel to the 'Ground' object in the 'Scene' panel.

2. Press the 'Floor' button

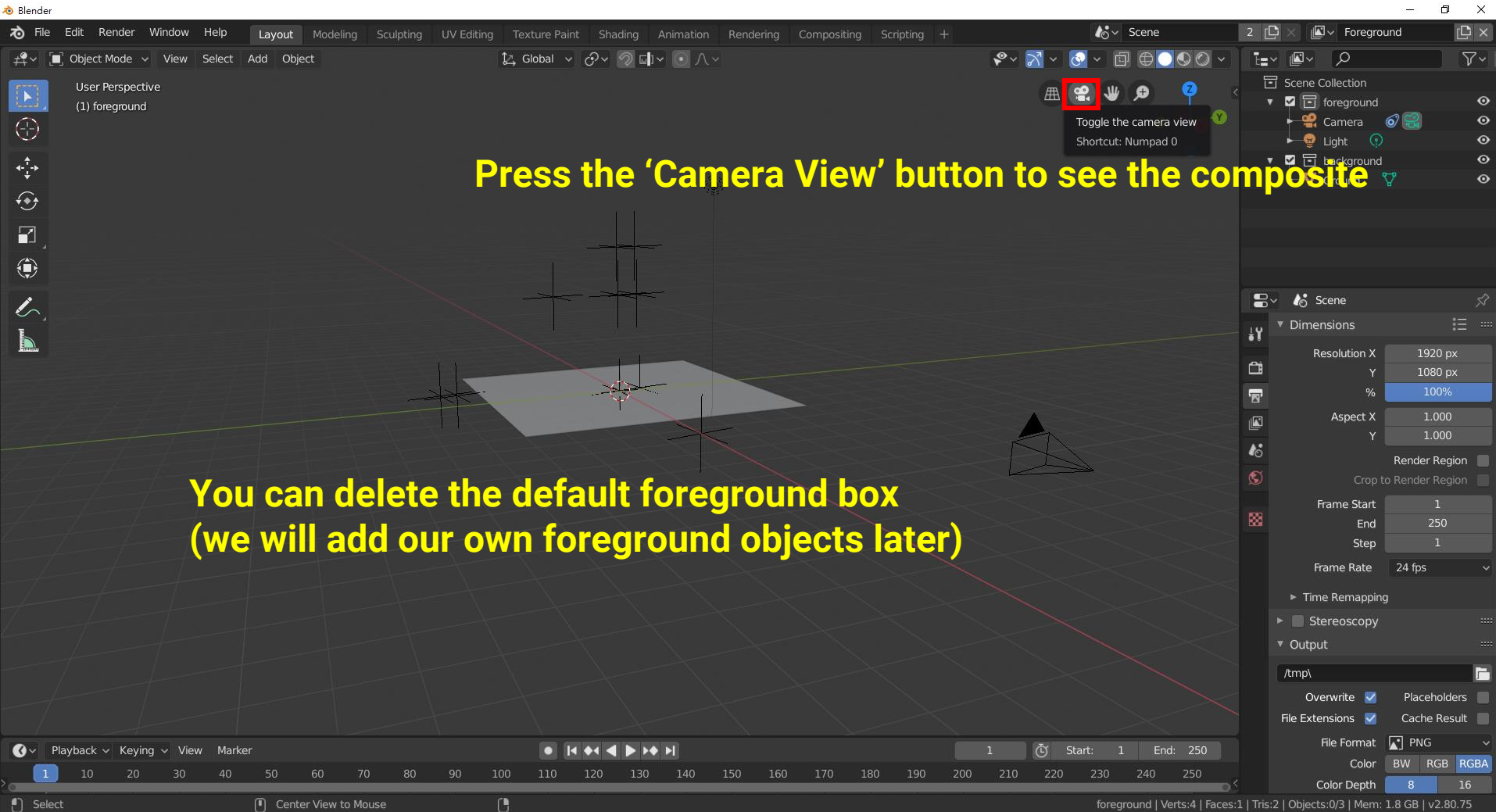
**1. Select 3 feature points (the plane of the scene)
It will map to the 'Ground' object (and receive shadows)**

Resolution X: 1920 px
Resolution Y: 1080 px
Aspect X: 1.000
Aspect Y: 1.000
Frame Start: 1
End: 250
Step: 1
Frame Rate: 24 fps
File Format: PNG
Color: RGB
Color Depth: 8

Setup Tracking Scene (7)



Setup Tracking Scene (8)



Press the 'Camera View' button to see the composite

You can delete the default foreground box (we will add our own foreground objects later)

Blender 2.80.75 interface showing a tracking scene setup. The 3D viewport displays a camera view of a scene with a grid floor and a camera frustum. The top toolbar has the 'Camera View' button highlighted with a red box. The right sidebar shows the 'Scene' properties panel with dimensions and output settings.

Scene Collection:

- foreground
 - Camera
 - Light
- background

Scene Properties:

- Dimensions
 - Resolution X: 1920 px
 - Y: 1080 px
 - %: 100%
 - Aspect X: 1.000
 - Y: 1.000
- Render Region
 - Crop to Render Region:
- Frame Start: 1
- End: 250
- Step: 1
- Frame Rate: 24 fps

Time Remapping:

- Stereoscopy:

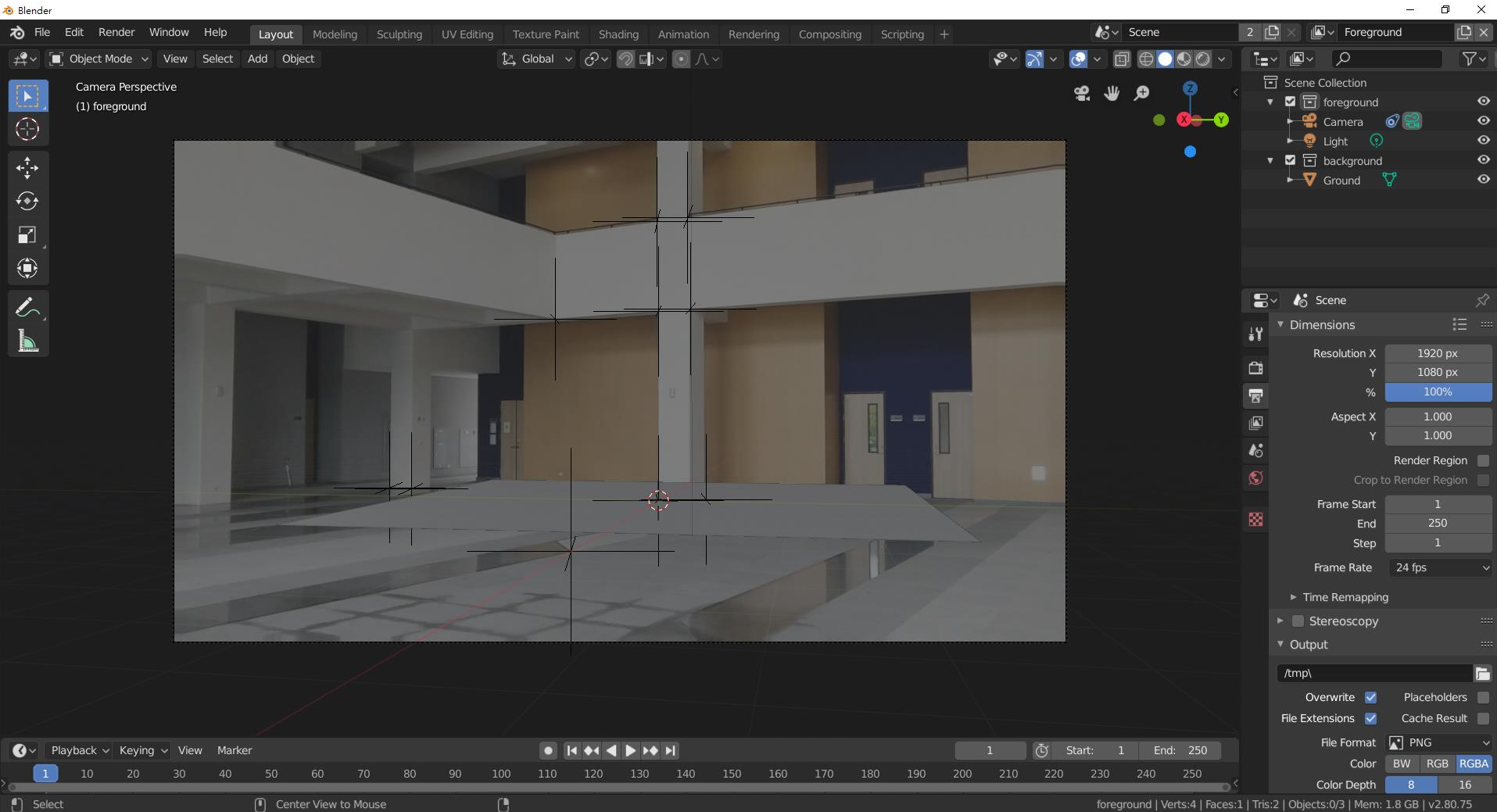
Output:

- File Path: /tmp/
- Overwrite:
- Placeholders:
- File Extensions:
- Cache Result:
- File Format: PNG
- Color: BW, RGB, **RGBA**
- Color Depth: 8, 16

Timeline: 1 | Start: 1 | End: 250

Status: foreground | Verts:4 | Faces:1 | Tris:2 | Objects:0/3 | Mem: 1.8 GB | v2.80.75

Setup Tracking Scene (9)



Setup Tracking Scene (10)

Blender 2.80.75 interface showing the 'Setup Tracking Scene' workflow. The 3D Viewport displays a scene with tracking markers. The 'Solve' panel on the left has 'Set Origin' highlighted in red. A tooltip explains: 'Set active marker as origin by moving camera (or its parent if present) in 3D space.' The 'Track' panel on the right shows tracking settings. The 'Scene' panel on the far right shows dimensions and output settings.

You can optionally select one feature point and press the 'Set Origin' button, the feature point will become the origin of the world space

Setup Tracking Scene (11)

1. Select the 'Ground' object

2. Adjust its transform to better match your scene

Property	Value
Location X	2.5m
Y	0m
Z	0m
Rotation X	0°
Y	0°
Z	-20°
Scale X	1.400
Y	1.000
Z	1.000

Rotation Mode: XYZ Euler

foreground | Ground | Verts:4 | Faces:1 | Tris:2 | Objects:1/3 | Mem: 1.8 GB | v2.80.75

Setup Tracking Scene (12)

The image shows the Blender 2.80.75 interface. The main viewport displays a 3D scene of a modern building interior with a camera and a ground plane. The timeline at the bottom is highlighted in red, showing frame 123. The right sidebar shows the 'Ground' object's transform properties.

Ground Object Transform Properties:

Property	Value
Location X	2.5m
Y	0m
Z	0m
Rotation X	0°
Y	0°
Z	-20°
Scale X	1.400
Y	1.000
Z	1.000
Rotation Mode	XYZ Euler

Timeline: Playback, Keying, View, Marker. Frame 123 is selected. Start: 1, End: 250.

Status Bar: foreground | Ground | Verts:4 | Faces:1 | Tris:2 | Objects:1/3 | Mem: 2.09 GB | v2.80.75

Drag the timeline to ensure the virtual plane matches the scene in each frame (if it is, congratulations; if it is not, you need to modify your feature tracking)

Add Virtual 3D Models (and Animations)

Add virtual 3D models and their animations



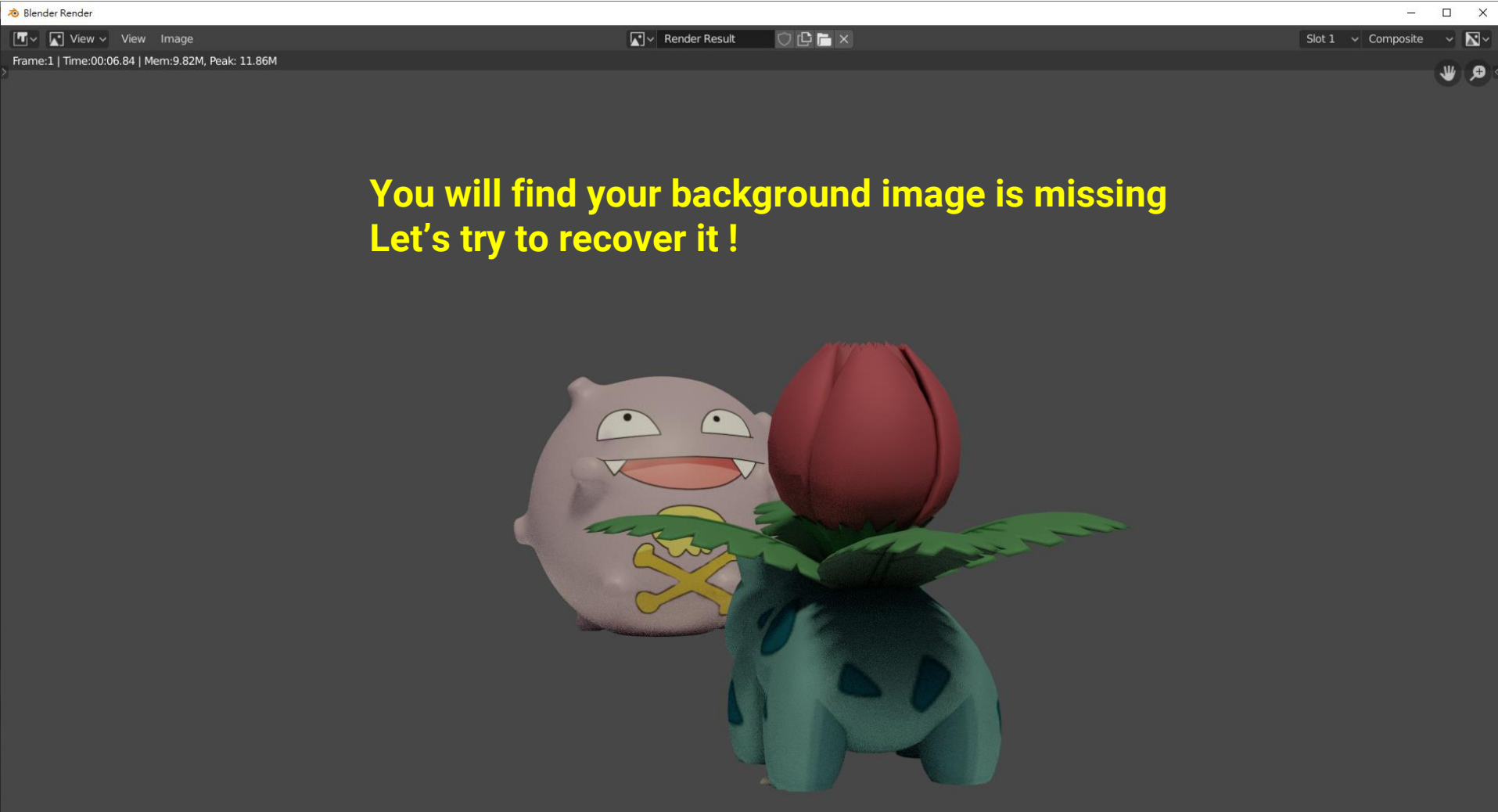
Try to Render the Frame (1)

The screenshot shows the Blender 2.80.7 interface. The top menu bar has 'Render' highlighted in red. The 3D viewport shows a scene with a pink Bulbasaur and a red flower on a green base. The right sidebar shows the 'Scene' properties panel with 'Render Engine' set to 'Cycles' (highlighted in red) and 'Device' set to 'CPU'. The bottom status bar shows 'foreground | Light | Verts:8,166 | Faces:11,133 | Tris:15,948 | Objects:1/5 | Mem: 3.8 GB | v2.80.75'.

2. Try to render the image for testing by selecting 'Render' → 'Render Image'

1. Switch to the 'Render' panel and change the renderer to 'Cycle' (ray-tracing)

Try to Render the Frame (2)



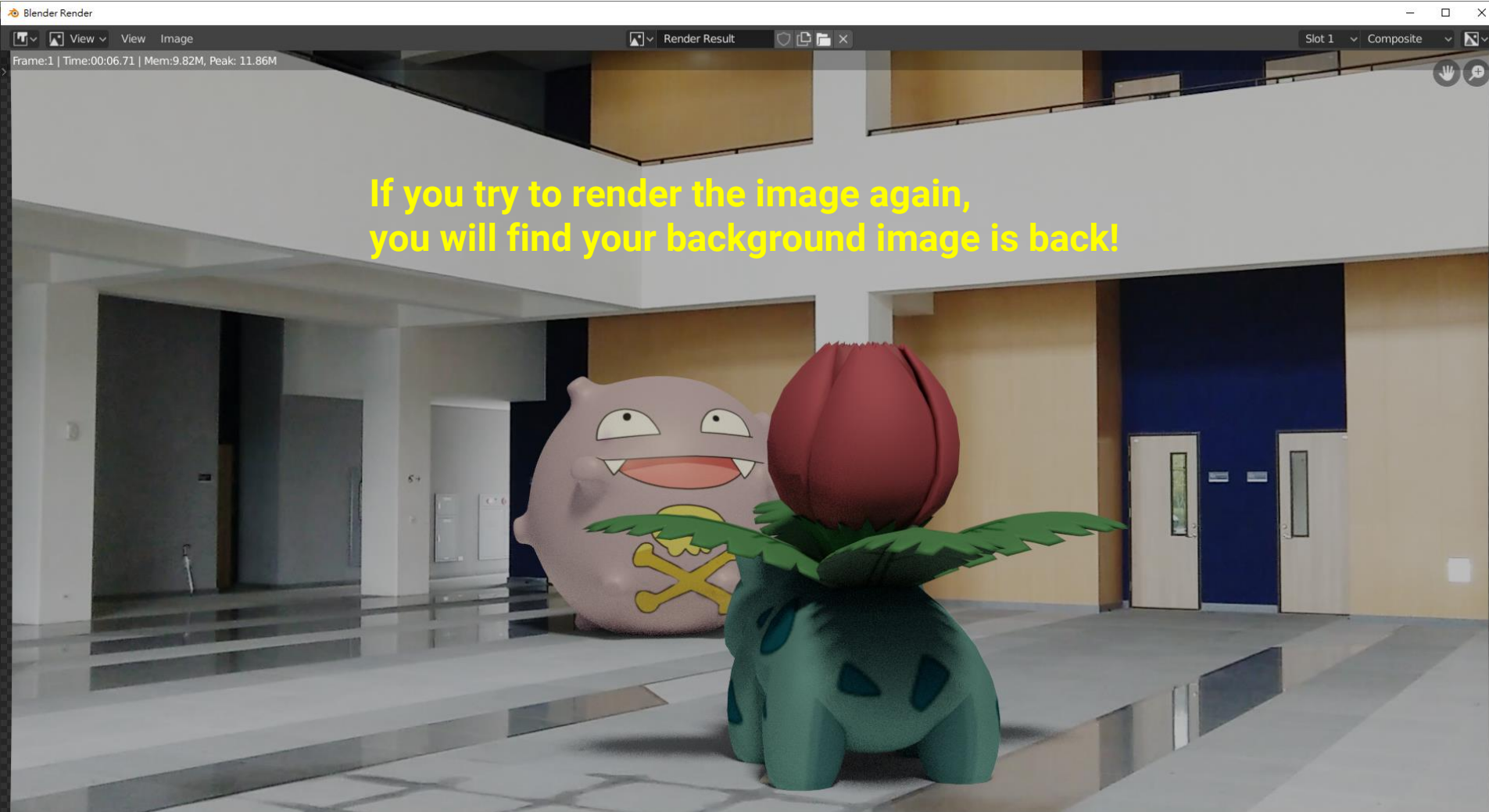
Try to Render the Frame (3)



The image shows the Blender 2.80.75 interface in Object Mode. The central viewport displays a 3D scene with a pink Pokémon (Jigglypuff) and a red flower (Tulip) on a green base. The scene is set in a modern building interior. The 'Render' panel is open on the right, and the 'Transparent' checkbox is checked, indicating that the render is being performed in a transparent mode. The 'Render' panel also shows the 'Light Paths' and 'Volumes' sections, with 'Hair' and 'Motion Blur' checked. The 'Pixel Filter' section shows 'Exposure' set to 1.00 and 'Pixel Filter' set to 'Blackman-Harris'. The 'Performance' section shows 'Bake' and 'Freestyle' options. The 'Color Management' section is also visible. The bottom status bar shows 'foreground | Light | Verts:8,166 | Faces:11,133 | Tris:15,948 | Objects:1/5 | Mem: 3.8 GB | v2.80.75'. A yellow text overlay at the bottom right of the viewport reads: 'In the 'Render' panel, tick 'Transparent''.

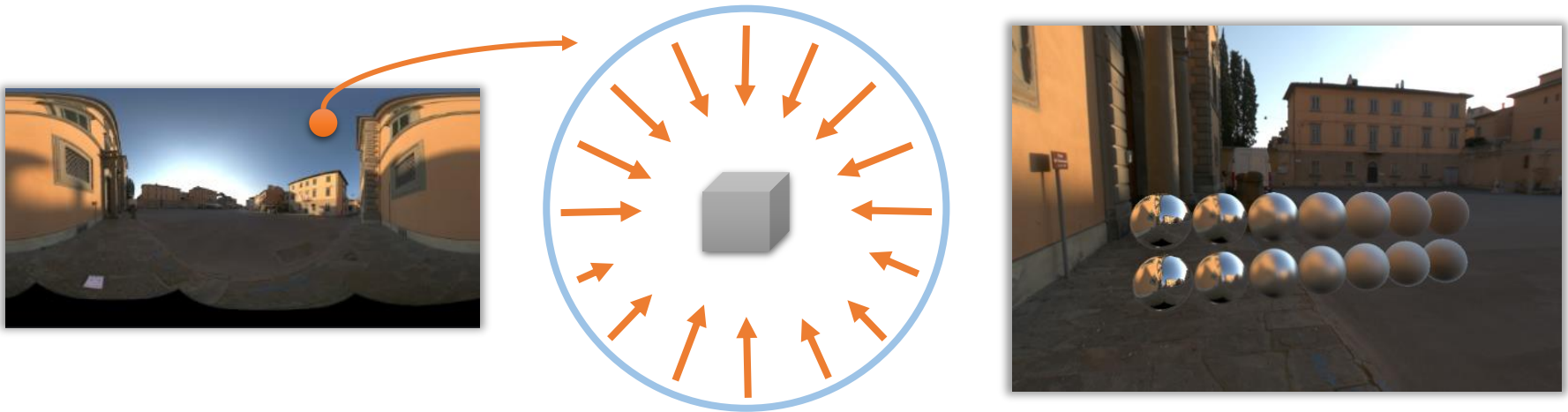
In the 'Render' panel, tick 'Transparent'

Try to Render the Frame (4)



Recap: Environment Lighting

- Environment light illuminates the scene from a **virtual sphere at infinite distance**
- The spherical energy distribution is usually represented with longitude-latitude images
- Also called **image-based lighting (IBL)**



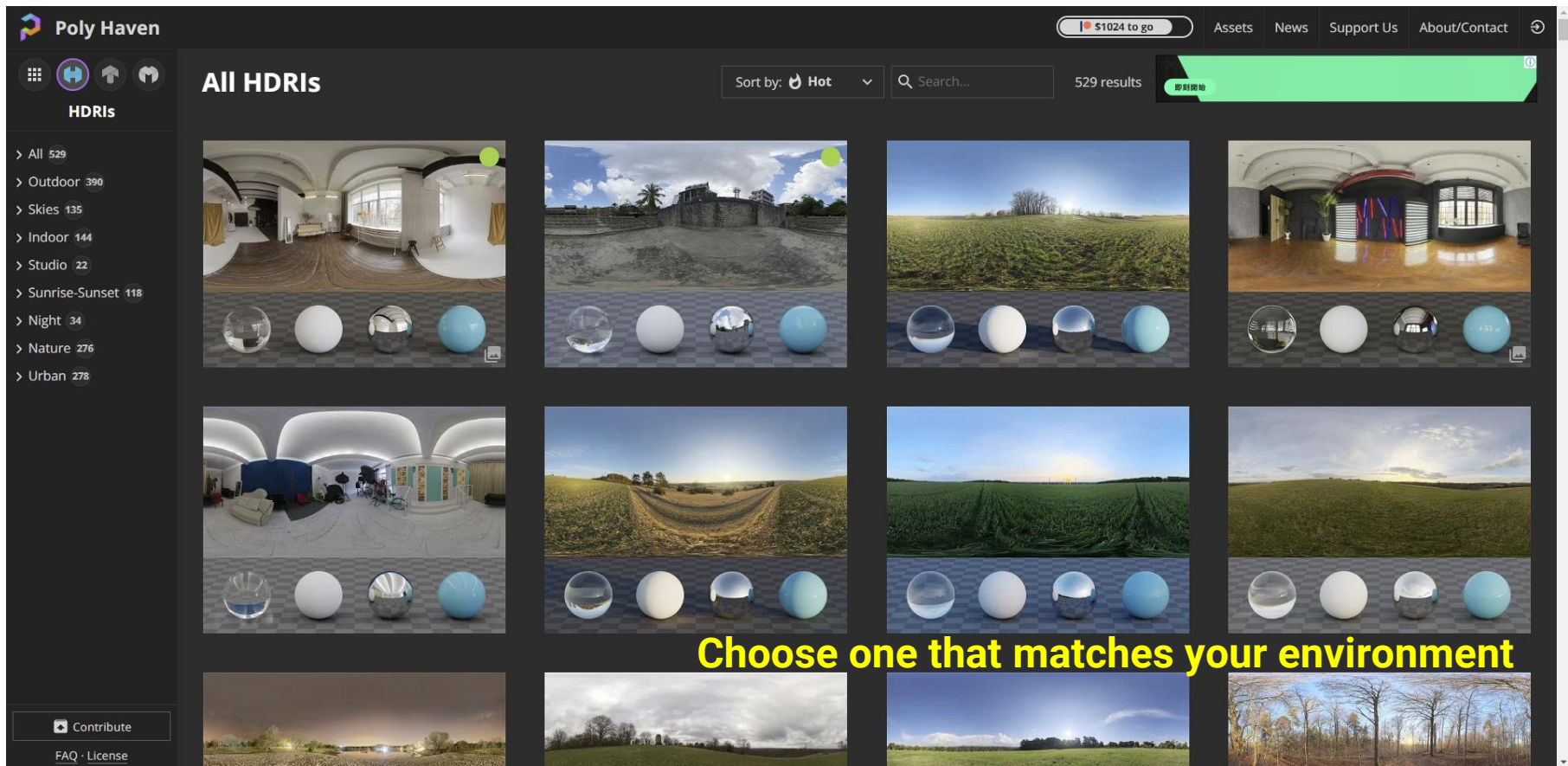
Recap: Environment Lighting

- Widely used in digital visual effects and film production



Environment Lighting Resource

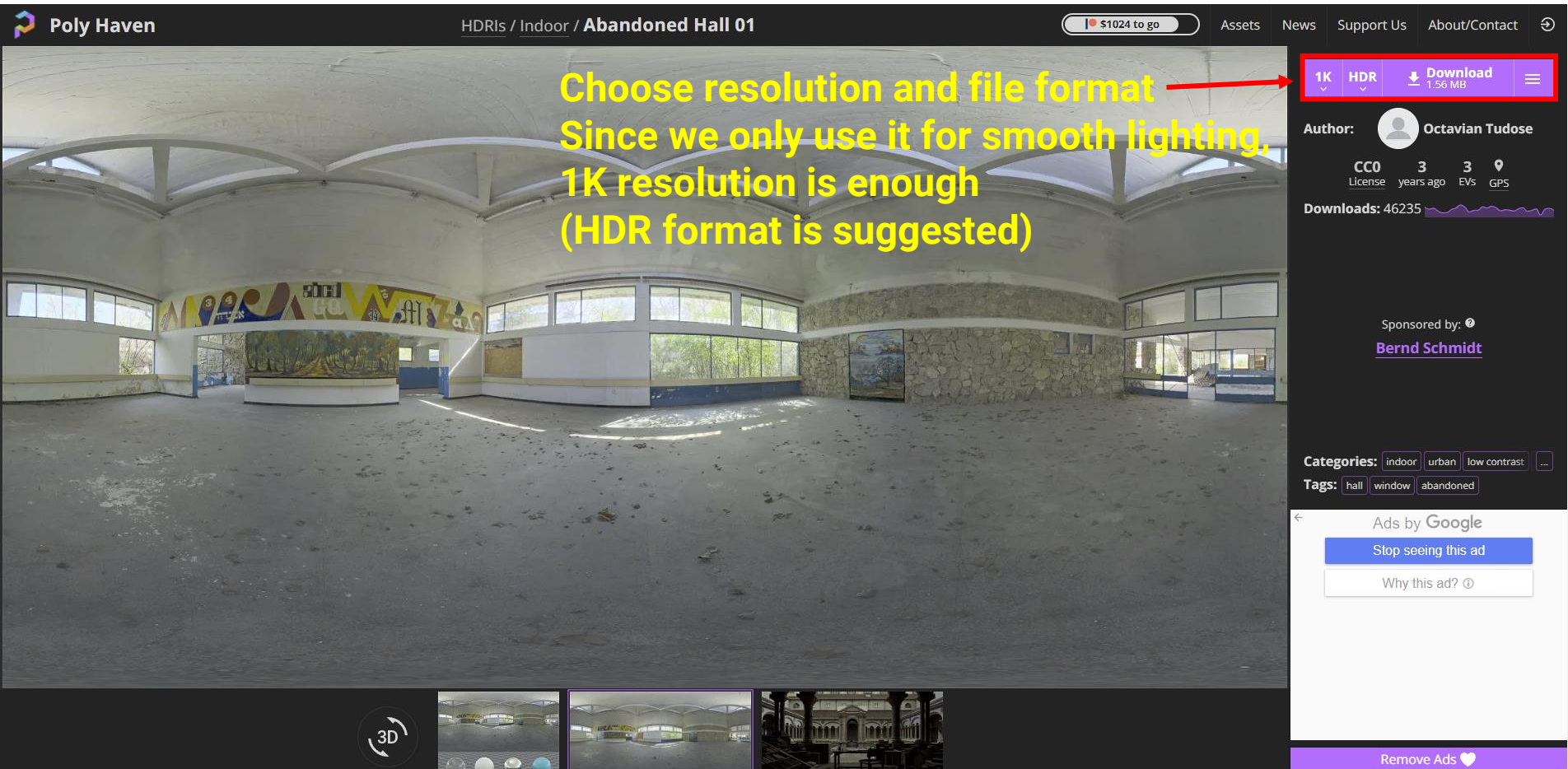
- Download free HDR environment map on the internet
<https://polyhaven.com/hdris>



The screenshot displays the Poly Haven website interface. At the top, the site name "Poly Haven" is visible along with navigation links for "Assets", "News", "Support Us", and "About/Contact". A balance indicator shows "\$1024 to go". The main content area is titled "All HDRis" and features a search bar and a "Sort by: Hot" dropdown menu. Below the search bar, there are 529 results displayed in a grid format. Each result consists of a large preview image of an environment and four smaller spherical preview images below it, representing different lighting conditions. The environments shown include indoor spaces like a modern living room and a studio, outdoor landscapes like a field at sunset, a dirt road, and a forest, and various architectural settings. A yellow text overlay at the bottom of the grid reads "Choose one that matches your environment".

Choose one that matches your environment

Environment Lighting Resource (cont.)



The screenshot displays the Poly Haven website interface for an HRI titled "Abandoned Hall 01". The main view is a 3D rendering of a large, empty, abandoned hall with a high, vaulted ceiling and large windows. A red arrow points to the download menu in the top right corner, which is highlighted with a red box. The menu options are "1K", "HDR", and "Download 1.56 MB".

Choose resolution and file format
Since we only use it for smooth lighting,
1K resolution is enough
(HDR format is suggested)

Download 1.56 MB

Author: **Octavian Tudose**
CC0 License 3 years ago 3 EVs GPS
Downloads: 46235

Sponsored by: **Bernd Schmidt**

Categories: indoor urban low contrast ...
Tags: hall window abandoned

Ads by Google
Stop seeing this ad
Why this ad?

Remove Ads

Add more realistic lighting (1)

The image shows the Blender 2.80.7 interface. The main viewport displays a 3D scene with a pink Gengar and a red flower on a green base. The 'World' properties panel is open on the right, and the 'Ambient Occlusion' button is highlighted with a red box. A yellow text overlay says "Switch to the 'World' panel".

Blender* [C:\Users\user\Desktop\Matchmove\untitled.blend]

File Edit Render Window Help Layout Modeling Sculpting UV Editing Texture Paint Shading Animation Rendering Compositing Scripting +

Scene 2 x Foreground

Object Mode View Select Add Object

Camera Perspective
(1) foreground | Camera
Rendering Done

Scene Collection

- foreground
 - Camera
 - Ivysaur
 - Light
 - Sphere
- background
 - Ground

World

Surface

Surface	Background
Color	
Strength	1.000

Volume

- Ambient Occlusion
- Ray Visibility

Settings

Viewport Display

Custom Properties

Playback Keying View Marker

1 Start: 1 End: 211

10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250

Select Move Rotate View Object Context Menu

foreground | Camera | Verts:8,166 | Faces:11,133 | Tris:15,948 | Objects:1/5 | Mem: 2.05 GB | v2.80.75

Switch to the 'World' panel

Add more realistic lighting (2)

The image shows the Blender 2.80.75 interface. The main viewport displays a 3D scene with a pink Gengar and a red flower on a green base. The 'Environment Texture' option is highlighted in the material editor. The interface includes a top menu bar, a toolbar, a left sidebar with viewports, a right sidebar with the Outliner and Properties panels, and a bottom timeline.

Select 'Environment Texture'

Environment Texture

foreground | Camera | Verts:8,166 | Faces:11,133 | Tris:15,948 | Objects:1/5 | Mem: 2.05 GB | v2.80.75

Add more realistic lighting (3)

The image shows the Blender 2.80.75 interface. The top menu bar includes File, Edit, Render, Window, Help, Layout, Modeling, Sculpting, UV Editing, Texture Paint, Shading, Animation, Rendering, Compositing, and Scripting. The left toolbar shows various tools like Select, Rotate, Translate, and Scale. The central viewport displays a 3D scene with a pink and purple creature and a pink flower. The right-hand Properties panel is open to the Surface tab, showing the Background color and a red box around the 'Open' button. A yellow text overlay reads "Select your downloaded image".

Blender* [C:\Users\user\Desktop\Matchmove\untitled.blend]

File Edit Render Window Help Layout Modeling Sculpting UV Editing Texture Paint Shading Animation Rendering Compositing Scripting +

Scene 2 x Foreground

Object Mode View Select Add Object

Camera Perspective
(1) foreground | Camera
Rendering Done

Scene Collection

- foreground
 - Camera
 - Ivysaur
 - Light
 - Sphere
- background
 - Ground

World

Surface

Surface Background

Color

+ Ne Op

Open.
Open image.

Vector

Strength 1.000

Volume

- Ambient Occlusion
- Ray Visibility
- Settings
- Viewport Display
- Custom Properties

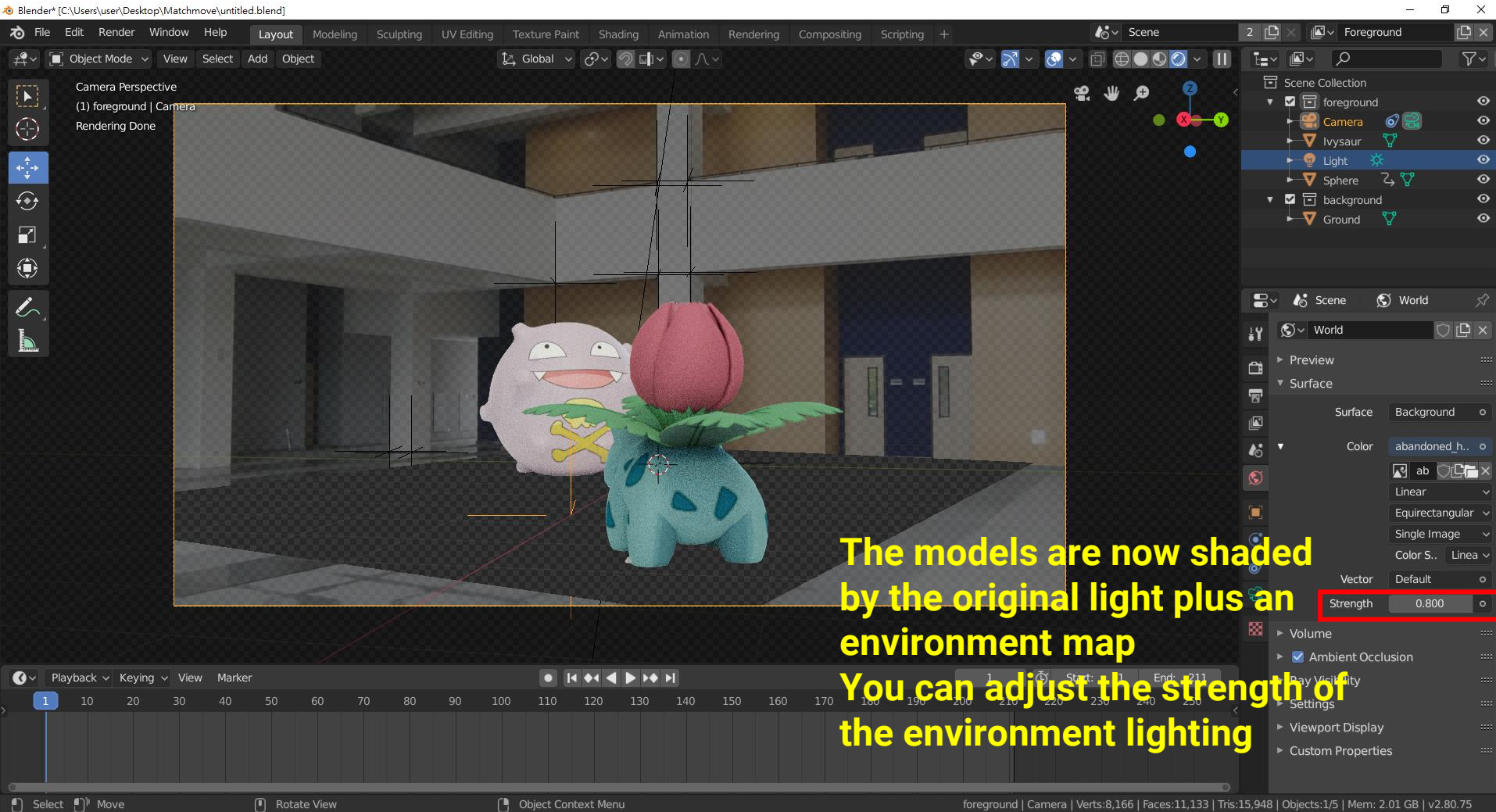
Playback Keying View Marker

1 Start: 1 End: 211

10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250

foreground | Camera | Verts:8,166 | Faces:11,133 | Tris:15,948 | Objects:1/5 | Mem: 2.05 GB | v2.80.75

Add more realistic lighting (4)

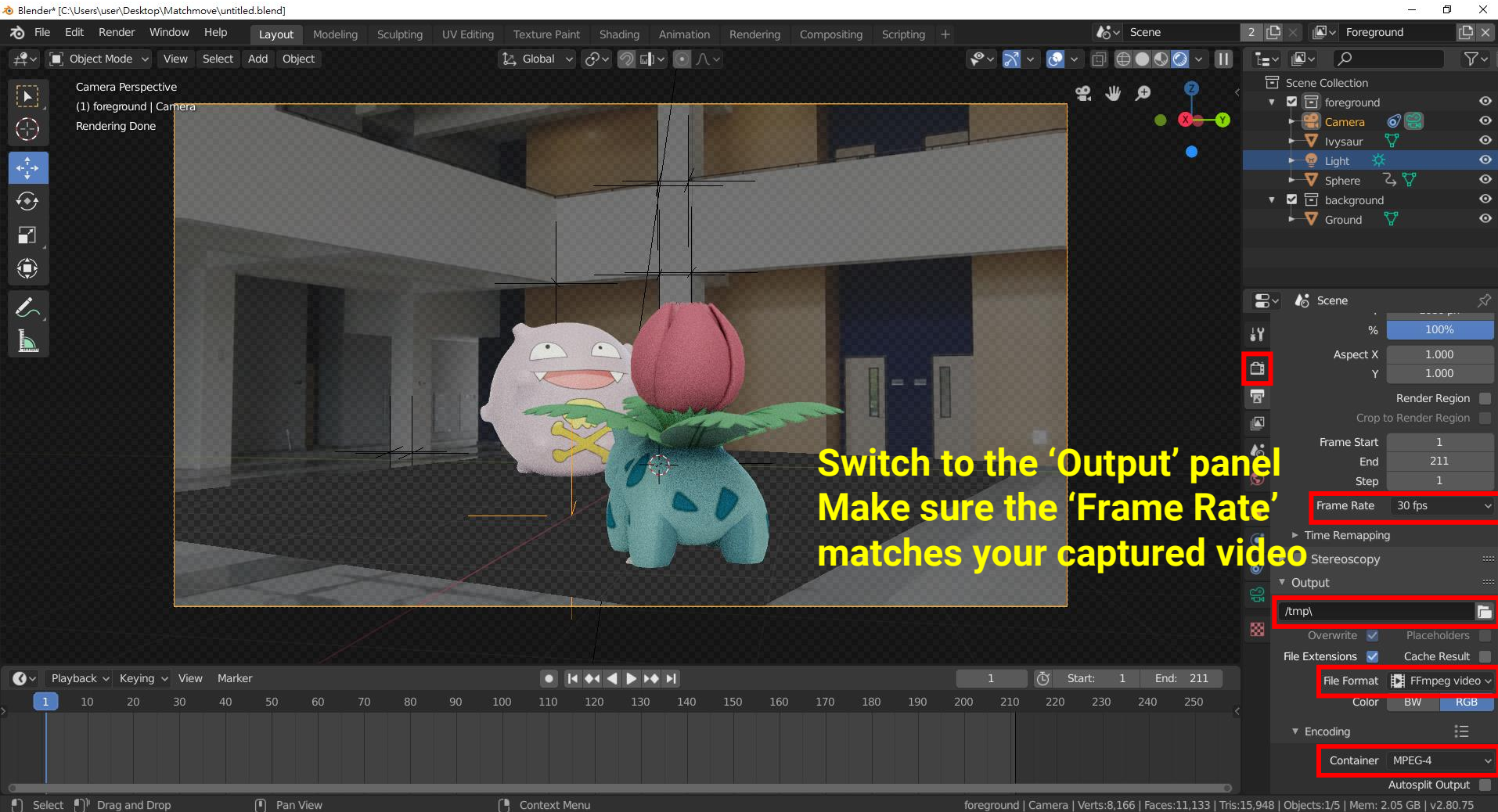


The models are now shaded by the original light plus an environment map. You can adjust the strength of the environment lighting.

Strength 0.800

Output Composite Video

Set output configuration (1)

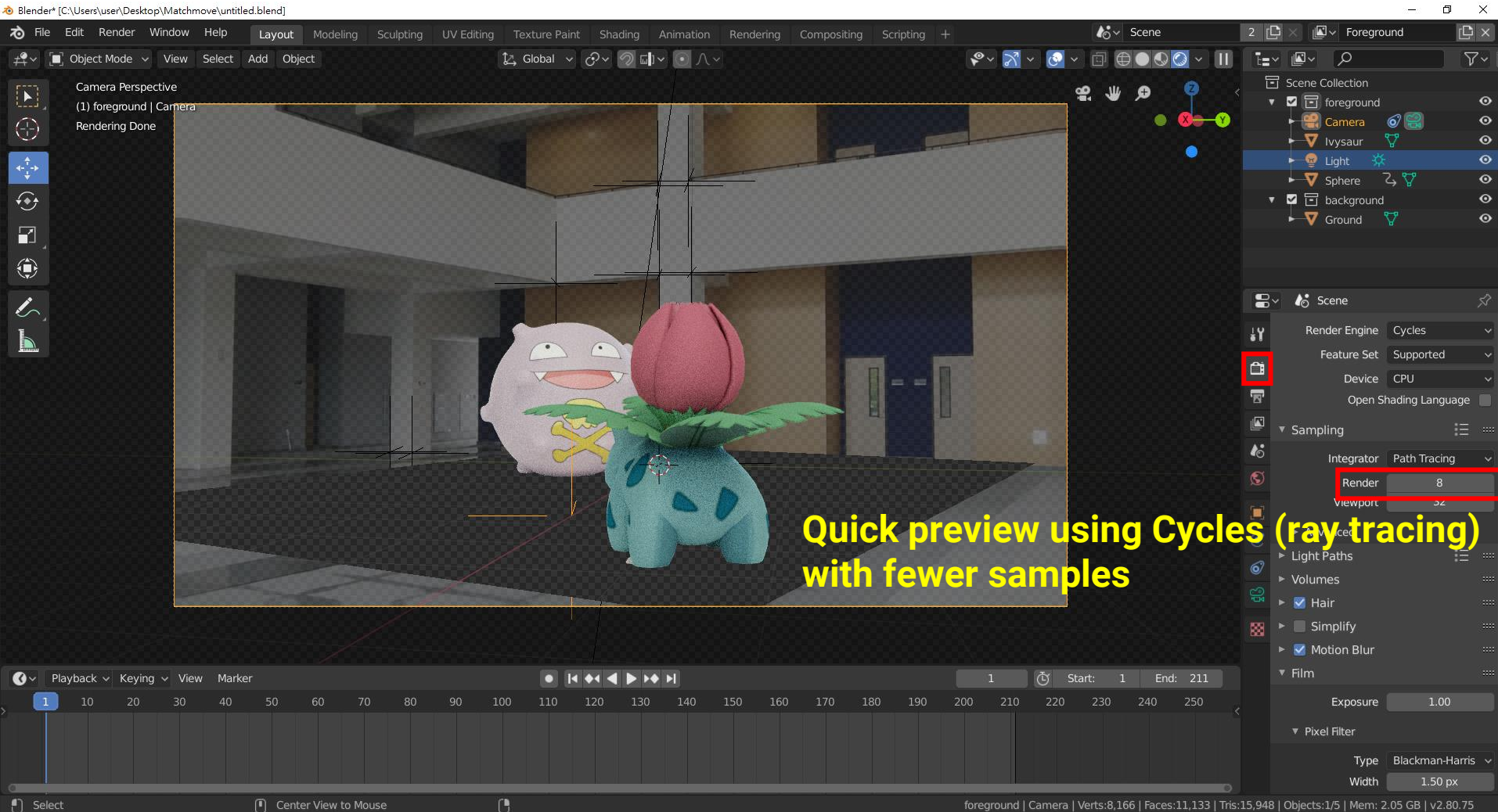


The screenshot displays the Blender 2.80.75 interface. The central viewport shows a 3D scene with a pink Bulbasaur and a blue Ivysaur in a modern building interior. The right-hand side features the Properties panel, which is currently set to the 'Output' tab. Several settings in this panel are highlighted with red boxes:

- The 'Output' tab icon in the left sidebar.
- The 'Frame Rate' dropdown menu, which is set to '30 fps'.
- The 'File Format' dropdown menu, which is set to 'FFmpeg video'.
- The 'Container' dropdown menu, which is set to 'MPEG-4'.

Yellow text overlaid on the scene reads: "Switch to the 'Output' panel. Make sure the 'Frame Rate' matches your captured video." The bottom status bar shows the current scene is 'foreground' with a camera, 8,166 vertices, 11,133 faces, 15,948 tris, 1/5 objects, 2.05 GB memory, and version 2.80.75.

Set output configuration (2)



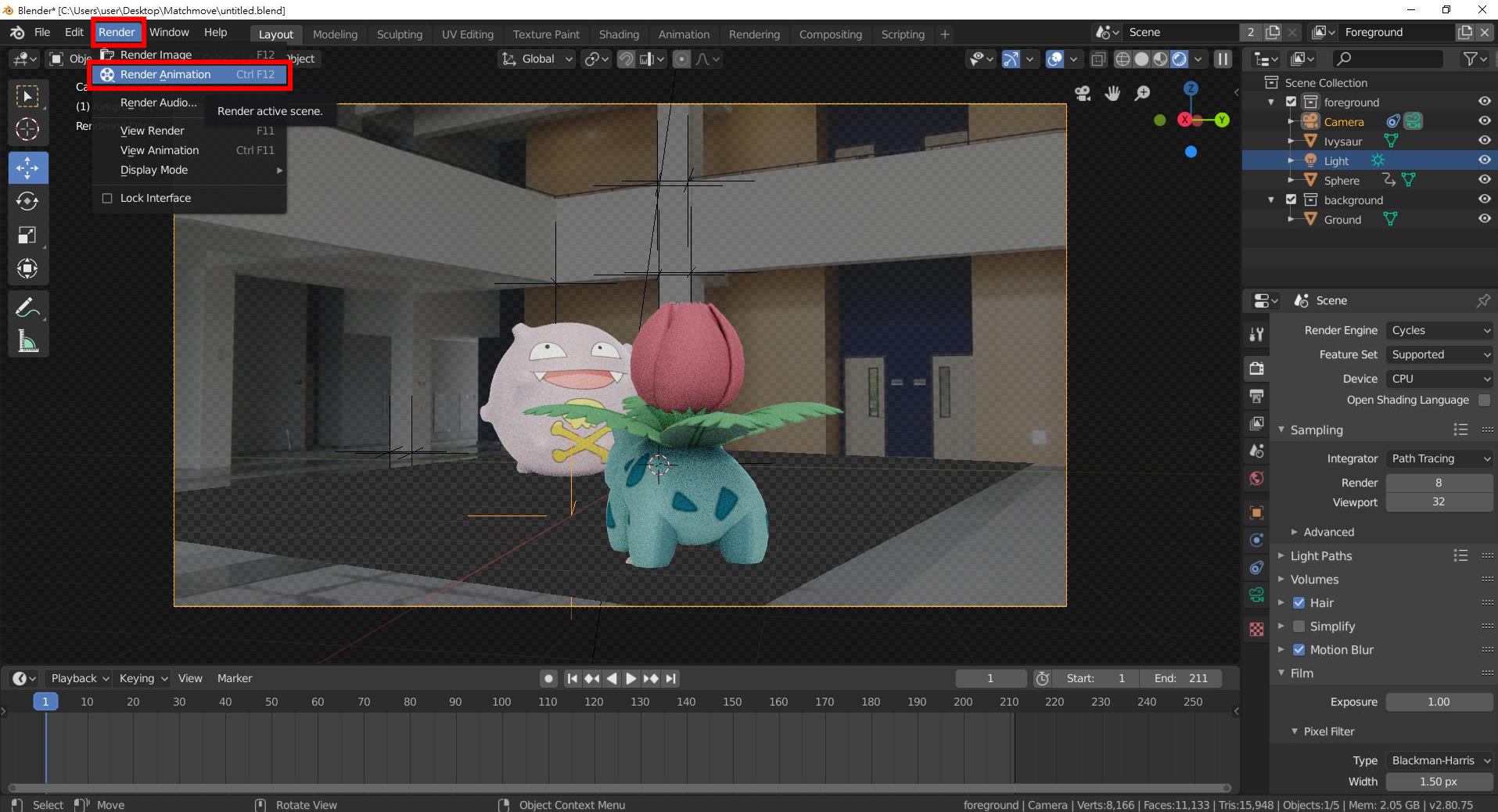
The image shows the Blender 2.80.75 interface with the Render properties panel open. The scene is a 3D render of a room with a pink and blue creature and a red tulip. The Render properties panel is set to Cycles engine, Path Tracing integrator, and 8 samples. The Render button is highlighted with a red box.

Quick preview using Cycles (ray tracing) with fewer samples

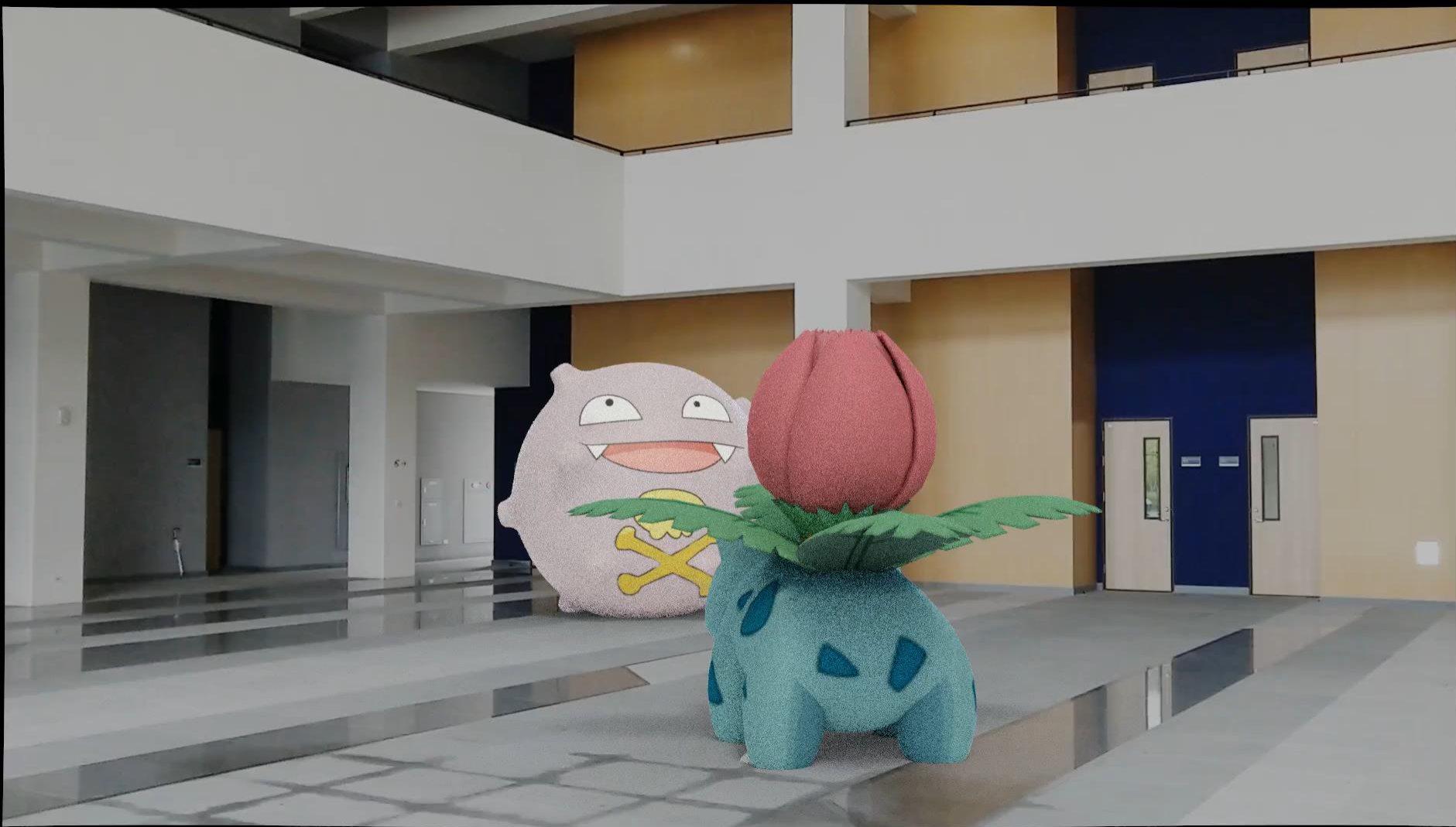
Render Engine: Cycles
Feature Set: Supported
Device: CPU
Open Shading Language
Sampling
Integrator: Path Tracing
Render: 8
Viewport: 32
Light Paths
Volumes
Hair
Simplify
Motion Blur
Film
Exposure: 1.00
Pixel Filter
Type: Blackman-Harris
Width: 1.50 px

foreground | Camera | Verts:8,166 | Faces:11,133 | Tris:15,948 | Objects:1/5 | Mem: 2.05 GB | v2.80.75

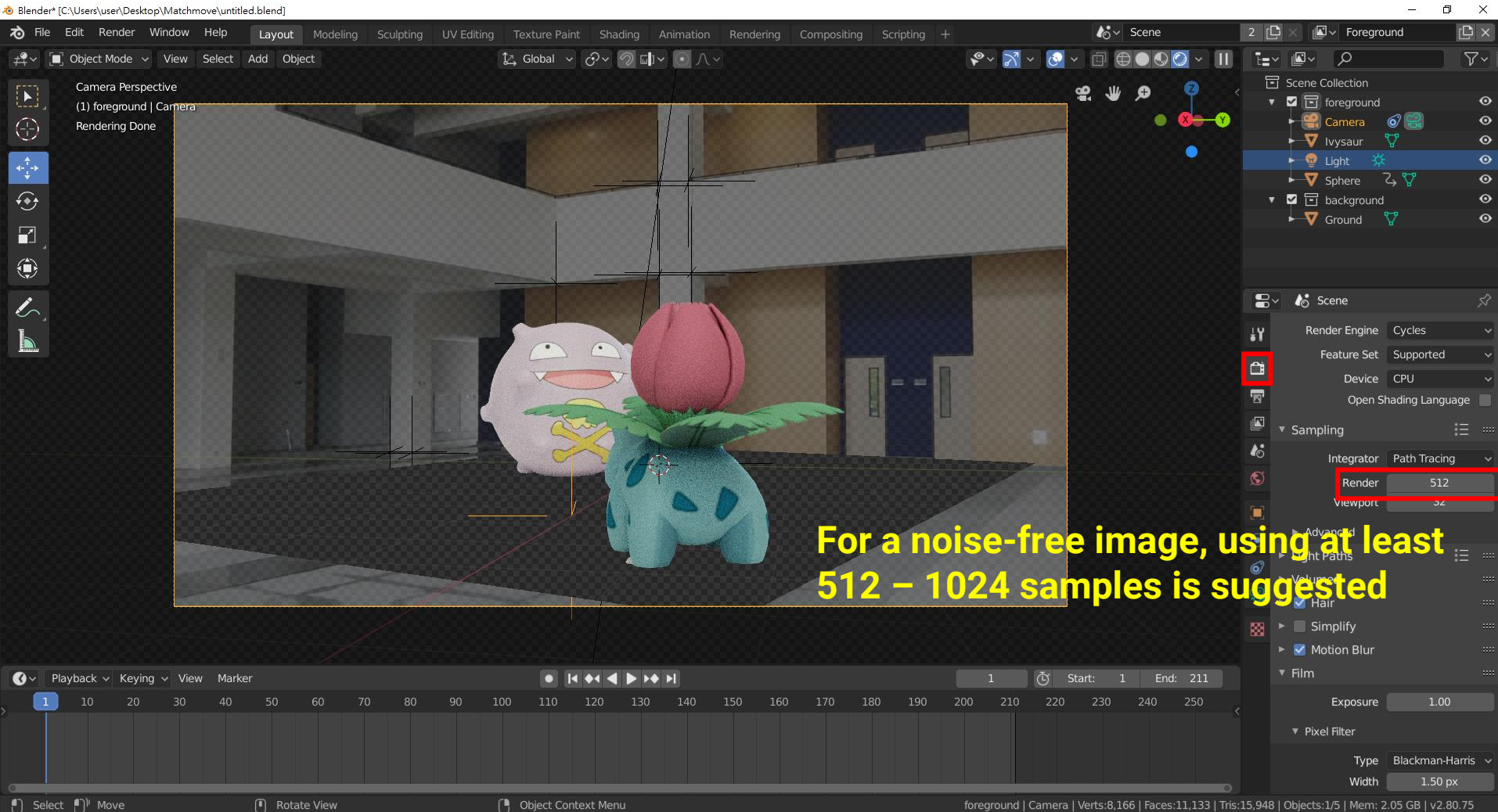
Render animation preview



Preview (check the poses and animations of the models)



Set to high-quality rendering



The image shows the Blender 2.80.75 interface with a rendered scene. The scene features a pink and blue creature (Ivysaur) and a red tulip on a blue base (Bulbasaur) in a modern building interior. The Render properties panel is open, showing the Render Engine set to Cycles, the Feature Set set to Supported, and the Device set to CPU. The Render samples are set to 512, which is highlighted with a red box. The Viewport samples are set to 32. The text "For a noise-free image, using at least 512 – 1024 samples is suggested" is overlaid on the scene.

For a noise-free image, using at least 512 – 1024 samples is suggested

Final Output

