

Problem of Uncalibrated Stereo

Shree K. Nayar

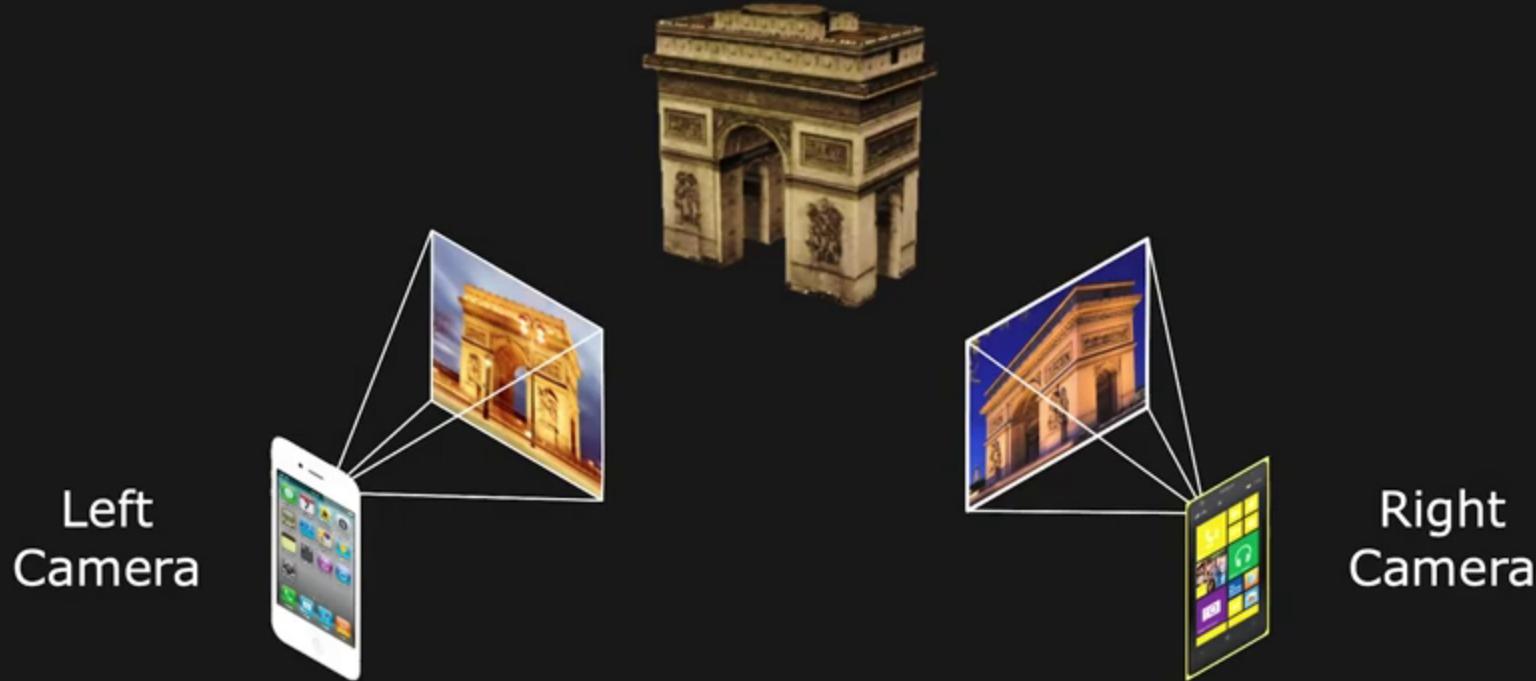
Columbia University

Topic: Uncalibrated Stereo, Module: Reconstruction II

First Principles of Computer Vision

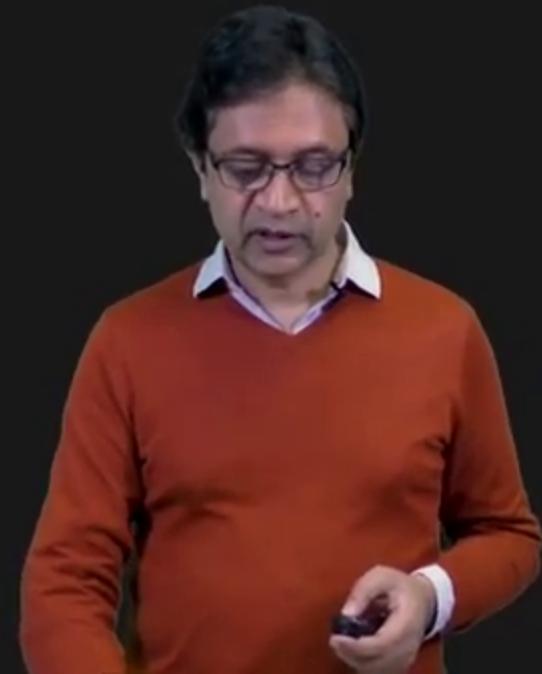
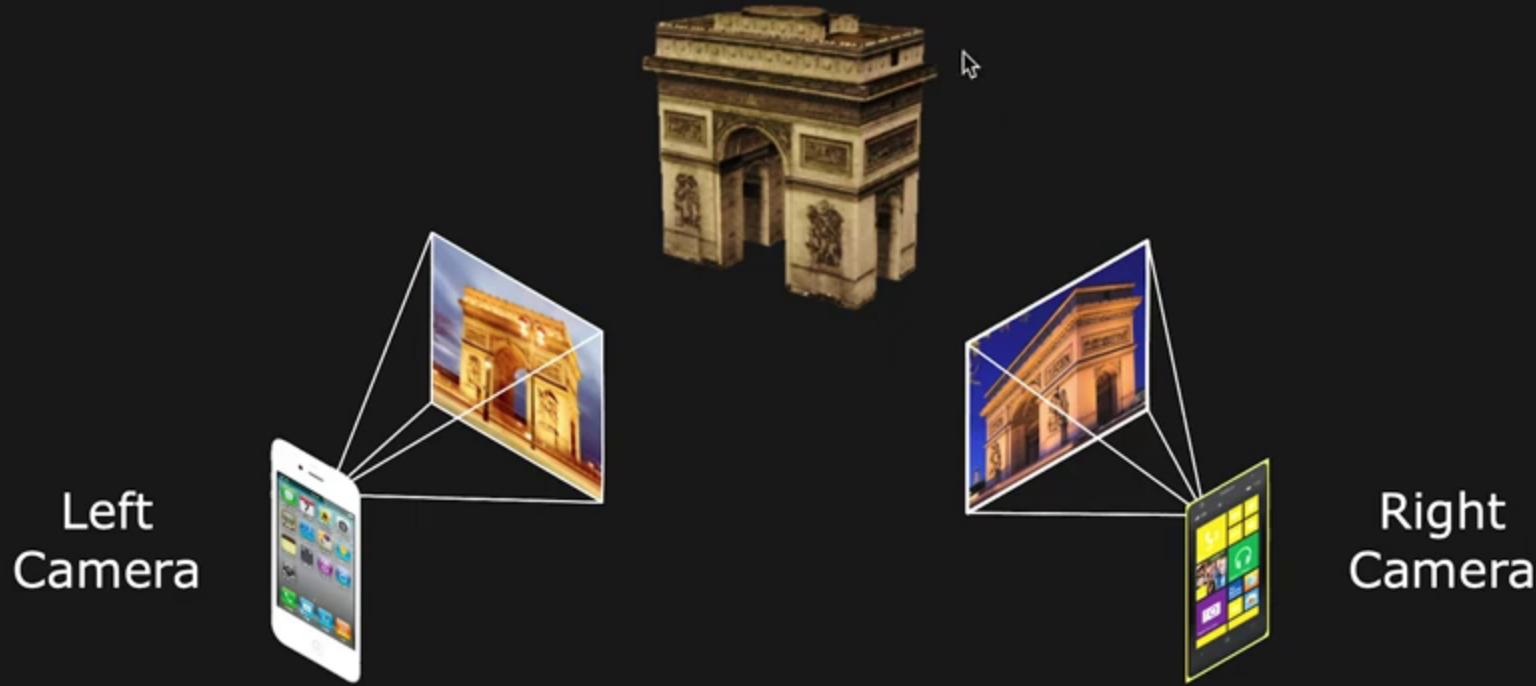
Uncalibrated Stereo

Compute 3D structure of static scene from two arbitrary views



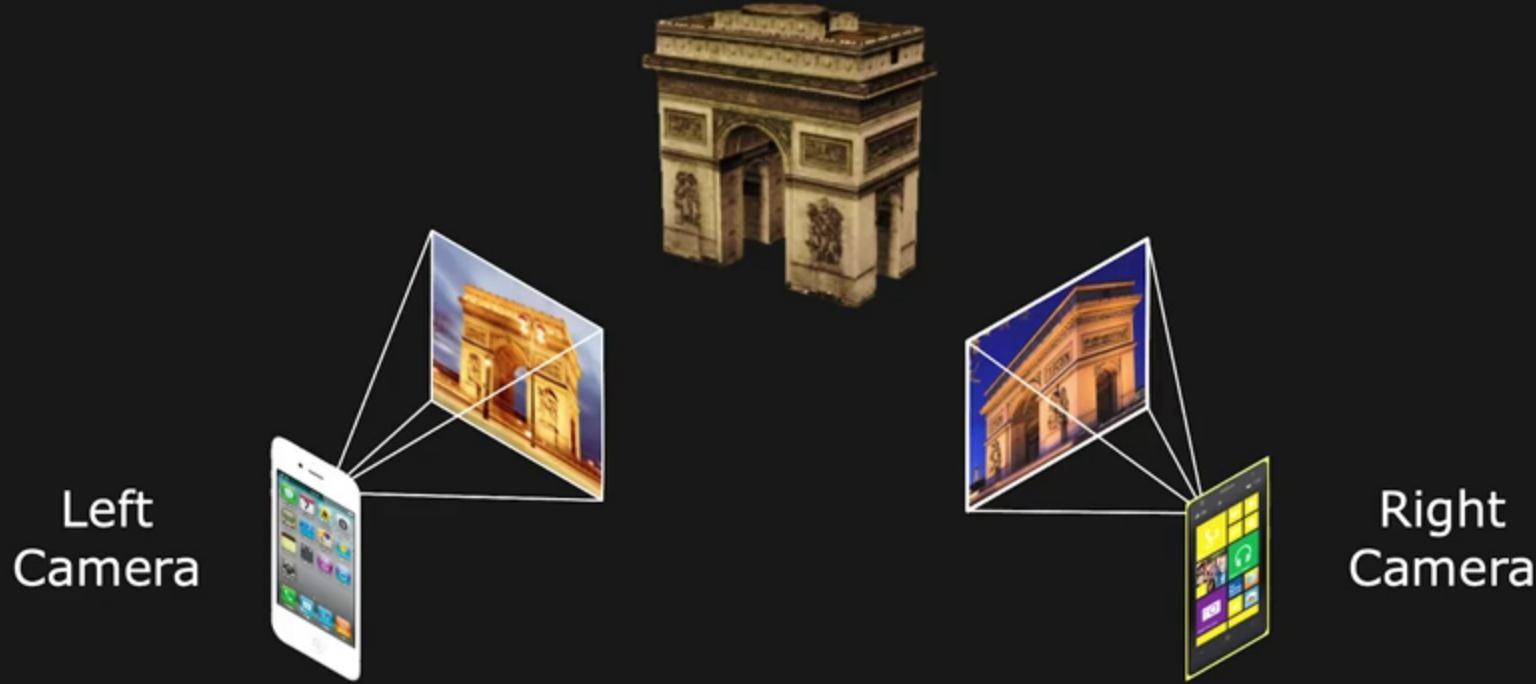
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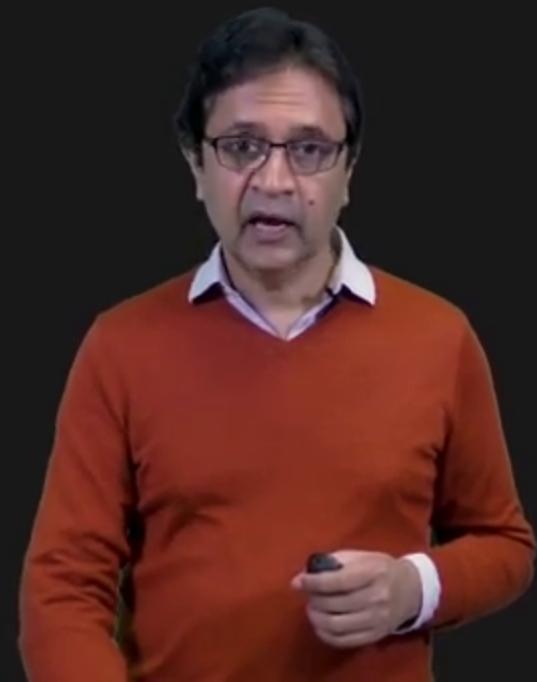


Uncalibrated Stereo

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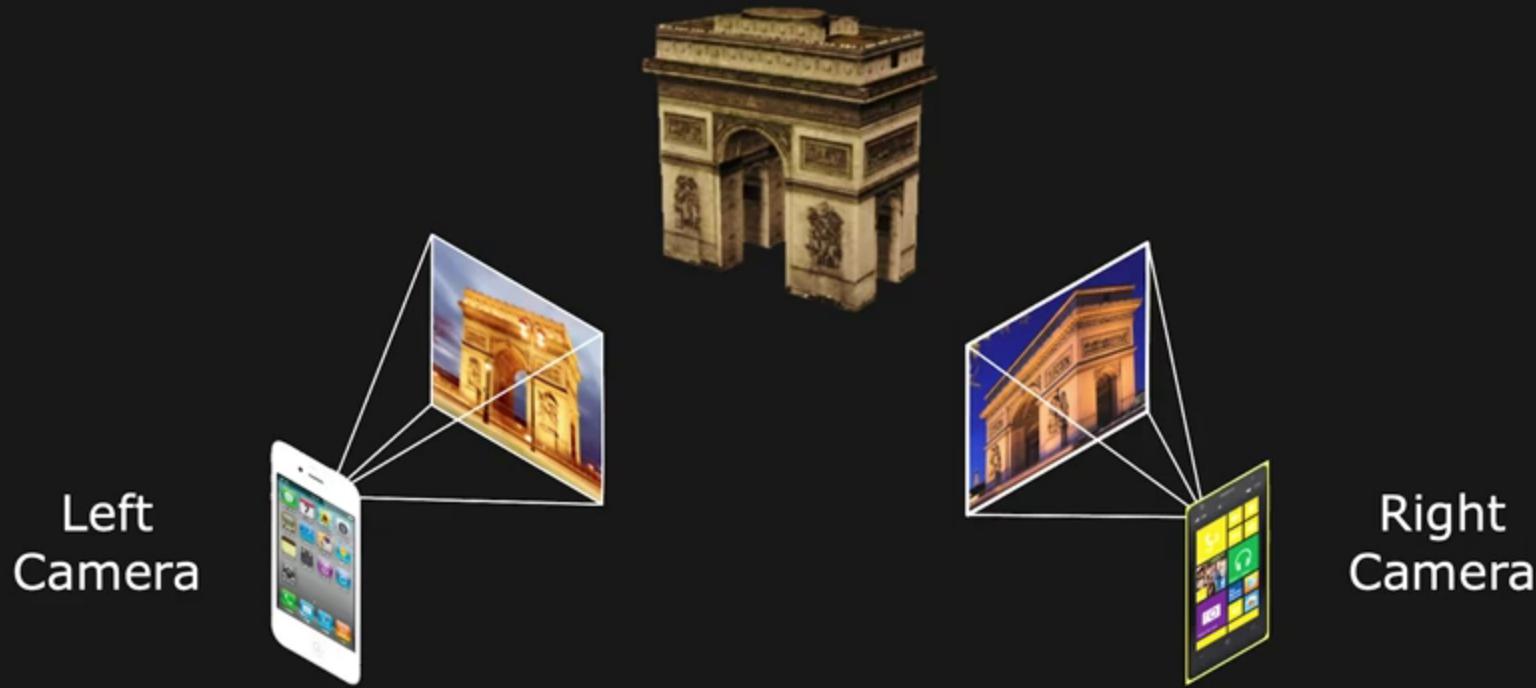


Intrinsics (f_x, f_y, o_x, o_y) are known for both views/cameras.



Uncalibrated Stereo

Compute 3D structure of static scene from two arbitrary views

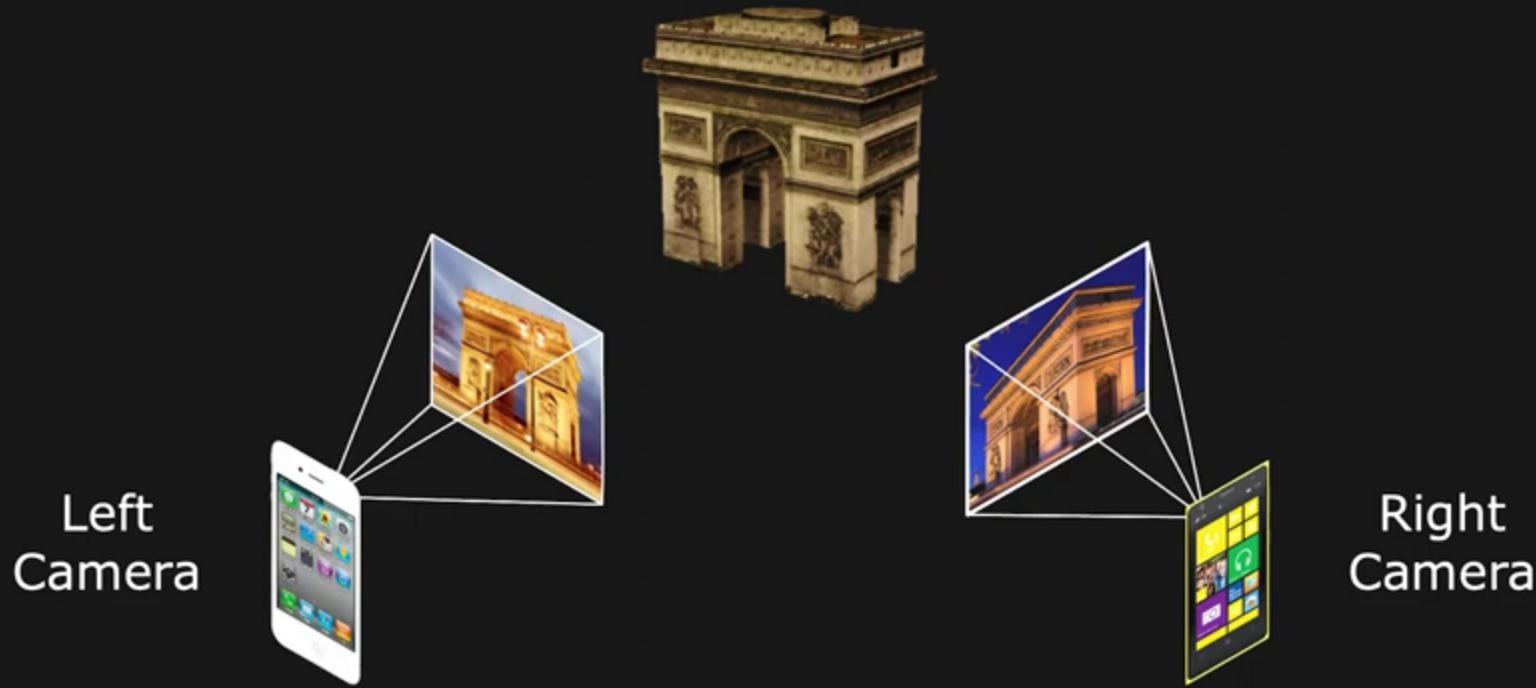


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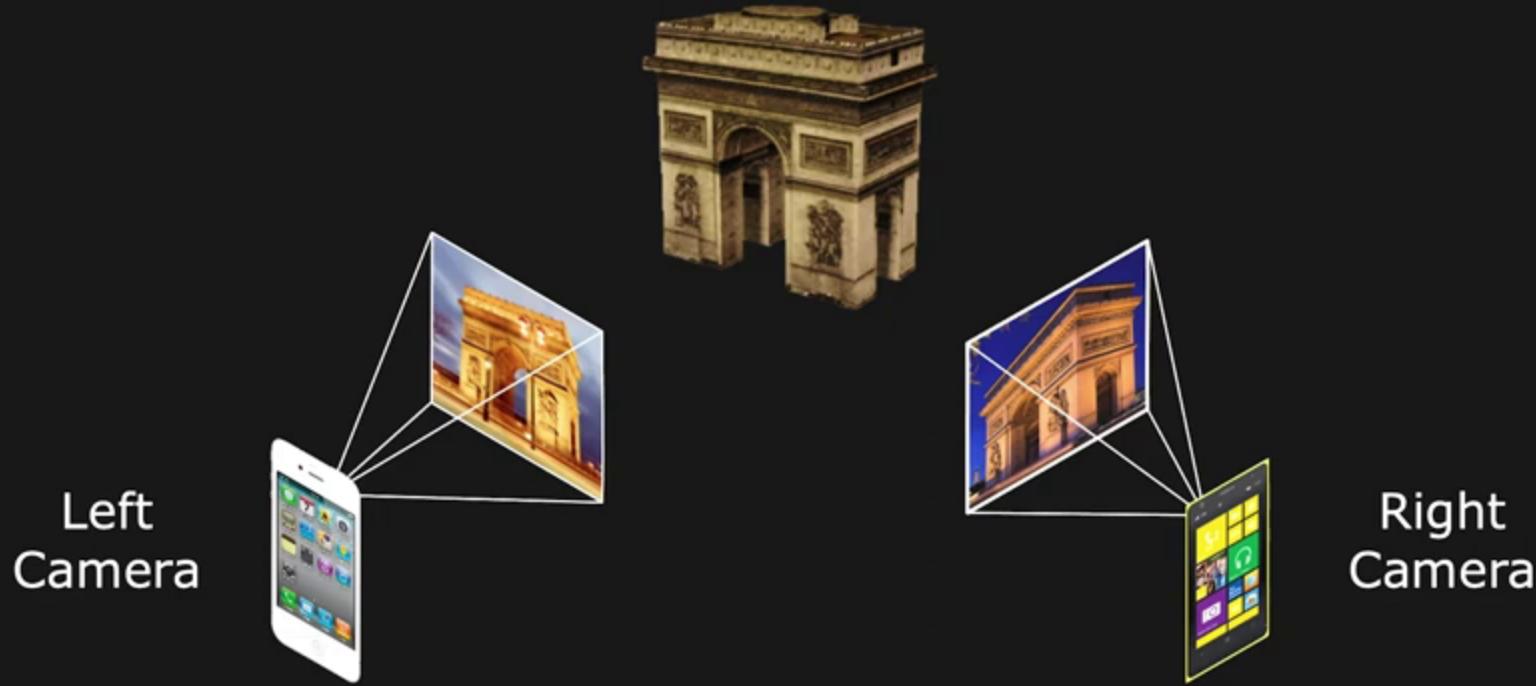


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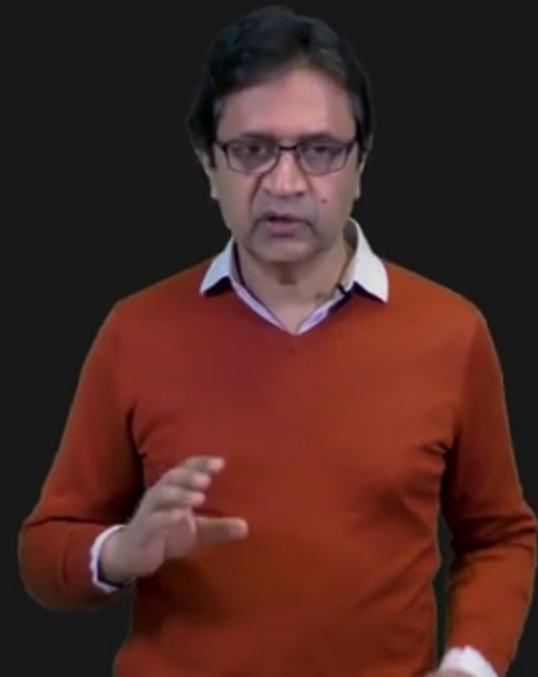


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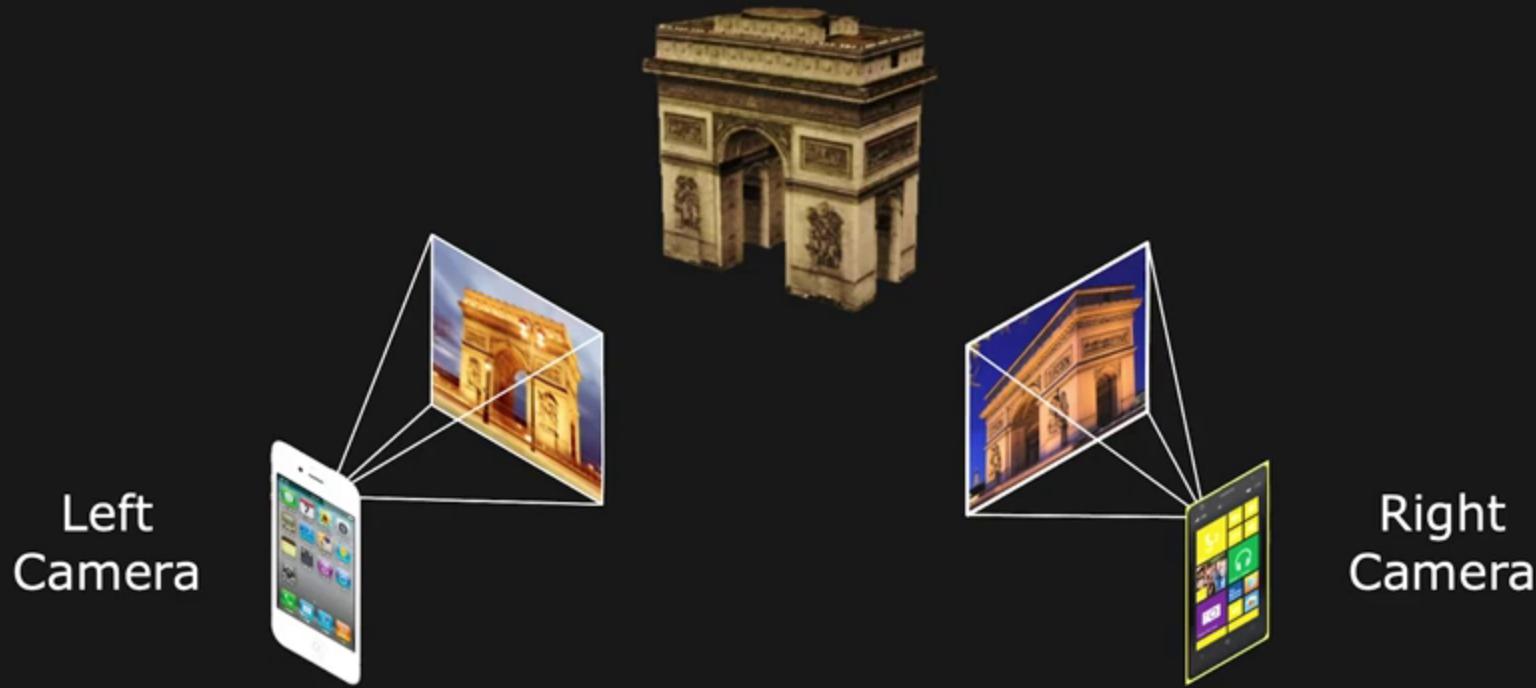


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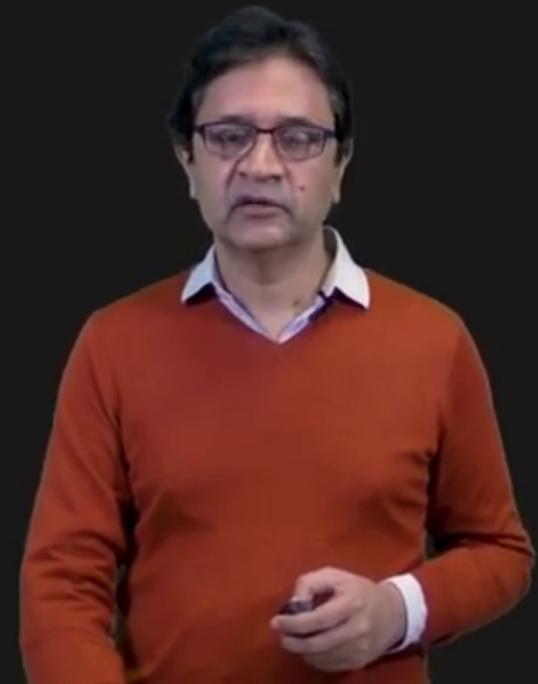


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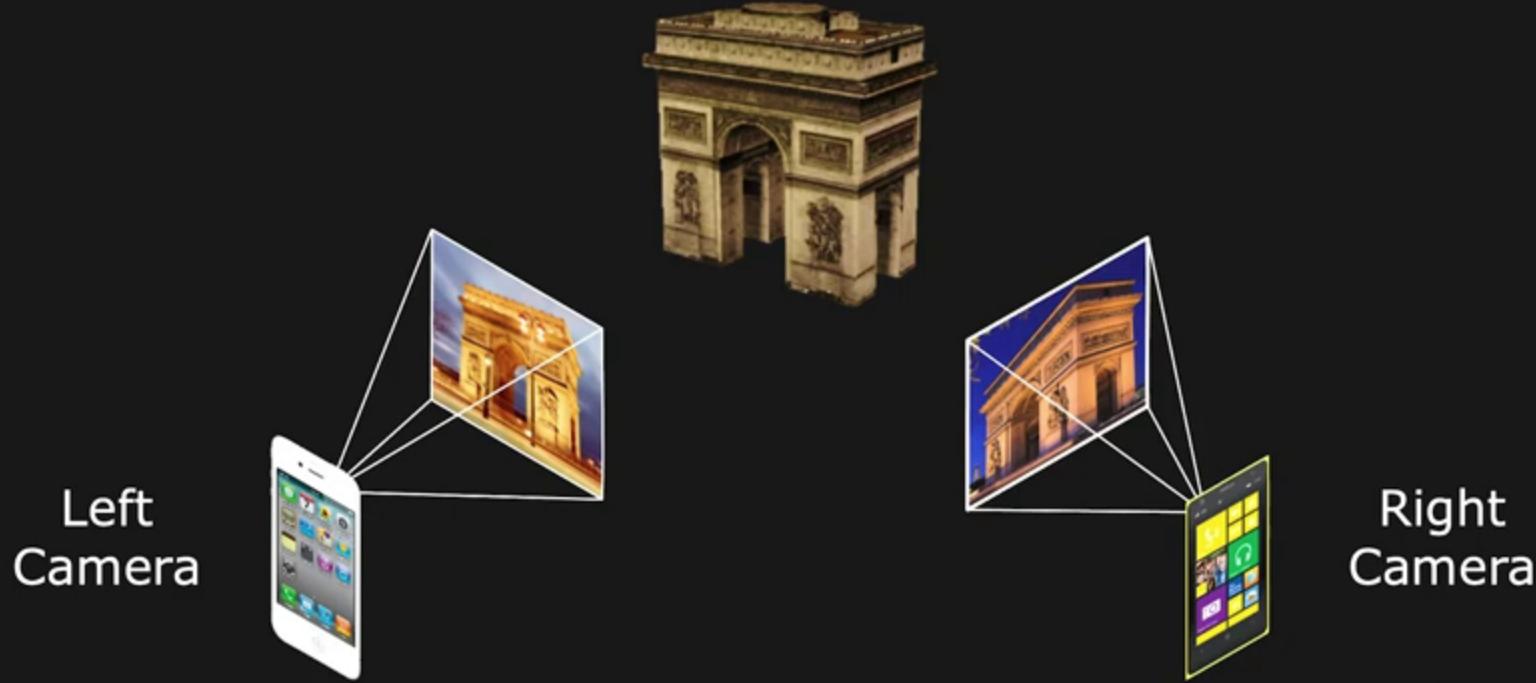


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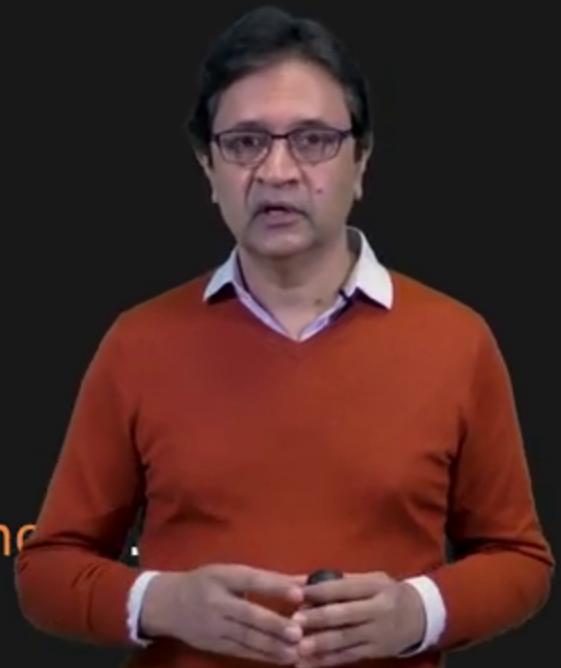
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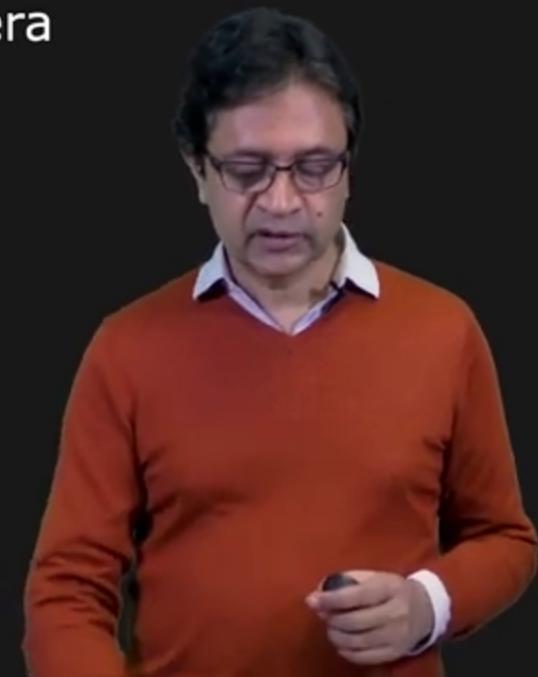
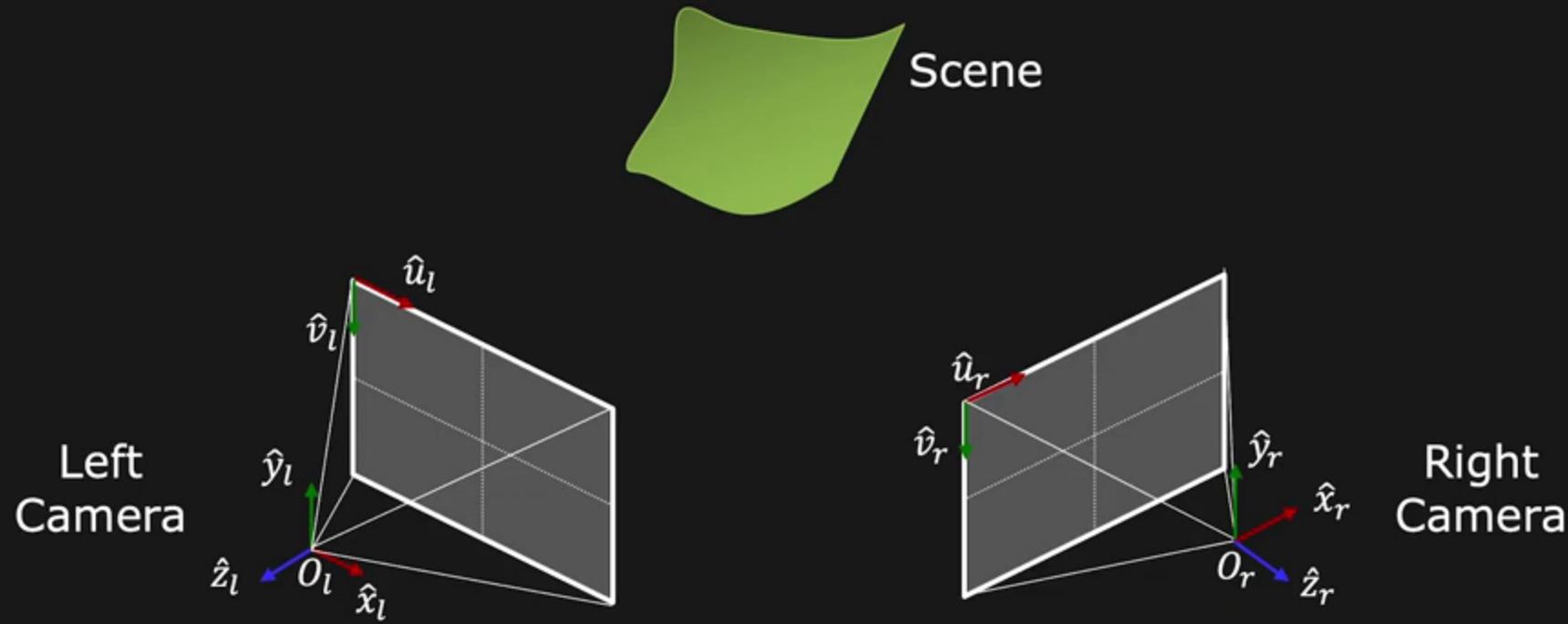


Intrinsics (f_x, f_y, o_x, o_y) are known for both views/cameras.

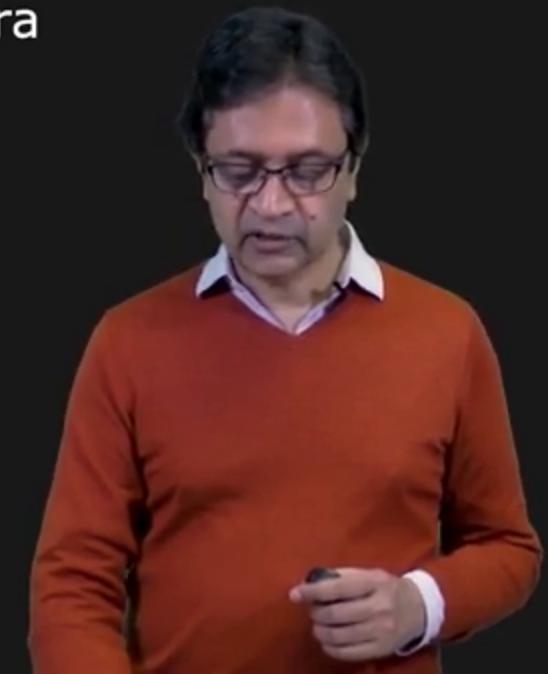
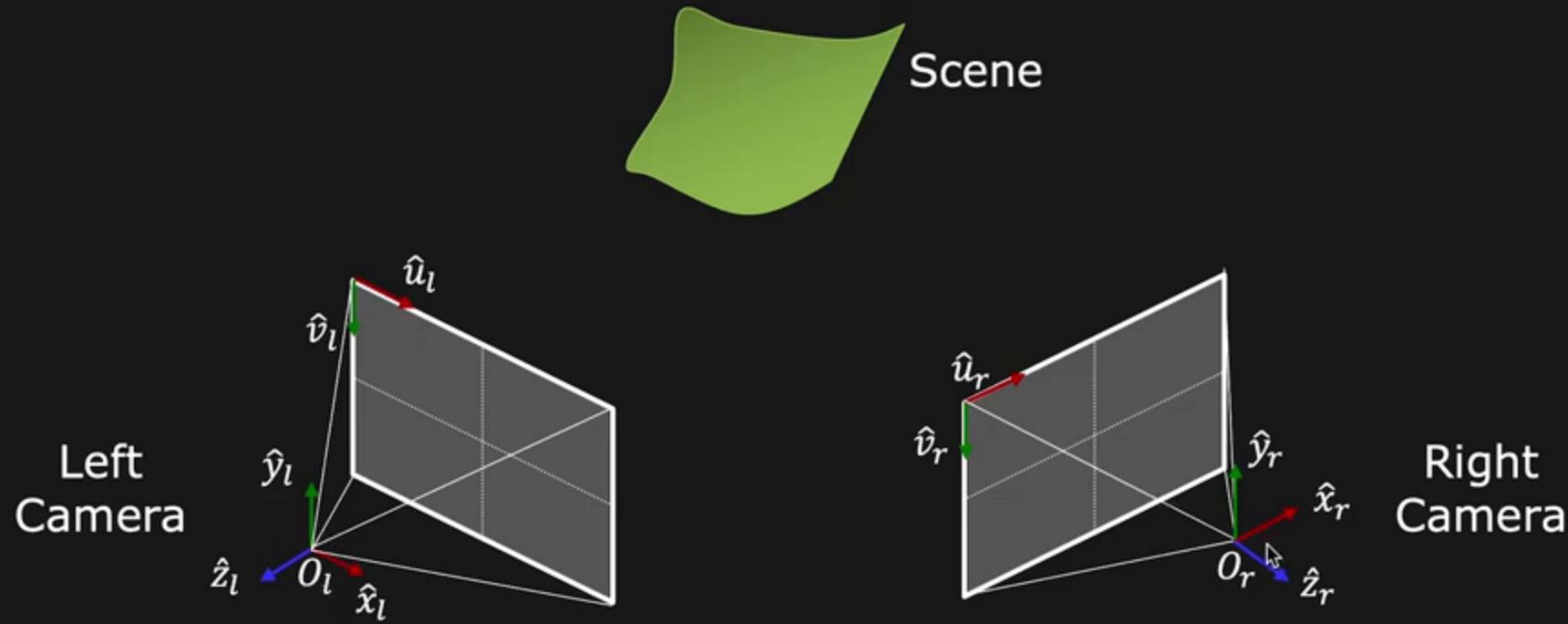
Extrinsics (relative position/orientation of cameras) are unknown.



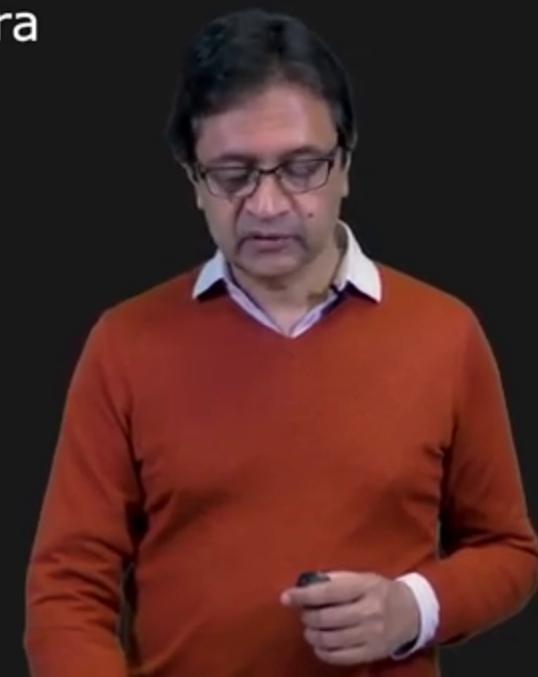
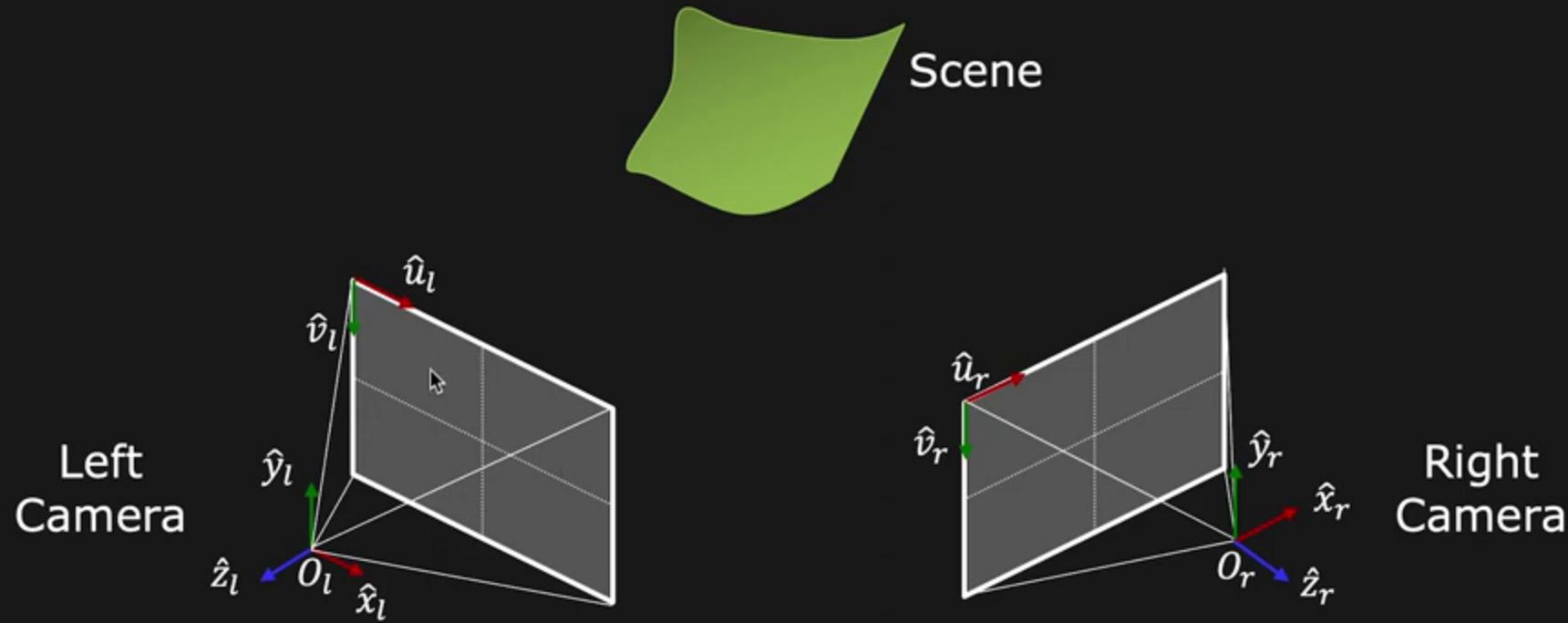
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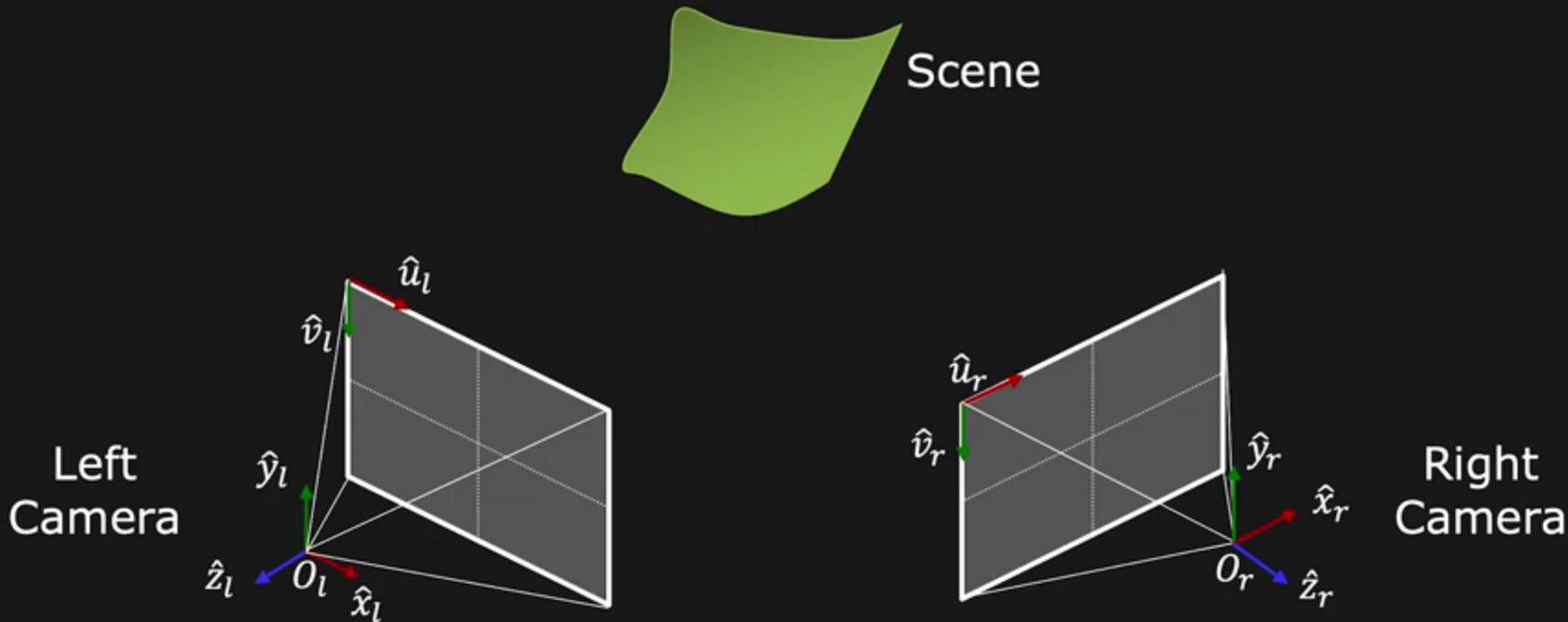
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Uncalibrated Stereo



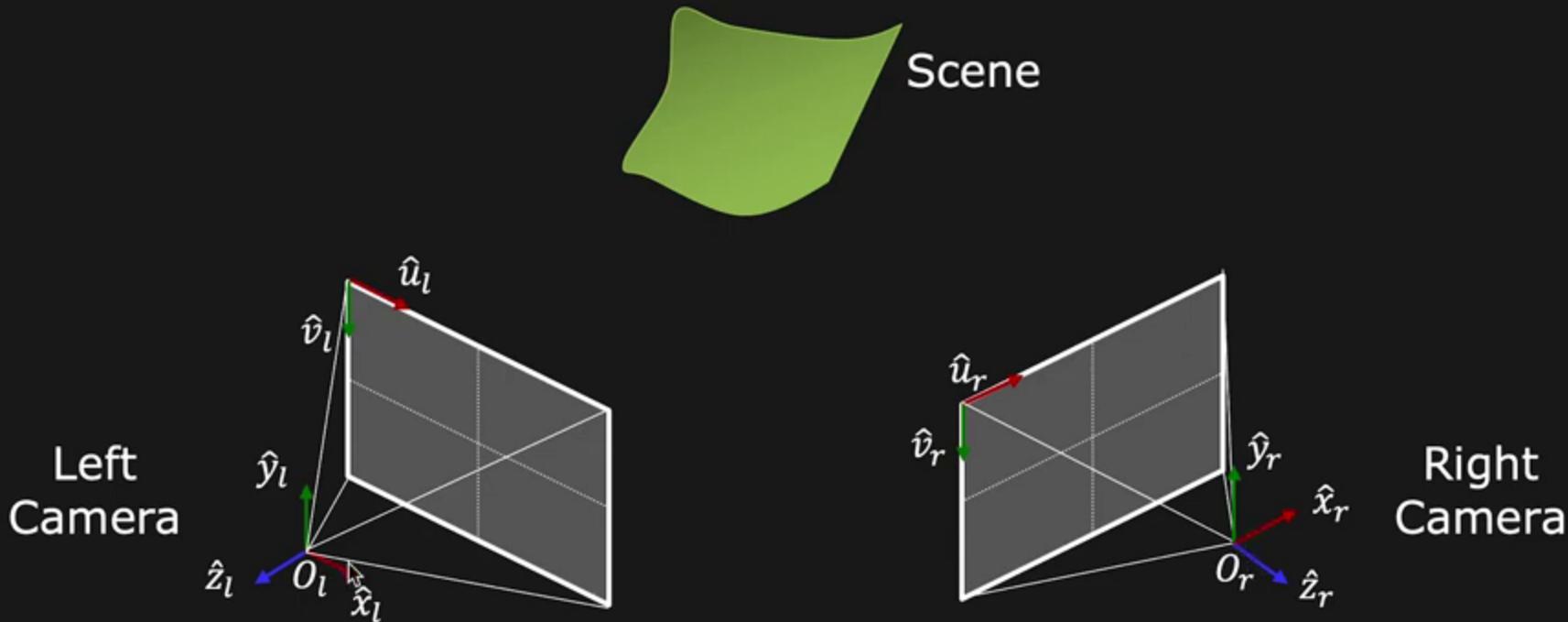
Uncalibrated Stereo



- 1. Assume Camera Matrix K is known for each camera



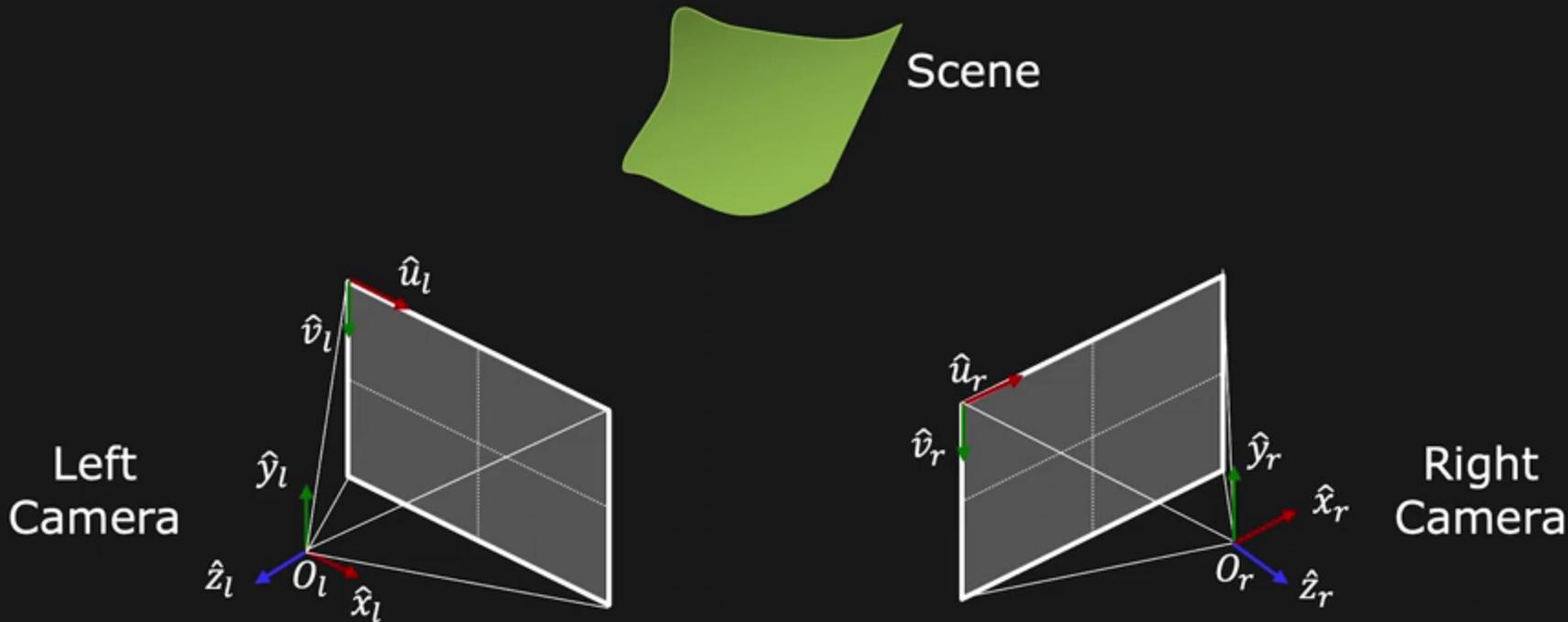
Uncalibrated Stereo



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Uncalibrated Stereo



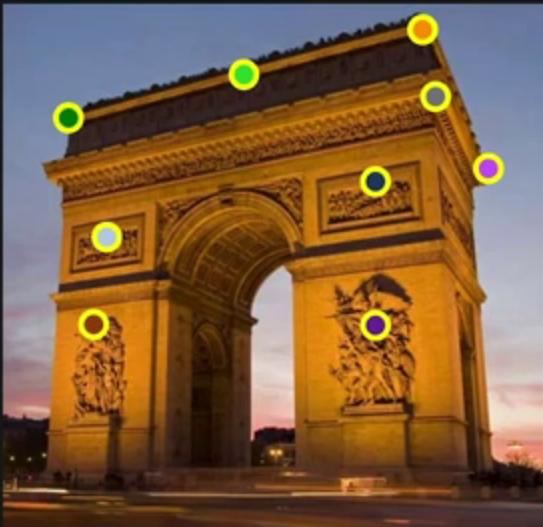
- ✓ 1. Assume Camera Matrix K is known for each camera
- 2. Find a few Reliable Corresponding Points



Initial Correspondence

Find a set of corresponding features (at least 8) in left and right images (e.g. using SIFT or hand-picked).

Left image

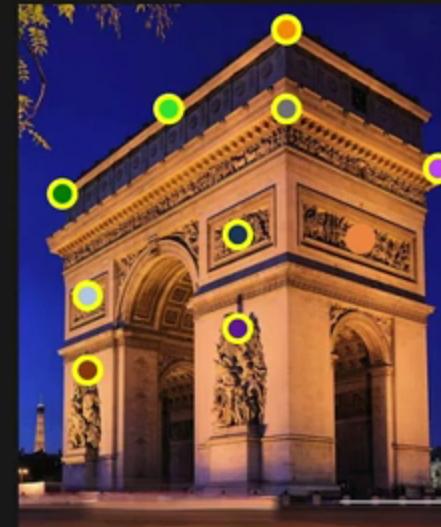


$$\bullet \quad (\mathbf{u}_l^{(1)}, \mathbf{v}_l^{(1)})$$

⋮

$$\bullet \quad (\mathbf{u}_l^{(m)}, \mathbf{v}_l^{(m)})$$

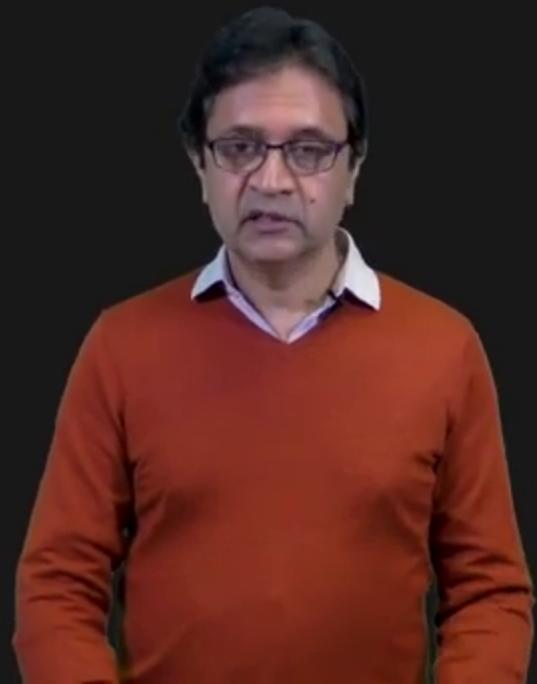
Right image



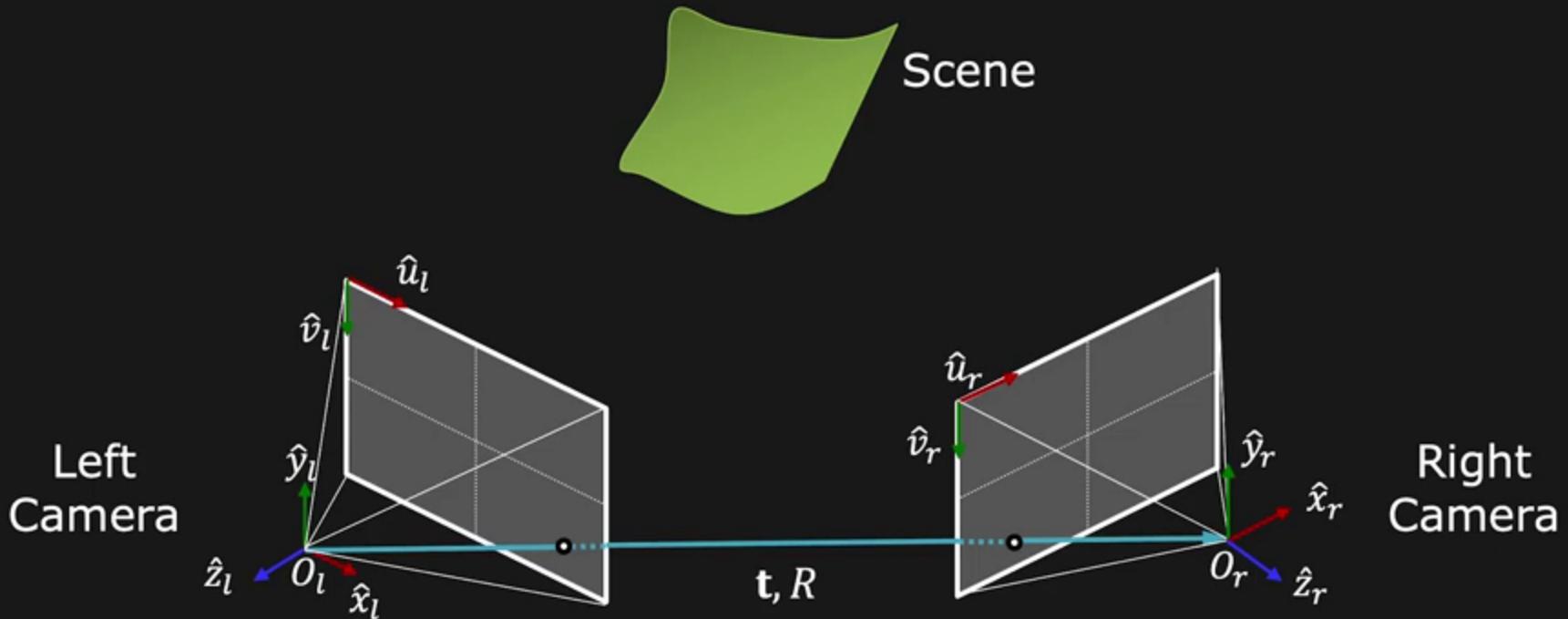
$$\bullet \quad (\mathbf{u}_r^{(1)}, \mathbf{v}_r^{(1)})$$

⋮

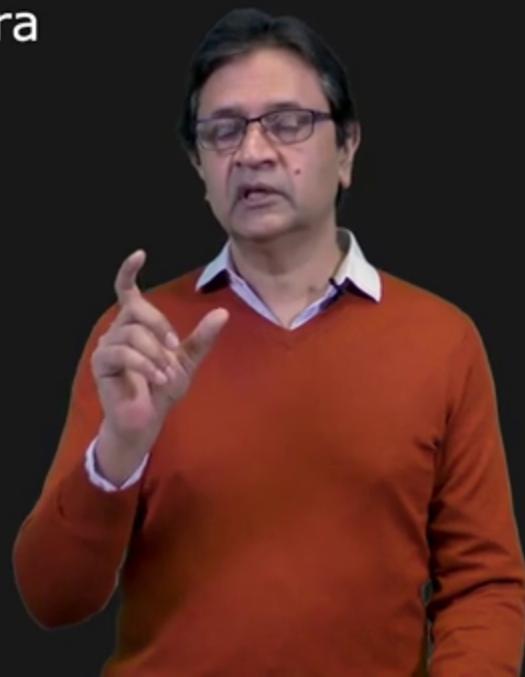
$$\bullet \quad (\mathbf{u}_r^{(m)}, \mathbf{v}_r^{(m)})$$



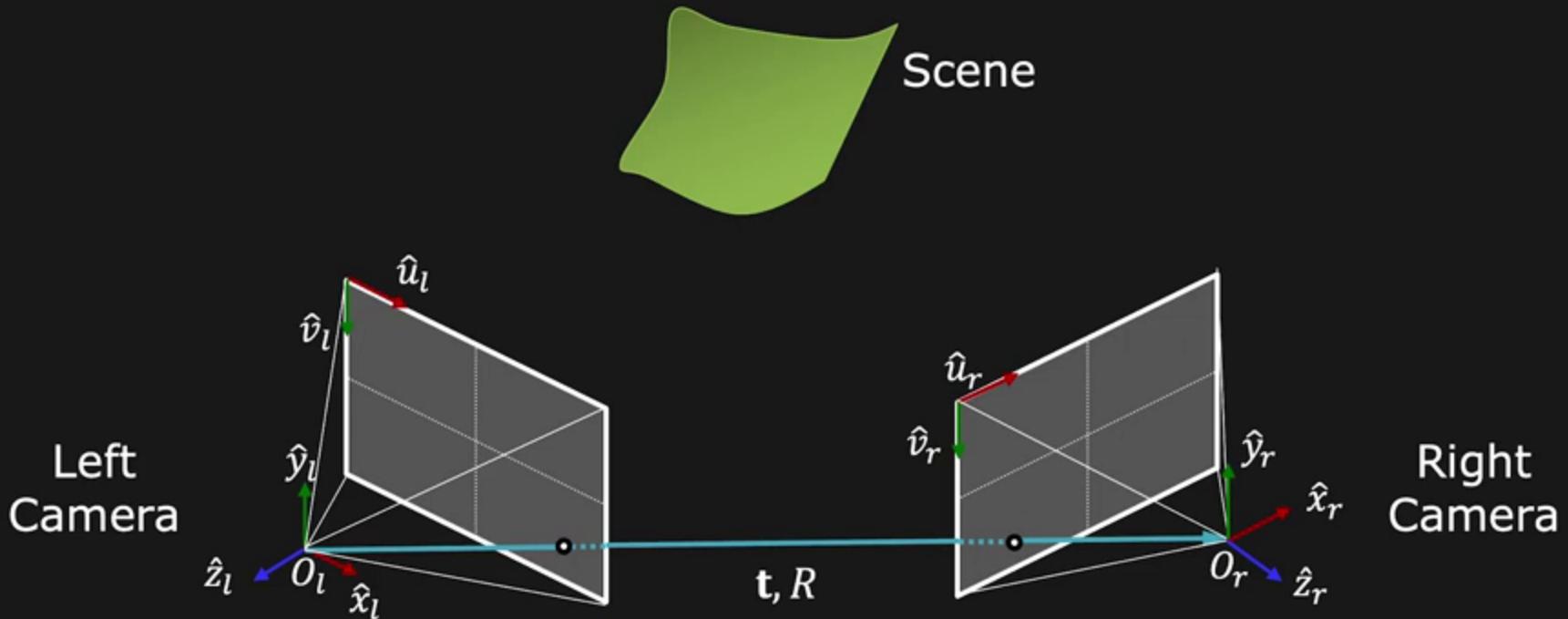
Uncalibrated Stereo



- ✓ 1. Assume Camera Matrix K is known for each camera
- ✓ 2. Find a few Reliable Corresponding Points
- 3. Find Relative Camera Position \mathbf{t} and Orientation R



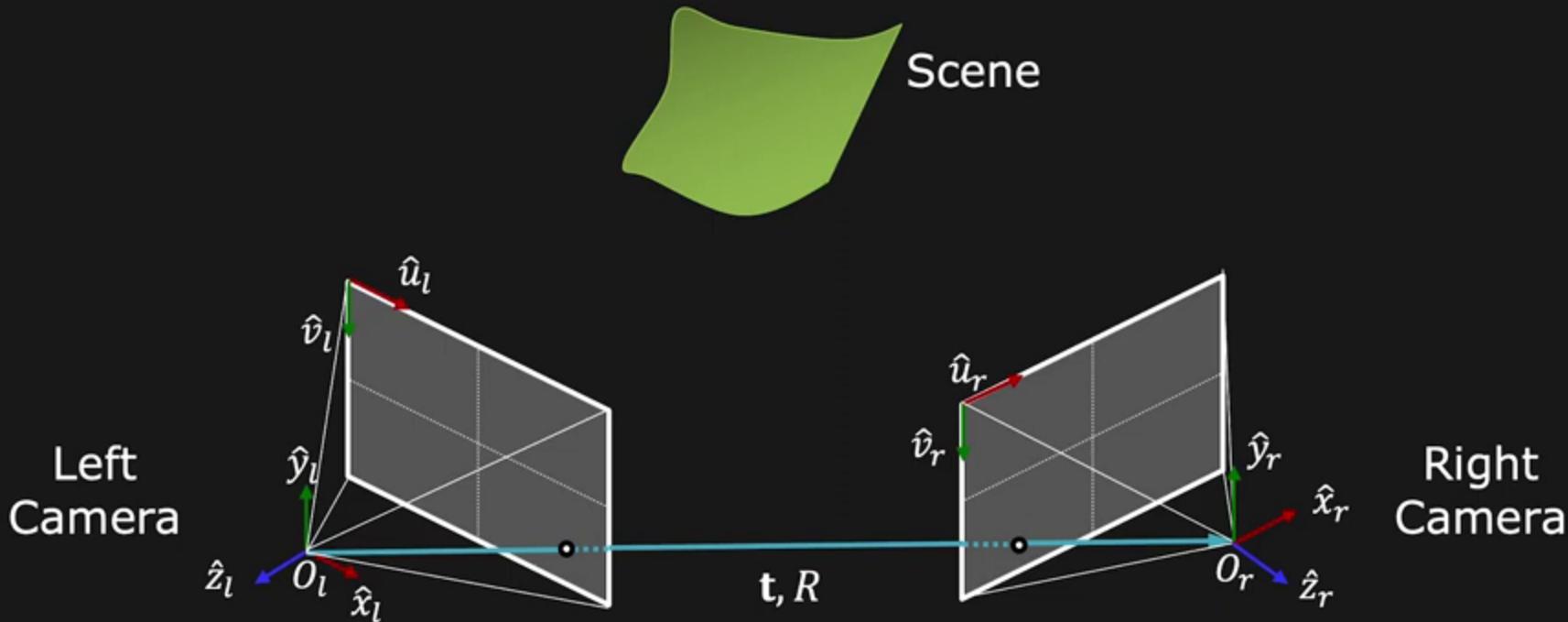
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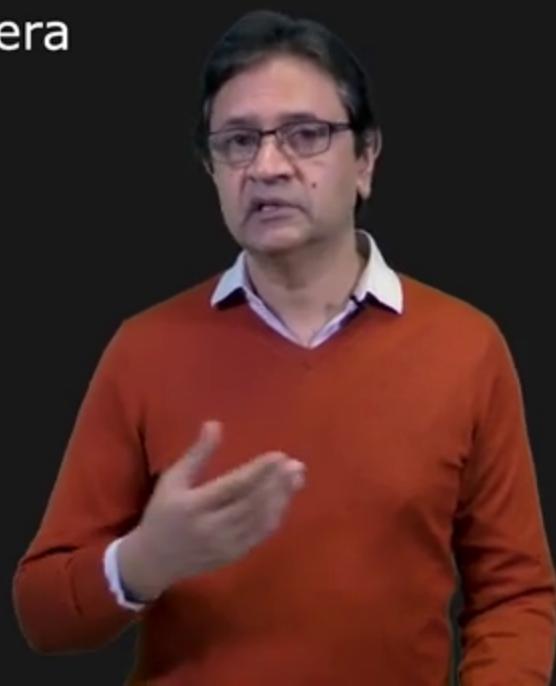
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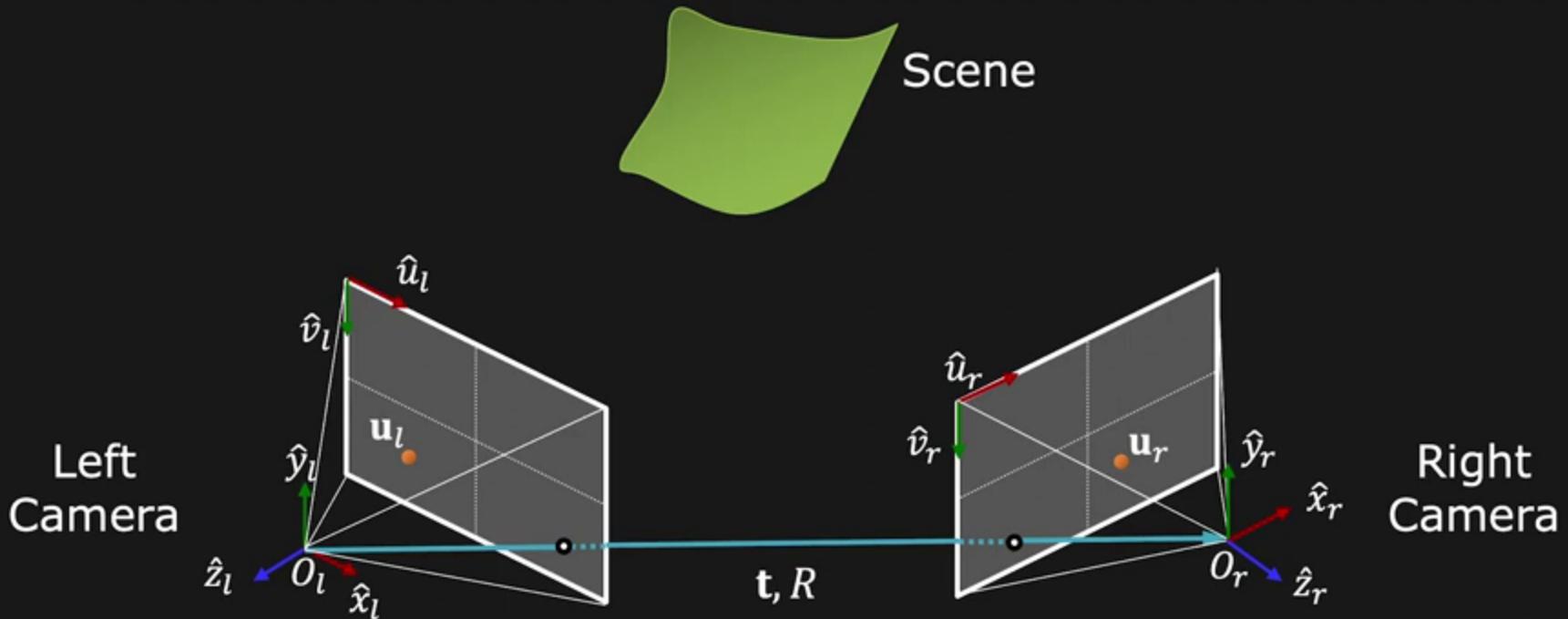
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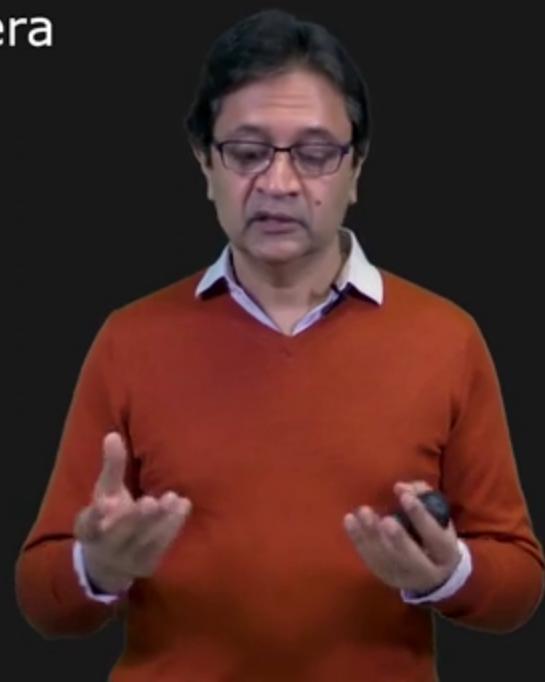
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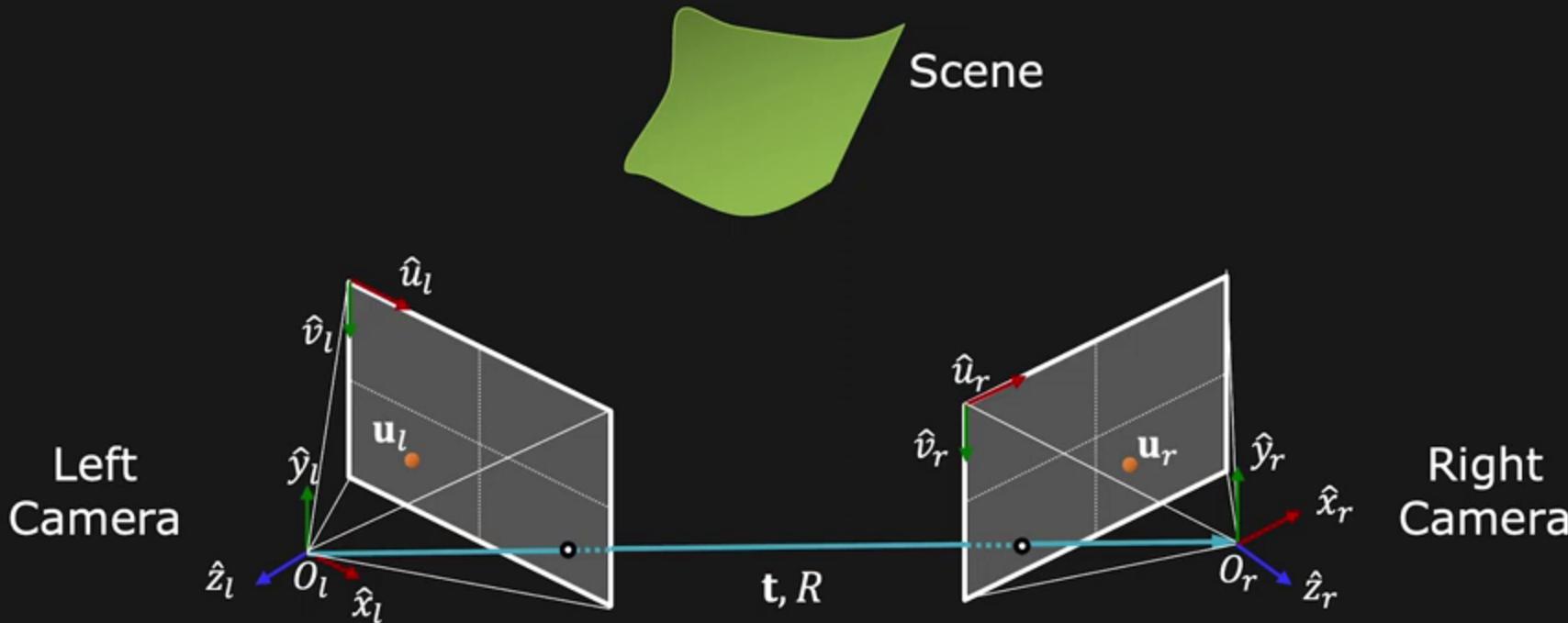
Uncalibrated Stereo



- ✓ 1. Assume Camera Matrix K is known for each camera
- ✓ 2. Find a few Reliable Corresponding Points
- 3. Find Relative Camera Position \mathbf{t} and Orientation R
- 4. Find Dense Correspondence



Uncalibrated Stereo



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