

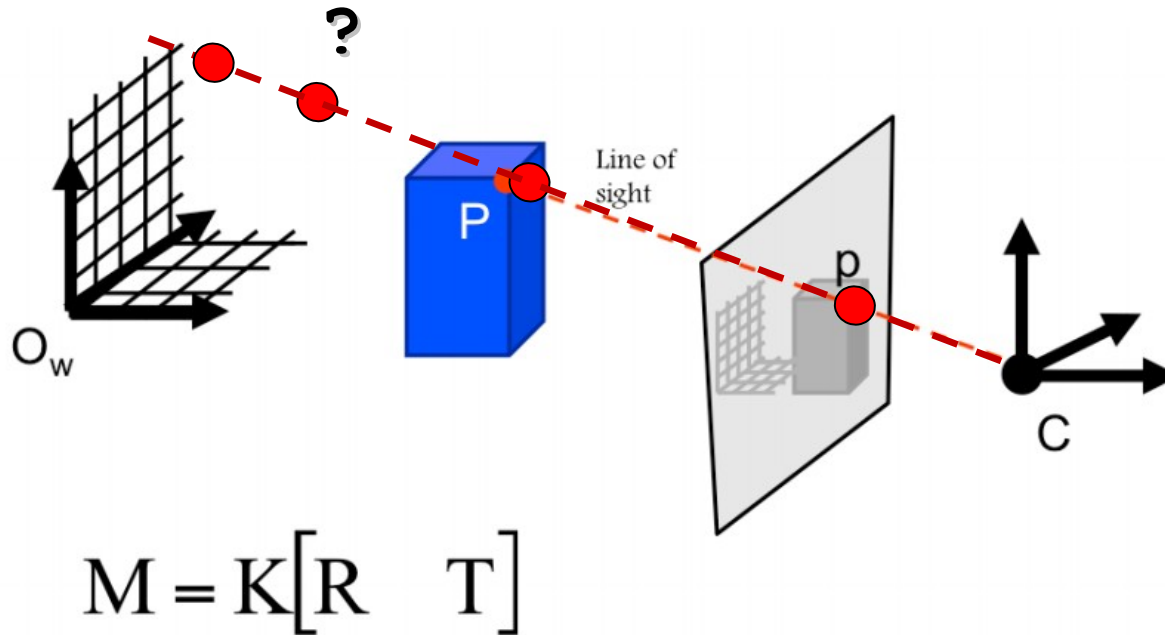


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LABORATORY #5

- Inverse Perspective transformations
- We want to find world coordinates of image points

- We already know that 3D world reconstruction is not possible from 2D images



- If we add a specific constraint it can be done
- I.e. that image points belong to a specific plane Π

$$\Pi: aX + bY + cZ + d = 0$$

$$\begin{bmatrix} u \\ v \\ w \end{bmatrix} = M \begin{bmatrix} X \\ Y \\ Z \\ 1 \end{bmatrix} \quad \rightarrow \quad \begin{bmatrix} u \\ v \\ w \\ 0 \end{bmatrix} = \begin{bmatrix} M \\ a \ b \ c \ d \end{bmatrix} \begin{bmatrix} X \\ Y \\ Z \\ 1 \end{bmatrix} \quad \begin{bmatrix} X \\ Y \\ Z \\ W \end{bmatrix} = \begin{bmatrix} M \\ a \ b \ c \ d \end{bmatrix}^{-1} \begin{bmatrix} u \\ v \\ 1 \\ 0 \end{bmatrix} \quad \xrightarrow{\text{euclidean}} \quad \begin{bmatrix} X/W \\ Y/W \\ Z/W \end{bmatrix}$$

Inverse Perspective Mapping

- Given
 - An image
 - Camera parameters
- Project image points on a given plane
- $Y = 0$
 - $(a, b, c, d) = (0, 1, 0, 0)$



Inverse Perspective Mapping

- When $Y = 0$
- We can simplify M
- M becomes a 3×3 matrix!

$$\begin{bmatrix} u \\ v \\ w \end{bmatrix} = M \begin{bmatrix} X \\ 0 \\ Z \\ 1 \end{bmatrix} \rightarrow \begin{bmatrix} u \\ v \\ w \end{bmatrix} = M'_{(3 \times 3)} \begin{bmatrix} X \\ Z \\ 1 \end{bmatrix}$$

$$\begin{bmatrix} X \\ Y \\ 1 \end{bmatrix} = M'^{-1} \begin{bmatrix} u \\ v \\ 1 \end{bmatrix}$$