UNIVERSITAT POLITÈCNICA DE CATALUNYA
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Centre de la Imatge i la Tecnologia Multimèdia

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Central Perspective Imaging Model

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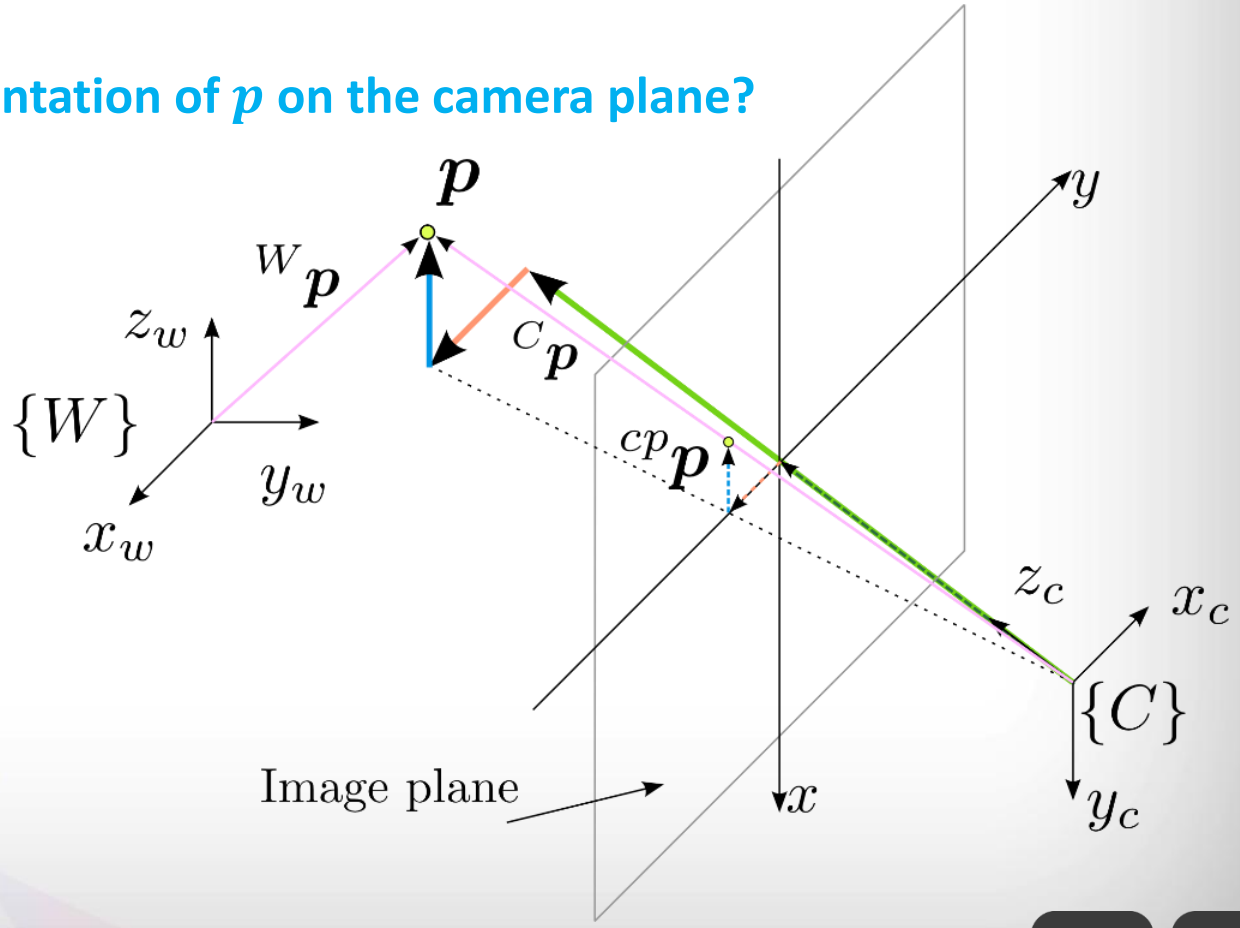
Terrassa, May 20th, 2016

Simple camera model

What is the representation of p on the camera plane?



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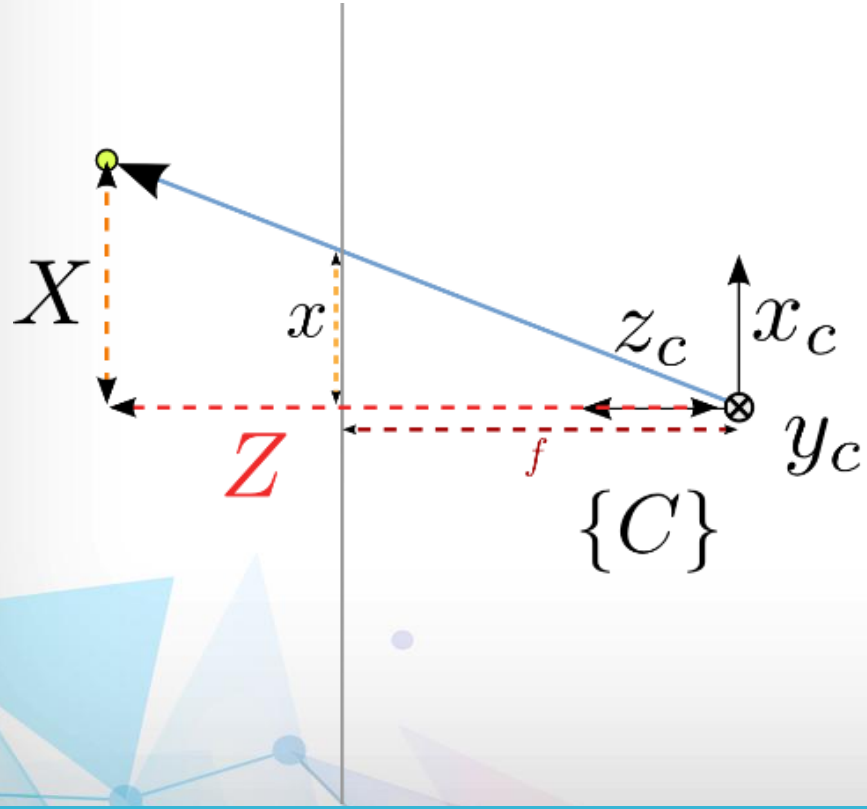
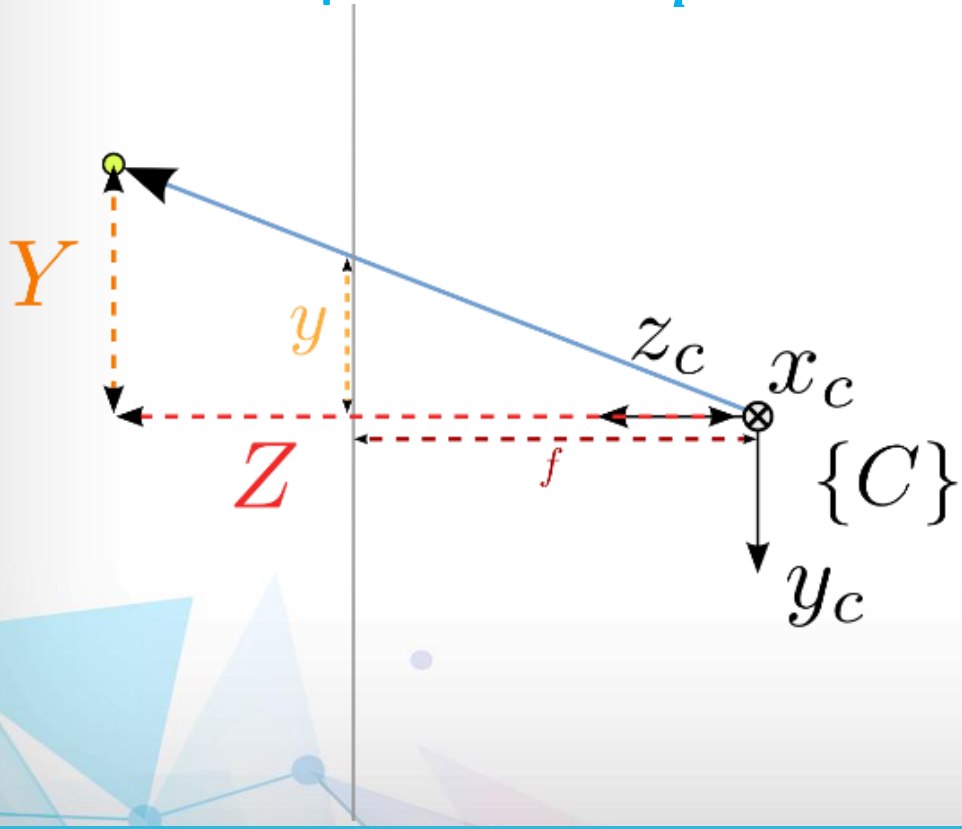


$$ {}^{C}\boldsymbol{p} = \begin{pmatrix} X \\ Y \\ Z \end{pmatrix} $$

$$ {}^{cp}\boldsymbol{p} = \begin{pmatrix} x \\ y \end{pmatrix} $$

Simple camera model

What is the representation of p on the camera plane?



$$ {}^{C}\boldsymbol{p} = \begin{pmatrix} X \\ Y \\ Z \end{pmatrix} $$

$$ {}^{cp}\boldsymbol{p} = \begin{pmatrix} x \\ y \end{pmatrix} $$

Simple camera model

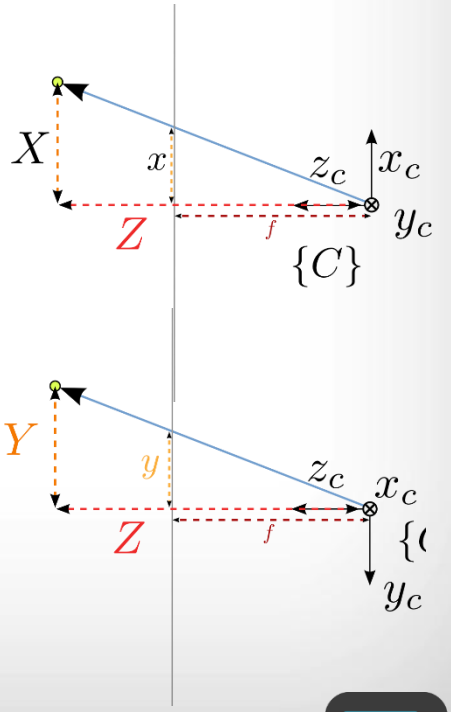
What is the representation of p on the camera plane?

Thales theorem or similar triangles says that

$$\frac{\mathrm{X}}{Z} = \frac{x}{f}; \quad \frac{\mathrm{Y}}{Z} = \frac{y}{f}$$

Which implies that

$$^{cp}\boldsymbol{p} = \begin{pmatrix} \frac{X}{Z} f \\ \frac{Y}{Z} f \end{pmatrix}$$



Perspective transformation

${}^{cp}\boldsymbol{p} = \begin{pmatrix} \frac{X}{Z} f \\ \frac{Y}{Z} f \end{pmatrix}$ is a transformation, known as perspective transformation which has the next properties:

- Is a mapping from 3-dimensional space to 2-dimensional space
- Straight lines in the world are projected to straight lines in the camera plane
- Parallel lines in the world are translated to lines that intersect at a vanishing point*
- Conics (circles, ellipses, parabolas and hyperbolas) are translated to other conics.
- The transformation does not preserve angles between lines*
- The mapping in general has not a unique inverse. Since any point in the form ${}^{c}\boldsymbol{p} = \begin{pmatrix} \lambda X \\ \lambda Y \\ \lambda Z \end{pmatrix}$ with different lambdas is mapped to the same ${}^{cp}\boldsymbol{p}$

Exercises

Mock Exam

- Exercise 4

Re-evaluation Exam

- Exercise 5