THE UNIVERSITY *of* EDINBURGH

Robotics: Science and Systems

Course Assignment 1

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1 Forward and inverse kinematics

1.1 (10 marks)

1.2 (10 marks)

1.3 (10 marks)

2 Signal filtering & State Estimation

2.1 (10 marks)

2.2 (10 marks)

2.3 (20 marks)

3 Computer Vision

3.1 Camera Geometry (10 marks)

$f = 10\,\text{mm}$

$D = 10\,\text{m} = 10\,000\,\text{mm}$

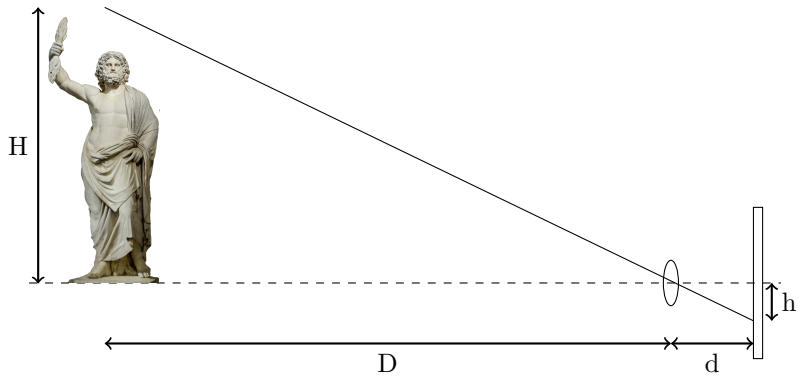
$sensor : 10\,\text{mm} \times 10\,\text{mm} = 1000 \times 1000\ \text{pixels}$

$h = 100\ \text{pixels} = 1\,\text{mm}$

$$\frac{1}{D} + \frac{1}{d} = \frac{1}{f}$$
$$\frac{1}{d} = \frac{1}{f} - \frac{1}{D}$$
$$\frac{1}{d} = \frac{1}{10} - \frac{1}{10000}$$
$$\frac{1}{d} = \frac{1000}{10000} - \frac{1}{10000}$$
$$\frac{1}{d} = \frac{999}{10000}$$
$$d = \frac{10000}{999}$$

$$\frac{d}{D} = \frac{h}{H}$$
$$H = \frac{hD}{d}$$
$$H = \frac{1 \times 10000}{\frac{10000}{999}}$$
$$H = 999\,\text{mm} = 0.999\,\text{m}$$

The observed statue is 0.999 m tall.



The distance D to the statue needs to be known in order to calculate the distance d between the lens and the film/sensor, using the focal length f. Furthermore, given D, d, and h, it is easy to calculate the height of the statue H.

3.2 Image Processing (10 marks)

3.3 Shape Recognition (10 marks)