

Name: _____

Signature: _____

- Calculator and documents are allowed.
- Test duration : 30 minutes.
- You have to answer the questions directly in this sheet.
- All communication between students is forbidden.
- You should turn off your mobile phone and put it in your backpack/handbag.

1. A picture of a planar rectangular object was taken with the plane of the object placed in parallel with the image plane of the camera. The planar object has width $w = 0,130$ m and height $h = 0,185$ m. It is placed at a distance of $d = 0,460$ m from the camera.

(a) If the camera has a resolution of 2592×1936 pixels (horizontal \times vertical) and the width and height of the object in the image buffer are $w_{\text{im}} = 722$ pixels and $h_{\text{im}} = 1040$ pixels, what are the intrinsic parameters, f_x , f_y , o_x and o_y of the camera? What is the intrinsic matrix \mathbf{M}_{int} of the camera? Assume that the origin of the image buffer is on the top left and that $f_\theta = 0$.

(b) The camera is then used in an augmented reality application. For its calibration, a calibration rig is used. Using the DLT method the following properly scaled camera matrix is obtained:

$$\mathbf{M} = \begin{bmatrix} 1801,5 & -1801,5 & 1296,0 & -1014,6 \\ -1825,5 & -1825,5 & 968,0 & -840,8 \\ 0 & 0 & 1,0 & 0,2 \end{bmatrix}$$

Give the extrinsic matrix of the camera \mathbf{M}_{ext} and the extrinsic parameters \mathbf{R} and \mathbf{t} .

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2. Present briefly the general linear approach for 3D reconstruction using stereo and explain how it can be modified to take into account $N > 2$ cameras instead of 2, with camera matrices $\mathbf{M}_1, \mathbf{M}_2, \dots, \mathbf{M}_N$.