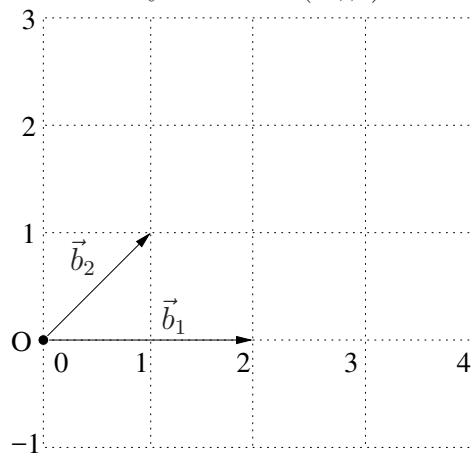


GVG'2021 Exercise-05 EN

1. The following picture shows a coordinate system $\sigma = (O, \beta)$ and a basis $\beta = (\vec{b}_1, \vec{b}_2)$.



- (a) Find a coordinate system $\sigma' = (O', \beta')$, $\beta' = (\vec{b}'_1, \vec{b}'_2)$, whose basis vector \vec{b}'_1 has in basis β coordinates

$$\vec{b}'_{1\beta} = \begin{bmatrix} 1 \\ -1 \end{bmatrix}$$

and its origin O' is in the coordinate system σ described by vector

$$\vec{O}'_{\beta} = \begin{bmatrix} 1/2 \\ 1 \end{bmatrix}$$

and there exists point X described by vector \vec{X} in σ and vector \vec{X}' in σ' with coordinates

$$\vec{X}_{\beta} = \begin{bmatrix} 3/2 \\ 1 \end{bmatrix}, \quad \vec{X}'_{\beta'} = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$$

and draw it on the picture.

- (b) Write the coordinates of vector O in coordinate system σ' .

2. Find coordinates of the image point which is the projection of point $[1, 1, 1]^T$ by the camera with the following camera projection matrix

$$P = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 1 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 \end{bmatrix}$$

3. Find the camera calibration matrix K , rotation R , and the projection center \vec{C}_{δ} of a camera with the camera projection matrix

$$P = \begin{bmatrix} 0 & 1 & 0 & 1 \\ 1 & 0 & 1 & 0 \\ 1 & 0 & 0 & 0 \end{bmatrix}$$

4. Denote the image coordinates by $[u, v]^T$. Write down coordinates of all points in the three-dimensional space that projects on the line $v = 0$ by a camera with the following camera projection matrix

$$P = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 1 & 1 & 0 & 0 \\ 0 & 0 & 1 & 2 \end{bmatrix}$$