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Tutorial 2

COMP/ENGN 4528/6528: Computer Vision

Question 1 Colour Space Conversion

1. Given RGB value $(25, 30, 40)$, what would the pixel value be in the HSV space? (Please refer to the Szeliski Computer Vision textbook and the lecture slides)

Question 2 Camera Projections

1. Given a lens with a focal length of 30, and a world point at $(20, 20, 200)$, where the camera center sits at $(0, 0, 0)$, and the optical axis is in direction $(0, 0, 1)$, with the x and y axes aligned to the world axes, what pixel will this world point project to?

Question 3 (Homogeneous) Coordinates Transformations

1. Image warping can be performed by pre-multiplying coordinate locations by a 2×2 matrix, and adding for translation. What would the effect be of the following transformation:

$$\begin{bmatrix} x' \\ y' \end{bmatrix} = \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} + \begin{bmatrix} d_x \\ d_y \end{bmatrix}$$

   where $a_{11} = 2$, $a_{12} = 0$, $a_{21} = 0$, $a_{22} = 1$, $d_x = 1$ and $d_y = 2$

2. Homogeneous coordinates simplify representation by allowing 2D image transformations to be represented by a single matrix operation (3×3). What are the effects of the following transformations:

   (a) $\begin{bmatrix} x' \\ y' \\ 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 & t_x \\ 0 & 1 & t_y \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ 1 \end{bmatrix}$, where $t_x = 1$ and $t_y = 2$.

   (b) $\begin{bmatrix} x' \\ y' \\ 1 \end{bmatrix} = \begin{bmatrix} \cos\theta & -\sin\theta & 0 \\ \sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ 1 \end{bmatrix}$, where $\theta = 45°$.

3. Suppose we have a set of transformations in the order of translation of $(1, 2)$, counterclockwise rotation of $25°$, and scaling of $(2, 1)$. What is the resulting transformation matrix?