Parking Spot Detection

Sheet 1 —

1. (a) Compute the Homography matrix $\mathbb{H}$ (We assume that the road is a flat surface with $\mathbb{Z} = 0$)

$$\begin{bmatrix} x \\ y \\ w \end{bmatrix} = \begin{bmatrix} H_{11} & H_{12} & H_{13} \\ H_{21} & H_{22} & H_{23} \\ H_{31} & H_{32} & H_{33} \end{bmatrix} \times \begin{bmatrix} X \\ Y \\ Z \end{bmatrix} \tag{1}$$

(b) Perform road segmentation on the entire image. The road segmentation is considered to be valid if road segmentation confidence > Threshold.

(c) At a distance of 5m in front of the vehicle we have

$$\begin{bmatrix} X \\ Y \\ Z \end{bmatrix} = \begin{bmatrix} 5 \\ Y \\ 0 \end{bmatrix} \tag{2}$$

Substituting equation 2 in equation 1 we get that the x and y coordinates are of the form

$$x = \frac{5H_{11} + YH_{12}}{5H_{31} + YH_{32}} \tag{3}$$

$$y = \frac{5H_{21} + YH_{22}}{5H_{31} + YH_{32}} \tag{4}$$

Eliminating Y from equation 3 and equation 4 we obtain a straight line equation in x and y of the form

$$y_1 = mx_1 + c_1 \tag{5}$$

The intersection of this line with the leftmost road pixel gives us the image coordinate of the bottom left corner of the potential parking region.

(d) Follow steps in (c) with $\begin{bmatrix} X \\ Y \\ Z \end{bmatrix} = \begin{bmatrix} 10 \\ Y \\ 0 \end{bmatrix}$ to find the top left corner of the potential parking region.

(e) Assume that the width of the vehicle is w pixels. Using the computed homography find the top right and the bottom right corners. This gives us an entire parallelogram which represents the potential parking region.

(f) Compute the midpoint of the parallelogram. Use inverse homography to find the real world coordinates corresponding to the midpoint.