

For each 2D NPC crop

- Transform the 2D image into a point cloud  $\mathcal{P}$ , defined as the set of pixel coordinates higher than a given threshold.
- Remove the farthest points from the center. The proportion of points to keep has to be set. The set of kept points is denoted as  $\mathcal{P}_s$
- Determine the orientation of the NPC  $\theta^*$  computed by :

$$\theta^* = \arg \min_{\theta \in [0, \frac{2\pi}{s}]} \sum_{p \in \mathcal{P}_s} \nu(\vartheta(p) [\frac{2\pi}{s}], \theta), \quad (1)$$

where  $\nu(\theta_1, \theta_2)$  is the angular difference between  $\theta_1$  and  $\theta_2$ , defined by  $\nu(\theta_1, \theta_2) = (\theta_1 - \theta_2 + \pi)[2\pi] - \pi$ ,  $\vartheta(p)$  is the argument of point  $p$ , and  $s$  is the symmetry of the object ( $s = 8$  in the particular case of NPC)

- Determine the sector borders, in polar coordinates

$$\mathcal{B} = \{(R, \theta^* - \frac{\pi}{s} + \frac{2\pi k}{s}); k \in [0, s-1]\} \quad (2)$$

Where  $R$  is the distance between the center and the farthest kept point.

- Count the number of points in each sector
- Count the number of activated sectors. A sector is said to be activated, if the number of points inside it is higher than a given threshold, defined as a proportion of the total number of points.