Assignment 3 Computer Vision Ruf, Hamann

Problem 1:

a)

$$\frac{1}{9} \times \begin{array}{c|cccc} & & & & \\ 0 & 1 & 1 & 1 & 0 \\ 1 & 2 & 0 & 0 & 1 \\ 2 & 0 & 1 & 1 & 0 \\ 3 & 0 & 0 & 0 & 1 \\ \hline i \,/\, s & 0 & 1 & 2 & 3 \end{array}$$

Mode / Largest probability: $(1,0) \rightarrow \underline{\underline{p_{1,0} = \frac{2}{9}}}$

$$\text{Contrast} = \underbrace{(0-0)^2}_{=0} \frac{1}{9} + (0-1)^2 \frac{1}{9} + (0-2)^2 \frac{1}{9} + (1-0)^2 \frac{2}{9} +$$
$$(1-3)^2 \frac{1}{9} + (2-1)^2 \frac{1}{9} + \underbrace{(2-2)^2}_{=0} \frac{1}{9} + \underbrace{(3-3)^2}_{=0} \frac{1}{9}$$
$$= \underline{\underline{\frac{10}{9}}}$$

b) Yes, this would yield the same highest probability and the same contrast, as the combination of the neighbouring pixel that are compared stay the same.

Problem 2:

$$a_{11} \cdot u + a_{12} \cdot v = b_1$$
$$a_{12} \cdot u + a_{22} \cdot v = b_2$$

$$\Rightarrow u = \frac{\begin{vmatrix} b_1 & a_{12} \\ b_2 & a_{22} \end{vmatrix}}{\begin{vmatrix} a_{11} & a_{12} \\ a_{12} & a_{22} \end{vmatrix}} = \frac{b_1 a_{22} - a_{12} b_2}{a_{11} a_{22} - a_{12} a_{12}} = \frac{\int f_x f_y \, dxy \int f_y f_z \, dx dy - \int f_x f_z \, dx dy \int f_y^2 \, dx dy}{\int f_x^2 \, dx dy \int f_y^2 \, dx dy - \left[\int f_x f_y \, dx dy\right]^2}$$

$$\Rightarrow \quad v = \frac{\begin{vmatrix} a_{11} & b_1 \\ a_{12} & b_2 \end{vmatrix}}{\begin{vmatrix} a_{11} & a_{12} \\ a_{12} & a_{22} \end{vmatrix}} = \frac{a_{11} b_2 - b_1 a_{12}}{a_{11} a_{22} - a_{12} a_{12}}$$

$$= \frac{\int f_x f_t \, dx\, dy \int f_x f_y \, dx\, dy - \int f_y f_t \, dx\, dy \int f_x^2 \, dx\, dy}{\int f_x^2 \, dx\, dy \int f_y^2 \, dx\, dy - \left[\int f_x f_y \, dx\, dy\right]^2}$$