ASSIGNMENT - 3

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Q2:

Consider two images captured at times 't' and '$t+\delta t$' respectively.

Let a point $X(x, y)$ in Image 1 displaced by $X'(x+\delta x, y+\delta y)$ in Image 2.

Assuming the intensity of point X' doesnot change in Image 2 and 1 as well.

$$I(x+\delta x, y+\delta y, t+\delta t) = I(x, y, t) \quad \text{— ①}$$

From Taylor's series expansion, we can write

$$I(x+\delta x, y+\delta y, t+\delta t) = I(x, y, t) + \frac{\partial I}{\partial x} \times \delta x + \frac{\partial I}{\partial y} \times \delta y + \frac{\partial I}{\partial t} \times \delta t \quad \text{— ②}$$

Subtracting ① from ②, we get:

$$I_x \delta x + I_y \delta y + I_t \delta t = 0$$

Divide by δt and taking limit $\delta t \to 0$.

$$\boxed{I_x u + I_y v + I_t = 0}$$

Considering two consecutive imageframes and 2x2 block of pixels from each image.

$$\begin{array}{ccc} l+1 & 57 & 105 \\ l & 64 & 108 \\ & k & k+1 \end{array} \quad (t)$$

(Image 1)

$$\begin{array}{ccc} 83 & 99 & \\ 53 & 112 & t+1 \\ k & k+1 & \end{array}$$

(Image 2)

$$I_x = \frac{105+108+99+112}{4} - \frac{57+64+83+53}{4}$$

$$= 106 - 64.25$$

$$= 41.75$$

$$I_t = \frac{83+53+112+99}{4} - \frac{57+105+108+64}{4}$$

$$= 86.75 - 83.5$$

$$= 3.25$$

$$I_y = \frac{57+105+83+99}{4} - \frac{64+108+53+112}{4}$$

$$= 86 - 84.25$$

$$= 1.75$$

$$41.75u + 1.75v + 1.75 = 0$$

Optical flow can be split as

$u \quad u_n + u_p$

where u_n Normal flow, u_p - parallel flow

Direction of $\hat{u}_n = \dfrac{(I_x, I_y)}{\sqrt{I_x^2 + I_y^2}}$

Magnitude of $|u_n| = \dfrac{|I_t|}{\sqrt{I_x^2 + I_y^2}}$

$= \dfrac{3.25}{\sqrt{(41.75)^2 + (1.75)^2}} = \dfrac{3.25}{\sqrt{1743 + 3.06}}$

$= 0.077$

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