classmate

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2 a) To derive the motion tracking equation from fundamental principles and to compute motion function estimates between two consecutive frames, we need to establish ~~basic~~ equations and assumptions used in optical flow.

Consider two images captured at times t and $t + \delta t$.

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

Assuming the ~~pixel~~ intensity of point x' doesn't change in Image 2 and Image 1 as well.

$$I(x + \delta x, y + \delta y, t + \delta t) = I(x, y, t) \rightarrow (1)$$

For the point (x, y) in the image at frame t, the intensity doesn't change when it is moved by $(\delta x, \delta y)$ later at frame $t + \delta t$.

From Taylor series expansion we can write

$$I(x + \delta x, y + \delta y, t + \delta t) = I(x, y, t) + \frac{\partial I}{\partial x}(\delta x) + \frac{\partial I}{\partial y}(\delta y) + \frac{\partial I}{\partial t}(\delta t) \rightarrow (2)$$

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 $\delta t \to 0$

$$I_x u + I_y v + I_t = 0$$

Optical flow can be split as $u_n + u_p$

where u_n Normal flow, u_p parallel flow

$\hat{u}_n$ the normal optical flow can be computed as

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

Scanned with CamScanner

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