Computer vision - week 7

Edvard Ohlström 729 255

Ex 2. Equation 10:

$$\Delta p = H^{-1} \sum_x \left[\nabla I \frac{\partial W}{\partial p} \right]^T \left[T(x) - I(W(x;p)) \right)$$

$$\frac{\partial W}{\partial p} = \begin{bmatrix} \frac{\partial W_x}{\partial u} & \frac{\partial W_x}{\partial v} \\ \frac{\partial W_y}{\partial u} & \frac{\partial W_y}{\partial v} \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \qquad \Delta p = \begin{bmatrix} u \\ v \end{bmatrix}$$

$$H = \sum_x \left[\nabla I \frac{\partial W}{\partial p} \right]^T \left[\nabla I \frac{\partial W}{\partial p} \right] \qquad I_x = \frac{\partial I}{\partial x} \quad I_y = \frac{\partial I}{\partial y}$$

$$H = \sum \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} I_x \\ I_y \end{bmatrix} \begin{bmatrix} I_x & I_y \end{bmatrix} \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

$$= \sum_x \begin{bmatrix} I_x^2 & I_x I_y \\ I_y I_x & I_y^2 \end{bmatrix} = \begin{bmatrix} \sum I_x I_x & \sum I_x I_y \\ \sum I_y I_x & \sum I_y I_y \end{bmatrix}$$

$$=>$$

$$\begin{bmatrix} u \\ v \end{bmatrix} = \begin{bmatrix} \sum I_x I_x & \sum I_x I_y \\ \sum I_y I_x & \sum I_y I_y \end{bmatrix}^{-1} \sum \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} I_x \\ I_y \end{bmatrix} \left[T(x) - I(W(x;p)) \right)$$

$$\begin{bmatrix} \sum I_x I_x & \sum I_x I_y \\ \sum I_y I_x & \sum I_y I_y \end{bmatrix} \begin{bmatrix} u \\ v \end{bmatrix} = \sum \begin{bmatrix} I_x \\ I_y \end{bmatrix} [T(x) - I(W(x;p))]$$

$$\begin{bmatrix} \sum I_x I_x & \sum I_x I_y \\ \sum I_y I_x & \sum I_y I_y \end{bmatrix} \begin{bmatrix} u \\ v \end{bmatrix} = \sum \begin{bmatrix} I_x \\ I_y \end{bmatrix} \left(T(x) - \begin{pmatrix} x + t_1 \\ y + t_2 \end{pmatrix} \right)$$

$$\begin{bmatrix} \sum I_x I_x & \sum I_x I_y \\ \sum I_y I_x & \sum I_y I_y \end{bmatrix} \begin{bmatrix} u \\ v \end{bmatrix} = \begin{bmatrix} \sum I_x I_{t_1} \\ \sum I_y I_{t_2} \end{bmatrix}$$

Ex 1.

c) The main reasons why most of the features are not tracked very long in case b:

The main difference between videos is that in video 1, the camera is still with an object that is moving around, whereas in video b, the camera is moving, looking at a stationary picture. Therefore, video A is more similar to its last frame, whereas in video B, the whole frame changes. In video B, there are also fast movements in both the x and y axes combined with rotations and shakiness(A point does not move like its neighbors) . Brightness is not constant in video B, whereas its constant in video A.

d) Improvements:

- Try to have constant brithness for each frame or preprocess the frames to minimize the effects of varying illumination with for example histogram equalization.
- Different windowsizes (Small window more sensitive to noise and may miss larger motions when large window more likely to cross an occlusion boundary.
- Check consistency of tracks with affine registration when the first observed instance of the feature is detected. An affine model is more accurate for larger displacements in the video.
- And lastly, just try slower and more stable cameramovements :D.