cv assignment 8

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1 Exercise

1. Run Exercise8.ipynb
2. Run Exercise8.ipynb with a different input by changing the input to obama.avi: frames=faceTracker('obama.avi')
3. What could be the main reasons why most of the features are not tracked very long in case b) above?
   Answer - The Key assumptions of optical flow are:
   - **Brightness constancy**: projection of the same point looks the same in every frame
   - **Small motion**: points do not move very far
   - **Spatial coherence**: points move like their neighbors

   In case b) the **Spatial coherence** and **Small motion** are no more longer met, because of rotating the camera and or moving the camera fast (high displacement).
4. How one could try to avoid the problem that the features are gradually lost? Suggest a one or more improvements.

   Answer
   - Restrict large movements in a short period of time.
   - We can adjust the outliers ration, to keep them for further tracking.
   - Increase the size of the ROI from cascade classifier.
5. Voluntary task: Capture a video of your own face or of a picture of a face, and check that whether the tracking works for you. - Result is presented inf Figure 1

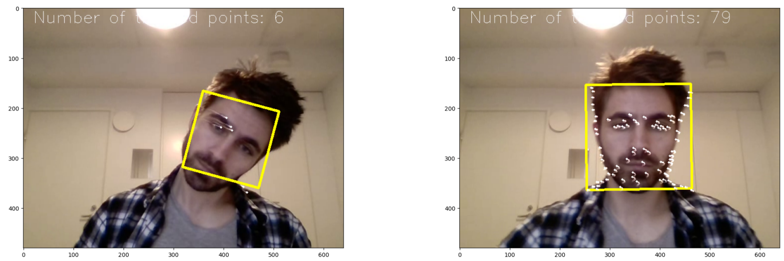

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Figure 1: Voluntary task

2 Exercise

The equation 10 in the paper is:

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

Where $\Delta p = \begin{bmatrix} u \\ v \end{bmatrix}$ and $W(x;p) = \begin{bmatrix} x+u \\ y+v \end{bmatrix}$
$\frac{\partial W}{\partial p} = \begin{bmatrix} \frac{\partial W_x}{\partial u} & \frac{\partial W_x}{\partial v} \\ \frac{\partial W_y}{\partial u} & \frac{\partial W_y}{\partial v} \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

$$H = \sum_x [\nabla I \frac{\partial W}{\partial p}]^T * [\nabla I \frac{\partial W}{\partial p}]$$

Matrix H can we rewritten as:

$$H = \sum_x (\frac{\partial W}{\partial p})^T * \nabla I^T * \nabla I * (\frac{\partial W}{\partial p})$$

=

$$H = \sum_x \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}^T * \begin{bmatrix} \frac{\partial I}{\partial x} \\ \frac{\partial I}{\partial y} \end{bmatrix} * \begin{bmatrix} \frac{\partial I}{\partial x} & \frac{\partial I}{\partial y} \end{bmatrix} * \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} =$$

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

Since, T(x) is extracted subregion from the image at time t=1 and I(x) is the image at tim t=2, we have equation 10 from the paper:

$$\Delta p = H^{-1} * \sum \begin{bmatrix} I_x \\ I_y \end{bmatrix} * \begin{bmatrix} -I_t \end{bmatrix}$$

result

$$\begin{bmatrix} \sum I_x I_x & \sum I_x I_y \\ \sum I_x I_y & \sum I_y I_y \end{bmatrix} * \Delta p = \sum \begin{bmatrix} I_x \\ I_y \end{bmatrix} * \begin{bmatrix} -I_t \end{bmatrix}$$

which is the same result as in the slides.

$$\begin{bmatrix} \sum I_x I_x & \sum I_x I_y \\ \sum I_x I_y & \sum I_y I_y \end{bmatrix} * \begin{bmatrix} u \\ v \end{bmatrix} = - \begin{bmatrix} \sum I_x I_t \\ \sum I_y I_t \end{bmatrix}$$