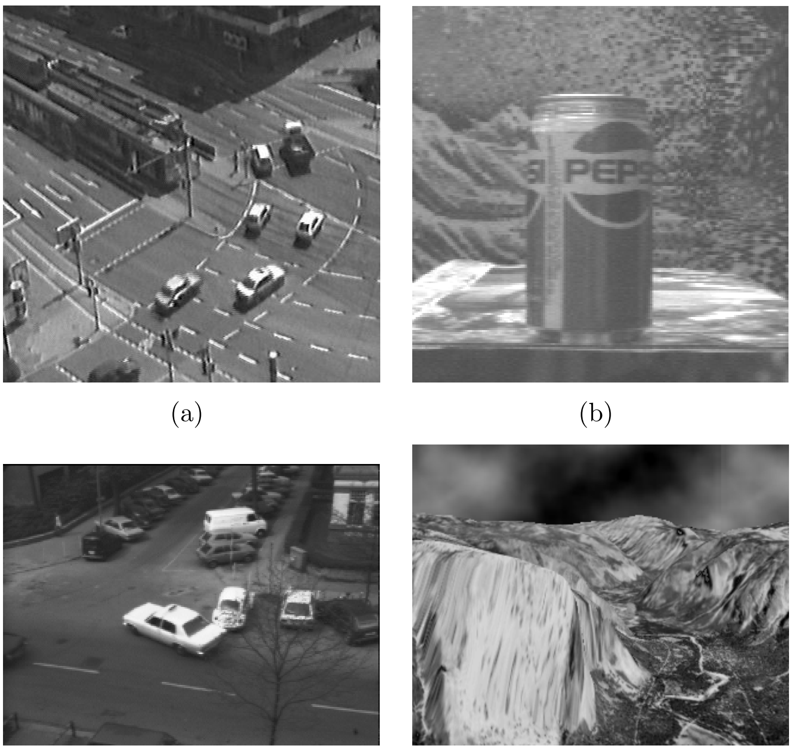
Optical Flow - Practical Class

The goal of this work is to familiarize yourself with optical flow problem. Horn-Schunck and Lucas-Kanade methods will be applied to image stabilization problem. Matlab code and image sequences are provided.

Exercice 1 : The basics

1. Complete the implementation of Horn and Schunck (*HS.m*) algorithm. Your algorithm will iterate a fix number of times (given by *iter* variable). Comment your code.
2. Complete the implementation of Lucas and Kanade (*LucasKanade.m*) algorithm. For this question, you will not consider the hierarchical extension. Comment your code.
3. Test and compare these methods on different sequences (*Hamburg*, *pepsi*, *taxi* and *Yosemite* (Fig 1.)). In each sequence, test different window sizes (for LK) and values of the term of penalization λ (for HS).
4. Improve the Lucas Kanade's method with a multiresolution scheme. You can start with *hierarchicalLK.m*. Test your implementation on the *Garden* sequence.



(a) (b) (c) (d)

FIGURE 1 – Sequence Test. (a) Hamburg, (b) pepsi (c) taxi and (d) Yosemite.

Exercice 2 : Parametric motion estimation and application to image stabilization

1. Suppose that the motion (u, v) for all pixels (x, y) in the image can be modeled by an affine model $\Theta = (a, b, c, d, e, f)^T$:

$$\begin{aligned} u &= ax + by + c \\ v &= dx + ey + f \end{aligned} \tag{1}$$

   Using this assumption, show that the solution (u, v) of the OFCE : $I_x u + I_y v + I_t = 0$ is also solution of :

$$M.\Theta = P$$

   where M is an $n \times 6$ matrix and Θ is a 6×1 matrix. (n is the number of pixels in the image).

2. Propose a method (inspired by LK's OF estimation algorithm) to estimate Θ.
3. Application to image stabilization : Let us consider the sequences called MotionHamburg and MotionTaxi. In these sequences, the camera is moving with an affine motion.
   (a) Implement a function Θ=AffineMotion(I_1,I_2) which computes the affine motion between I_1 and I_2.
   (b) Compensate the camera motion of successive images with Θ to stabilize the sequence.