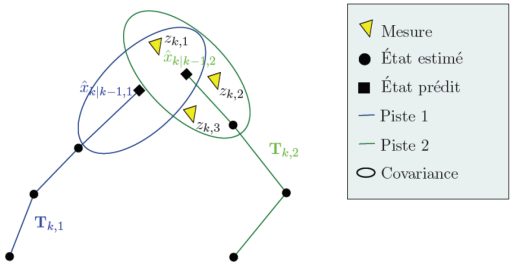
Multi-object tracking (data association)

Introduction

Given a set of detections for each frame of a video sequence:

- find objects trajectories (targets)

Data association



Multi-object tracking (data association)

Two problems

- associate object detections between two successive frames
- handle birth and death of a new object

From noisy observation

- occluded objects
- wrong detections (false positive and/or object not detected)

Multi-object tracking (data association)

data association can be divided into two categories:

- each target has a state vector (targets are independent)
- a global state vector merges all targets.

K nearest neighbour association

$$z = \underset{z_{k,i}}{argmax} \left\{ P_{ass} \left(z_{k,i}, x_{k,j} \right) \right\}$$

- Pass: association probability
- Association can be achieved from a data association matrix

PDA: probabilistic data association

$$\hat{x}_{k|k,j} = \sum_{i=1}^{N} p_{i,j}\hat{x}^{i}_{k|k,j}$$

$$p_{i,j} = \begin{cases} \frac{b}{b+\sum_{l=1}^{n}\alpha_{j,l}} & pour\ j = 0 \\ \frac{\alpha_{j,l}}{b+\sum_{l=1}^{n}\alpha_{j,l}} & pour\ 1 \leq j \leq N \end{cases}$$

$$b = (1 - P_D)\,\beta\,(2\pi)^M \sqrt{|S_j|} \qquad \alpha_{i,j} = P_D exp\left(\frac{-d^2_{i,j}}{2}\right)$$

- weighted sum of updated state with observations

JPDA: joint probabilistic data association

- Dealing with complex situations: two targets share the same observation

Pij is modified

The power of video interlacing

Introduction

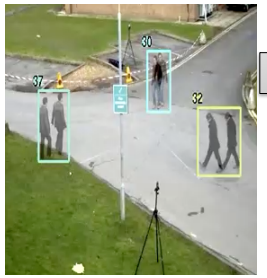
The classical tracking-by-detection scheme:

- object detection (for each frame of the video sequence)
- **association (spatio-temporal and/or appearance models)**
- birth and death trajectories algorithms

The power of video interlacing

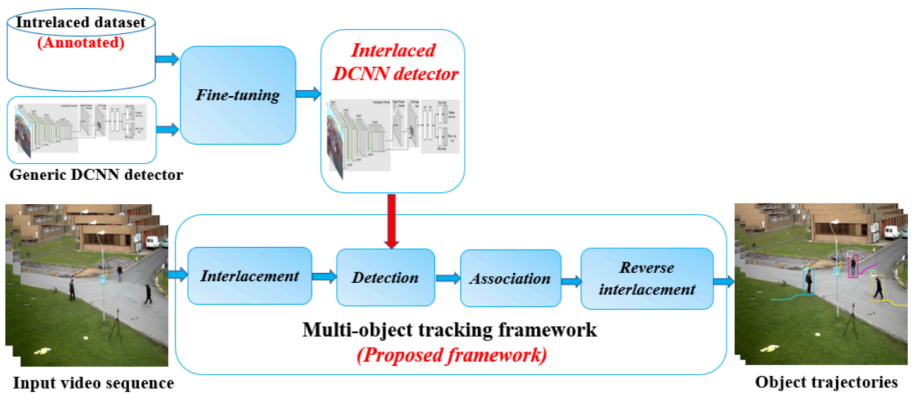
The key idea

build an **interlaced** video and train an interlaced pedestrian detector



to:
- increase overlapping between successive frames
- learn appearance association within a deep convolution neural network

The power of video interlacing



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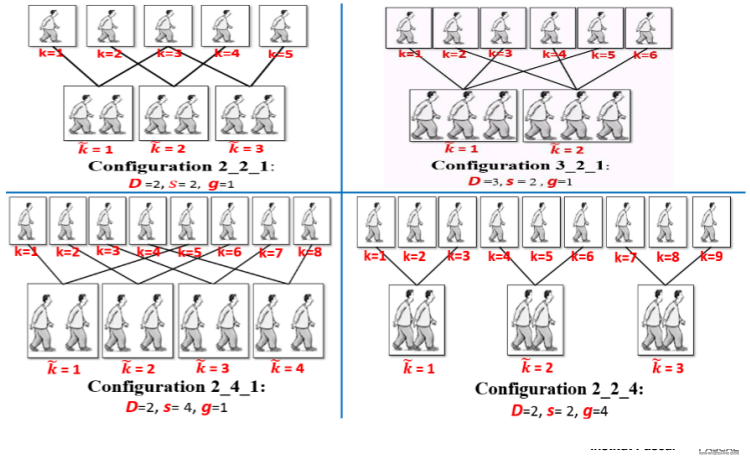
Build a interlaced video

$$\tilde{\mathtt{I}}_{\tilde{k}}(x,y) \doteq \sum_{d=0,..,(D-1)} \mathtt{I}_{(\tilde{k}g+ds)}(x,y).\delta(y[D]-d)$$



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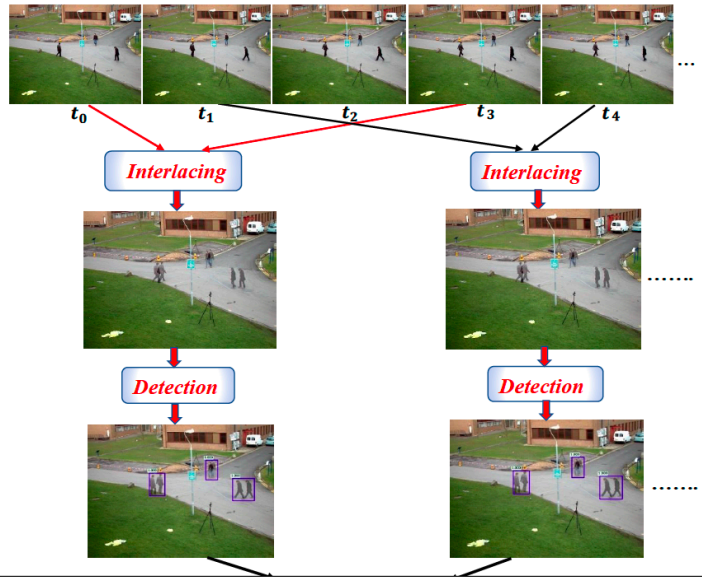

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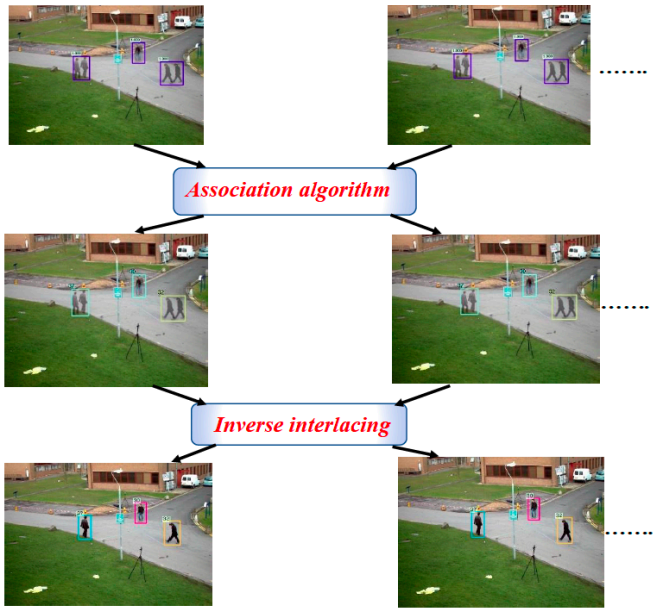

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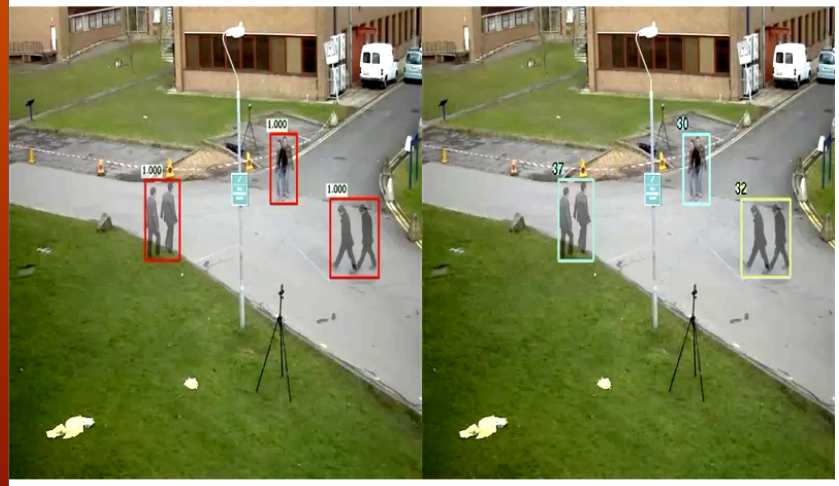

Detection Tracking

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