

# Charlie's notes

November 23, 2015

## 1 CS31310 - AGILE

## 2 CS36110 - MACHINE LEARNING

## 3 CS34110 - COMPUTER VISION

### 3.1 NOVEMBER 20: MOTION MODELS

#### Modelling Change & Tracking

MOTION:

- Background Subtraction
- Optical Flow

MIXTURE OF GAUSSIANS (MOG):

- Robust to noise
- Handles shadows ok
- Common first step

#### 3.1.1 TRACKING: MODELLING CHANGE

VIDEO:

- detections in each frame
- detections are noisy & computationally expensive
- tracking mitigates both issues

Noise can occur if the camera on a robot/car is moving up/down

#### 3.1.2 A GENERAL FRAMEWORK FOR TRACKING

RECURSIVELY:

- An idea about how something will change (*Model*)
- Make a prediction (*Predict*)
- See what happens (*Measure*)
- Update model (*Update*)

ADVANTAGES:

- Smooths the data
  - estimate location upon predictions & the measurement
- Constrains search
  - start looking for target in the location it was last seen

### 3.1.3 KALMAN FILTER

- Like predict, measure, update from earlier
- Useful for tracking
- Copes well with missing information (occlusions)

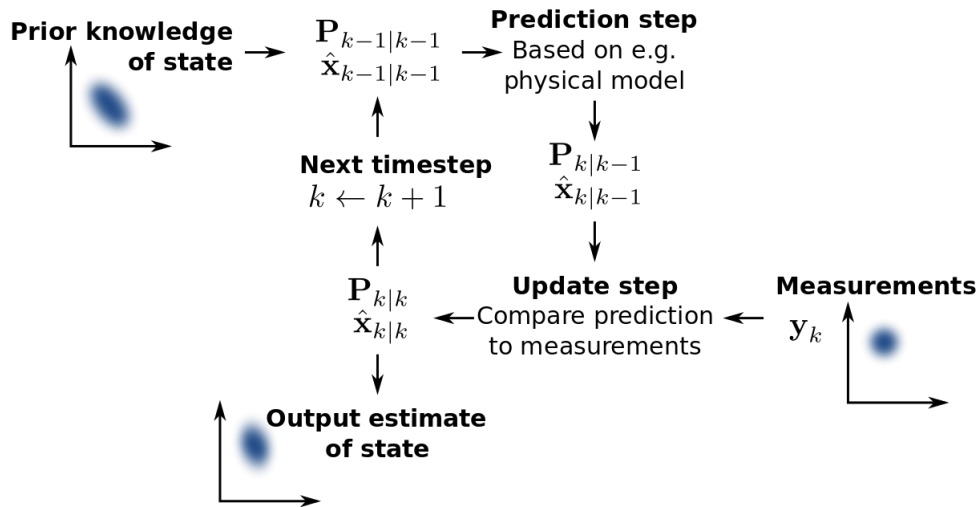


Figure 3.1: Sourced from Wikipedia

Background subtraction	→	Pixels grouped into objects	→	Tracker
Sparse Optical Flow	→	Features grouped into objects	→	
Face Detection	→	→	→	

USE KALMAN TO SMOOTH ANY MEASUREMENT

- X,Y location
- size
- colour

**See also:** Particle filtering: works with combining and splitting objects (e.g. people holding hands, then letting go)

**Hannah's video:** <https://www.youtube.com/watch?v=NYdwpX1a7-Y>

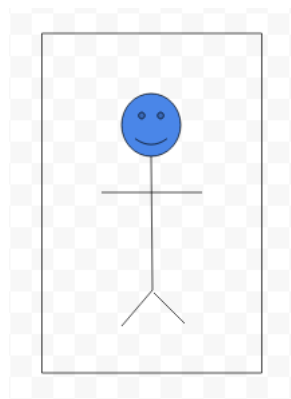
### 3.1.4 MEAN SHIFT

Computer the mean of the data within the window

Shift the window to the mean every time

NOTES:

- Changes size - can use CAM-Shift to mitigate?
- Lighting change - not really, gradually changes mean over time
- If it picks up something you're not looking for, will slowly drift off



### 3.1.5 PROBLEMS WITH TRACKING

- Initialisation (what are you tracking?)
- Having more than 1 item to track
- Losing target due to motion / occlusion
- Losing target due to appearance change

Usually initialise from a detector of some sort

**Useful speed up for detectors & accuracy**

Look into: TLD: Tracking Learning Description

### 3.1.6 CLOSING NOTE

Vision Systems tend to have multiple layers

Tracking is extremely common in anything which deals with change.

HOG FOR EXAMPLE, HAS SEVERAL LAYERS:

- 2D filters
- Tangent
- Histogram
- Superimpose grid
- SVM

*May be more, however couldn't write quick enough... You get the idea...*

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4 CS32310 - ADVANCED COMPUTER GRAPHICS

5 SE31520 - INTERNET-BASED APPLICATIONS

6 OTHER