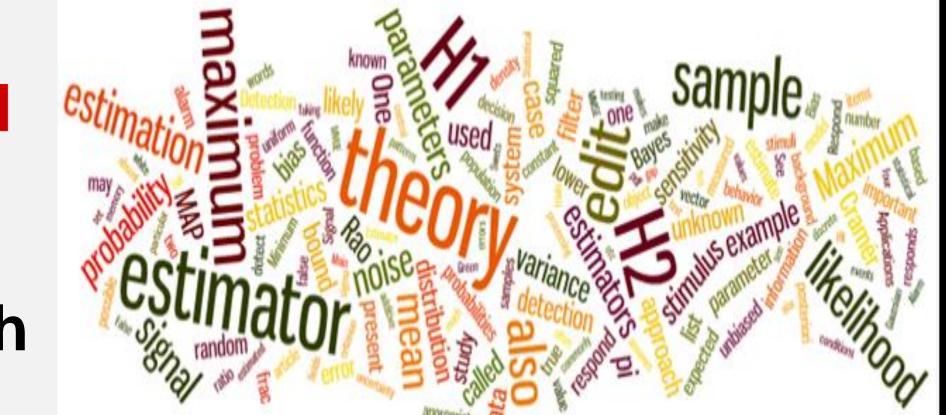


# Object Tracking Using Kalman Filter

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### **Introduction and Motivation**

# Track Om I

### Why tracking is important?

- ☐ Security Surveillance Applications
- ☐ Traffic Information, Vehicle tracking
- ☐ Study of animal behaviors
- Military Applications
- □ Robotics and Machine vision
- ☐ Medical: Visual Assistance

#### **Motivation:**

Considering all these critical applications, our main motivation is to work on an Estimation Theory project which will have practical applications. Apply Kalman theory in practical object tracking.

#### What is Kalman Filter?

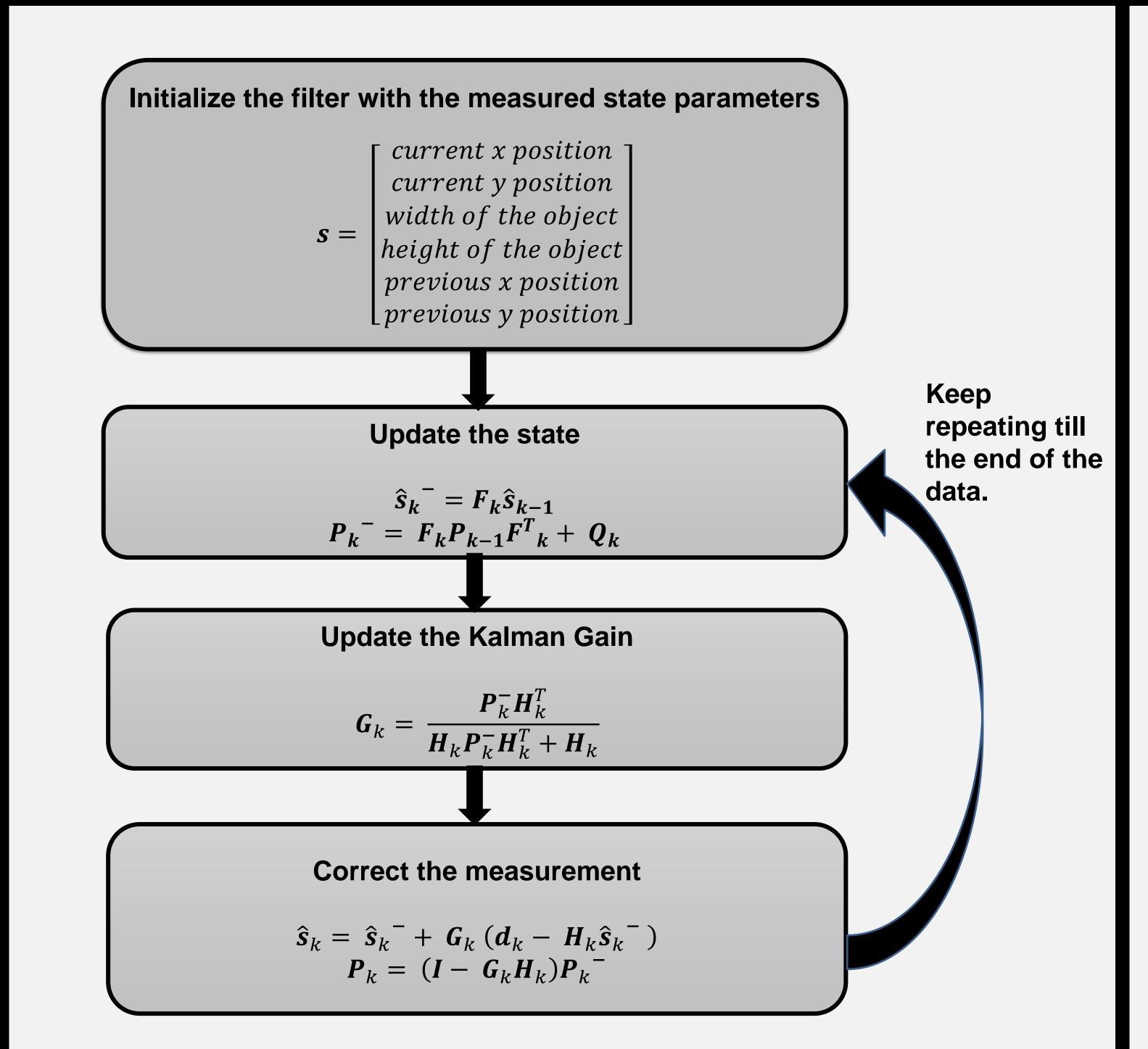
Kalman filtering is an algorithm that uses a series of measurements observed over time, containing statistical noise and other inaccuracies, and produces estimates of unknown variables that tend to be more precise than those based on a single measurement alone, by using Bayesian inference and estimating a joint probability distribution over the variables for each timeframe.

It is sequential MMSE estimator of a signal embedded in noise where the signal is characterized by a dynamic or state model

## **Challenges:**

- ☐ Multiple Objects☐ Occlusion
- ☐ Size change of Object
- ☐ Shadow interference

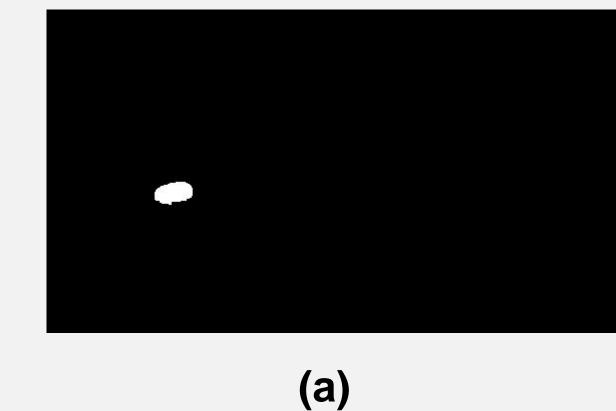
# Kalman Filter Algorithm



# **Methodology for Detection**

# Steps we followed for detection of object:

- ☐ Select background frame
- ☐ Select frame with the target/object
- ☐ Background subtraction for each frame
- ☐ Morphology (Opening/Closing) for de-noising
- ☐ Detection based on color statistics
- ☐ Kalman filter algorithm based on the data available from detection





(b)

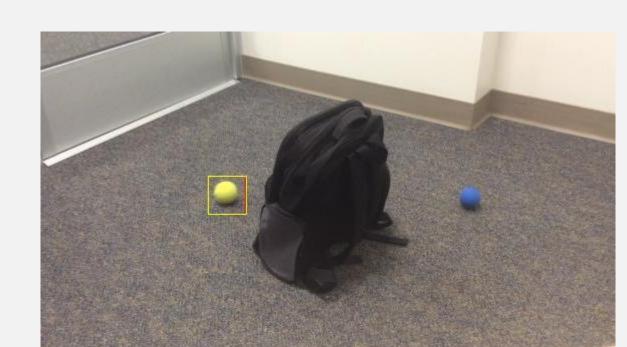
Background subtraction and morphology de-noising for ball and human

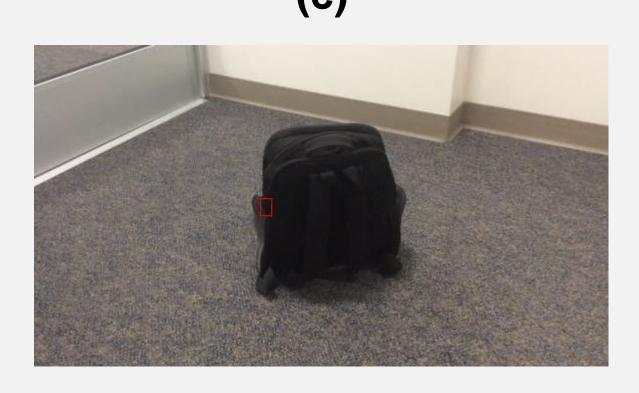
#### Results

#### Tracking of a ball: With Occlusion and multiple objects

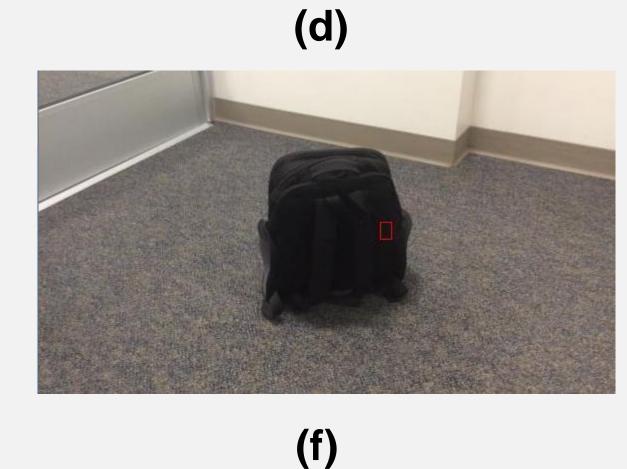
(Red box is Kalman prediction and yellow box is detection)





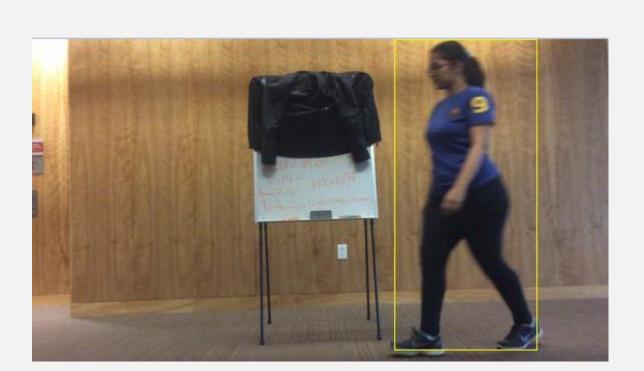


(e)

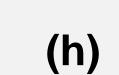


Tracking of Human: With Occlusion and Change in size





**(g)** 







(i)

**(j)** 

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- [2] A. Yilmaz, O. Javed, and M. Shah, "Object tracking: A survey," ACM Comput. Surv., vol. 38, no. 4, pp. 1–45, 2006.
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- [4] Malik M. Khan, Tayyab W. Awan, Intaek Kim, and Youngsung Soh, "Tracking Occluded Objects Using Kalman Filter and Color Information" International Journal of Computer Theory and Engineering, Vol. 6, No. 5. October 2014
- [5] Oscar Efrain Ramos Ponce, Mohammad Ali Mirzaei, Frederic Merienne, "Tracking in Presence of Total Occlusion and Size Variation using Mean Shift and Kalman Filter"