# ImageObject Kalman Filtering

## Location

State vector s:

where

x = horizontal location in the image  
y= vertical location in the image  
vx = horizontal velocity in the image  
vy= vertical velocity in the image  
ax = horizontal acceleration in the image  
ay= vertical acceleration in the image

Coordinate system:

0/0 --- x --- >  
|

|

y

|

|

v

State equation in differential form:

State equation in difference form:

where is the time increment and Gaussian noise with covariance R.

Measurement equation

Where is Gaussian noise with covariance matrix Q.

Kalman filter initialization:

where x(0) and y(0) are the first location measurements.

where α, β and γ are believed variances of location, velocity and acceleration, for example 1.

where , and are believed variances of location, velocity and acceleration, for example 1.

Where q is the believed measurement variance. It is larger than system variance because the objects have tendency to move smoothly but the bounding boxes exhibit more random behaviour. Q can be set to 10, for example.

Kalman filter update:

## Size

State vector s:

where

sx = horizontal size of the image  
sy= vertical size of the image  
vsx = horizontal size change of the image  
vsy= vertical size change of the image  
asx = horizontal size change acceleration in the image  
asy= vertical size change acceleration in the image

Coordinate system:

0/0 --- x --- >  
|

|

y

|

|

v

State equation in differential form:

State equation in difference form:

where is the time increment and Gaussian noise with covariance R.

Measurement equation

Where is Gaussian noise with covariance matrix Q.

Kalman filter initialization:

where sx(0) and sy(0) are the first size measurements.

where α, β and γ are believed variances of size, change and acceleration, for example 1.

where , and are believed variances of location, velocity and acceleration, for example 1.

Where q is the believed measurement variance. It is larger than system variance because the objects have tendency to change smoothly but the bounding boxes exhibit more random behaviour. Q can be set to 10, for example.

Kalman filter update: