See kalman\_filter.m

I made it as described in the book that you sent me. Use appendix A. Section A.8 “Kalman filterenig”. Page 32 in pdf (reference\_1.png reference\_2.png), original page number 328

Also Wikipedia used:

<http://en.wikipedia.org/wiki/Kalman_filter>

The filter was applied to trajectory of body that start motion on the ground with velocity start at angle 40 degrees:



First part of the code generate this motion.

Nose added to simulate nose of measurement or nose of object detection recognition:



Gaussian nose used that is randn function in matlab. sig\*randn will give random number from Gaussian distribution with standard deviation sig. In the code sgx – variable is standard deviation of horizontal nose, sgy – variable is standard deviation of vertical nose.

Then in the code Kalman filtering applied as described in page 330 (p. 33 in pdf). Formulas A.11 – A.14. Instead of formula A.14 was used P=(I-KH)P’. As explained A.14 get more stable filtering but I failed to apply it (“Matrix dimensions must agree” -error). It seems that A.14 formula can be used when number of measured value equal to length of state vector. But in out case 2 measured values (x and y) and 5 components of state vector (x vx y vy ay). In wikipedia P=(I-KH)P’ described.

Kalman filter give some estimation of state of the system in time using some info about model. In our case this info is that we have free motion in horizontal direction and accelerated motion in vertical direction. Acceleration is constant. Then body can be described by postion ( ) velocity ( ) and vertical acceleration . Then state of our system is vector:

Equations of motion:

If time step is small enough then we can use Euler approximation:

Then equation of motion is:

Where means then we need to update the value in loop. Note: and not change.

Kalman filter require this in matrix form:

It is matrix in the pdf:

In the code it is variable F. matrix is covariance matrix for noise of noise that add inside model. We not have noises inside model then has all emements zeros and not used.

We observe only coordinates with nose:

Where noised positions that we only can see we can not get . is random number from Gaussian destitution with standard deviation . is random number from Gaussian destitution with standard deviation . In the code is sgx variable, is sgy variable. is characteristics of nose amplitude in horizontal direction, is characteristics of nose amplitude in vertical direction. In matrix form:

Or:

Where - observation, - observation mnatrix.

For initial value of estimation of state vector was get initial nosised position with zero velocity and zero acceleration:

For initial P –matrix unit matrix was taken. Equation A.11 – A.13 and P=(I-KH)P’ was applied in loop.

Result:

Reconstructed trajectories:



Velocities:



It is possible to see some period of adaptation of the filter in the beginning. Then filter give correct values for velocity components.

See also kalman\_filter\_tmp\_2.m it is my initial tests of kalman filter in case of 1d motion.