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% kalbat.m - 28-dec-03
% kalman filter batch process
% with simple linear problem (moving line)

x1=1;
x2=2;
x3=3;
y1=[1.4697;2.5201;3.5832;4.5122;5.4588;6.5080;7.4933;8.4065;9.4516;10.3884];
y2=[1.8834;2.9197;3.9974;4.9869;6.1528;7.0747;7.9417;9.0500;10.0601;10.8991];
y3=[2.5088;3.5834;4.5229;5.5508;6.4905;7.5041;8.5206;9.6136;10.5878;11.5400];
sigy=0.07;

PHI=[1 0 0;0 1 1;0 0 1];
sigt=[0.05;0.10;0.05];
I3=eye(3);

neqn=10*3 + 9*3; % (57)
npar=3*10;       % (30)

B=zeros(neqn,npar);
f=zeros(neqn,1);
W=zeros(neqn,neqn);

rowidx=1;
colidx=1;
epoch=1;

% add the observation equations
% for the first epoch;

B(rowidx,colidx)= -x1;
B(rowidx,colidx+1)= -1;
f(rowidx)= -y1(epoch);
W(rowidx,rowidx)=1/sigy^2;
B(rowidx+1,colidx)= -x2;
B(rowidx+1,colidx+1)= -1;
f(rowidx+1)= -y2(epoch);
W(rowidx+1,rowidx+1)=1/sigy^2;
B(rowidx+2,colidx)= -x3;
B(rowidx+2,colidx+1)= -1;
f(rowidx+2)= -y3(epoch);
W(rowidx+2,rowidx+2)=1/sigy^2;
rowidx=rowidx+3;
colidx=colidx+3;
epoch=epoch+1;

% do all subsequent epochs

for i=1:9
  % add the state transition equations

  B(rowidx:rowidx+2,colidx-3:colidx-1)=-PHI;
  B(rowidx:rowidx+2,colidx:colidx+2)=I3;
  % f is zero
  W(rowidx,rowidx)=1/sigt(1)^2;
  W(rowidx+1,rowidx+1)=1/sigt(2)^2;
  W(rowidx+2,rowidx+2)=1/sigt(3)^2;
  rowidx=rowidx + 3;

  % add the observation equations

  B(rowidx,colidx)= -x1;
  B(rowidx,colidx+1)= -1;
  f(rowidx)= -y1(epoch);
  W(rowidx,rowidx)=1/sigy^2;
  B(rowidx+1,colidx)= -x2;
  B(rowidx+1,colidx+1)= -1;
  f(rowidx+1)= -y2(epoch);
  W(rowidx+1,rowidx+1)=1/sigy^2;
  B(rowidx+2,colidx)= -x3;
  B(rowidx+2,colidx+1)= -1;
  f(rowidx+2)= -y3(epoch);
  W(rowidx+2,rowidx+2)=1/sigy^2;

  % update the indices

  rowidx=rowidx+3;
  colidx=colidx+3;
  epoch=epoch+1;
  end

N=B'*W*B;
N(1:10,1:6)
pause
t=B'*W*f;
Ni=inv(N);
X=Ni*t;
disp('params');
X
disp('covariance');
for i=1:10
  idx=(i-1)*3 + 1;
  cv=Ni(idx:idx+2,idx:idx+2);
  i
  cv
  end

% ok now do it by block gauss elimination and show how it could
% therefore be done sequentially - by intuition method


for i=1:9
  idx=(i-1)*3 + 1;
  n11=N(idx:idx+2,idx:idx+2);
  n12=N(idx:idx+2,idx+3:idx+3+2);
  n21=n12';
  t1=t(idx:idx+2);
  n22=N(idx+3:idx+3+2,idx+3:idx+3+2);
  t2=t(idx+3:idx+3+2);
  n11i=inv(n11);
  n22p=n22-n21*n11i*n12;
  t2p=t2 - n21*n11i*t1;
  N(idx+3:idx+3+2,idx+3:idx+3+2)=n22p;
  t(idx+3:idx+3+2)=t2p;
  end

idx=idx+3;
nf=N(idx:idx+2,idx:idx+2);
tf=t(idx:idx+2);
nfi=inv(nf);
Xs=nfi*tf;
disp('params from elimination');
Xs
disp('covariance from elimination');
nfi
```