HW 6: Setting Up the Term Project

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Initialize

clearvars -except function_list pub_opt

```
global function_list;
function_list = {};
close all

stat_od_proj_init
ObsData = load('ObsData.txt');
```

Compute information matrix, normal matrix, x_hat

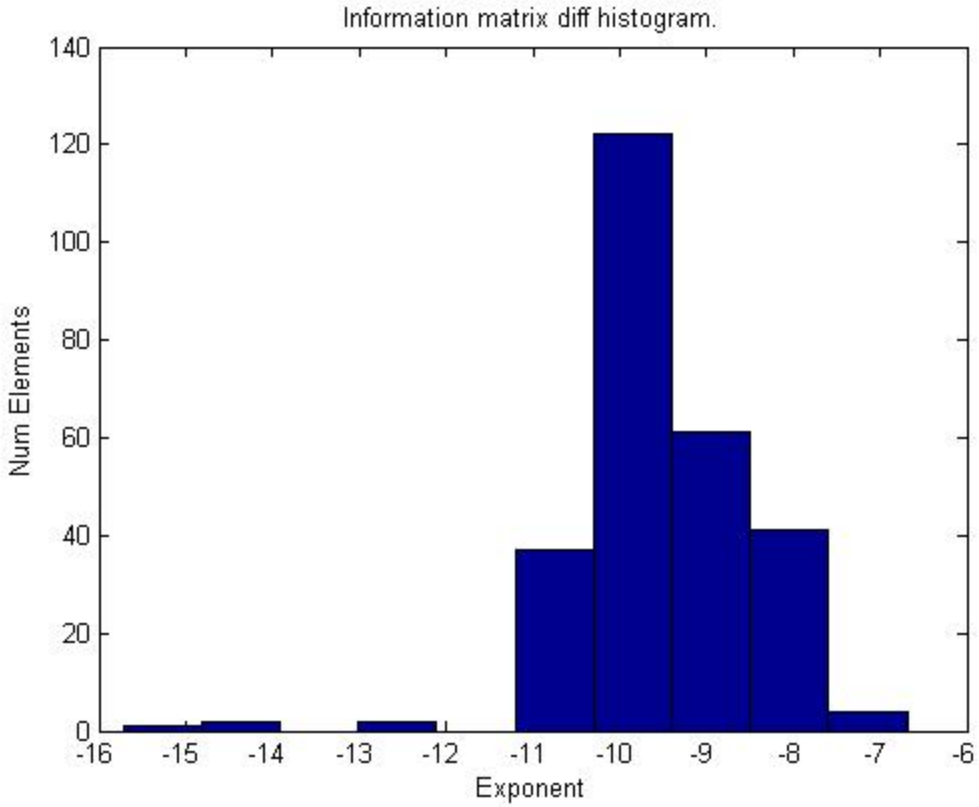
```
consts.Re = Re;
consts.area = drag.A;
consts.rho = compute_density(ri);
consts.theta_dot = theta_dot;
consts.m = drag.m;
consts.state_len = 18;

P0 = eye(consts.state_len)*1e6;
P0(7,7) = 1e20;
P0(10:12,10:12) = eye(3)*1e-10;

x0_ap = zeros(consts.state_len,1);

sig_range = 0.01; % m
sig_rangerate = 0.001; %m/s
W = [1/(sig_range*sig_range) 0; 0 1/(sig_rangerate*sig_rangerate)];


dt = 0.1;
times = 0:dt:18340;
ode_opts = odeset('RelTol', 1e-12, 'AbsTol', 1e-20);

% for iter = 1:3
[T,X] = ode45(@two_body_state_dot, times, state, ode_opts, propagator_opts);

% Store off every 20 seconds of data
X_store = X(mod(times,20) == 0,:);
T_store = T(mod(times,20) == 0);
```

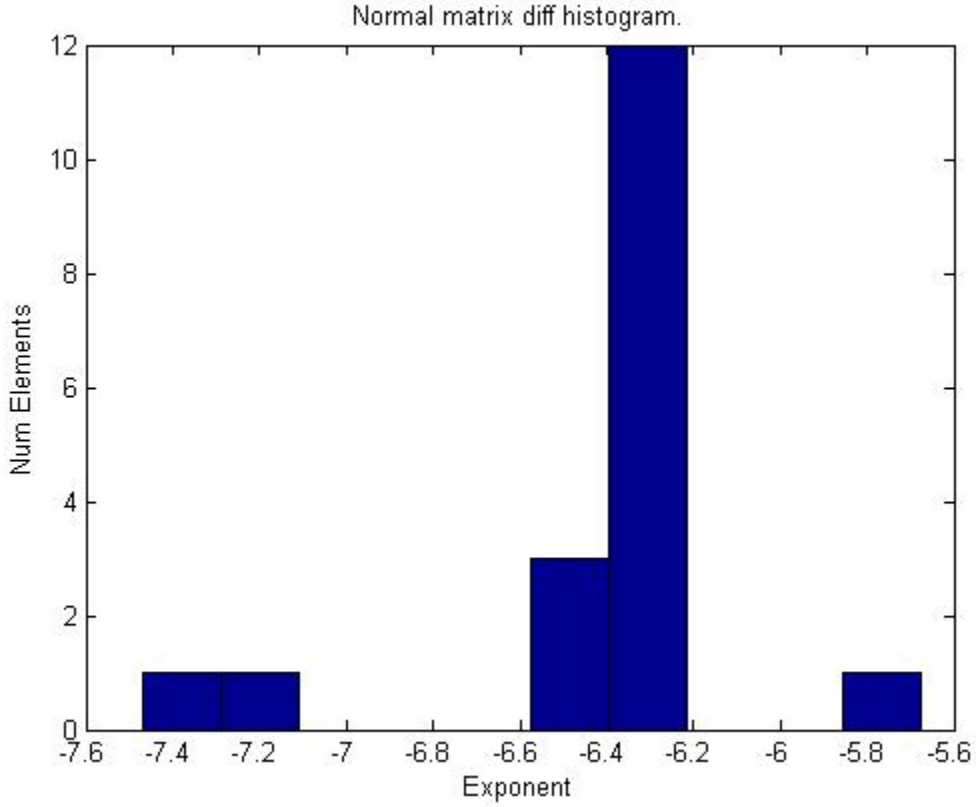
```
% Accumulate the information and normal matrices
[num_obs, ~] = size(ObsData);
% info_mat = zeros(consts.state_len);
chol_P0 = chol(P0,'lower');
P0_inv = chol_P0'\inv(chol_P0);
info_mat = P0_inv;
norm_mat = P0_inv*x0_ap;
% H_tilda_given = load('BatchHtilda.mat');
cntr =1 ;
% Obs. deviation
y1 = zeros(num_obs,1);
y2 = zeros(num_obs,1);
for ii = 1:num_obs
    site_num = 0;
    for jj = 1:3
        if ObsData(ii, 2) == site(jj).id
            site_num = jj;
            break
        end
    end
    t_obs = ObsData(ii,1);
    ostate = X(T(:,1)==t_obs,1:6);

    r_comp = compute_range_ECFsite(ostate(1:3),...
        site(site_num).r,theta_dot*t_obs);
    rr_comp = compute_range_rate_ECFsite(ostate(1:6),...
        site(site_num).r,theta_dot*t_obs, theta_dot);

    y1(ii) = (ObsData(ii,3)-r_comp);
    y2(ii) = (ObsData(ii,4)-rr_comp);

end
for ii = 1:num_obs
    obs_time = ObsData(ii,1);
    obs_site = ObsData(ii,2);
    % STM
    STM = eye(consts.state_len);
    STM(1:important_block(1),1:important_block(2)) = ...
        reshape(X_store(T_store == obs_time,consts.state_len+1:end), ...
        important_block(1), important_block(2));

    % H~
    consts.t = obs_time;
    for xx = 1:3
        if site(xx).id == obs_site
            consts.site = xx;
            break
        end
    end
    state_at_obs = X_store(T_store == obs_time,1:consts.state_len);
    H_tilda = stat_od_proj_H_tilda(state_at_obs, consts);

    %H
```

```
    H = H_tilda*STM;

    % Accumulate information matrix
    info_mat = info_mat + H'*W*H;

    % Accumulate normal matrix
    y = [y1(ii); y2(ii)];
    norm_mat = norm_mat + H'*W*y;

end
x_est = cholesky_linear_solver(info_mat,norm_mat);
% x0_ap = x0_ap-x_est;
% state(1:18) = state(1:18) + x_est;
% end

info_mat_given = load('BatchInfoMat.mat');
info_diff = abs((info_mat-info_mat_given.InfoMat)./info_mat_given.InfoMat);
hist(reshape(log10(info_diff),18*18,1))
title('Information matrix diff histogram.')
xlabel('Exponent')
ylabel('Num Elements')

figure
norm_mat_given = load('BatchNormMat.mat');
norm_diff = abs((norm_mat-norm_mat_given.NormMat)./norm_mat_given.NormMat);
hist(log10(norm_diff))
title('Normal matrix diff histogram.')
xlabel('Exponent')
ylabel('Num Elements')

x_hat_given = load('BatchXhat');
x_diff = abs((x_est - x_hat_given.xhat_pass1)./x_hat_given.xhat_pass1);
x_est
fprintf('Estimated State Deviation Error\n')
for ii = 1:consts.state_len
    fprintf('%.0e\n',x_diff(ii))
end
```

```
x_est =

   1.0e+06 *

  -0.000000036301876
  -0.000000274106867
  -0.000000180875321
   0.000000040934961
   0.000000032748395
  -0.000000014753039
  -9.463433517218595
  -0.000000000000657
   0.000000147561584
   0.000000000001863
   0.000000000001379
```

```
  -0.000000000000254
  -0.000010563629542
   0.000009983376706
   0.000005794325174
  -0.000005781912402
   0.000002344367740
   0.000001512457637

Estimated State Deviation Error
3e-03
2e-05
8e-04
2e-06
2e-07
3e-06
3e-04
4e-06
6e-03
6e-05
6e-05
7e-06
2e-06
8e-06
8e-06
9e-06
5e-05
7e-06
```


Information matrix diff histogram.
Num Elements
Exponent
140
120
100
80
60
40
20
0
-16
-15
-14
-13
-12
-11
-10
-9
-8
-7
-6


Normal matrix diff histogram.
Num Elements
Exponent
12
10
8
6
4
2
0
-7.6
-7.4
-7.2
-7
-6.8
-6.6
-6.4
-6.2
-6
-5.8
-5.6

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