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```
% Filtering and Identification - final assignment
% Section 1 - Random Walk Model

close all;

load systemMatrices.mat;
load turbulenceData.mat; % load the data provided
```

Question 1

```
% We see that we have been provided data corresponding to s0(k) and G,
 and
% we have to determine the value of phi(k) such that the error, e(k),
 is
% minimum, given no prior information. This is clearly a linear least
% squares problem.

rank_G = rank(G);

% We get the rank of G as 47, whereas the number of columns in G is 49
 and
% the number of rows is 72. Hence, G is not full rank, we conclude.

% Getting the SVD of G:
[U, S, V] = svd(G, 0);
```

Question 5

```
% In Question 5, we need to know the rank of the system matrix H so as
 to
% determine a solution for the linear least squares problem minimizing
 the
% 2-norm of epsilon (k + 1|k)
rank_H = rank(H);

% We get the rank of H as 49, and hence we conclude that H is a full
 rank,
% invertible matrix.
```

Question 6

```
% The function AOloopRW is present in the same directory as the
 current
% one.

% Considering the first cell in the given cell array
phiSim_1 = phiSim{1,1};

% Calculating the dimensions of each phiSim cell
[phi_len, n] = size(phiSim_1);

% Covariance matrix is square
covariance_phi = zeros(phi_len, phi_len);

% We are provided with a cell array of 20 datasets for phiSim
num_Datasets = length(phiSim);

variance_closed_loop = 0;
variance_no_control = 0;

for cellIndex = 1:num_Datasets
    phi_currentCell = phiSim{1,cellIndex};
    for k = 1:n
        covariance_phi = covariance_phi +
 (phi_currentCell(:,k)*phi_currentCell(:,k)');
    end

    covariance_phi = covariance_phi/n;

    variance_closed_loop = variance_closed_loop + AOloopRW(G,H,
 covariance_phi, sigmae, phi_currentCell);
    variance_no_control = variance_no_control +
 AOloop_nocontrol(phi_currentCell,sigmae,H,G);
end

% Taking the average of the values obtained from all of the provided
% datasets
variance_closed_loop = variance_closed_loop/num_Datasets;
variance_no_control = variance_no_control/num_Datasets;
```

Question 7

```
VAF_cumulative = 0;

for cellIndex = 1:num_Datasets
    phi_currentCell = phiSim{1,cellIndex};
    covariance_phi = zeros(phi_len, phi_len);
    for k = 1:n
        covariance_phi = covariance_phi +
 (phi_currentCell(:,k)*phi_currentCell(:,k)');
    end
```

```
    covariance_phi = covariance_phi/n;

    VAF_cumulative = VAF_cumulative + VAF_RW(G,H, covariance_phi,
 sigmae, phi_currentCell);
end

VAF = VAF_cumulative/num_Datasets;
```

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