Contents

Load Data from rawtrimmed_158.bin

```
clear; close all; clc;
```

Get Signal

```
%----- Setup
Tfull = 0.5;         % Time interval of data to load
fs = 40e6/7;         % Sampling frequency (Hz)
N = fs*Tfull;
N = floor(N/16)*16;  % Number of data samples to load
nfft = 2^10;          % Size of FFT used in power spectrum estimation
fIF     = 1.610476e6;        % Intermediate frequency (Hz)

%----- Load data
fid = fopen("C:\Users\gsh04\Desktop\2024-Fall\GPS\exam2\problem 5\dataout_raw_trimmed_158.bin",'r','l');
[Y,count] = binloadSamples(fid,N,'dual');
Y = Y(:,1);
```

Genererate Code

```
%---- Generate all possible PRN (37 SVIDs or PRN Sign No.)
% LFSR Parameters:
nStages      = 10;
ciVec1       = [10, 3]';
ciVec2       = [10, 9, 8, 6, 3, 2,]';
a0Vec1       = ones(nStages,1);
a0Vec2       = ones(nStages,1);
% G2Delay      = [5;6;7;8;17;18;139;140;141;251;252;254;255;256;257;258;...
%     469;470;471;472;473;474;509;512;513;514;515;516;859;860;...
%     861;862;863;950;947;948;950];
% Oversampling Parameters:
Tc = 1e-3/1023;             % Chip interval in seconds
T  = 1/fs;                  % Bandpass Sampling time interval in seconds
delChip = T/Tc;             % Sampling interval in chips
Np = 2^nStages - 1;         % Period of the sequence in chips
Ns = length(Y);             % Number of Samples should equal to that of Y(signal)
Ta = 0.001;                 % Accumulation time in seconds
Nk = floor(Ta/T);           % Number of samples in one 1-ms accumulation
% Generate 37 Seqeuences and Oversample them:
codeOS = zeros(Nk,37);
G2tab = [2,6;3,7;4,8;5,9;1,9;2,10;1,8;2,9;3,10;2,3;3,4;5,6;6,7;7,8;...
    8,9;9,10;1,4;2,5;3,6;4,7;5,8;6,9;1,3;4,6;5,7;6,8;7,9;8,10;1,6;2,7;...
    3,8;4,9;5,10;4,10;1,7;2,8;4,10];
```

```
parfor j = 1:length(G2tab)
    [GoldSeq] = generateGoldLfsrSequenceCA(nStages,ciVec1,ciVec2,a0Vec1,...
        a0Vec2,G2tab(j,:));
    % Make code +1/-1 not +1/0
    GoldSeq = 2*GoldSeq - 1;
    % Oversample Code: It makes sense to oversample code, since the code
    % embedded within the signal is sampled at a higher rate than its chip
    % rate. Assuming that the code I generate is sampled at the chip rate,
    % oversampling my code I generated at the rate the signal is sampled
    % will allow my code to correlate with the code embedded in the signal
    GoldSeqOS = oversampleSpreadingCode(GoldSeq,delChip,0,Nk,Np);
    codeOS(:,j) = GoldSeqOS;
end
%

fD = [-300000:100:0];
tk = [0:Nk-1]'*T;
PF = 0.05;
sigmaIQ = 149;
threshold = 39.5;
CN0 = zeros(37,1);
for mm =1:37
    for kk = 1:length(fD)
        Cr = fft(codeOS(:,mm));
        fi = fD(kk) + fIF;
        xkTilde = Y(1:Nk).*exp(-1i*2*pi*fi*tk);
        XrTilde = fft(xkTilde);
        Zr = XrTilde.*(conj(Cr));
        zk = ifft(Zr);
        [maxValue,kmax] = max(abs(zk).^2);
        CN0(mm) =10*log10((maxValue-2*sigmaIQ^2)/(2*sigmaIQ^2*Ta));
        if CN0(mm)  > threshold
            signalStrenghth(mm)=CN0(mm);
            start_time(mm) = tk(kmax+1)*10^6;
            apparent_fD(mm) = fD(kk);
            disp('-----------------------------------------------------------')
            disp(['PRN :',num2str(mm)])
            disp(['Apparent Doppler Frequency: ', num2str(apparent_fD(mm)), ' Hz']);
            disp(['Approximate Start Time from first sample: ', num2str(start_time(mm)), ' microseconds']);
            disp (['C/N0: ', num2str(CN0(mm))])
            break;
        end
    end
end
```

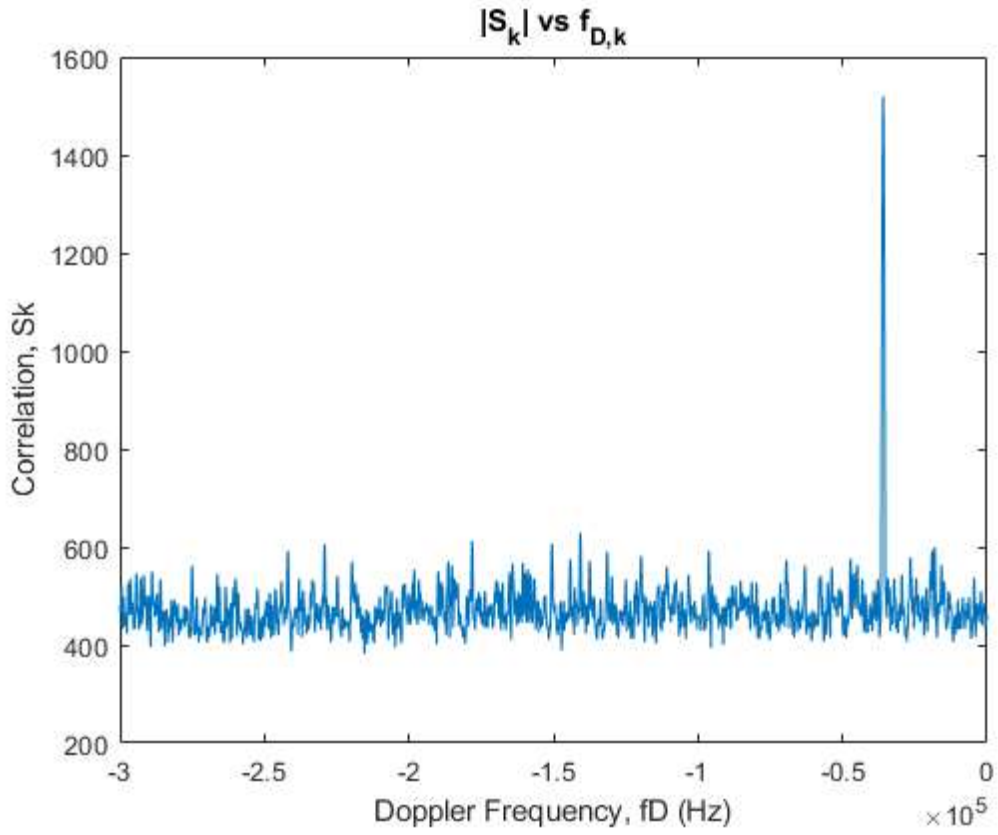
```
-----------------------------------------------------------
PRN :1
Apparent Doppler Frequency: -34300 Hz
Approximate Start Time from first sample: 411.075 microseconds
C/N0: 41.491
-----------------------------------------------------------
PRN :11
Apparent Doppler Frequency: -36500 Hz
Approximate Start Time from first sample: 578.55 microseconds
C/N0: 41.8547
-----------------------------------------------------------
PRN :18
```

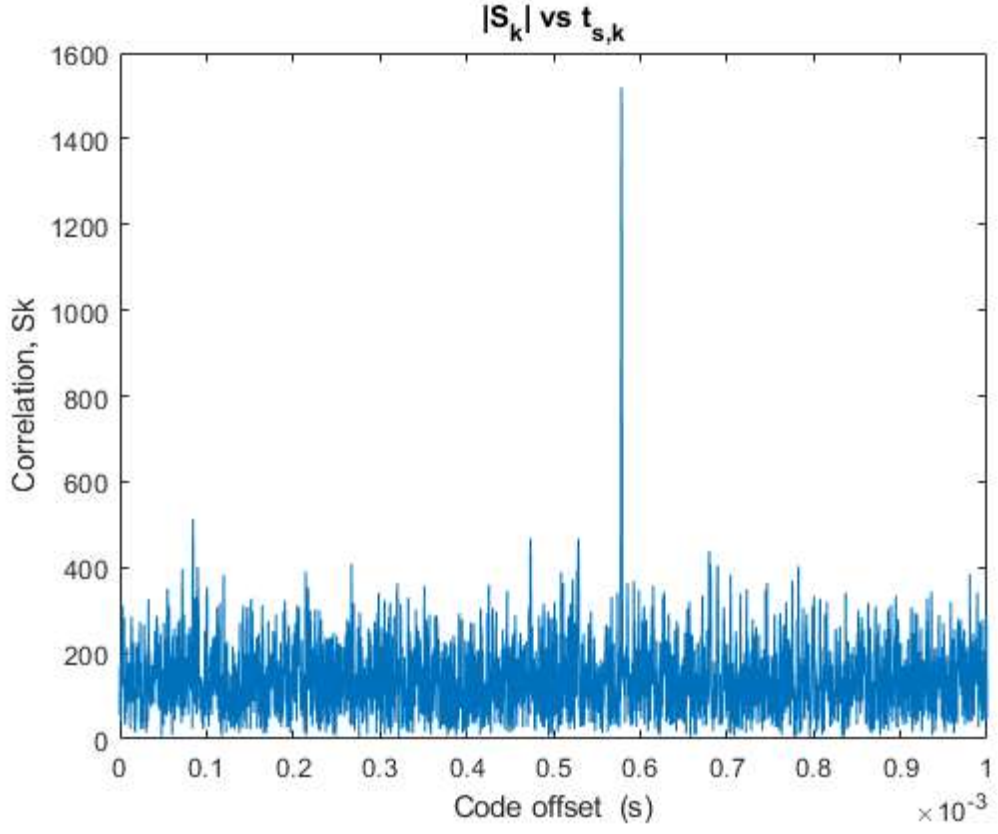
```
Apparent Doppler Frequency: -34800 Hz
Approximate Start Time from first sample: 370.125 microseconds
C/N0: 41.5946
------------------------------------------------------------
PRN :21
Apparent Doppler Frequency: -135200 Hz
Approximate Start Time from first sample: 42.875 microseconds
C/N0: 39.7039
------------------------------------------------------------
PRN :29
Apparent Doppler Frequency: -287200 Hz
Approximate Start Time from first sample: 584.85 microseconds
C/N0: 39.514
```

Find the best estimates for fd and ts

```
[~,strongPrn] = max(CN0)

% Sk vs fdk
for hh = 1:length(fD)
    Cr = fft(codeOS(:,strongPrn));
    fi = fD(hh) + fIF;
    xkTilde = Y(1:Nk).*exp(-1i*2*pi*fi*tk);
    XrTilde = fft(xkTilde);
    Zr = XrTilde.*(conj(Cr));
    zk = ifft(Zr);
    Sk(hh) = max(abs(zk));
end
figure,
plot(fD,Sk)
ylabel('Correlation, Sk')
xlabel('Doppler Frequency, fD (Hz)')
title(['|S_k| vs f_{D,k}'])

% Sk vs tsk
[~,idx] = max(Sk);
fd_best = fD(idx);
Cr = fft(codeOS(:,strongPrn));
fi = fd_best + fIF;
xkTilde = Y(1:Nk).*exp(-1i*2*pi*fi*tk);
XrTilde = fft(xkTilde);
Zr = XrTilde.*(conj(Cr));
zk = ifft(Zr);
Sk = abs(zk);
figure,
plot(tk,Sk)
ylabel('Correlation, Sk')
xlabel('Code offset  (s)')
title(['|S_k| vs t_{s,k}'])
```

```
strongPrn =

    11
```





Weak Signal Search

```
fD = [-300000:100:0];
tk = [0+110e-3:Nk-1+110e-3]'*T;
```

```
threshold = 36;
CN0 = zeros(37,1);
for mm = 31
    for kk = 1:length(fD)
        Cr = fft(codeOS(:,mm));
        fi = fD(kk) + fIF;
        Y = Y(round(110e-3/T):end);
        xkTilde = Y(1:Nk).*exp(-1i*2*pi*fi*tk);
        XrTilde = fft(xkTilde);
        Zr = XrTilde.*(conj(Cr));
        zk = ifft(Zr);
        [maxValue,kmax] = max(abs(zk).^2);
        CN0(mm) =10*log10((maxValue-2*sigmaIQ^2)/(2*sigmaIQ^2*Ta));
        if CN0(mm)  > threshold
            signalStrenghth(mm)=CN0(mm);
            start_time(mm) = tk(kmax+1)*10^6;
            apparent_fD(mm) = fD(kk);
            disp('------------------------------------------------------------')
            disp(['PRN :',num2str(mm)])
            disp(['Apparent Doppler Frequency: ', num2str(apparent_fD(mm)), ' Hz']);
            disp(['Approximate Start Time from first sample: ', num2str(start_time(mm)), ' microseconds']);
            disp (['C/N0: ', num2str(CN0(mm))])
            break;
        end
    end
end
```

```
------------------------------------------------------------
PRN :31
Apparent Doppler Frequency: -300000 Hz
Approximate Start Time from first sample: 173.7942 microseconds
C/N0: 36.9558
```

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