Part 4: SSS search & Cell Id Detection

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Parameters

```
FFT_size = 4096;
CP_length = 288;
SCS = 30e3;
Ts = 1/FFT_size/SCS;
CP_OFDM_length = FFT_size+CP_length;
num_sc = 240;
N_id_1 = 77;
N_id_2 = 2;
```

SSS

```
% OFDM Modulation
SSS_stream = SSS_BPSK(N_id_1,N_id_2);
% Map symbol to subcarrier
d_SSS = [zeros(56,1);SSS_stream;zeros(FFT_size-183,1)];
% FFT
OFDM_SSS_body = ifft(d_SSS)*sqrt(FFT_size);
% Add CP
CP_OFDM_SSS = [OFDM_SSS_body(end-CP_length+1:end);OFDM_SSS_body];
```

Channel and Noise

```
h = 1;
signal_after_channel = conv(CP_OFDM_SSS,h);

SNR_values = [-5, 20]; % SNR values in dB
corr_all = zeros(length(SNR_values), 336);

for snr_idx = 1:length(SNR_values)
    SNR = SNR_values(snr_idx);
    N_0 = 10^(-SNR/10) * (norm(signal_after_channel)^2/
length(signal_after_channel));
    noise = sqrt(N_0/2)*(randn(length(signal_after_channel),1) +
1j*randn(length(signal_after_channel),1));
    received_SSS_signal = signal_after_channel + noise;

    corr = zeros(1,336);
```

```
    for i = 0:335
        SSS_ref_stream = SSS_BPSK(i,N_id_2);
        d_SSS_ref = [zeros(56,1);SSS_ref_stream;zeros(FFT_size-183,1)];
        OFDM_SSS_ref_body = ifft(d_SSS_ref);
        CP_OFDM_SSS_ref = [OFDM_SSS_ref_body(end-
CP_length+1:end);OFDM_SSS_ref_body];
        corr(i+1) = abs(received_SSS_signal' * CP_OFDM_SSS_ref) ;
    end
    [~,N_id_1_est_pos] = max(corr);
    N_id_1_est = N_id_1_est_pos - 1;
    disp(['N_ID1 for SNR = ', num2str(SNR), ' dB: ', num2str(N_id_1_est)]);

    % Compute Cell ID using the formula
    Cell_ID = 3 * N_id_1_est + N_id_2;
    disp(['Cell ID for SNR = ', num2str(SNR), ' dB: ', num2str(Cell_ID)]);

    % Store correlation results
    corr_all(snr_idx, :) = corr;
end
```

```
N_ID1 for SNR = -5 dB: 77
Cell ID for SNR = -5 dB: 233
N_ID1 for SNR = 20 dB: 77
Cell ID for SNR = 20 dB: 233
```

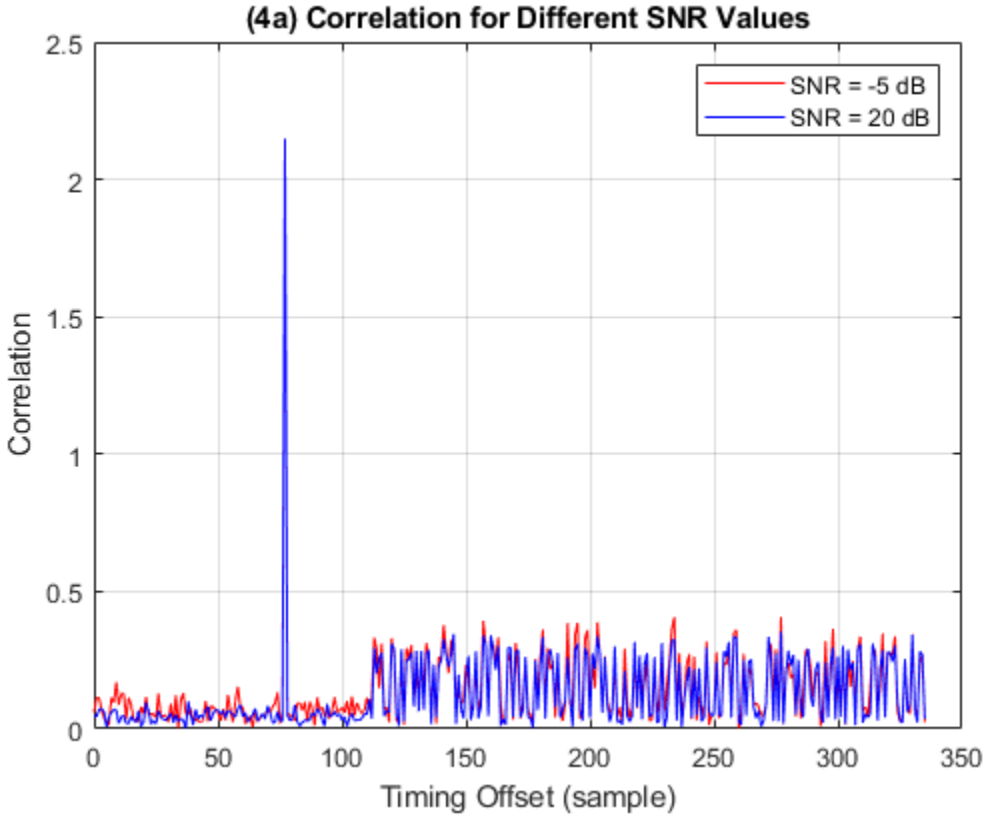
(a) Plot Correlation for all SNR values

```
figure;
plot(0:335, corr_all(1, :), 'r', 'DisplayName', 'SNR = -5 dB');
hold on;
plot(0:335, corr_all(2, :), 'b', 'DisplayName', 'SNR = 20 dB');
xlabel("Timing Offset (sample)")
ylabel("Correlation")
title('(4a) Correlation for Different SNR Values')
legend show;
grid on;
```

```
function BPSK_stream = SSS_BPSK(N_id_1,N_id_2)
    x_0 = zeros(127,1);
    x_1 = zeros(127,1);
    BPSK_stream = zeros(127,1);
    x_init = [1 0 0 0 0 0 0];
    x_0(1:7) = x_init;
    x_1(1:7) = x_init;

    for i = 1:120
        x_0(i+7) = mod(x_0(i+4)+x_0(i),2);
        x_1(i+7) = mod(x_1(i+1)+x_1(i),2);
    end
    for n = 0:126
        m_0 = mod(n + 15* floor(N_id_1/112) + 5*N_id_2,127);
```

```
        m_1 = mod(n + mod(N_id_1,112),127);
        BPSK_stream(n+1) = (1-2*x_0(m_0+1))*(1-2*x_1(m_1+1));
    end
end
```



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