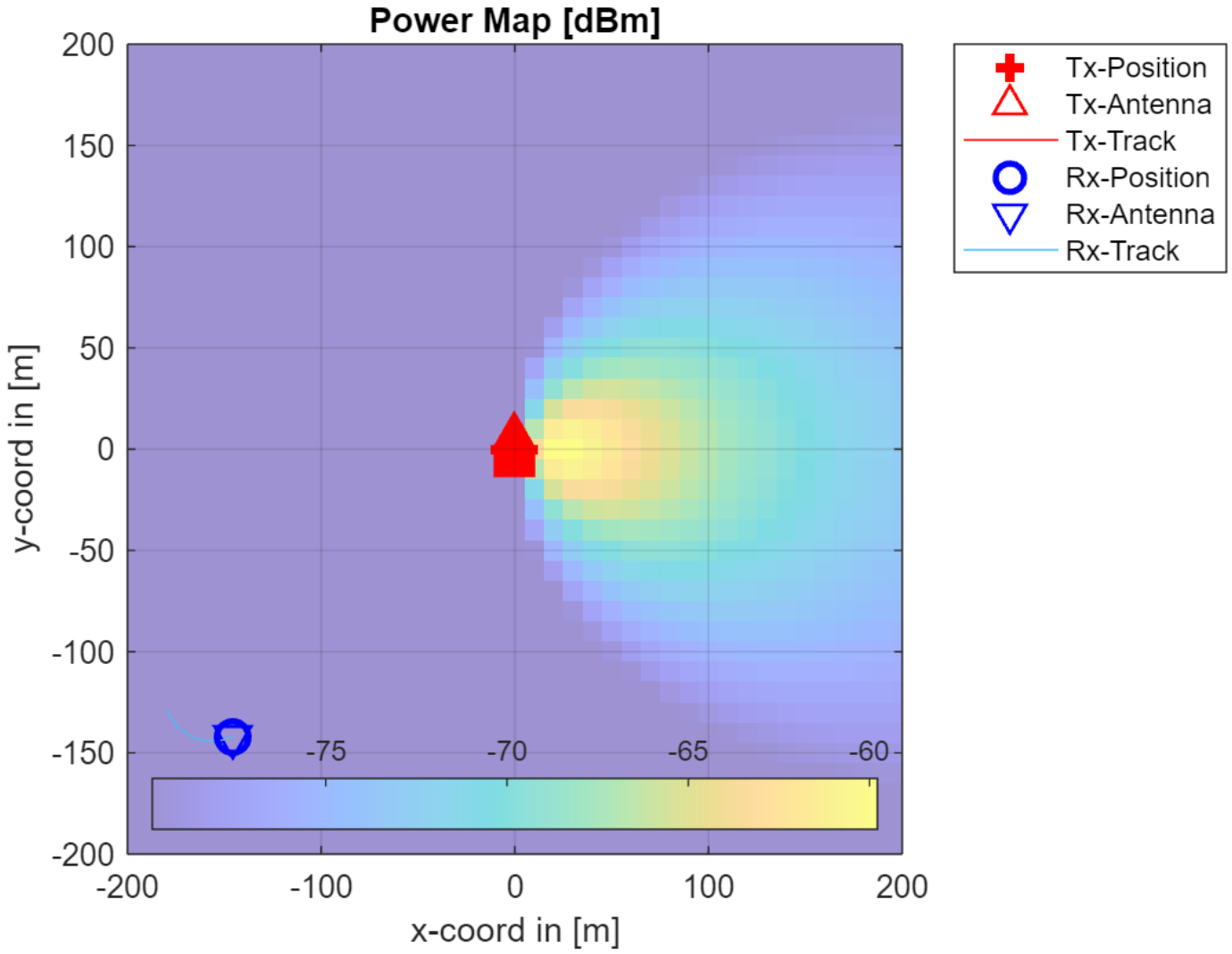
```
clear all; close all; clc;

% Определяем, нужно ли создавать набор данных
dataset_creation_flag = 0;

% Установка количества образцов данных в зависимости от режима отладки
if dataset_creation_flag == 1
    num_samples = 1000;
else
    num_samples = 10;
end

% Параметры трека мобильного терминала
track_length = 100; % [м]
track_speed = 0.9; % [м/с]
feedback_interval = 5; % [с]

% Параметры сценария моделирования
area_length = 400; % [м^2]
timeslots = 10;
feedback_times = (0:timeslots-1) * feedback_interval;
feedback_locs = feedback_times * track_speed;
feedback_profile = [feedback_times; feedback_locs];

% Параметры для MIMO
num_rx_antennas = 1; % количество антенн на приемнике (мобильном терминале)
num_tx_antennas = 32; % количество антенн на передатчике (базовой станции)
num_subcarriers = 128; % количество поднесущих
subcarrier_bandwidth = 2.0e7; % Ширина полосы пропускания поднесущих в Гц
(20 МГц)

% Создание набора данных
H_dataset = zeros(num_samples, timeslots, num_tx_antennas, num_subcarriers);

for i_sample = 1:num_samples

    % Инициализация сценария моделирования
    simulation_params = qd_simulation_parameters;
    simulation_params.center_frequency = 3.0e8; % несущая частота в Гц (300
МГц)
    simulation_params.show_progress_bars = 0; % Отключение визуализации
выполнения
    num_users = 1;

    % Создание трека для мобильного терминала

    % Выбор типа трека (линейный или кривой)
    track_type = randi([1, 2]); % случайный выбор между 1 и 2
%     track_type = 1;
```

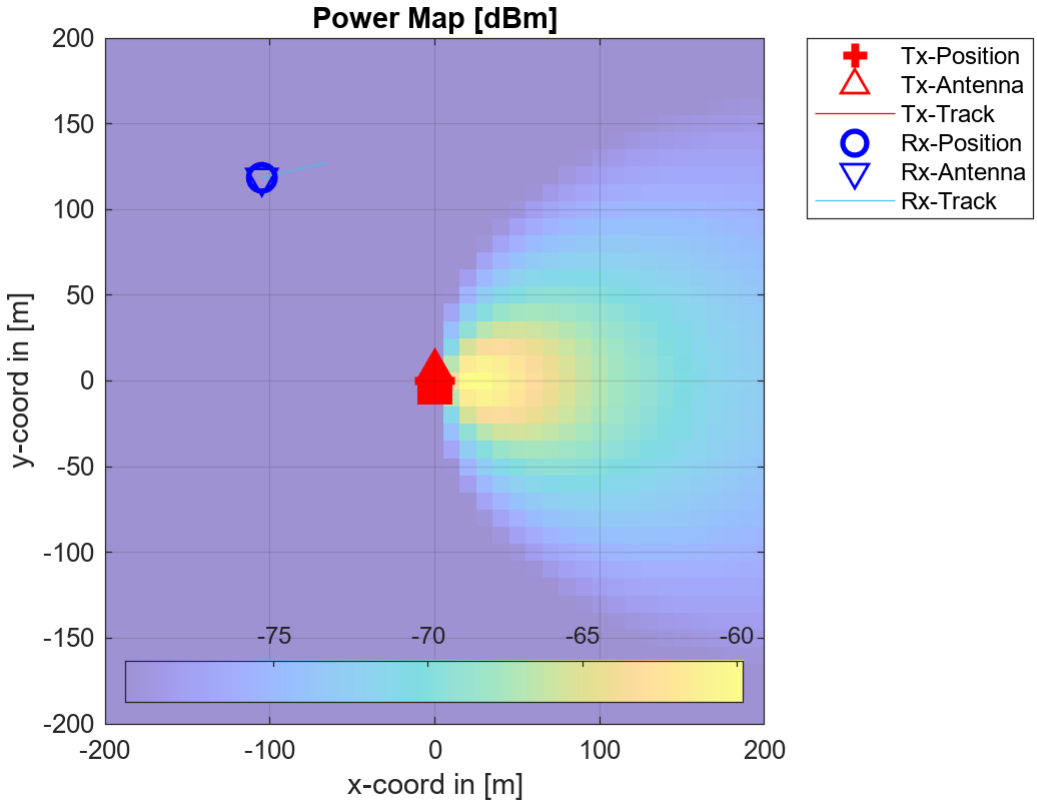
```
    if track_type == 1
        % Линейный трек
        x_init = area_length * rand(1) - area_length/2; % случайная
инициализация координаты x
        y_init = area_length * rand(1) - area_length/2; % случайная
инициализация координаты y
        theta = pi * (2 * rand(1) - 1); % случайный угол направления
        track = qd_track('linear', track_length, theta); % создание
линейного трека
    else
        % Кривой трек
%         radius = 50 + rand() * track_length; % случайный радиус
        x_init = area_length * rand(1) - area_length/2; % случайная
координата x центра круга
        y_init = area_length * rand(1) - area_length/2; % случайная
координата y центра круга
        theta = pi * (2 * rand(1) - 1); % случайный угол дуги
        track = qd_track('circular', (track_length / 2)  * pi, x_init,
y_init, theta); % создание кривого трека
    end

    track.initial_position = [x_init; y_init; 1.5]; % начальная позиция
    track.set_speed(track_speed);
    track.interpolate('time', feedback_interval, feedback_profile);
    track.segment_index = 1;
    track.scenario = {'BERLIN_UMa_LOS'}; % выбор сценария {'BERLIN_UMa_LOS',
'3GPP_3D_UMa_LOS', 'BERLIN_UMa_NLOS','3GPP_3D_UMa_NLOS'}
    track.name = 'MT'; % имя трека

    layout = qd_layout(simulation_params); % Создание объекта сценария
моделирования

    layout.rx_track = track; % Назначение трека для мобильного терминала
    layout.tx_position = [0, 0, 20]'; % Положение базовой станции

    % Настройка антенн
    layout.rx_array = qd_arrayant('omni'); % Мобильный терминал использует
всенаправленную антенну

    layout.tx_array = qd_arrayant.generate('3gpp-3d', num_rx_antennas,
num_tx_antennas, simulation_params.center_frequency(1), 1); % БС использует
антенную решётку из 32 элементов

    % Генерация коэффициентов каналов
    channels = layout.get_channels;

    % Оценка частотной характеристики каналов
    H_freq_response = zeros(timeslots, num_tx_antennas, num_subcarriers);
    for t_i = 1:timeslots
```

```
        H_freq_response(t_i, :, :) = channels.fr(subcarrier_bandwidth,
num_subcarriers, t_i, 1);
    end

    H_dataset(i_sample, :, :, :) = H_freq_response(:, :, :);

    if dataset_creation_flag == 0
        % Вывод графика карты мощности
        figure; clf; hold on;
        [map, x_coords, y_coords] = layout.power_map(track.scenario,
'quick');
        % Визуализация карты мощности
        power = 10*log10(sum(map{1}, 4));
        imagesc(x_coords, y_coords, power);
        clim(max(power(:)) + [-20 0]);
        colmap = colormap;
        colormap ( colmap *0.5 + 0.5 ); % Настройка цвета (осветление)
        set(gca,'layer','top') % Показать сетку поверх карты
        colorbar('south')
        xlabel('X (m)');
        ylabel('Y (m)');
        title('Power Map [dBm]');
        layout.visualize([],[],0,0);
        axis([-200 200 -200 200])
        hold off;
    end
end
```

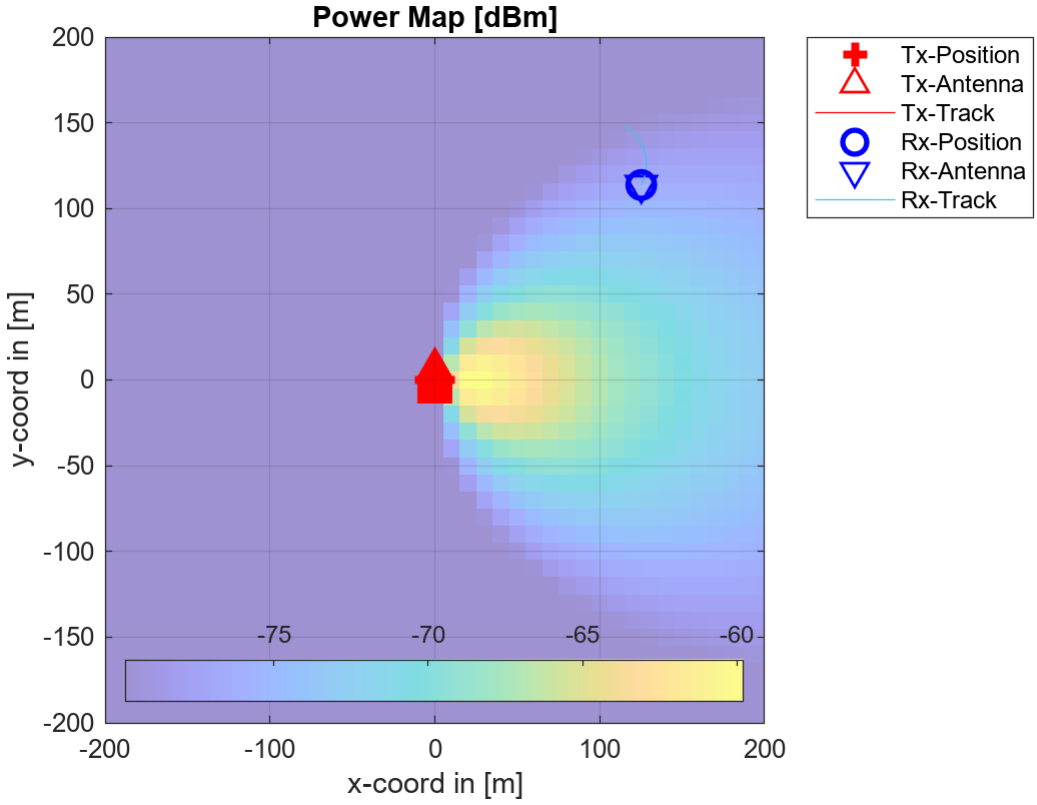
```
Warning: Sample density in tracks does not fulfill the sampling theoreme.
```



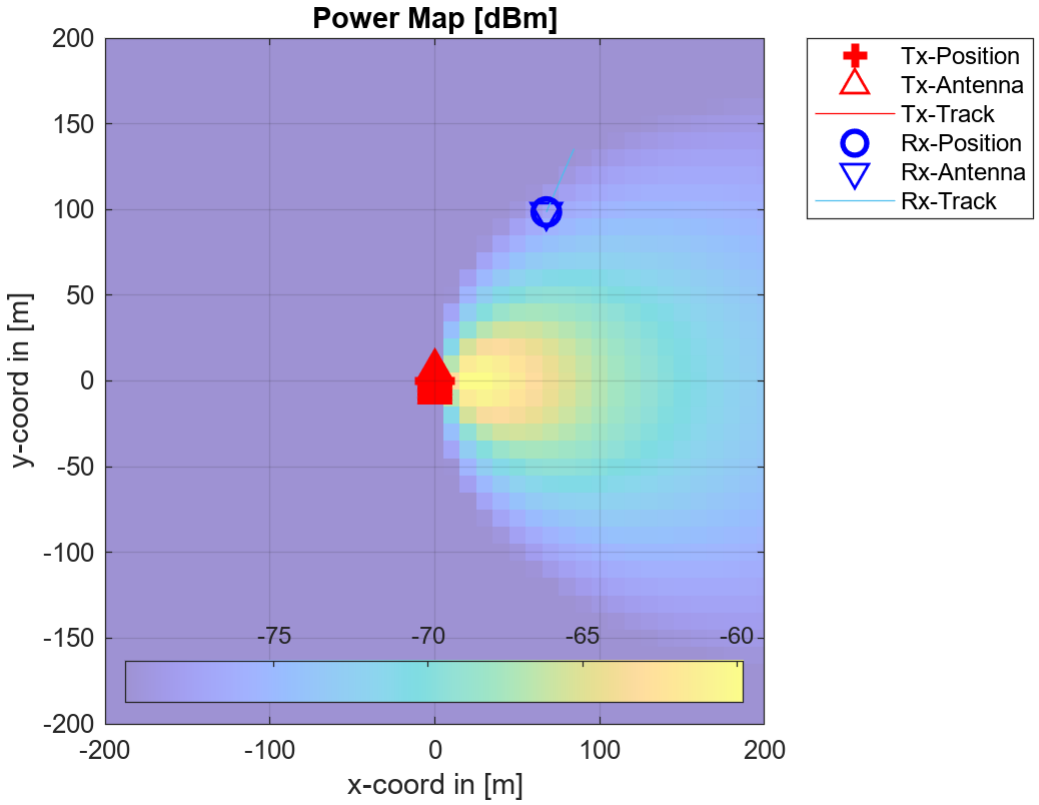

```
Warning: Sample density in tracks does not fulfill the sampling theoreme.
```



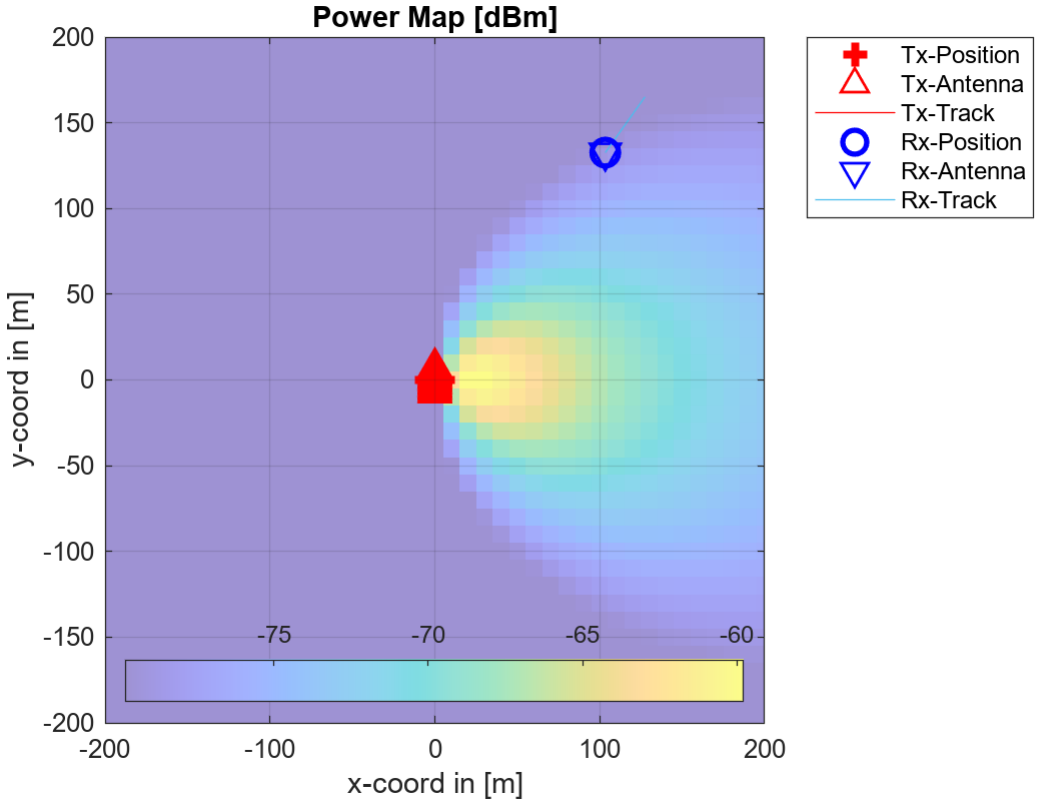

```
Warning: Sample density in tracks does not fulfill the sampling theoreme.
```



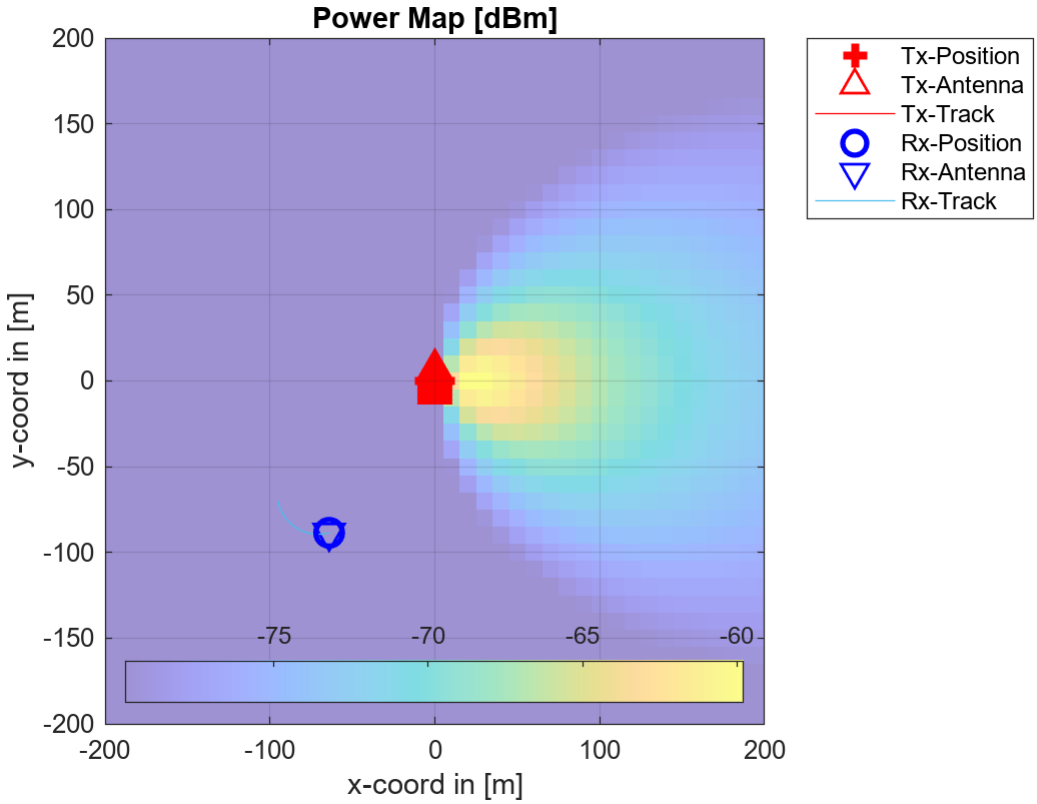

```
Warning: Sample density in tracks does not fulfill the sampling theoreme.
```



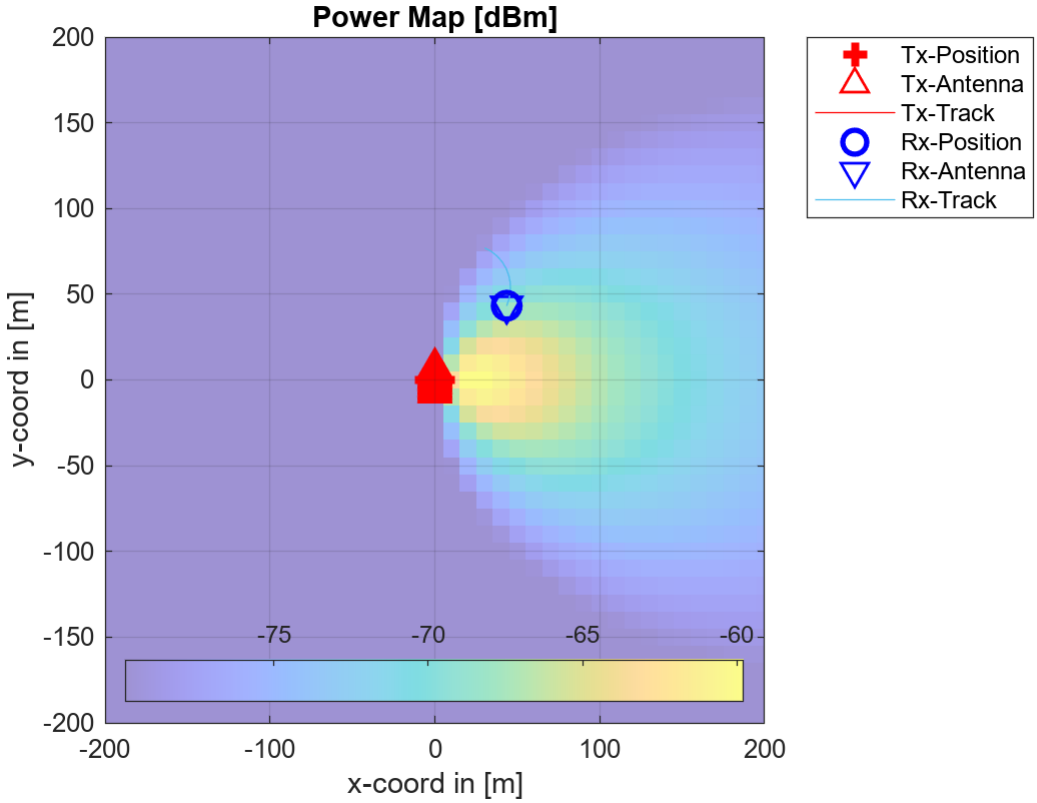

```
Warning: Sample density in tracks does not fulfill the sampling theoreme.
```



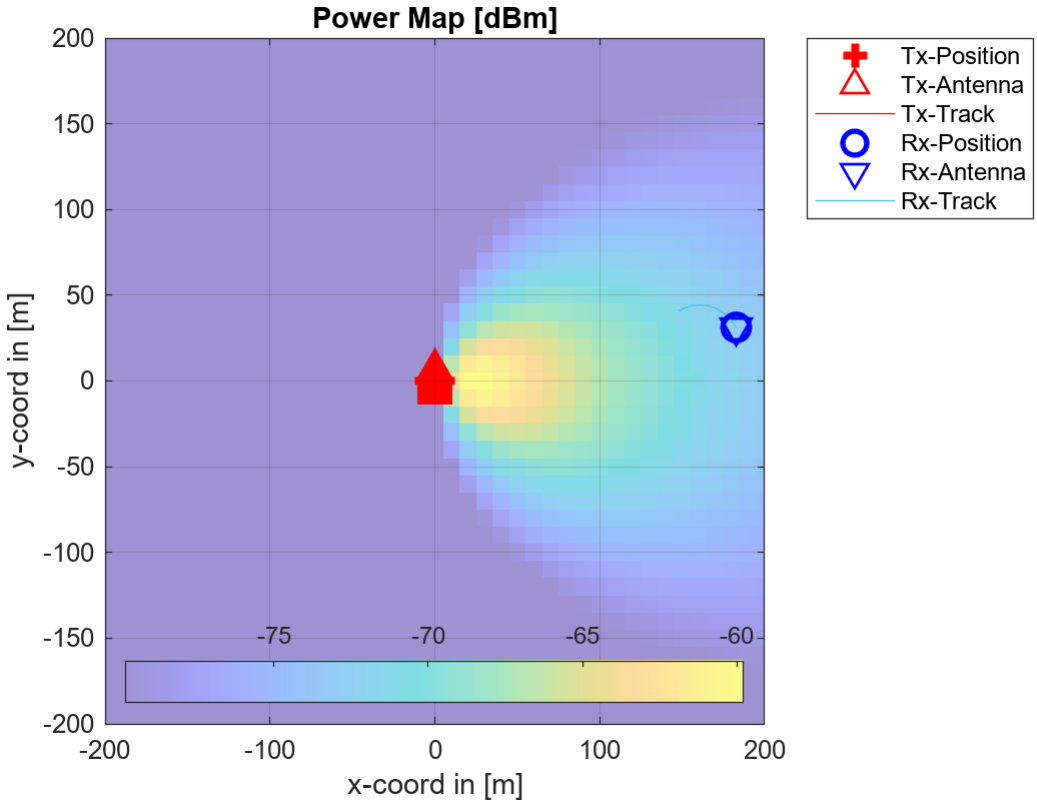

```
Warning: Sample density in tracks does not fulfill the sampling theoreme.
```



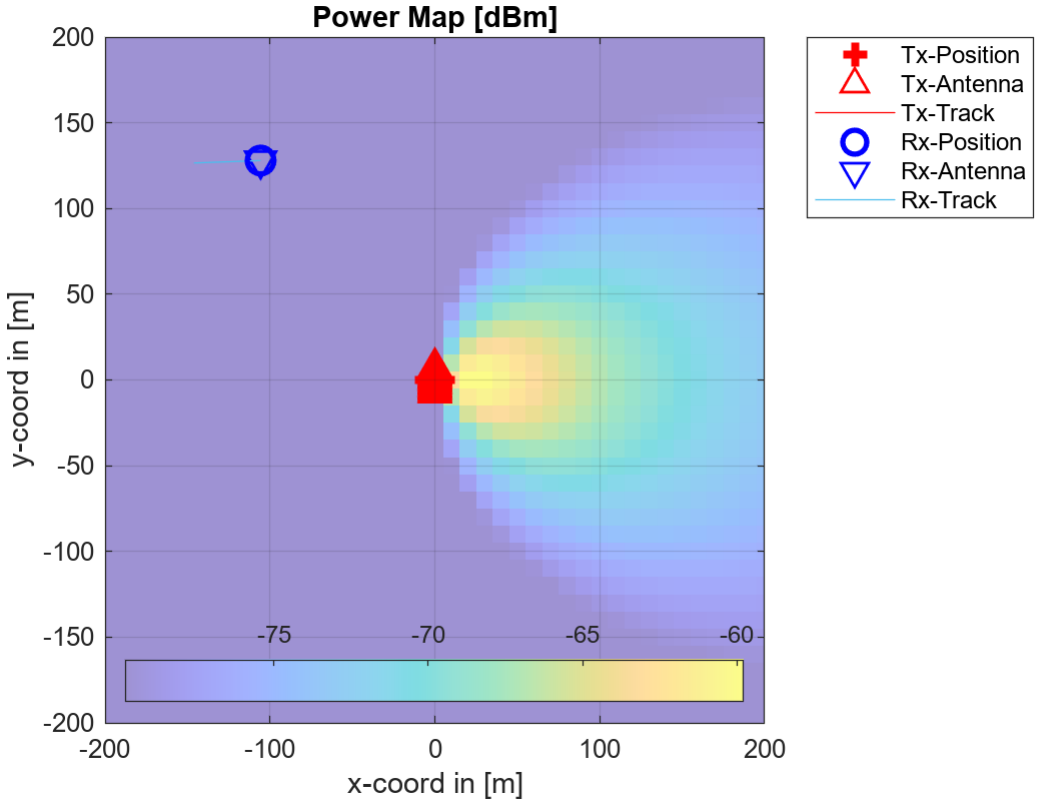

```
Warning: Sample density in tracks does not fulfill the sampling theoreme.
```



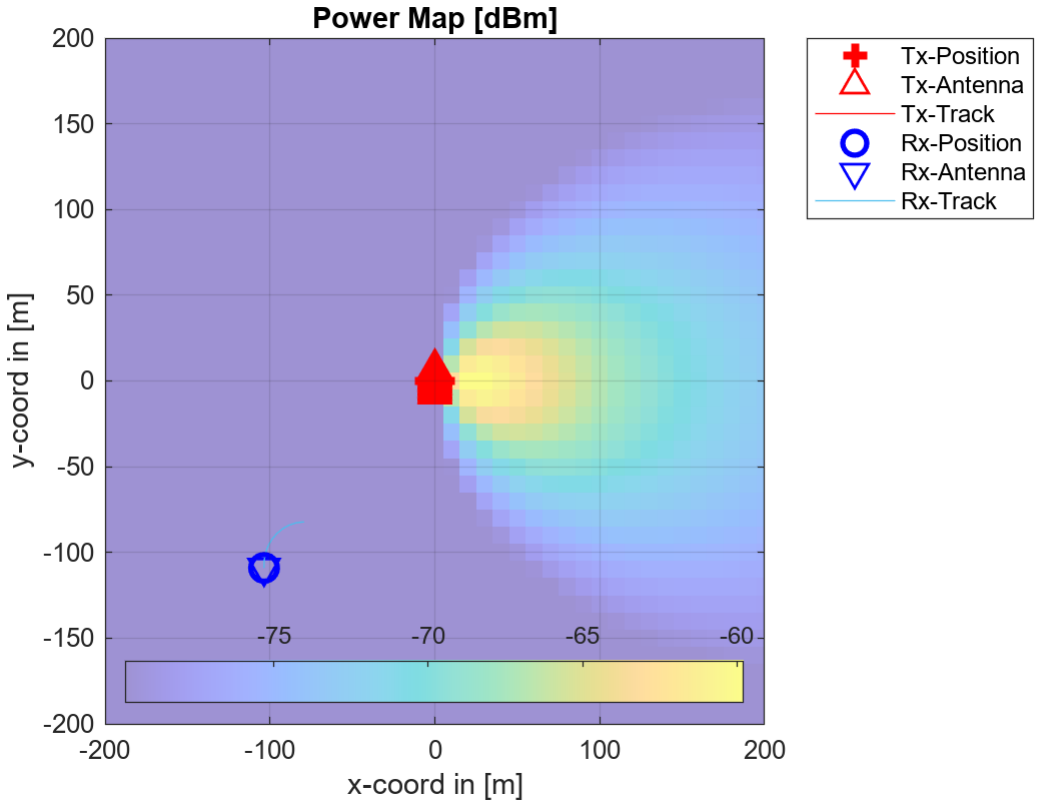

```
Warning: Sample density in tracks does not fulfill the sampling theoreme.
```



Warning: Sample density in tracks does not fulfill the sampling theoreme.



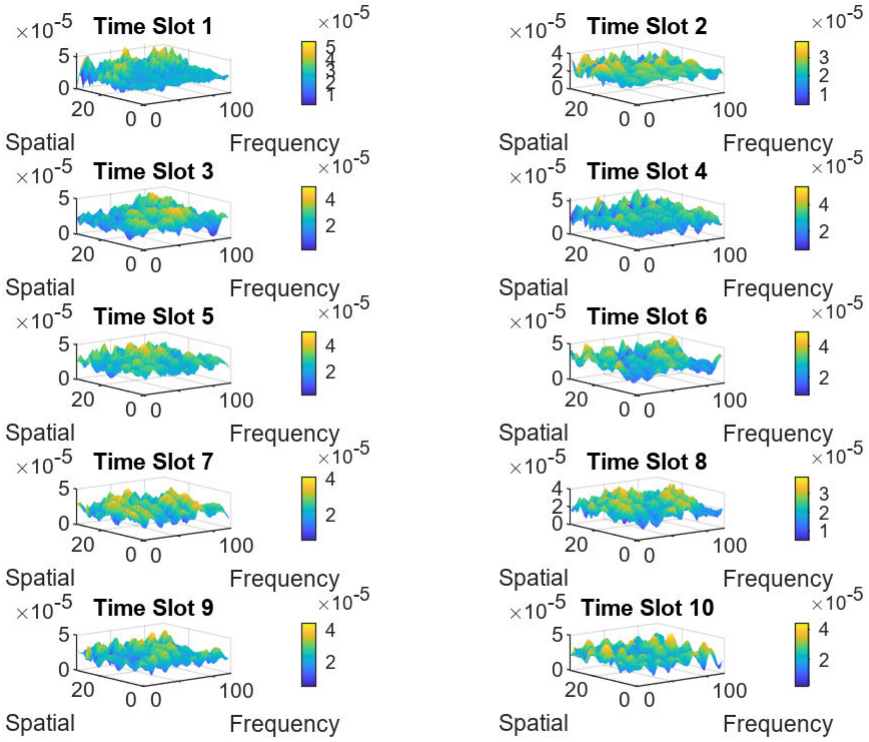
Warning: Sample density in tracks does not fulfill the sampling theoreme.

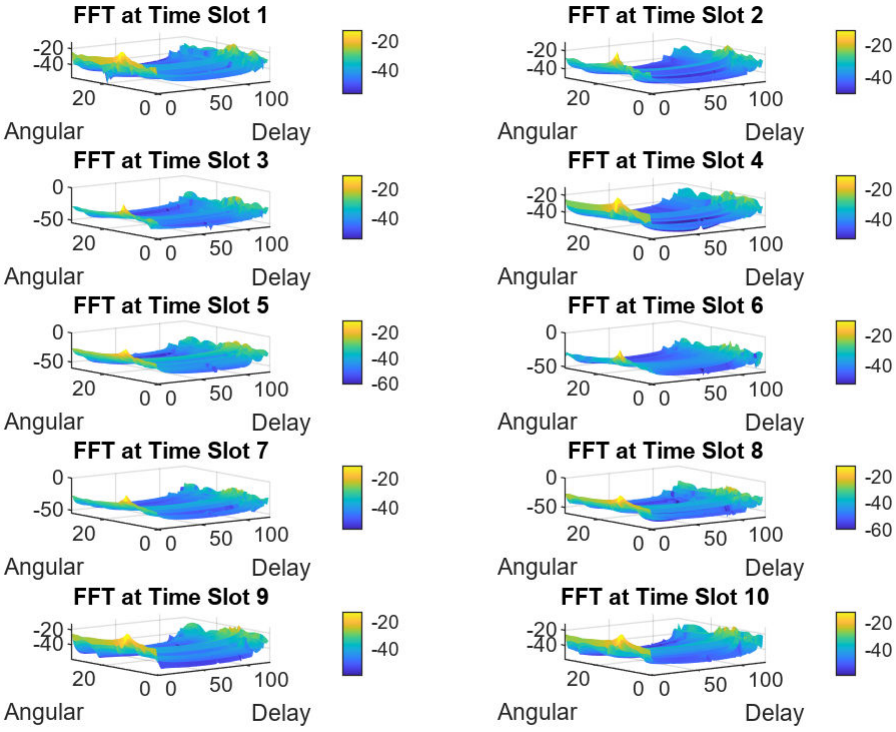



```
if dataset_creation_flag == 1
    % Сохранение набора данных
    filename = sprintf('H_quadriga_%d_%s.mat', num_samples, track.scenario);
    save(filename, 'H_dataset');
end


if dataset_creation_flag == 0
    % Вывод графиков для матриц H_dataset
    for i_sample = 1:num_samples
        sprintf('Sample %d', i_sample)
        H_dataset_sq = squeeze(H_dataset(i_sample, :, :, :));
        figure;
        for t_i = 1:timeslots
            subplot(timeslots/2, 2, t_i);
            surf(abs(squeeze(H_dataset_sq(t_i, :, :))), 'EdgeColor', 'none');
            colorbar;
            xlabel('Frequency');
            ylabel('Spatial');
            title(sprintf('Time Slot %d', t_i));
        end

        % FFT график
        figure;
        for t_i = 1:timeslots
```

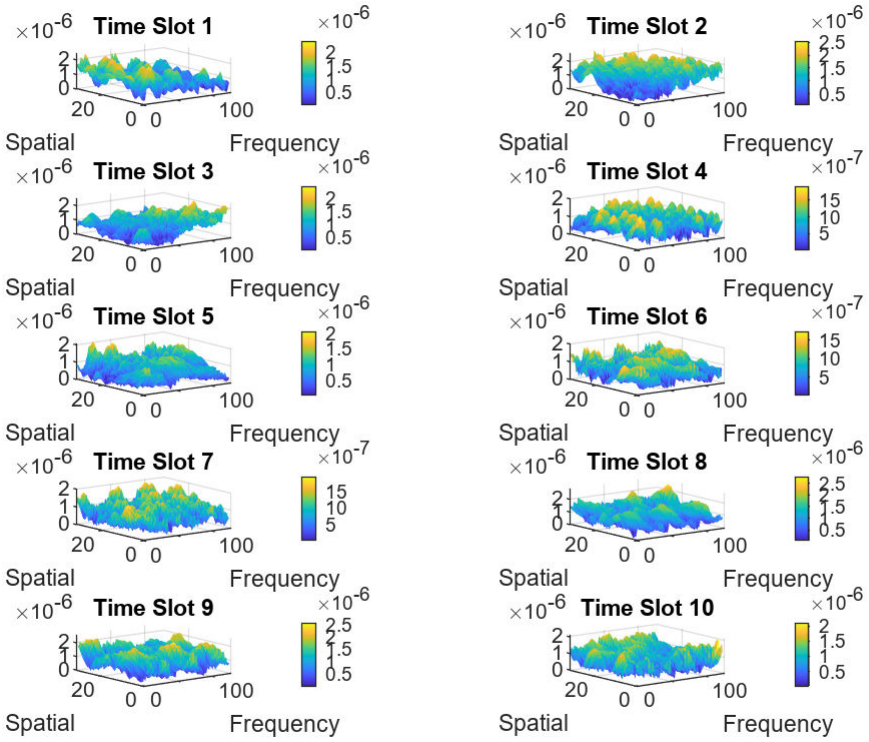
```
            subplot(timeslots/2, 2, t_i);
            fft2_H_dataset_sq = fft2(squeeze(H_dataset_sq(t_i, :, :)));
            surf(10*log10(abs(fft2_H_dataset_sq(:,:))), 'EdgeColor',
'none');
            colorbar;
            xlabel('Delay');
            ylabel('Angular');
            title(sprintf('FFT at Time Slot %d', t_i));
        end
    end
end
```

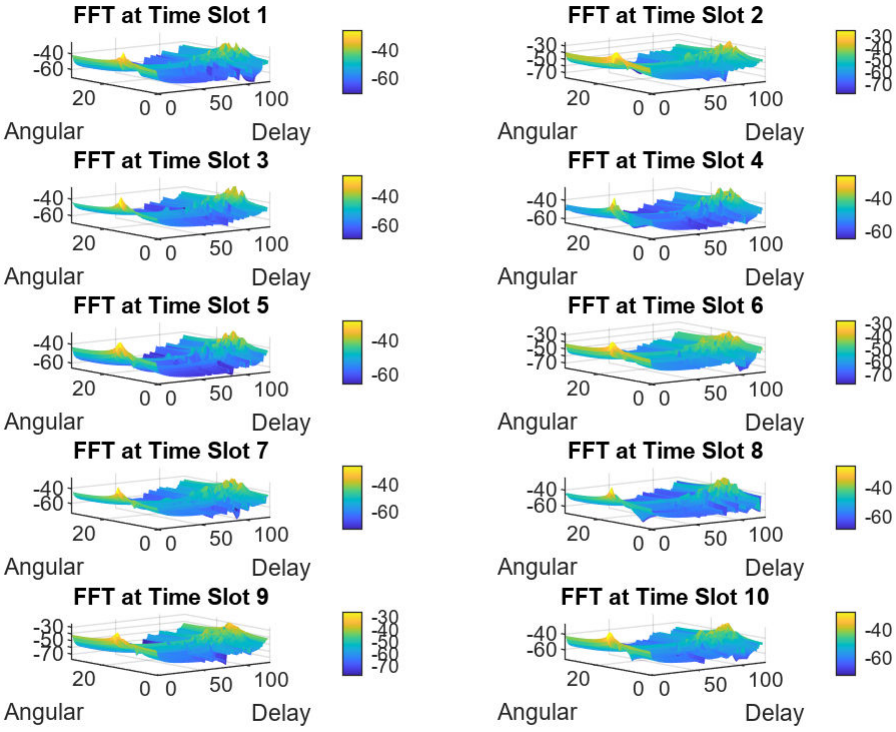
```
ans =
'Sample 1'
```



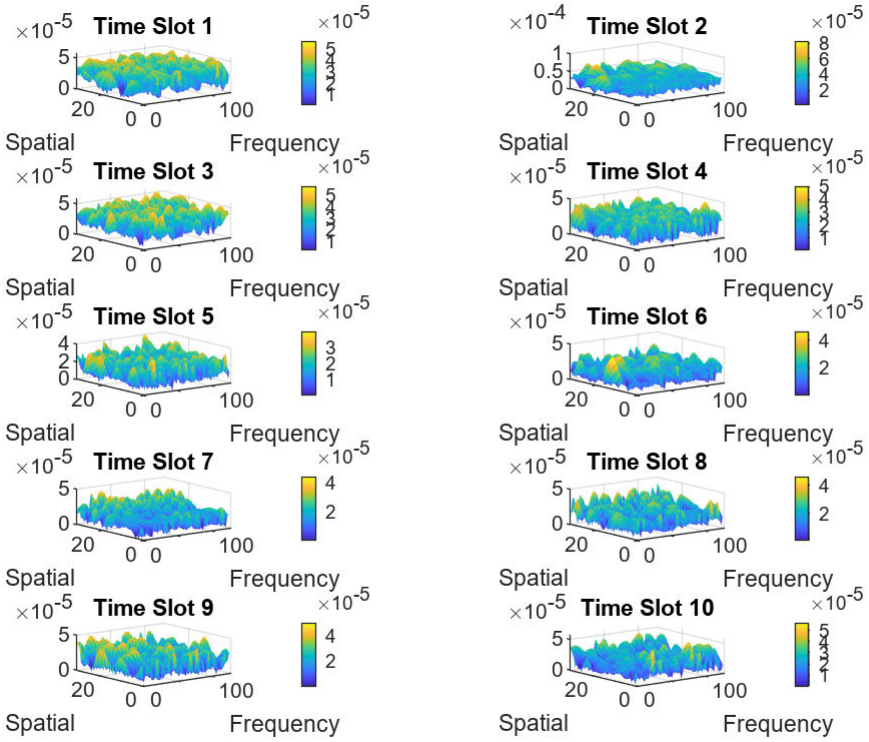

FFT at Time Slot 1
FFT at Time Slot 2
FFT at Time Slot 3
FFT at Time Slot 4
FFT at Time Slot 5
FFT at Time Slot 6
FFT at Time Slot 7
FFT at Time Slot 8
FFT at Time Slot 9
FFT at Time Slot 10
Angular
Delay

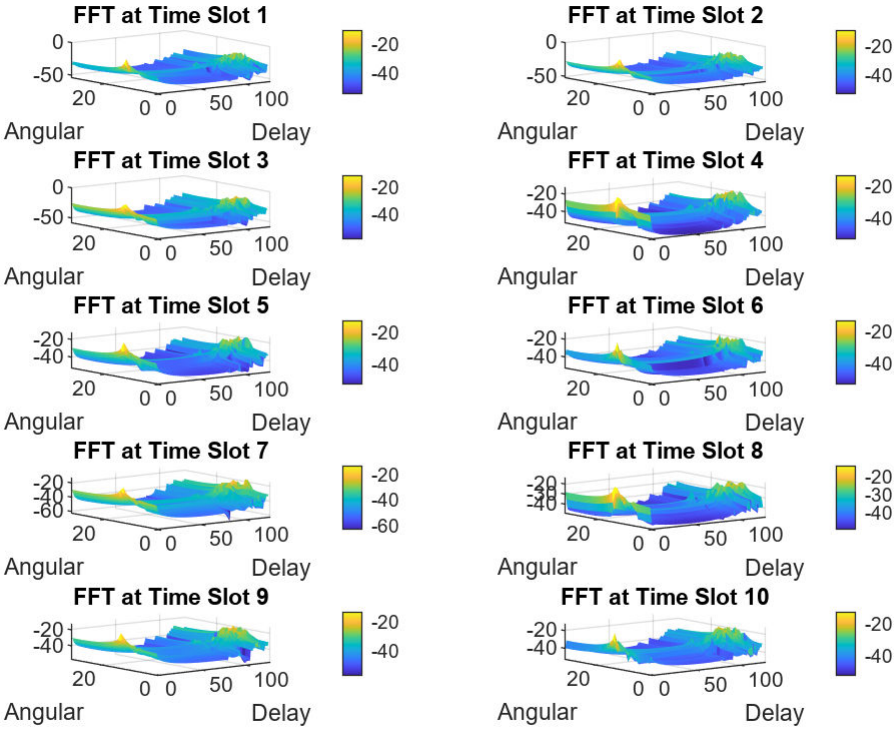
```
ans =
'Sample 2'
```


Time Slot 1
Time Slot 2
Time Slot 3
Time Slot 4
Time Slot 5
Time Slot 6
Time Slot 7
Time Slot 8
Time Slot 9
Time Slot 10
Spatial
Frequency

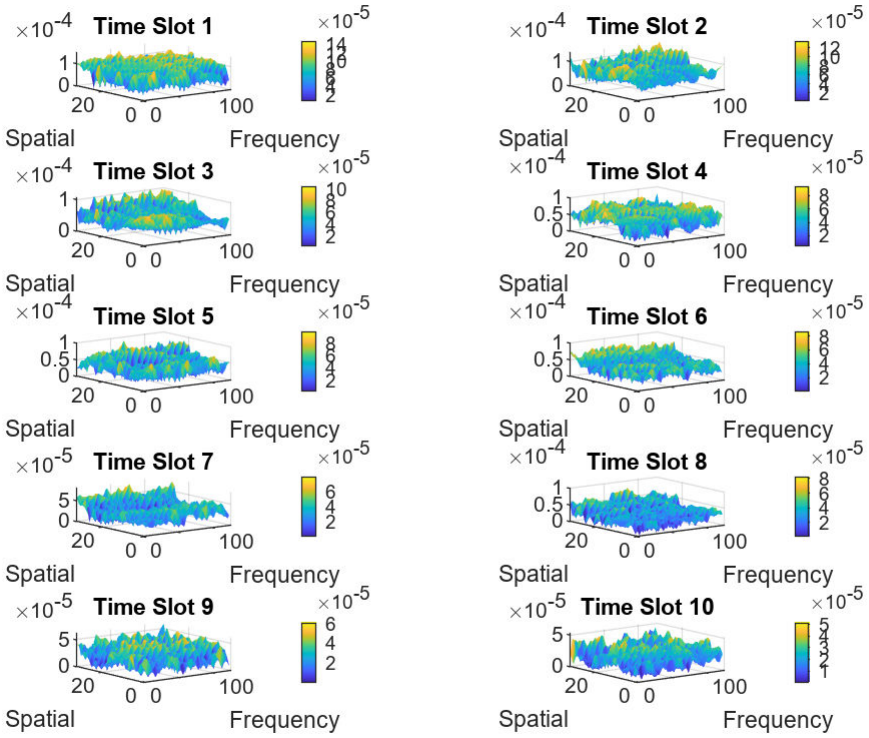

FFT at Time Slot 1
FFT at Time Slot 2
FFT at Time Slot 3
FFT at Time Slot 4
FFT at Time Slot 5
FFT at Time Slot 6
FFT at Time Slot 7
FFT at Time Slot 8
FFT at Time Slot 9
FFT at Time Slot 10
Angular
Delay

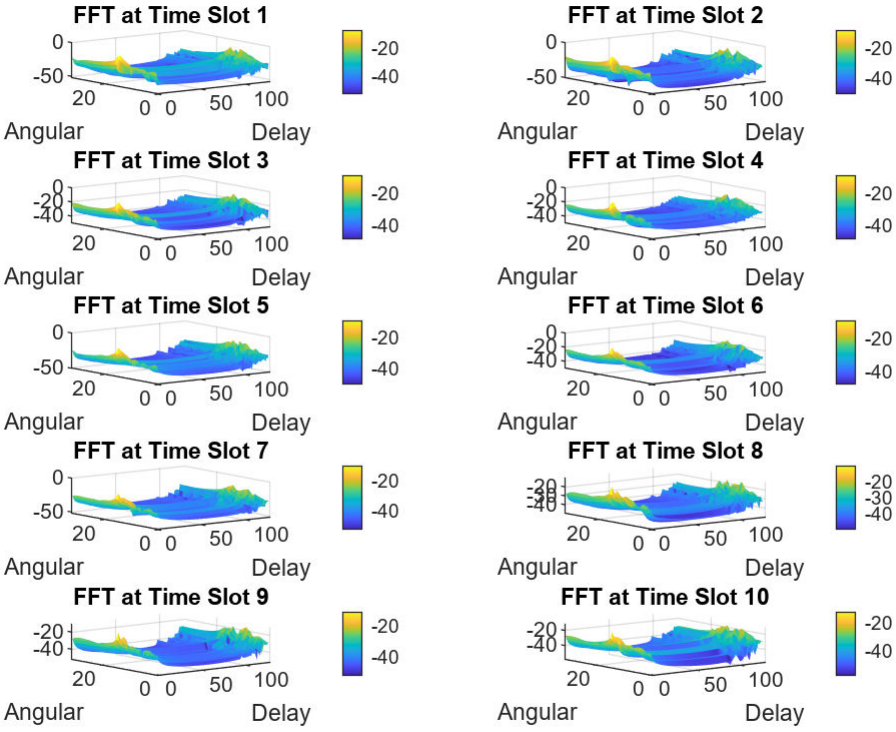
```
ans =
'Sample 3'
```


Time Slot 1
Time Slot 2
Time Slot 3
Time Slot 4
Time Slot 5
Time Slot 6
Time Slot 7
Time Slot 8
Time Slot 9
Time Slot 10
Spatial
Frequency

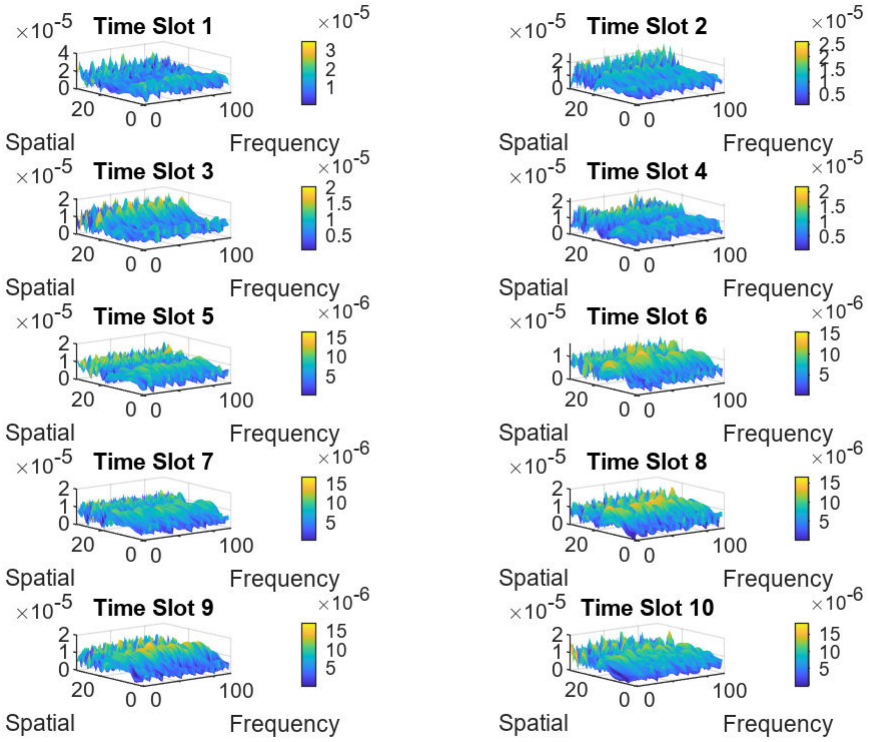

FFT at Time Slot 1
FFT at Time Slot 2
FFT at Time Slot 3
FFT at Time Slot 4
FFT at Time Slot 5
FFT at Time Slot 6
FFT at Time Slot 7
FFT at Time Slot 8
FFT at Time Slot 9
FFT at Time Slot 10
Angular
Delay

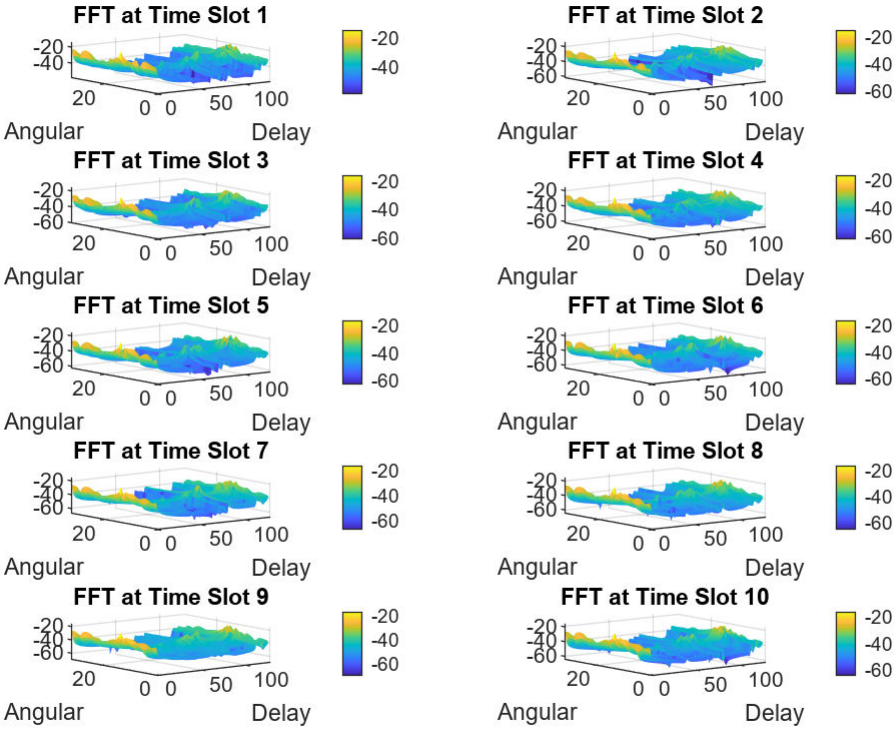
```
ans =
'Sample 4'
```


Time Slot 1
Time Slot 2
Time Slot 3
Time Slot 4
Time Slot 5
Time Slot 6
Time Slot 7
Time Slot 8
Time Slot 9
Time Slot 10
Spatial
Frequency

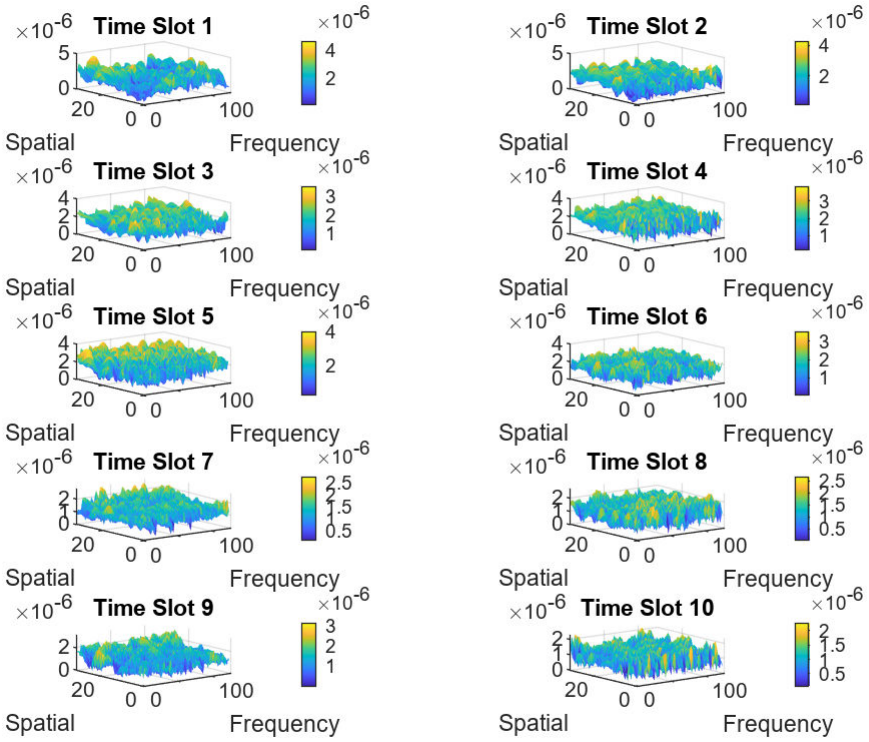

FFT at Time Slot 1
FFT at Time Slot 2
FFT at Time Slot 3
FFT at Time Slot 4
FFT at Time Slot 5
FFT at Time Slot 6
FFT at Time Slot 7
FFT at Time Slot 8
FFT at Time Slot 9
FFT at Time Slot 10
Angular
Delay

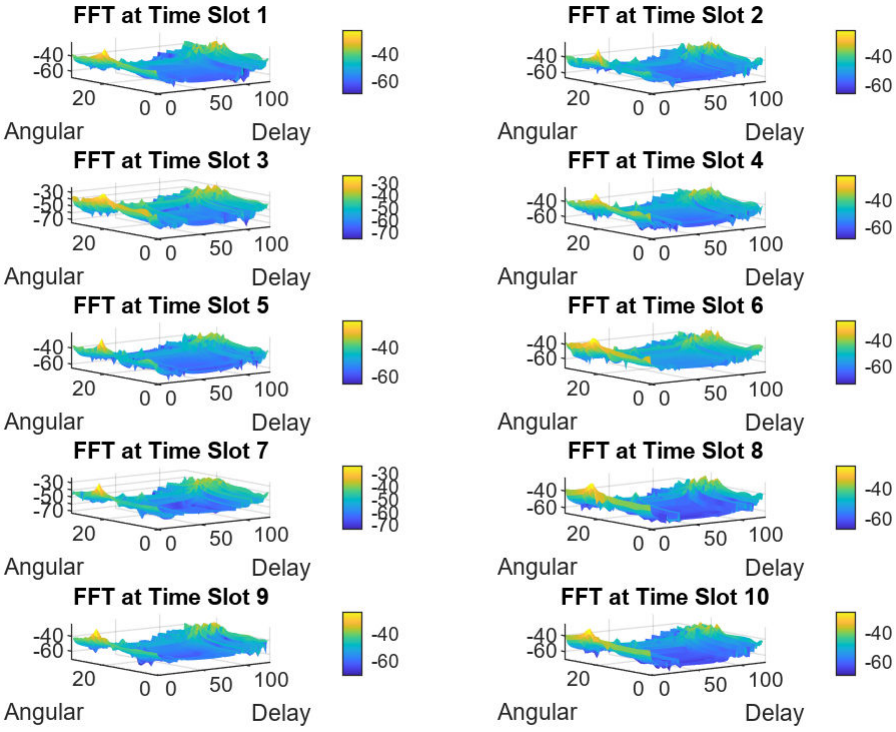
```
ans =
'Sample 5'
```


Time Slot 1
Time Slot 2
Time Slot 3
Time Slot 4
Time Slot 5
Time Slot 6
Time Slot 7
Time Slot 8
Time Slot 9
Time Slot 10
Spatial
Frequency

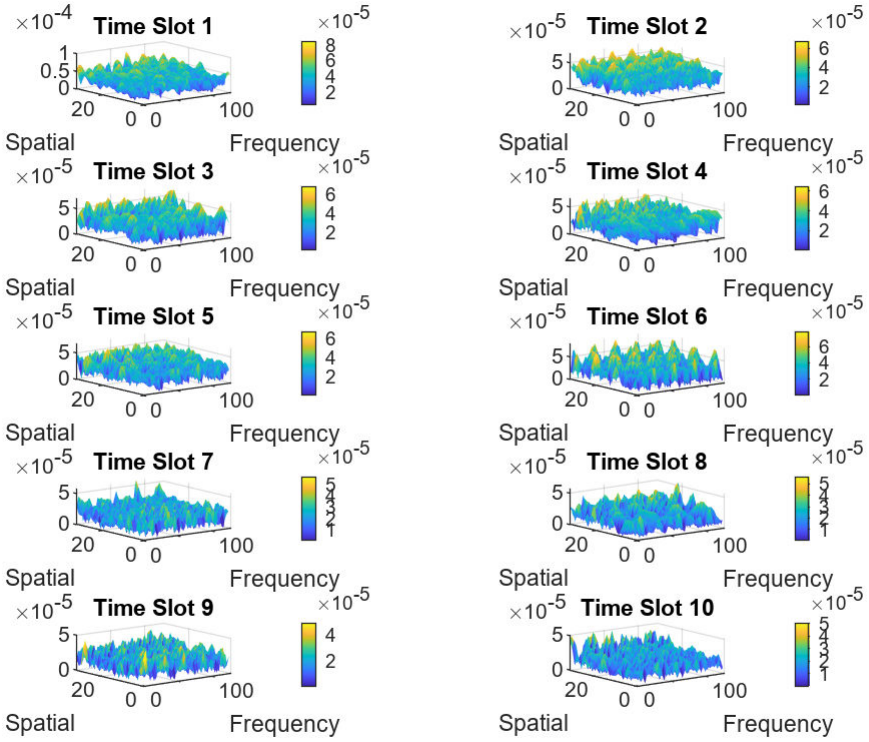

FFT at Time Slot 1
FFT at Time Slot 2
FFT at Time Slot 3
FFT at Time Slot 4
FFT at Time Slot 5
FFT at Time Slot 6
FFT at Time Slot 7
FFT at Time Slot 8
FFT at Time Slot 9
FFT at Time Slot 10
Angular
Delay

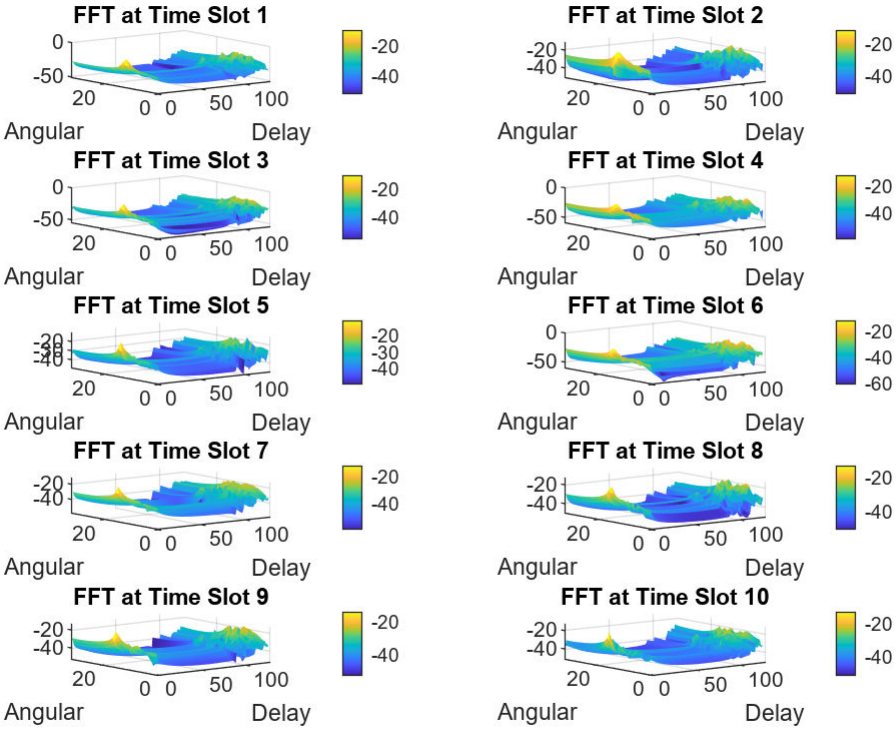
```
ans =
'Sample 6'
```


Time Slot 1
Time Slot 2
Time Slot 3
Time Slot 4
Time Slot 5
Time Slot 6
Time Slot 7
Time Slot 8
Time Slot 9
Time Slot 10
Spatial
Frequency

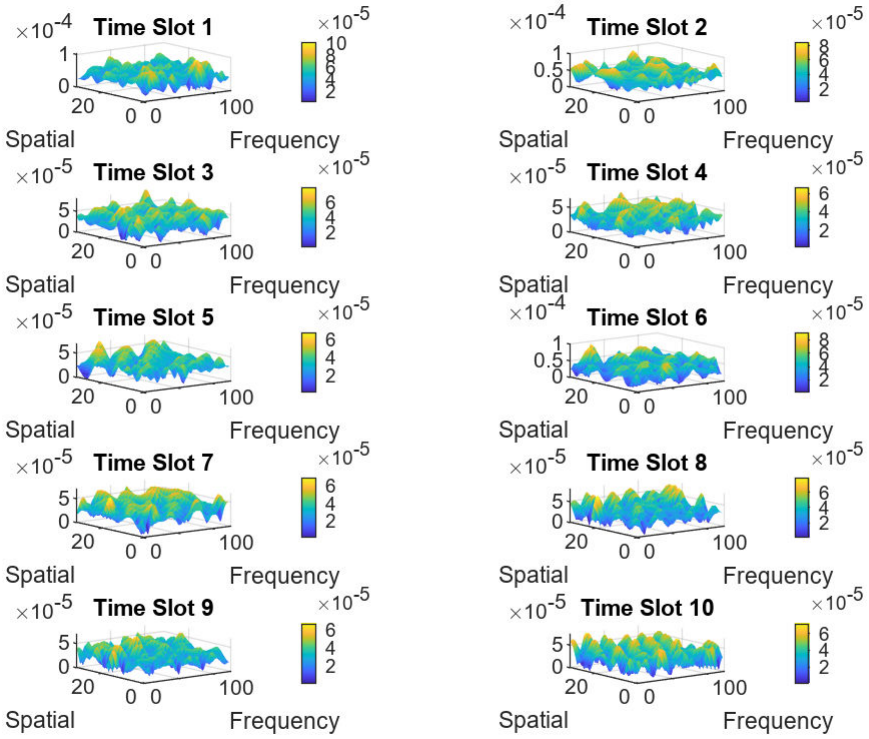

FFT at Time Slot 1
FFT at Time Slot 2
FFT at Time Slot 3
FFT at Time Slot 4
FFT at Time Slot 5
FFT at Time Slot 6
FFT at Time Slot 7
FFT at Time Slot 8
FFT at Time Slot 9
FFT at Time Slot 10
Angular
Delay

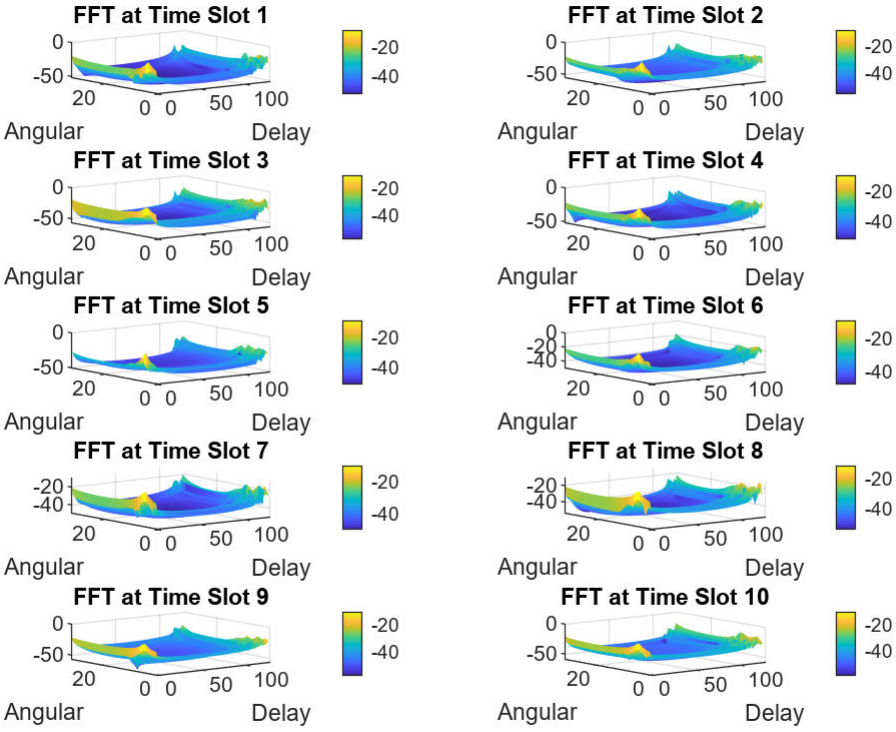
```
ans =
'Sample 7'
```


Time Slot 1
Time Slot 2
Time Slot 3
Time Slot 4
Time Slot 5
Time Slot 6
Time Slot 7
Time Slot 8
Time Slot 9
Time Slot 10
Spatial
Frequency

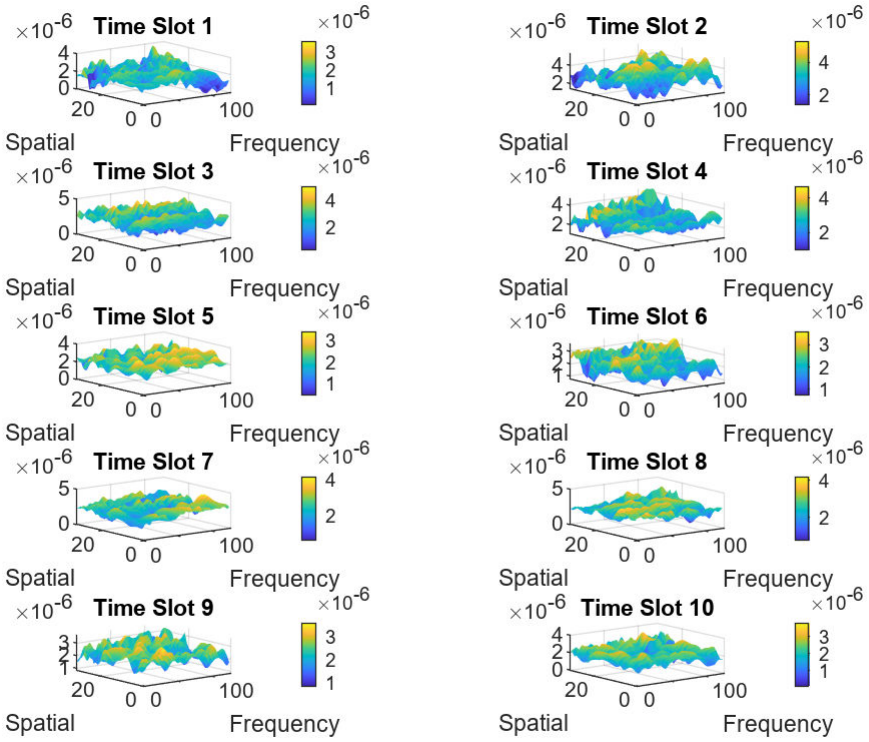

FFT at Time Slot 1
FFT at Time Slot 2
FFT at Time Slot 3
FFT at Time Slot 4
FFT at Time Slot 5
FFT at Time Slot 6
FFT at Time Slot 7
FFT at Time Slot 8
FFT at Time Slot 9
FFT at Time Slot 10
Angular
Delay

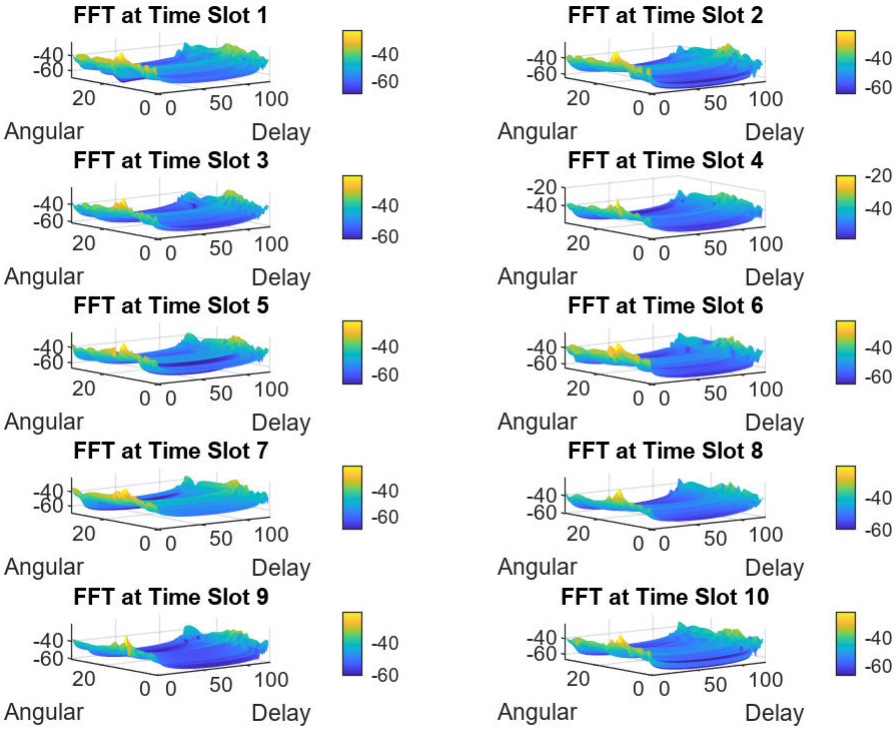
```
ans =
'Sample 8'
```


Time Slot 1
Time Slot 2
Time Slot 3
Time Slot 4
Time Slot 5
Time Slot 6
Time Slot 7
Time Slot 8
Time Slot 9
Time Slot 10
Spatial
Frequency

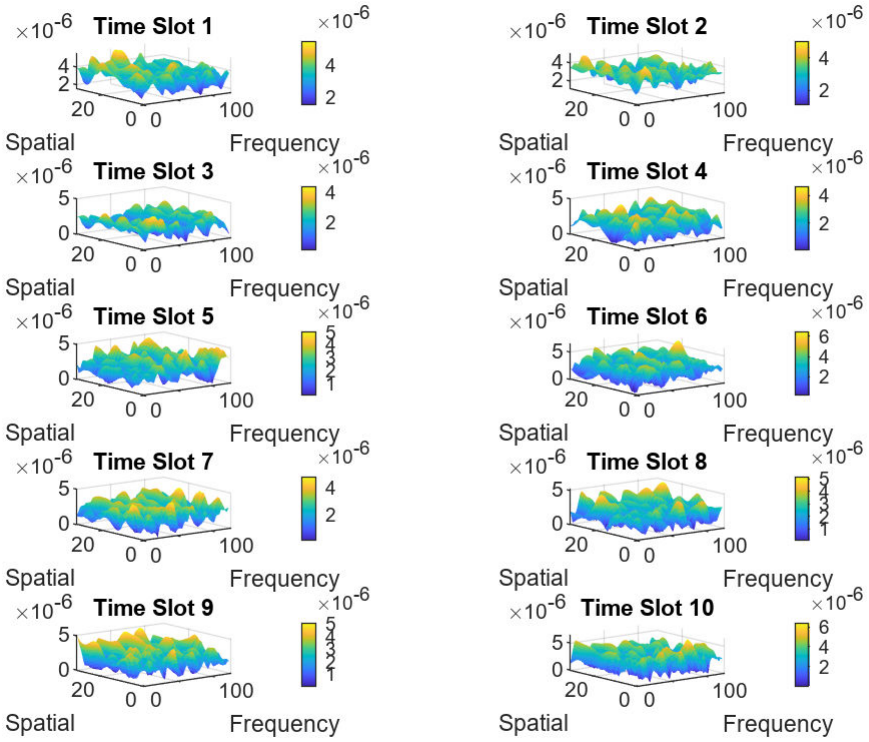

FFT at Time Slot 1
FFT at Time Slot 2
FFT at Time Slot 3
FFT at Time Slot 4
FFT at Time Slot 5
FFT at Time Slot 6
FFT at Time Slot 7
FFT at Time Slot 8
FFT at Time Slot 9
FFT at Time Slot 10
Angular
Delay

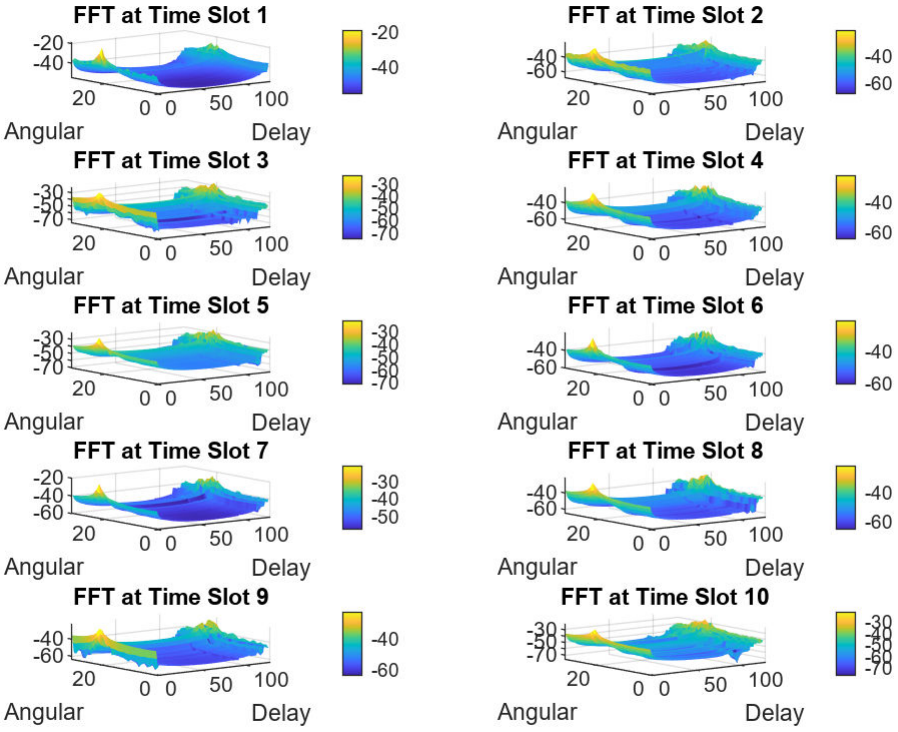
```
ans =
'Sample 9'
```


Time Slot 1
Time Slot 2
Time Slot 3
Time Slot 4
Time Slot 5
Time Slot 6
Time Slot 7
Time Slot 8
Time Slot 9
Time Slot 10
Spatial
Frequency




```
ans =
'Sample 10'
```






```
% H_method = squeeze(H_dataset(1,1,:,:));
%
% fft2_H_method = fft2(H_method);
%
% truncationFactor = 32;
%
% norms_sum = sum(abs(fft2_H_method(:,:)),1);
% [sorted_norms,sorted_index] = sort(norms_sum, "descend");
% figure; clf; hold on;
% semilogy(sorted_norms);
% select_index = sort(sorted_index(1:truncationFactor));
% % Создание новой матрицы с пороговым значением и её усечение
% H_truncate_temp = fft2_H_method(:,select_index);
% H_truncate = ifft2(H_truncate_temp);
% figure; clf; hold on;
% surf(10*log10(abs(squeeze(H_truncate_temp))), 'EdgeColor', 'none');
colorbar;
%
% % Создание вектра позиций сохранёнnных элементов
% zero_vector = zeros(1, num_subcarriers);
% zero_vector(select_index) = 1;
%
%
% H_recover_temp = fft2(H_truncate);
```

```
% H_recover_zero = zeros(num_tx_antennas,num_subcarriers);
%
% fill_rows = zero_vector == 1;
% H_recover_zero(:, fill_rows) = H_recover_temp;
% figure; clf; hold on;
% surf(10*log10(abs(squeeze(H_recover_zero))), 'EdgeColor', 'none');
colorbar;
% H_recover(:, :) = ifft2(H_recover_zero);
```