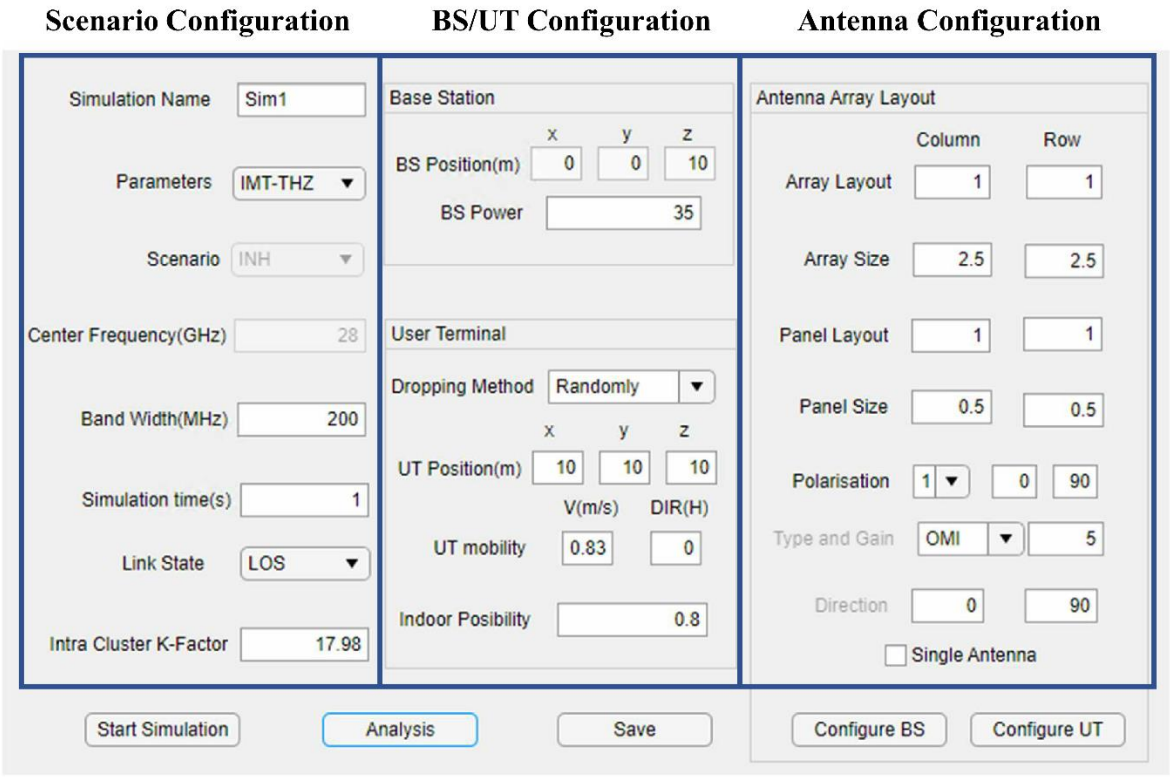
BUPTCMG-IMT2030_THz User Manuel

Graphical User Interface (GUI)：



Scenario Configuration

Simulation Name： The user-defined name of this simulation. After completing the simulation, click the Save button to store the configuration and results in a folder named by it.

Parameters： There are three parameter options: ITU-A, ITU-B, and THz. ITU-A and ITU-B have different parameters below 6 GHz and the same parameters above 6 GHz. THz parameters are used for simulations at 100 GHz and 132 GHz

Scenario： Choose a scenario from UMA, UMI, INH, and RMA. THz simulations can only be performed in the INH scenario at 100 GHz and the UMI scenario at 132 GHz. Other scenarios can be configured as desired.

Center Frequency： Input the center frequency in GHz. For THz simulations, the value will be fixed and cannot be modified.

Band Width： Input the bandwidth in MHz

Simulation Time： Specify the duration of the sampling in seconds.

Link State： Set the state of the link to either LOS/NLOS or O2I-LOS/NLOS. Alternatively, you

can choose Random for random allocation.

Intra Cluster K-Factor： This parameter is used for sparse channel simulations. A higher value will concentrate the power of multipaths in the channel. While setting to 0, the simulation of sparsity is disabled.

BS/UT Configuration

BS Position： The position of the base station, fixed at (0,0) and cannot be modified. The height may automatically vary depending on the scenario.

BS Power： The transmission power of the signal.

Dropping Method： The method of user placement. Selecting "Randomly" will drop users uniformly around the base station, while selecting "Manually" will allow you to set the positions of users using UT Position.

UT Position： This parameter is only effective when the Dropping Method is set to "Manually."

UT mobility： The speed and direction of user movement. The direction is considered only in the horizontal plane (x-y plane), where 0 points towards the positive x-axis, and positive angles indicate rotation towards the positive y-axis.。

Indoor Possibility： The probability of users being indoors. This parameter is only used for random allocation of Link State when the scenario is not INH.

Antenna Configuration

Array Layout: The number of rows (Row) and columns (Column) of panels in the antenna array.

Array Size： The distance between panels in each row and column of the antenna array, specified as a multiple of the signal wavelength.

Panel Layout： The number of antenna elements in each row and column on a panel

Panel Size： The distance between antenna elements in each row and column on a panel.

Polarization： The polarization of individual antenna elements. Selecting 1 represents single polarization, while selecting 2 represents dual polarization. The following two fields are for specifying the polarization angles. The first field is for the polarization angle in the vertical plane (0 represents the upward direction, and 90 represents the horizontal direction).

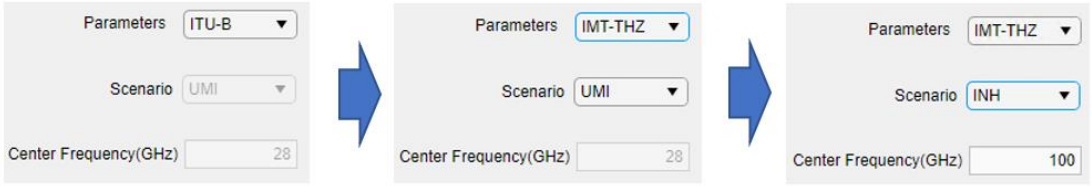
Type and Gain： The type of antenna element (OMI: omnidirectional antenna, Direction: directional antenna). The subsequent field is for specifying the maximum directional gain of the antenna element.

Direction： The pointing direction of the antenna, specified in degrees. This parameter is effective when the antenna type is set to directional. The first field is for the azimuth angle (0 represents the positive x-axis direction, and positive angles rotate towards the positive y-axis). The second field is for the downtilt angle (0 represents the upward direction, and 90 represents the horizontal direction)

Single Antenna： Selecting this option will automatically configure the antenna as a single antenna.

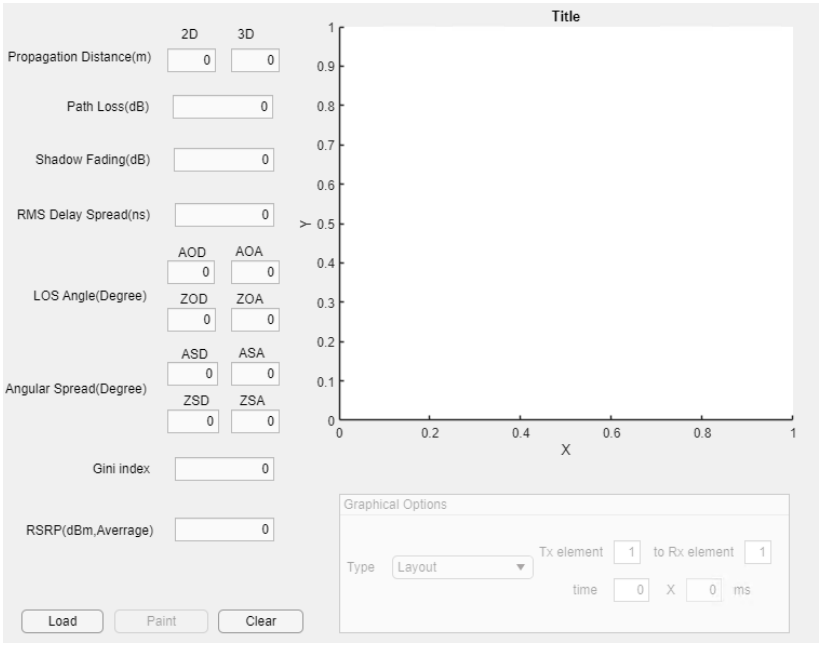
Instructions for use

1. Right-click the “BUPTCMG_IMT2030_THz” file in MATLAB and select “Run”, The GUI will appear.
2. Configure the settings in the following order:
   a) Scenario Configuration: Set the parameters in the order of Parameter, Scenario, and Center Frequency. Repeat this configuration for each simulation.

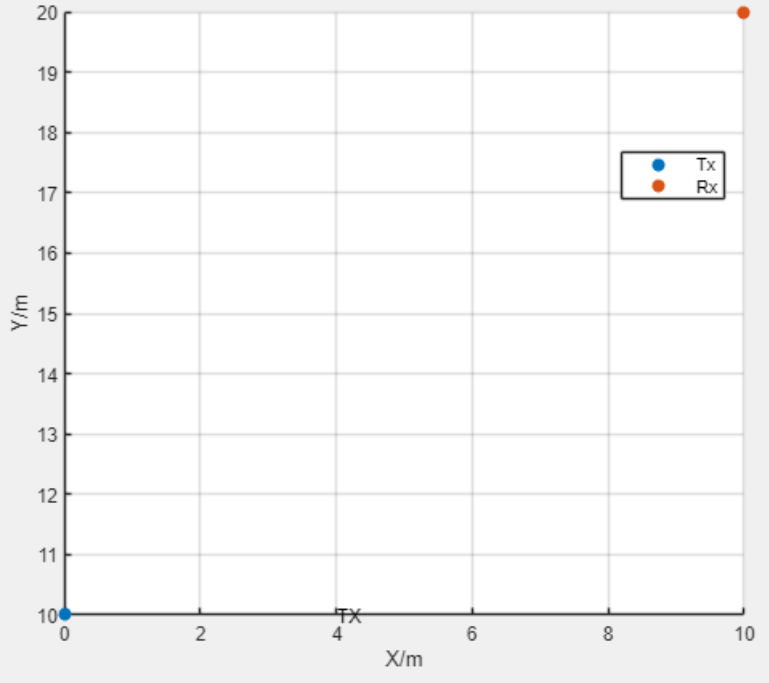


   b) Base Station/User Configuration: Configure according to your requirements.
   c) Once the configurations are set, click the "Configure BS" button to save the settings for the base station antenna. Click the "Configure UT" button to save the settings for the user antenna. These buttons need to be clicked both for each simulation.

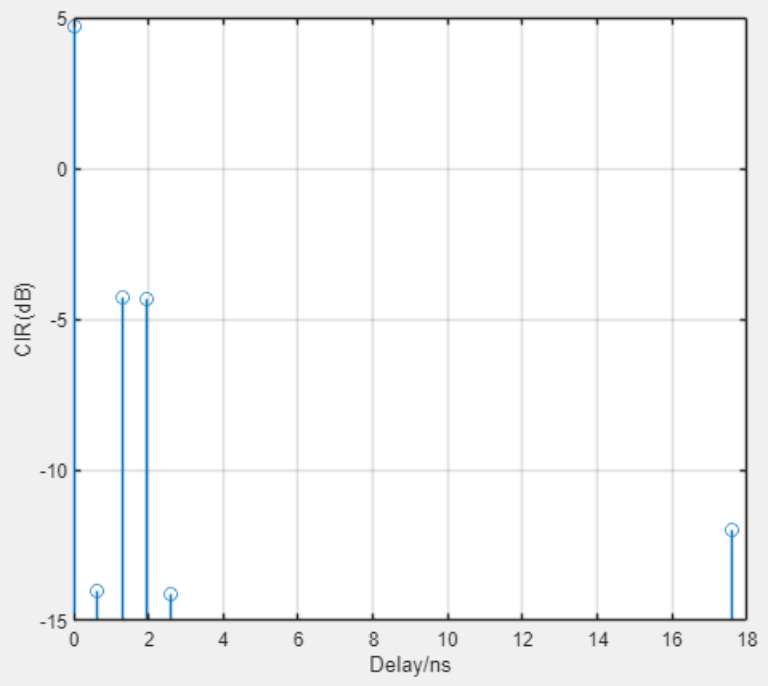
   Once the configuration is completed, the "Start Simulation" button will become active, indicating that the configuration is done.
3. Click the "Start Simulation" button to initiate the simulation. A progress bar will indicate the simulation progress. Once completed, the "Analysis" and "Save" buttons will become active.
4. Click the "Analysis" button to open a simple analysis interface. This interface allows users to view the basic characteristics of the channel:



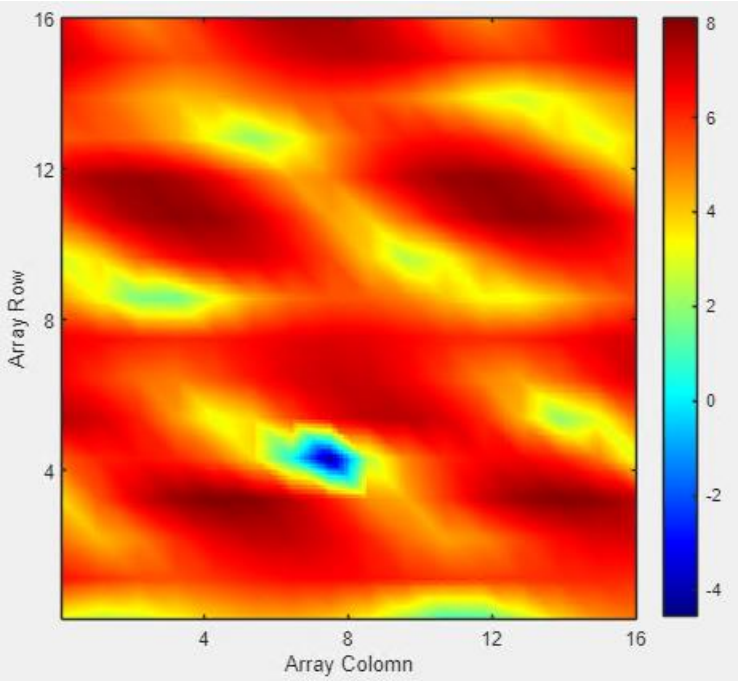
   a) Click "Load" to load the results of the simulation. The parameters will be displayed in the interface
   b) Under "Graphical Options," you can configure and plot various graphs in the coordinate area on the right side.
      i. Select "Layout" under "Type" to plot the positions of base stations and users.



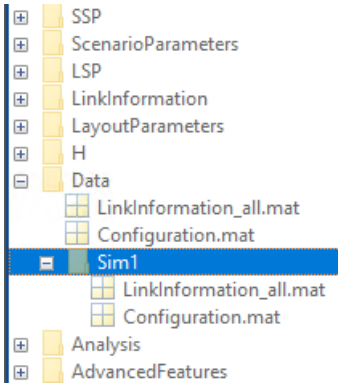
ii. Select "CIR on Element" to display the Channel Impulse Response (CIR) from a specific transmitting element (Tx Element) to a specific receiving element (Rx Element) at a particular sampling time (time).



iii. Select "CIR on Tx/Rx Array" to plot a heatmap of the amplitude of the CIR from the entire transmitting/receiving array to a specific element at sampling time 0. If the Tx or Rx is a single antenna, the plot will be the same as in ii.



5. Click the "Save" button to store the configuration and simulation results in the "Data" folder, under a folder named by the Simulation Name (e.g., "Sim1")



a) Configuration.mat

The file contains the following content, which primarily consists of the GUI.

C	1
N_user	1
fc	28
BW	200
sim	1
T	1
Sce	'UMI_B'
Tx_Power	35
O2I_rate	0.8000
UT_S	0
UT_Pos	[10,10,10]
BS_Pos	[0,0,10]
V	[0.8300,0.8300]
V_Dir	[0,90]
LinkState	'LOS'
AA_Bs	[1,1,1,1,1,2.5000,2.5000,0.5000,0.5000,90]
AA_Ut	[1,1,1,1,1,2.5000,2.5000,0.5000,0.5000,90]
Bs_Polar_Angle	[0,90]
Ut_Polar_Angle	[0,90]
Bs_antype	'OMI'
Ut_antype	'OMI'
Bs_gain	5
Ut_gain	5
Bs_Dir	[0,90]
Ut_Dir	[0,90]

b) LinkInformation_all.mat

The file contains the following content, which is the simulation result.

linkid	1
BaseStation	*1x1 struct*
Tx_Power	35
ISD	200
UserStation	*1x1 struct*
Distance2d	97.9637
Distance3d	98.3317
LOS_Angle	*1x1 struct*
PropagationCondition	'LOS'
Pathloss	103.1897
ShadowFading	-3.3480
Large_Scale_Parameters	*1x1 struct*
Small_Scale_Parameters	*1x1 struct*
Channel_Coefficient	*1x1 struct*
RSRP	-53.4518
ASA	24.8887
ASD	11.9566
ESA	11.6964
ESD	0.3005
RMS_DS	1.2305e-08
SV	11.3899
Gini_Index	0.8719

Base Station： Stores data related to the base station, including position (Pos), element positions (Element), and sector (not used in this version)

LinkInformation_all | LinkInformation_all.BaseStation

LinkInformation_all.BaseStation

Field	Value
Pos	[0;10;3]
Element	*1x256 struct*
Sector	*1x3 struct*
AALayout	[1,1,16,16,1,2.5000,2.5000,0.5000,0.5000,90]

Tx Power： Transmission power

ISD： Inter-site distance between base stations (not used in this verison)

User Station： Stores data related to the user, including position (Pos), wrapped position (Pos_wrapped, not used in this version), element positions (Element), user speed (speed), and user movement direction.

LinkInformation_all | LinkInformation_all.UserStation

LinkInformation_all.UserStation

Field	Value
Pos	[10;20;1.5000]
Pos_Wrapped	[10;20;1.5000]
Element	*1x1 struct*
AALayout	[1,1,1,1,1,2.5000,2.5000,0.5000,0.5000,90]
Speed	[0.8333;0;1.5708]

Distance2d、Distance3d： Straight-line distances between users and base stations in the 2D plane and 3D space, respectively.

LOS Angle： Line-of-sight angles between users and base stations, including Angle of Arrival (AOA), Angle of Departure (AOD), Zenith Offset Departure (ZOD or EOD), and Zenith Offset Arrival (ZOA or EOA).

LinkInformation_all | LinkInformation_all.LOS_Angle

LinkInformation_all.LOS_Angle

Field	Value
AOA	-135
AOD	45
EOA	83.9455
EOD	96.0545

Propagation Condition： Link propagation type.

Path Los： Path loss.

Shadow Fading： Random shadow fading

Large Scale Parameters： Large-scale distribution parameters, including Angle Spread of Departure (ASD), Angle Spread of Arrival (ASA), Elevation Spread of Departure (ESD), Elevation Spread of Arrival (ESA), K-factor, shadow fading, and delay spread. These parameters are randomly generated using distribution parameters from the standard large-scale parameter table.

LinkInformation_all | LinkInformation_all.Large_Scale_Parameters

LinkInformation_all.Large_Scale_Parameters

Field	Value
ASD	104
ASA	51.4610
ESD	0.4801
ESA	10.3594
K_factor	0.7037
Shadow_Fading	1.0160
Delay_Spread	5.3114e-09

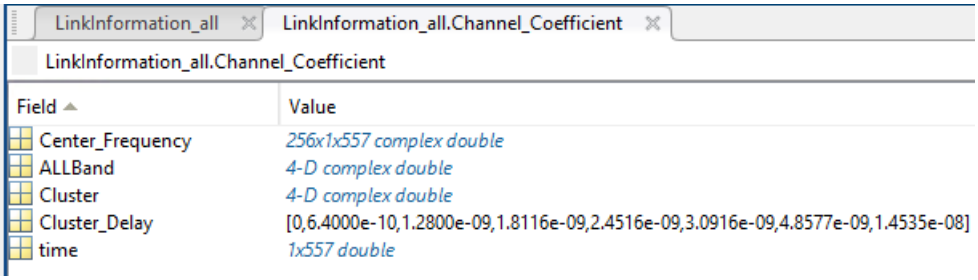
Small Scale Parameters： Small-scale multipath parameters, including cluster delay, cluster angle, cluster power, intra-cluster multipath angle, and Cross Polarization Ratio (XPR).

LinkInformation_all | LinkInformation_all.Small_Scale_Parameters

LinkInformation_all.Small_Scale_Parameters

Field	Value
Cluster_Delay	[0,1.5163e-09,4.0659e-09,1.2166e-08]
Cluster_Delay_K_Scaled	[0,1.8116e-09,4.8577e-09,1.4535e-08]
Cluster_Power	[0.1752,0.3810,0.3786,0.0652]
Cluster_Power_K_Scaled	[0.5158,0.2237,0.2222,0.0382]
Ray_Power	*1x4x3 double*
Ray_Power_K_Scaled	*1x4x3 double*
Cluster_AOA	[-135,152.8246,-63.8391,77.1007]
Cluster_AOD	[45,-123.6929,-92.7214,-20.3645]
Cluster_EOA	[83.9455,94.5932,93.2076,50.3781]
Cluster_EOD	[96.0545,96.6221,96.7884,97.6992]
Ray_AOA	*1x4x3 double*
Ray_AOD	*1x4x3 double*
Ray_EOA	*1x4x3 double*
Ray_EOD	*1x4x3 double*
XPR	*1x4x3 double*
K_factor	0.7037

Channel Coefficient： Channel parameters, including channel frequency response (CFR) at the center frequency (Center_Frequency), CFR at all frequencies within the bandwidth (ALLBand), channel impulse response (CIR) at the center frequency (Cluster), excess delay of the CIR (Cluster_Delay), and time series of samples (time).



RSRP： Reference Signal Received Power, averaged over all elements.

ASA、ASD、ESA、ESD： Angle spread values calculated using small-scale parameters.

RMS_DS: Root Mean Square Delay Spread, same as above.

RMS_DS： Root Mean Square Delay Spread, same as above.

SV： Maximum singular value of the channel parameter matrix.

Gini_index： Gini coefficient of the channel, describing the concentration of power in the channel. The closer it is to 1, the more concentrated the power, indicating a sparse channel. Conversely, a lower value indicates a more dispersed power distribution.