FB_Quadriga User Guide

This document will walk through all of the settings in the configurer for setting up your desired simulation. This document will be a living document as we continue to add features. After filling in the values and running Matlab_configurer.m, you will be given some short information about the simulation you have defined to ensure your simulation is operating as expected. After this feel free to run main.m to perform the simulation.

config.simulation

The majority of the parameters and choices belong here. These define how the simulation is run, what outputs you want to provide, and whether or not to use the following categories.

- **run_i**: Used for CCO or batch simulation output folder naming. If an output folder is not specified from the command line and the simulation is set to CCO or batch_tilts has more than one value, the data will be placed in this folder
- **sim_num**: Used for single-tilt MRO simulation output folder naming. If an output folder is not specified from the command line and the simulation is set to MRO and batch_tilts only has one value, then the data will be placed within savedResults/sim_num/Trial # where # is inferred based on the number of folders within the sim_num directory.
- **parallel**: Selects whether to use parallel computation in the inner loop. By setting this to 1, the channel merging and splitting are sped up significantly. This is especially useful for CCO, and only reasonably useful for MRO. Setting it to 0 disables all parallelization.
- **seed**: Chooses the random seed for the channel realizations. Changing this value will result in the same layout (unless rnd is chosen for BS_drop) but with a different set of channel parameters. RSRP may vary significantly depending on the scenario, but tends to be within +- 3 * log shadowing value 95% of the time.
- **carrier_frequency_Mhz**: Sets the simulation carrier frequency in MHz. If multiple values are provided, the simulation runs for multiple carrier frequencies, so outputs are tagged with _fc_# to differentiate the values. All scattering objects are the same between the carrier frequencies, but simulation models must be the same, so the scenario should be set to one that applies for both carrier frequencies. A good choice is usually '3GPP_38.901_UMi'.
- **no_tx**: Defines the number of TX to drop if BS_drop == 'hex' or 'rnd'.
- **isd**: This defines the minimum distance to drop BS apart by. This is especially important for the 'hex' layout as it will directly define how far apart each BS is for the simulation.
- **BS_drop**: This parameter selects how the BS will be placed in the layout. If this value is anything besides 'hex', 'rnd', 'csv' the base stations will be placed according to config.BS. If it is 'hex' the values will be placed in a hex shape, although not having {1, 7, 21..} will make it an incomplete hex. 'rnd' will be totally random, except it will verify that the placements are not too close. This can waste a lot of time if the random layout is not extremely sparse! Use at your own risk.
- **batch_tilts**: Another very important parameter that defines the downtilts for the simulation. If no values are given, it uses the tilts in config.BS. If one value is given, it runs the simulation where all downtilts are that value. If more than one value is given, it will perform the simulation in batch mode, so data will be placed within the run_i folder and the simulation will be run iteratively with the same channel and layout, but different downtilts.
- **Type**: This is a string of either 'CCO', 'MRO', or anything else. If set to 'CCO', UE are placed in a grid over the region for a single snapshot. If set to anything else, mobility is run, and the UE are placed based on later settings and config.UE and driven for a length of time.
- **sampling_frequency_hz**: Defines how often to sample the UE tracks in MRO mode. The default is 1000 which corresponds to one sample per millisecond. This is the rate ns-3 expects data to be sampled at as well, but can be reduced probably if the tracks are going to be used for CCO interpolation, because this is much faster than the

decorrelation time for most UE mobilies (anything satisfying 2*3e8/fc <= 25*fs works, where 25 is based on the UE max speed for 3 std above the mean).

- **bandwidth_Mhz**: When calculating MRO channels for ns-3, the bandwidth is used to get per-resource block measurements. This can only be one of the specified values for LTE, i.e. 1.25, 2.5, 5, 10, 15, 20. All resource block, FFT size, and similar values will be determined based on this value. Also when using it with ns-3, only use 5MHz or greater channels, otherwise ns-3 does not calculate the correct RSRP.
- **ue_seed**: Random seed for the UE distribution. Changing this value causes the UE's to be laid out differently.
- **simulation_duration_s**: The simulated time duration for MRO runs. The total time does not cause linear scaling, but making this number larger than about 10s is still very challenging.
- **random_UEs**: The number of random UEs to place. This will overwrite the information from config.UE, place the UEs randomly according to the parameters and ue_seed value.
- **P_local**: The probability of a UE being within the "local sphere" of a BS. In generating random UEs, the UEs are first split evenly between the BS, then placed with a probability of being within the local_radius, or else anywhere within the region.
- **P_turn**: The probability of a UE turning each second. Setting this value to 0 will result in purely straight routes, while setting it to 1 will results in the UEs turning every second.
- **max_xy**: A rough approximation of the distance in each x and y direction to make the simulation model. Note that this mainly affects the picture at the end, and if a UE goes outside of this region its measurements are still obtained.
- **output_rsrp**: Boolean value determining whether to save the rsrp and channel rsrp measurements for ns-3 (1), or save .mat files of the channel coefficients (0). Default is 1–save rsrp measurements
- **sample_distance**: Distance between each UE in a grid when doing CCO maps.
- **no_rx_min**: The minimum number of UEs to place in the grid for CCO. This value will be rounded up to the nearest square value. To reach higher resolution values this is often set to 50,000.

config.UE

Defines the specific UEs if you have chosen to not overwrite them (setting config.simulation.random_UEs to anything besides 0 overwrites this category!).

- **name**: Usually follows the trend 'UE_#' counting up. If you make it not count up this may lead to unusual results.
- **initial_position**: vector of three values specifying the x, y, and z coordinate in meters of the UE at the start of simulation. Normally z is set to 1.5.
- **velocity**: vector of three values specifying the direction and speed of the UE for the entire simulation. Note that only straight lines are available at this time.

config.BS

Defines the specific BSs if you have chosen not to overwrite them (setting batch_tilts to any values overwrites the downtilts, setting BS_drop to 'hex', 'rnd', or 'csv' overwrites the locations).

- **name**: Similar to the UE this should count up like 'BS_#'.
- **location**: a vector specifying the x, y, and z values in meters. Usual z values are in [20, 30].
- **number_of_sectors**: only the first BS uses this value to set the number of sectors for all of the BSs. Normally this is 3.
- **azimuth_rotations_degrees**: The rotation about the z axis to direct the antennas. Should have the number_of_sectors total values in the vector.
- **downtilts_degrees**: The downtilt value for each sector.

- **tx_p_dbm**: Sets the transmit power for each sector. Some functions allow different TX power but most only use the first tx_p_dbm value.
- **azimuth_beamwidth_degrees**: Not currently used.
- **elevation_beamwidth_degrees**: Not currently used.
- **front_to_back_ratio**: Not currently used.