

Longley Rice Propagation in DTDMA

Software: NetSim Pro v14.3, Visual Studio 2022, MATLAB R2020 or higher, Antenna Toolbox or Communications Toolbox.

Note: Internet Connection is required.

Project Download Link:

<https://github.com/NetSim-TETCOS/Longley-Rice-Propagation-v14.3/archive/refs/heads/main.zip>

Follow the instructions specified in the following link to download and setup the Project in NetSim:

<https://support.tetcos.com/en/support/solutions/articles/14000128666-downloading-and-setting-up-netsim-file-exchange-projects>

Follow the instructions specified below to place the additional NetSim and MATLAB files in respective folders:

1. Copy the **TDMA-PHY.xml** file provided in the NetSim_Files folder of the project directory and paste it in <NetSim_install_directory>/ Docs/ UI_xml/ ExternalFiles path (**For eg: C:\Program Files\NetSim\Pro_v14_2\Docs\UI_xml\ExternalFiles**), after renaming the already existing file as a backup.
2. Make sure the matlab file (Longley_Rice.m) is present in the bin_x64 of the current workspace directory, or paste the file from the matlab folder provided (**For eg: C:\Users\TEST\Documents\NetSim\Workspaces\Longley_Rice_Propagation\bin_x64\MATLAB**)

Propagation Model:

Propagation models allow you to predict the propagation and attenuation of radio signals as the signals travel through the environment. You can simulate different models by using the propagation Model function.

Longley Model:

The Longley–Rice model (LR) is a radio propagation model: a method for predicting the attenuation of radio signals for a telecommunication link in the frequency range of 20 MHz to 20 GHz. Longley-Rice is also known as the irregular terrain model (ITM).

Configuration:

In NetSim Longley-Rice Loss Model can be configured in the Wireless Nodes INTERFACE(WIRELESS) Physical Layer properties as shown below:

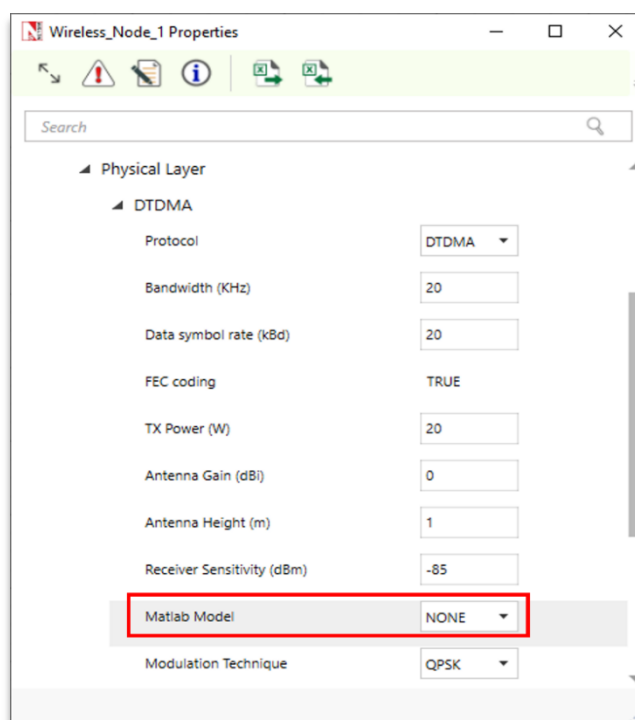


Figure 1: Wireless Node>Interface_1(WIRELESS)>Physical layer properties.

Longley_Rice Loss Model is set to NONE by default. When Longley_Rice model is selected, MODEL drop down with options Longley_Rice will appear along with associated parameters as shown below:

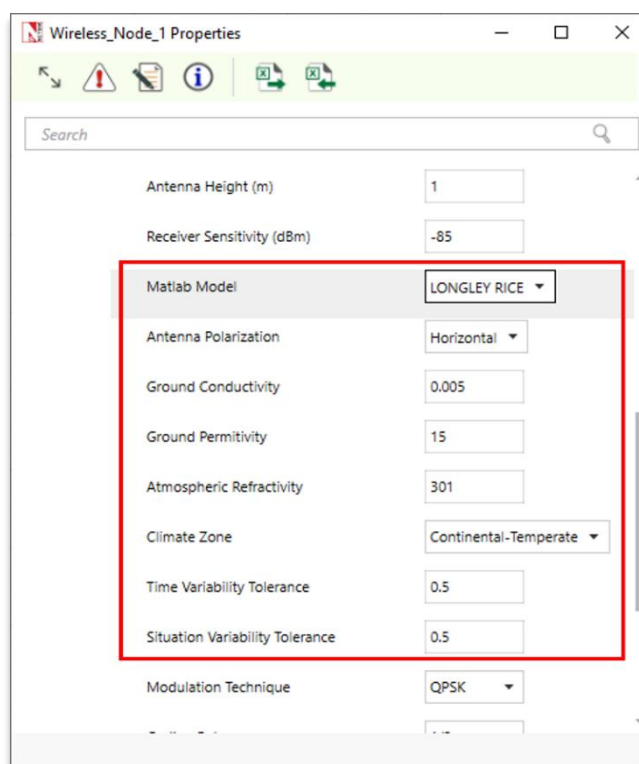


Figure 2: MATLAB Model is set to Longley_Rice Loss Model in Wireless Node >Interface_1 (WIRELESS) >Physical layer properties

Longley_Rice model has associated parameters that can be configured, which is listed in the table below:

| Longley Rice Model Parameter's | Values |
|---|---|
| Antenna Polarization | Horizontal (default), Vertical |
| Ground Conductivity | 0.005 (default) |
| Ground Permittivity | 15 (default) Range 1 to 100 |
| Atmospheric Refractivity (Depends on Climate Zone) | 301 (default), 360, 320, 370, 280, 320, 350 |
| Climate Zone | Continental-Temperate (default), Equatorial, Continental-Subtropical, Maritime-Subtropical, Desert, Maritime-Over-Land, Maritime-Over-Sea |
| Time Variability Tolerance | 0.5 (default) Range 0.001 to 0.999 |
| Situation Variability Tolerance | 0.5 (default) Range 0.001 to 0.999 |

Table 1: Longley Rice Associated Parameters

Note: Longley_Rice model support frequencies from 1 to 1000 GHz and Fog model supports frequencies from 20 MHz to 20 GHz only.

Longley Rice in NetSim with MATLAB Interfacing

Longley Rice is implemented in NetSim by Interfacing with MATLAB for point-to-point path loss. The devices Latitude, Longitude, Antenna Gain, Antenna Height, Antenna Polarization, Ground Conductivity, Ground Permittivity, Atmospheric Refractivity, Climate Zone, Time variability tolerance, Situation variability tolerance are fed as input to MATLAB.

NOTE: To run this code 64-bit version of MATLAB must be installed in your system.

Configuring Environment for MATLAB Execution

1. Add the following MATLAB install directory path in the Environment PATH variable
 <MATLAB_INSTALL_DIRECTORY>\bin\win64
 For eg: C:\Program Files\MATLAB\R2023a\bin\win64

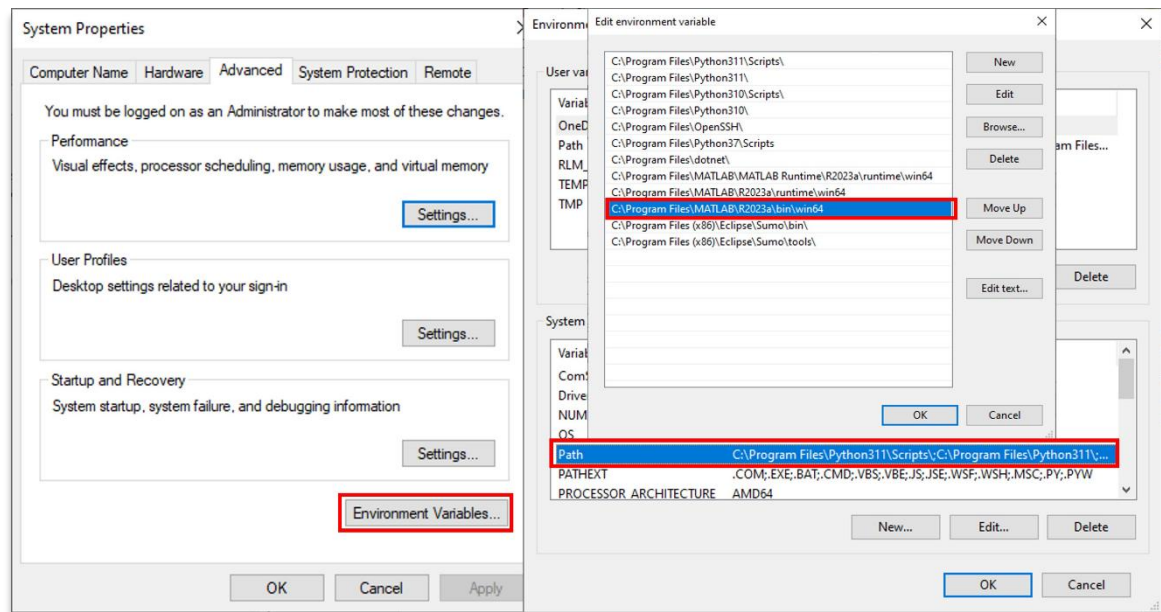


Figure 3: Environment variable PATH

Note: If the machine has more than one MATLAB installed, the directory for the target platform must be ahead of any other MATLAB directory (for instance, when compiling a 64-bit application, the directory in the MATLAB 64-bit installation must be the first one on the PATH).

2. Open Command prompt as admin and execute the command “matlab -regserver”. This will register MATLAB as a COM automation server and is required for NetSim to start MATLAB automation server during runtime.

Example

1. Start NetSim as administrator.
2. The **Longley Rice Propagation workspace** comes with a sample network configuration that are already saved. To open this example, go to the Your Work menu in the Home screen of NetSim and click on the Sample-Longley-Rice-Model from the list of experiments.
3. The saved network scenario consists of 2 Wireless Nodes uniformly distributed in the grid environment. Traffic is configured between Wireless_Nodes

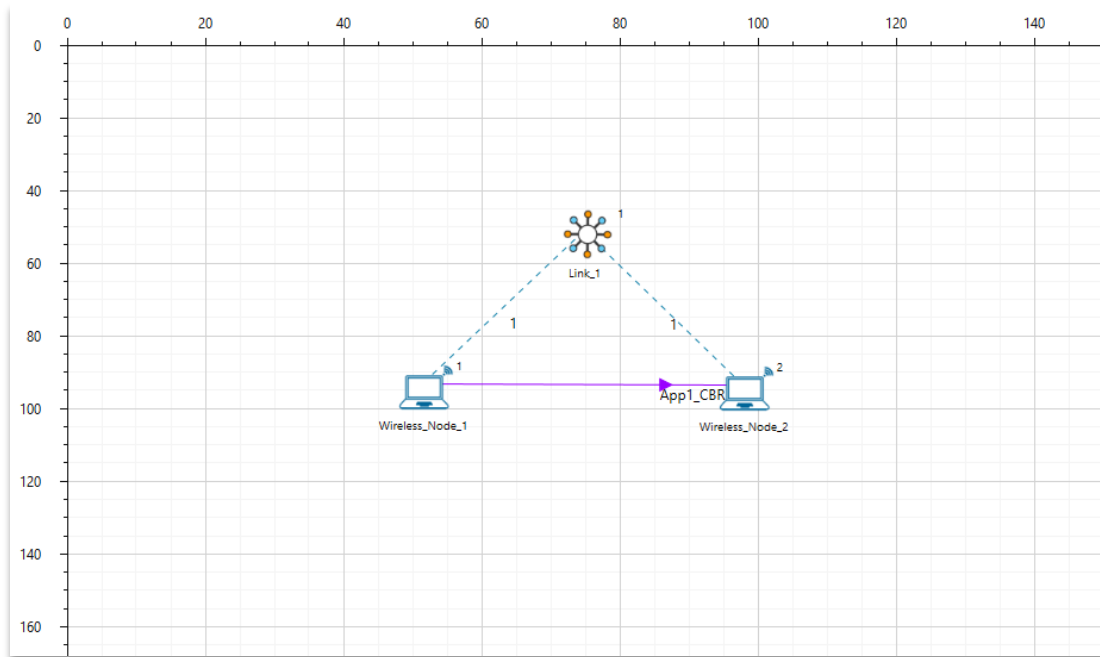
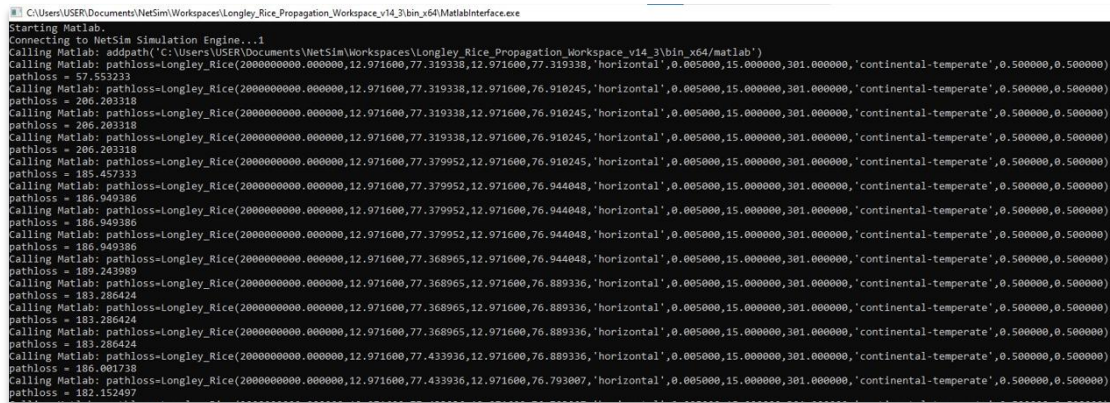


Figure 4: Network Scenario of Longley Rice Propagation in DTDMA

4. Run simulation for 100 seconds and press any key to continue.
5. Following Input Parameters are passed to MATLAB via NetSim

```
function [Pathloss] = Longley_Rice (centralFrequency_MHz, transmitter_lat, transmitter_lon,
receiver_lat, receiver_lon, antennaPolarization, groundConductivity, groundPermittivity,
atmosphericRefractivity, climateZone, timeVariabilityTolerance, situationVariabilityTolerance)
```
6. It will open MatlabInterface.exe console window. You will observe that as the simulation starts in NetSim, MATLAB gets initialized



```

C:\Users\USER\Documents\NetSim\Workspaces\Longley_Rice_Propagation_Workspace_v14_3\bin_x64\MatlabInterface.exe
Starting Matlab.
Connecting to NetSim Simulation Engine...1
Calling Matlab: addpath('c:\Users\USER\Documents\NetSim\Workspaces\Longley_Rice_Propagation_Workspace_v14_3\bin_x64\matlab')
Calling Matlab: pathloss=Longley_Rice(2000000000.000000,12.971600,77.319338,12.971600,77.319338,'horizontal',0.005000,15.000000,301.000000,'continental-temperate',0.500000,0.500000)
pathloss = 57.553233
Calling Matlab: pathloss=Longley_Rice(2000000000.000000,12.971600,77.319338,12.971600,76.910245,'horizontal',0.005000,15.000000,301.000000,'continental-temperate',0.500000,0.500000)
pathloss = 206.203318
Calling Matlab: pathloss=Longley_Rice(2000000000.000000,12.971600,77.319338,12.971600,76.910245,'horizontal',0.005000,15.000000,301.000000,'continental-temperate',0.500000,0.500000)
pathloss = 206.203318
Calling Matlab: pathloss=Longley_Rice(2000000000.000000,12.971600,77.319338,12.971600,76.910245,'horizontal',0.005000,15.000000,301.000000,'continental-temperate',0.500000,0.500000)
pathloss = 206.203318
Calling Matlab: pathloss=Longley_Rice(2000000000.000000,12.971600,77.379952,12.971600,76.910245,'horizontal',0.005000,15.000000,301.000000,'continental-temperate',0.500000,0.500000)
pathloss = 185.457333
Calling Matlab: pathloss=Longley_Rice(2000000000.000000,12.971600,77.379952,12.971600,76.944048,'horizontal',0.005000,15.000000,301.000000,'continental-temperate',0.500000,0.500000)
pathloss = 186.949386
Calling Matlab: pathloss=Longley_Rice(2000000000.000000,12.971600,77.379952,12.971600,76.944048,'horizontal',0.005000,15.000000,301.000000,'continental-temperate',0.500000,0.500000)
pathloss = 186.949386
Calling Matlab: pathloss=Longley_Rice(2000000000.000000,12.971600,77.379952,12.971600,76.944048,'horizontal',0.005000,15.000000,301.000000,'continental-temperate',0.500000,0.500000)
pathloss = 186.949386
Calling Matlab: pathloss=Longley_Rice(2000000000.000000,12.971600,77.368965,12.971600,76.944048,'horizontal',0.005000,15.000000,301.000000,'continental-temperate',0.500000,0.500000)
pathloss = 189.243989
Calling Matlab: pathloss=Longley_Rice(2000000000.000000,12.971600,77.368965,12.971600,76.889336,'horizontal',0.005000,15.000000,301.000000,'continental-temperate',0.500000,0.500000)
pathloss = 183.286424
Calling Matlab: pathloss=Longley_Rice(2000000000.000000,12.971600,77.368965,12.971600,76.889336,'horizontal',0.005000,15.000000,301.000000,'continental-temperate',0.500000,0.500000)
pathloss = 183.286424
Calling Matlab: pathloss=Longley_Rice(2000000000.000000,12.971600,77.368965,12.971600,76.889336,'horizontal',0.005000,15.000000,301.000000,'continental-temperate',0.500000,0.500000)
pathloss = 183.286424
Calling Matlab: pathloss=Longley_Rice(2000000000.000000,12.971600,77.433936,12.971600,76.889336,'horizontal',0.005000,15.000000,301.000000,'continental-temperate',0.500000,0.500000)
pathloss = 186.001720
Calling Matlab: pathloss=Longley_Rice(2000000000.000000,12.971600,77.433936,12.971600,76.793007,'horizontal',0.005000,15.000000,301.000000,'continental-temperate',0.500000,0.500000)
pathloss = 182.152497

```

Figure 5: Runtime MATLAB interfacing window.

The pathloss value obtained from MATLAB is added to the total loss calculated as per the Longley_Rice Model specifications. At simulation end the MATLAB Interface process closes the MATLAB process that it started.