1.0 VLAB 2 Overview: Fading processes (documentation extract)

1.1 Application execution and usage

To start the application, execute the generic launcher via the start menu and select the second VLAB.

The simulation setup form and the 3D visualization form will appear:

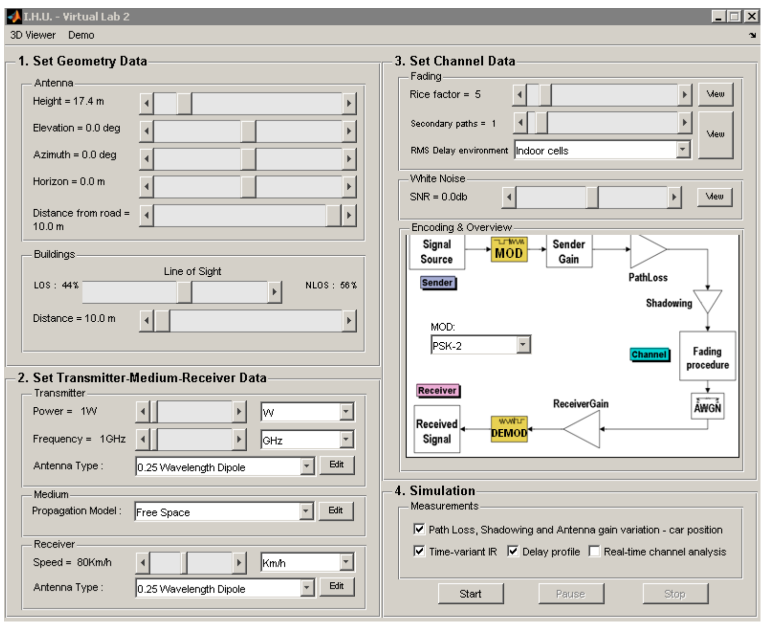

Figure 1: The simulation setup form.

Understanding the 3D visualization and related control.

The 3D visualization form displays a vehicle moving on a road between two rows of buildings. An transmitting antenna is placed at an arbitrary point on the plane. The car carries a receiving antenna. Due to the obstruction of buildings and the movement of the client/vehicle, electromagnetic shadowing, fading and doppler frequency shift phenomena occur. The user can study the effects of this phenomena on the signal reception quality, while varying the

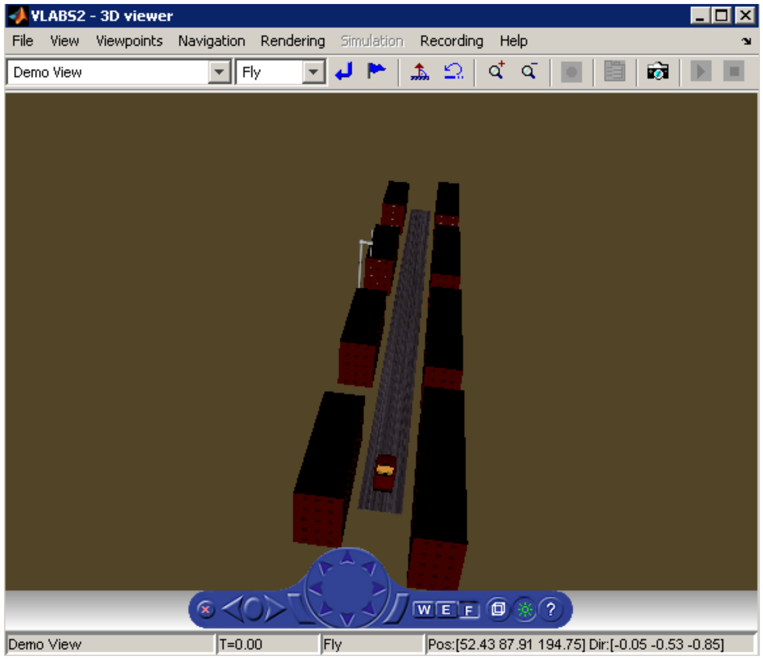

Figure 2: The 3D visualization form.

system's geometry and signal modulation parameters in pre-specified ways.

Using the menu bar, toolbar, and navigation panel on the 3D visualization form, you can

- Customize the Orbisnap window
- Manage virtual world viewpoints
- Manage scene rendering
- Navigate in the scene

Menu Bar The menu bar has the following menus:

- File – General file operation options, including:
- ++Open – Invokes a browser that you can use to browse to the virtual world you want to visualize.

- ++Connect to server – Allows you to connect to a Simulink 3D Animation server. Enter the IP address or host name of the host computer running the Simulink 3D Animation server (127.0.0.1 by default) and the port number at which the Simulink 3D Animation server is listening (8124 by default).
- ++Reload – Reloads the saved virtual world. Note that if you have created any viewpoints in this session, they are not retained unless you have saved those viewpoints with the Save As option.
- ++Save As – Allows you to save the virtual world.
- ++Close – Closes the form.
- View – Enables you to customize the form, including:
- ++Toolbar – Toggles the toolbar display.
- ++Status Bar – Toggles the status bar display at the bottom of the form. This display includes the current viewpoint, simulation time, navigation method, and the camera position and direction.
- ++Navigation Zones – Toggles the navigation zones on/off (see Navigation for a description of how to use navigation zones).
- ++Navigation Panel – Controls the display of the navigation panel, including toggling it.
- ++Zoom In/Out – Zooms in or out of the world view.
- ++Normal (100%) – Returns the zoom to normal (initial viewpoint setting).
- Viewpoints – Manages the virtual world viewpoints.
- Navigation – Manages scene navigation.

- Rendering – Manages scene rendering.
- Help – Displays the Help browser.

Toolbar The toolbar has buttons for some of the more commonly used operations available from the menu bar. These buttons include:

- Drop-down list that displays all the viewpoints in the virtual world
- Return to viewpoint button
- Create viewpoint button
- Straighten up button
- Drop-down list that displays the navigation options Walk, Examine, and Fly.
- Undo move button
- Zoom in/out buttons ,

Navigation Panel The navigation panel has navigation controls for some of the more commonly used navigation operations available from the menu bar. These controls include:

Hide panel – Toggles the navigation panel. Next/previous viewpoint – Toggles through the list of viewpoints. Return to default viewpoint – Returns focus to original default viewpoint. Slide left/right – Slides the view left or right. Navigation wheel – Moves view in one of eight directions. Navigation method – Manages scene navigation. Wireframe toggle – Toggles scene wireframe rendering. Headlight toggle – Toggles camera headlight. Help – Invokes the online help.

Navigation

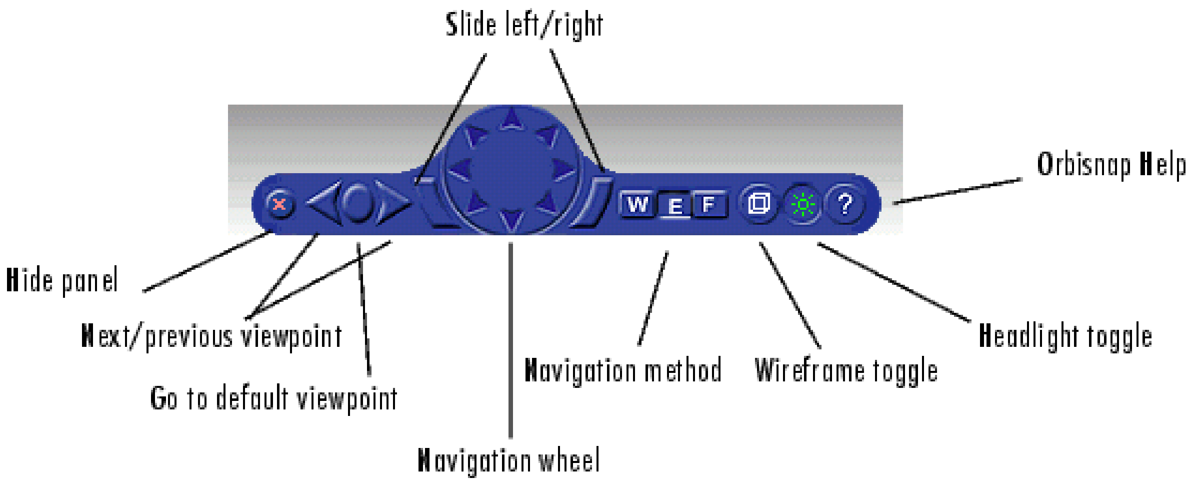

Figure 3: Navigation Panel.

You can navigate around a virtual world using the menu bar, toolbar, navigation panel, mouse, and keyboard.

Navigation view – You can change the camera position. From the menu bar, select the Navigation menu Straighten Up option. Alternatively, you can click the Straighten Up control from the toolbar or press F9 on the keyboard. This option resets the camera so that it points straight ahead.

Navigation methods – Navigation with the mouse depends on the navigation method you select and the navigation zone you are in when you first click and hold down the mouse button. You can set the navigation method using one of the following:

From the menu bar, select the Navigation menu Method option. This option provides three choices, Walk, Examine, or Fly. See the table Mouse Navigation. From the toolbar, select the drop-down menu that displays the navigation options Walk, Examine, and Fly. From the navigation panel, click the W, E, or F buttons. From the keyboard, press Shift+W, Shift+E, or Shift+F. Navigation zones – You can view the navigation zones for a virtual world through the menu bar or keyboard.

From the menu bar, select the View menu Navigation Zones option. The virtual world changes as the navigation zones are toggled on and appear in the virtual world. Alternatively, from the keyboard, press the F7 key.

The following table summarizes the behavior associated with the movement modes and navigation zones when you use your mouse to navigate through a virtual world. Turn the navigation zones on and experiment by clicking and dragging your mouse in the different zones of a virtual world.

Movement Mode	Zone and Description
Walk	**Outer** -- Click and drag the mouse up, down, left, or right to slide the camera in any of these directions in a single plane. **Inner** -- Click and drag the mouse up and down to move forward and backward. Drag the mouse left and right to turn left or right.
Examine	**Outer** -- Click and drag the mouse up and down to move forward and backward. Drag the mouse left and right to slide left or right. **Inner** -- Click and drag the mouse to rotate the viewpoint around the origin of the scene.
Fly	**Outer** -- Click and drag the mouse to tilt the view either left or right. **Inner** -- Click and drag the mouse to pan the camera up, down, left, or right within the scene. **Center** -- Click and drag the mouse up and down to move forward and backward. Move the mouse left or right to turn in either of these directions.

Figure 4: Navigation through mouse.

Understanding the simulation setup form controls. This form contains all the controls than enable you to create customized scenarios and study the fading processes with regard to client mobility.

Menu Bar

- 3D viewer: Enables you to reopen the 3D viewer form if it has been closed.
- Demo : A non-interactive demo of the application will be played.

To setup a simulation follow through the panels described below in the mentioned order:

1. "Set Geometry Data" panel:

Use the contained controls at the "Antenna" sub-panel to place the antenna at the desired location on the field. Labels are trivial and self-descriptive. Any change will be reflected instantly at the 3D visualization form.

Use the contained controls at the "Buildings" sub-panel to define the street's width ("Distance") and building size ("LOS"). The former will affect the distribution model used to generate the secondary propagation paths and will alter the value of the "RMS Delay environment" listbox in Panel No. 3 ("set channel data" / "Fading"). The latter will define the time percentage during the vehicle's movement that there is visual contact (Line Of Sight-LOS) between the antenna and the vehicle.

2. "Set Transmitter-Medium-Receiver Data" panel:

Use the contained controls to change the carrier frequency, power and antenna types of the transmitter and receiver. Propagation models of the medium can also be altered through the corresponding control. A more detail description of these controls have been given at "Virtual Lab 1: Antennas and propagation".

3. "Set Channel Data" panel:

Use the contained controls to set the rice factor for the line-of-sight part of the vehicle's trip. The corresponding non-line-of-sight value of this parameter is hardwired to 0 and may not be changed.

Use the "secondary paths" slider to set the number of secondary propagation paths.

Use the "AWGN" slider to set the $\frac{E_b}{N_0}$ ratio.

In any case, the corresponding "View" buttons will show an **indicative** altered form of the original signal. The parameters that will be used during the simulation are set randomly at the beginning of its execution.

The "Encoding and Overview" panel includes a block diagram representation of the system and a modulation selection that will be used during the simulation.

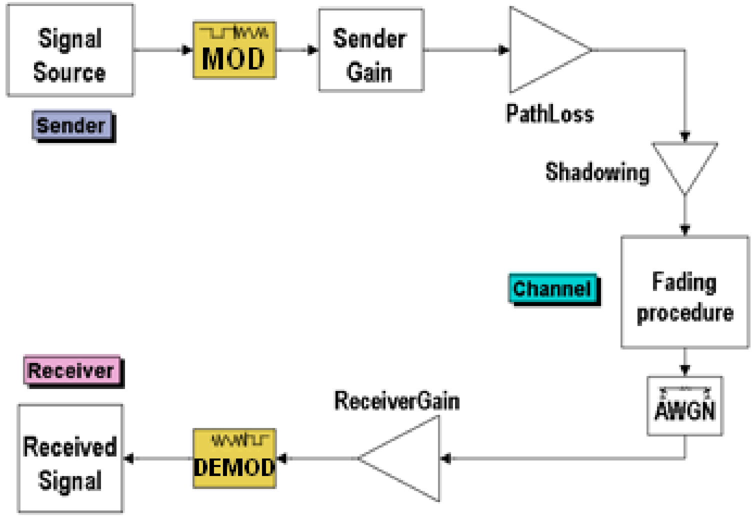

Figure 5: A signal source is modulated, altered (in terms of gain) by the transmitting antenna, endures losses according to the selected medium model, suffers the effect of shadowing (only when obstructed by one of the four buildings) and fading (according to selected LOS rice factor, number of paths, and RMS environment). White noise is then added at the entry point of the receiving antenna (selected $\frac{E_b}{N_0}$ is used). The gain of the receiving antenna is taken into account (geometry and vehicle relative position counts). The signal is then demodulated and the number of erroneous bits and symbols ir measured.

4. "Simulation" panel:

In this panel the user may set the metrics that he wishes to be recorded during the simulation. Labels are self-describing, with he exception of the "real-time analysis" option. Check this box to open the MATLAB channel visualization tool when the simulation starts. Notice that this will have a great negative impact on the simulation speed. You may close the tool at any moment for the simulation to return to normal execution speed. However, you may not re-open it during simulation. For more information on this tool consult the MATLAB documentation on "Using the Channel Visualization Tool".

Finally, the controls "Start", "Stop" and "Pause" have the corresponding effect on the simulation.

1.2 Simulating and obtaining results

Once all the described parameters are set, click on the "start" button. The vehicle on the 3D visualization form will start to move towards the end of the road. If the "real-time analysis" option has been checked, the MATLAB channdel visualization tool will open as well. Once the car has reached the end, the simulation stops and the following result forms are shown:

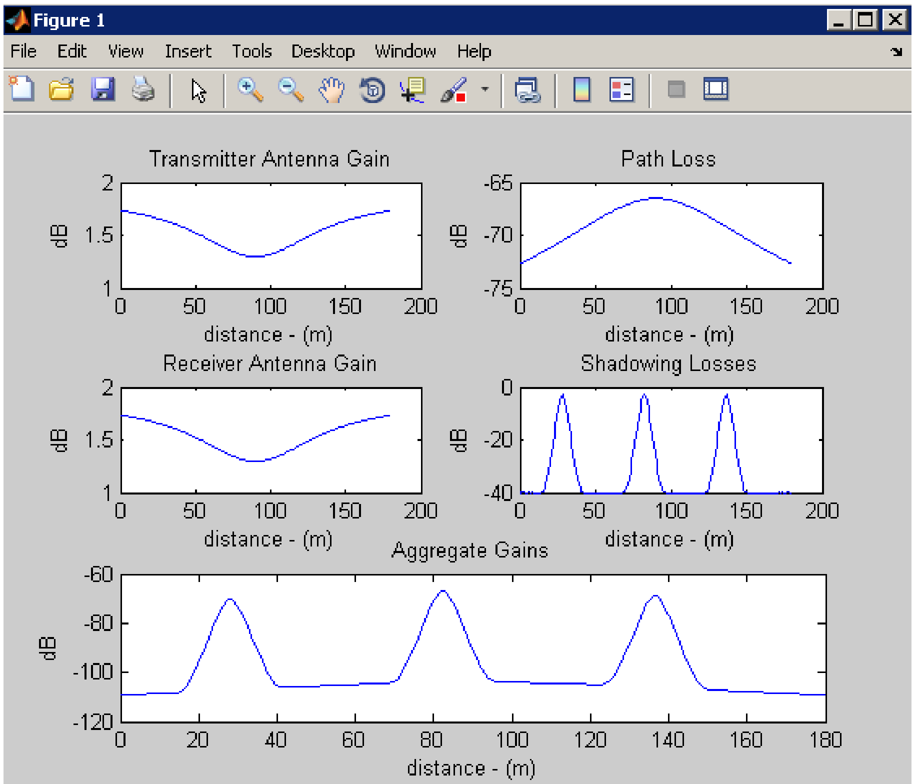

Figure 6: Gain forms. This forms shows the antenna gains, the shadowing losses and their aggregation as a function of the vehicle's position.

1.3 Characterizing the wireless channel

The second results' form contains as described a panel showing the Power Delay Profile (PDP) of the channel. This is sufficient for characterizing the bandwidth of the channel. [2] describes the complete procedure for this purpose. No additional data is required for this task, both in theory and in practice.

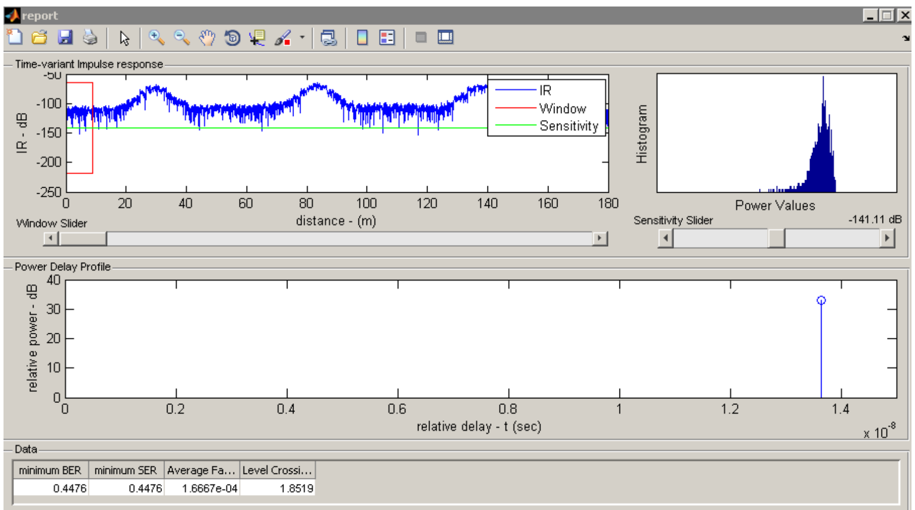

Figure 7: Results forms. Three distinct panels are visible or not, depending on the choices of the user in the "Simulation" panel described above. In this figure, all panels are visible and active. The topmost panel shows the time-variant impulse response. The user may move the "window" slider to obtain a histogram of values inside the red window. This can be used for checking that the values follow the rice distribution. By altering the sensitivity slider, the green line denoting the receiver's sensitivity is shifted proportionately. This affects the Average Fade Duration and Level Crossing Frequency values at the lower most panel. Notice that the SER/BER values correspond to a receiver of unlimited sensitivity, and the extraction of their practical values is left as an exercise to the user. The power delay profile is shown in the middle panel. NOTICE: this form may not show if the simulation is stopped prematurely, due to lack of sufficient number of results.

References

[1] John G. Proakis (1995). Digital Communications (3rd ed.). Singapore: McGraw-Hill Book Co. ISBN 0-07-113814-5.

[2] Simon R. Saunders (1999). Antennas and Propagation for Wireless Communication Systems. Wiley, ISBN 0471986097.

[3] Patzold, M.; Killat, U.; Li, Y.; Laue, F.; (1997), Modeling, analysis, and simulation of nonfrequency-selective mobile radio channels with asymmetrical Doppler power spectral density shapes, Vehicular Technology, IEEE Transactions on, Volume: 46 , Issue: 2.