**ASSESSMENT**

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| **Course Title** | Spacecraft Communication |
| **Course Code** | EG4217/EG7217 |

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| **Student Name** |  |
| **Roll No.** |  |
| **Department** |  |

# Declaration:

I declare that this assignment is my own work, that sources of reference are acknowledged and that it has not been submitted for any other course. I understand that plagiarism is a serious offence under the University’s regulations and that appropriate penalties will be applied if I am found to have submitted plagiarised work.

# Questions

**Q1** ***freespace.m***

*This programme calculates free space loss assuming isotropic antennas*.

Plot the free-space loss for ranges between 100 km and 1000 km for frequencies 1 GHz and 2 GHz.

To make this curve easy for the reader to view and understand:

* Plot these curves in different colours on the same graph using ‘hold on’.
* Add a graticule using the command ‘grid on’.
* Add a legend using the command ‘legend’.
* Add axis labels using ‘xlabel’ and ‘ylabel’, not forgetting units.
* Add a figure number and caption to the plot.
* Add some text, referring to Figure 1 and describing the trend.
* Explain why loss increases with distance.

*(Subsequent plots should also all have these embellishments to make them clear.)*

**ANSWER**

The given code has frequency in MHz, hence 1GHz= 1000MHz and 2GHz = 2000 MHz.

% using function loss=freespace(frequency, distance) storeed in freespace.m

% Generate data for plotting

frequencies = [1 2]; % GHz

distances = 100:1:1000; % km

% Calculate loss for each frequency and distance

loss\_data = zeros(length(frequencies), length(distances));

for i = 1:length(frequencies)

loss\_data(i,:) = freespace(frequencies(i) \* 1e3, distances); % Convert GHz to MHz

end

% Plot the results

figure(1); % Set figure number

hold on;

for i = 1:length(frequencies)

plot(distances, loss\_data(i,:), 'DisplayName', [num2str(frequencies(i)) ' GHz']);

end

% Customize the plot

grid on;

legend;

xlabel('Distance (km)');

ylabel('Free Space Loss (dB)');

title('Free Space Loss vs. Distance for Different Frequencies');

% Add text description

text(200, 140, 'As distance increases, free space loss increases.', 'FontSize', 12, 'Color', 'red');

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Radio Communication and Free-Space Path Loss:

In telecommunication, the free-space path loss (FSPL) refers to the attenuation of radio energy between two antennas due to the combination of the receiving antenna’s capture area and the obstacle-free, line-of-sight path through free space (usually air) [1] .

The FSPL increases with the square of the distance between the antennas. Here’s why:

Intensity (I): The power density of radio waves decreases with the square of the distance from the transmitting antenna. As waves propagate, they spread out, leading to a decrease in energy density.

Wavelength: The FSPL also decreases with the square of the wavelength of the radio waves. Longer wavelengths experience less attenuation over distance.

The FSPL is a crucial factor in radio communication systems, ensuring that sufficient power reaches the receiver for intelligible signal reception

**Q2 *visible\_time.m, freespace.m and sat\_dist.m***

*visible\_time.m calculates the time in seconds for which a satellite is visible from the earth sat\_dist calculates the distance from a satellite to the ground-station.*

An Earth observation satellite at an altitude of 400 km collects data at a rate of 10 kbit/s as it goes round the Earth. It must download this data using a 5 GHz carrier wave as it flies over its mission control centre. An adequate SNR is only possible the when the satellite is above 10o elevation, as seen from the mission control centre. Assume that it flies directly over the mission control centre.

1. Calculate the approximate free-space loss in the satellite-mission control centre link when data collection starts. Don’t forget the units.
2. Calculate the data rate required to ensure that all the data from the latest orbit can be downloaded as the satellite passes over the mission control centre.

**ANSWER**

# References

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| [1] | "Free-space Path Loss," Wikipedia, 09 01 2024. [Online]. Available: https://en.wikipedia.org/wiki/Free-space\_path\_loss.. [Accessed 26 02 2024]. |

Wikipedia. 2024. "Free-space Path Loss." Wikimedia Foundation. Last modified January 9, 2024. https://en.wikipedia.org/wiki/Free-space\_path\_loss.