UESTC4024 – Wireless & Optical Transmission Systems

(2019 – 2020 Semester 1)

(Report [15%])

The numbers in square brackets in the right-hand margin indicate the marks allotted to the part of the question against which the mark is shown. These marks are for guidance only.

Purpose of the Assignment

This assignment is intended to provide an opportunity for students to:

1. Apply concepts of satellite communication systems associated with the operation of satellite communication networks;
2. Demonstrate the use of advanced knowledge to solve basic and advance radio link design problems associated with satellite communication systems;
3. Apply skills required to design an end-to-end satellite communications link budget, based on the standard engineering practices;
4. Identify engineering applications that are affected by satellite communications.

Resources: Matlab Communications Tool Box and Communication & RF Block set.

Date Issued to Students: 21st October 2019 / Monday
Deadline / Submission Date: 21st November 2019 / Thursday
Submission: via Moodle

Submission Instructions:

- You must submit in **ONE pdf document** (not a zipped file, not two times, not in a word document).
- You must clearly indicate in the file name and in the document the students' name and students' ID in the form **StudentName_GUID_UESTCID.pdf**.
- The marking criteria is provided.
- You must submit a **plagiarism declaration** and your submission will go through **plagiarism check**.
- **No late submissions will be allowed in the Moodle** so if you don't submit you will get a zero for this complete assessment.
- This is a **SUMMATIVE assessment** (i.e. marked assessment).
- While using references, you must use **IEEE style/format**.

Design and Implement a Satellite Communications System for Poor Quality Satellite Communication Channels using MATLAB

Task Description

This coursework assignment project aims to design and implement an end-to-end satellite communications link over a poor-quality satellite communications channel using MATLAB simulation software.

The end goal is to implement a satellite data communications system, in which a stream of data is analysed being communicated over satellite communication systems. This will involve a significant amount of background research.

Some environments of path loss will be present inclusive of mobile and fixed propagation environments. Some sources of interference and noise will be present inclusive of atmospheric attenuation, attenuation, and depolarisation. A large part of your brief is to study the constellations, satellite orbital design, angle from satellite to earth station, radio interface, link budget design inclusive of advanced link calculations, antennas, error coding, multi-access inclusive of code division multiple access (CDMA), frequency division multiple access (FDMA), time division multiple access (TDMA), and random access, followed by variations in system design with their respective performances. The performance metrics to be utilised include outage probability, throughput, bit-error rate, and capacity. Your goal is to design and implement a satellite communications system that achieves high performance and reliable transmission.

You have full control over what simulation components and parameters to use, and you are encouraged to try several different combinations of these.

You should start by designing and modelling the satellite communications system and channel in MATLAB before implementing the final physical system. MATLAB provides several non-ideal communication channel models for you to utilise in evaluating your design.

Important points:

- Your implementation will be at the level of MATLAB Communications Toolbox and Communications Blockset (i.e. NO hardware design is required).
- Assume the data to be transmitted over the link is already digitised and analogue to digital conversion is NOT part of the coursework task.
- You are *not* required to use data compression.

Useful links to help getting started with MATLAB Communications:

https://uk.mathworks.com/products/communications.html

https://uk.mathworks.com/help/comm/

https://uk.mathworks.com/solutions/wireless-communications.html

https://uk.mathworks.com/help/comm/examples/rf-satellite-link.html

Deliverables and Marking Scheme

You are required to submit a report of up to 4000-words for this Task.

The report should include:

1. Your final overall designs demonstrating MATLAB component blocks and connections between them, and application to satellite communications systems.
   [20 marks]
2. A description of the overall purpose of each component in the design and why it is required. **[30 marks]**
3. A detailed description of the design choices and calculations for each component and for the complete system. This section should also include results (e.g. graphical or numerical results of simulations) obtained while investigating and refining your design. This might, for example, include a discussion of trade-offs in your design, based on measured performance etc. **[40 marks]**
4. Demonstration of a final working satellite communications system. **[10 marks]**

-------------------------------------- **END OF ASSESSMENT** ----------------------------------