Digital Communications Lab

**Experiment 1**

Basics of BER calculations and channel models

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Experiment

## Part 1

**Example 1:** the receiver gives a 0 bit as output. This output does not depend at all on what the channel is giving out.

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| **Questions** | |
| **What is the corresponding BER for that receiver? You do not need to implement it in the m-file to answer.** | **Given the channel input has 50% chance of 1s or 0s the BER = 0.5** |
| **What is the reason behind the performance of this receiver?** | **Each 1 input gives of an error, while each 0 input is correct, so always 50% of the bits are received incorrectly, assuming the channel input is of truly random 0s and 1s, if 1s are 70% of the input then the BER is 70%** |

**Example 2:** the receiver gives random output, i.e., 0s and 1s with a probability of 0.5. Again, this output is not based on what the channel is giving out.

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| **Questions** | |
| **What is the corresponding BER for that receiver? You do not need to implement it in the m-file to answer.** | **chance of 1s and 0s, the BER is 0.5** |
| **What is the reason behind the performance of this receiver?** | **Each 1 input has error probability of 50% and each 0 input has error probability of 50%, and at whatever percentage mix of 1s and 0s the error rate will be 50%** |

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| **Questions** | |
| **What is the corresponding BER for receivers 1 and 2 above? You do not need to implement the two receivers to answer.** | **Receiver 1 depends on the number of 1s in the input (would be 0.5 in case of random input), receiver 2 is always 0.5** |
| **What is the reason behind the performance of these two receivers?** | **For receiver 1: Each 1 input gives of an error, while each 0 input is correct, so always 50% of the bits are received incorrectly, assuming the channel input is of truly random 0s and 1s, if 1s are 70% of the input then the BER is 70%**  **For receiver 2: Each 1 input has error probability of 50% and each 0 input has error probability of 50%, and at whatever percentage mix of 1s and 0s the error rate will be 50%** |
| **What is the BER of the best receiver?** | **Last receiver BER = 0.207** |

## Part 2

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| **Questions** | |
| **What is the BER of the best receiver?** | **The best receiver with 5 repetitions has a better BER at lower p values than 0.5  specifically at p = 0.2 the BER =0.0608** |
| **What is the expected (theoretical) BER if the number of repetitions is increase to 10?** | **Theoretically it should reach 0.049, by analysis of the valid bit condition from symbols (1-2\*p) = (1-2\*BER)^(N/2)** |
| **What is the cost/downside of using the transmitter in Part 2?** | **The number of repetitions means using more resources whether time or bandwidth** |

## Part 3

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| **Questions** | |
| **What is the BER of the best receiver?** | **The last receiver achieved similar results to the part 1 -a receiver with approx. 0.2 BER, the best so far is part2a** |
| **What is the reason behind such a performance?** | **The correlation between bits make them reducible to one bit similar to part1-a case** |

### Part 3-a

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| **Please insert the plot here** |

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| **Which of the three systems have the best performance in terms of BER?** | **Part 2-a with 5 repetitions** |
| **If the receiver you designed in any of the previous parts attain a BER more than 0.5, how can it be changed to attain a maximum of 0.5 BER?** | **Just flipping the logic of the system, would yield new BER of 1- old BER** |