

Student: Ty Davis

Course: ECE 5420

Subject: Programming Assignment 4 - M-ary Modulation

Date: November 2, 2025

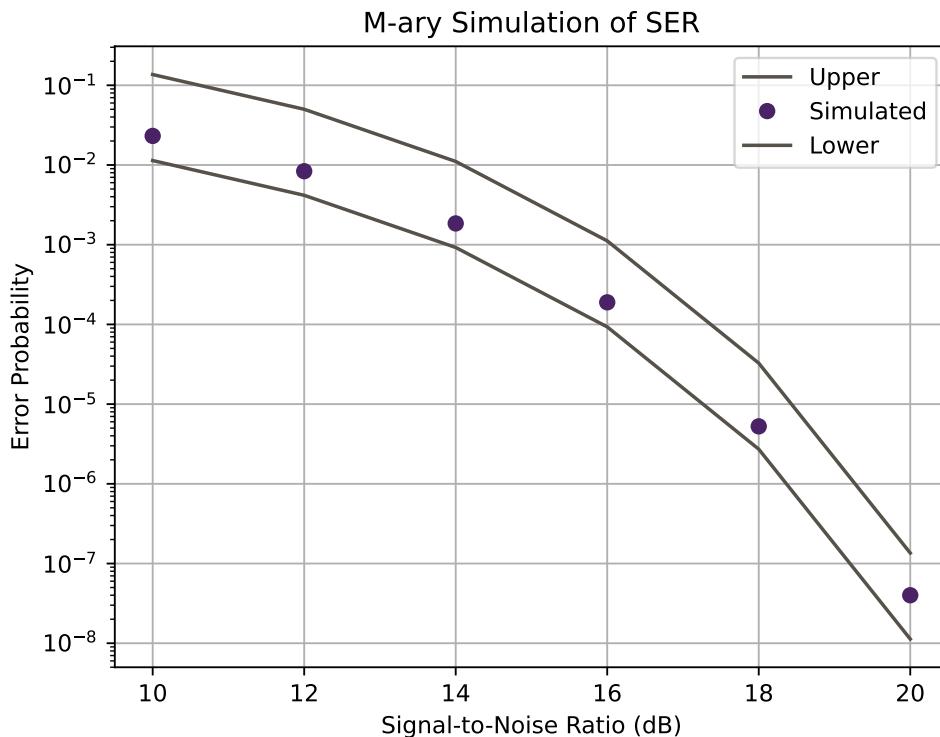


WEBER STATE UNIVERSITY
Engineering, Applied Science & Technology

DEPARTMENT OF
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The following are the values that I calculated for the assignment.

E_s	7	7	7	7	7	7
N_0	0.7	0.4417	0.2787	0.1758	0.1109	0.07
E_s/N_0	1.429	2.264	3.588	5.687	9.014	14.29
E_s/N_0 in dB	10	12	14	16	18	20
P_e Simulation	2.3157e-02	8.3524e-03	1.8483e-03	1.8658e-04	5.4100e-06	2.0000e-08
P_e Upper Bound	1.3645e-01	5.0009e-02	1.1078e-02	1.1169e-03	3.2663e-05	1.3546e-07
P_e Lower Bound	1.1371e-02	4.1674e-03	9.2314e-04	9.3075e-05	2.7219e-06	1.1288e-08



Output from the Python script:

```
SIM: 2.3157e-02    UPPER: 1.3645e-01    LOWER: 1.1371e-02
SIM: 8.3524e-03    UPPER: 5.0009e-02    LOWER: 4.1674e-03
SIM: 1.8483e-03    UPPER: 1.1078e-02    LOWER: 9.2314e-04
SIM: 1.8658e-04    UPPER: 1.1169e-03    LOWER: 9.3075e-05
SIM: 5.4100e-06    UPPER: 3.2663e-05    LOWER: 2.7219e-06
SIM: 2.0000e-08    UPPER: 1.3546e-07    LOWER: 1.1288e-08
```