2.2 Lab 2B: MIMO Detection Algorithms (MMSE and Singular Value Decomposition (SVD)) for a 4x4 System

MIMO systems can be used to increase data rate between users with multiple antennas. In this lab, you will implement decoding algorithms for 4x4 MIMO systems where the transmitter has 4 antennas and the receiver also has 4 antennas.

Goal: Implement two 4x4 MIMO systems, via simulation, for the following scenarios:

- The transmitter **does not** know the channel properties of the system.

- The transmitter **does** know the channel properties of the system.

All channels can be assumed as flat fading with timing synchronized.

Unlike the last part of this lab, you will have to construct the data you would like to send. You should use BPSK data (e.g. pulses of heights 1 and -1) and send it through a channel. This channel will be provided to you as a matlab function named MIMOChannel4x4. You should choose the appropriate decoder algorithm for each of the cases. Your options are

- Zero-forcing

- Minimum mean square error (MMSE)

- Singular Value Decomposition (SVD

Deliverables: Please turn in your MATLAB implementation for each of the scenarios *and* the corresponding report. Make sure to refer to the technical writing expectations for this course in the appendix as you write your report.

Table 2.2: Lab 2B Rubric

	Points	Self-Assessment
Introduction Section *Introduction of the goal of the lab and any contextual information*	5 points	
System Explanation *Explanation of the physical system; Diagrams are well suited to this*	10 points	
Explanation of the First Decoder *Explanation of the decoder algorithm you implemented for the first case. Include why you chose this algorithm.*	20 points	
Explanation of the Second Decoder *Explanation of the decoder algorithm you implemented for the second case. Include why you chose this algorithm.*	20 points	
Implementation Section *Discussion of your particular implementation that highlights any design decisions*	10 points	
Code Explanation *Explanation of your code that isn't super granular; Include a flow diagram for each algorithm implemented*	10 points	
Results Section *An overview of the results of your implementation; Include all plots that illustrate your implementation* *Include:* *- Plots that show the sent and received data before rounding* *- Plots that show the sent and received data after rounding* *- BER* *- Quantitative comparison between the two decoding algorithms (include SNR)* *- Qualitative comparison between the two decoding algorithms*	10 points	
Technical Writing *Refer to the technical writing guidelines*	10 points	
Self-Assessment *Fill out this rubric and include it in your submission.*	5 points	