ECE-361

Final Project Part 3

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A screenshot of a graph

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This project utilized both "Target Absent" and "Target Present" datasets to determine the most optimal thresholds using Youden’s index. By applying this threshold, we identified the best-fit probability distributions for each dataset, specifically the Rayleigh and Rician distributions, to model and generate new randomized and parameterized data. Through comprehensive analysis, performance indices were calculated under different signal processing strategies, including Arithmetic Mean, Maximum, and Geometric Mean, demonstrating significant improvements in detection accuracy and predictive performance compared to raw input data. Empirical metrics, such as the Area Under the Curve (AUC), error rates, positive predictive values (PPV), and performance indices, highlighted that the Geometric Mean approach yielded the highest AUC (0.941) and the lowest error rate (13/130), making it the most effective strategy. The study's results emphasize the value of signal processing in enhancing classification and detection capabilities within probabilistic frameworks. This project serves as a practical example of how statistical tools and probability analysis can be applied in engineering contexts to optimize decision-making processes. The ability to model, simulate, and automate such systems is invaluable, with applications spanning system diagnostics, resource management, and real-time monitoring to drive efficiency and accuracy in industrial and technological settings.