Automatic modulation classification of MIMO signals

Handan Agirman-Tosun

INTRODUCTION

The literature was searched for automatic modulation classification techniques for SISO systems. Basically, it is seen that two different approaches are proposed for this problem. One is likelihood-based approaches and the other is feature-based approaches. We chose feature-based modulation classification techniques due to less complexity and we simulated one of these techniques through MATLAB for differentiating QPSK and BPSK modulation types.

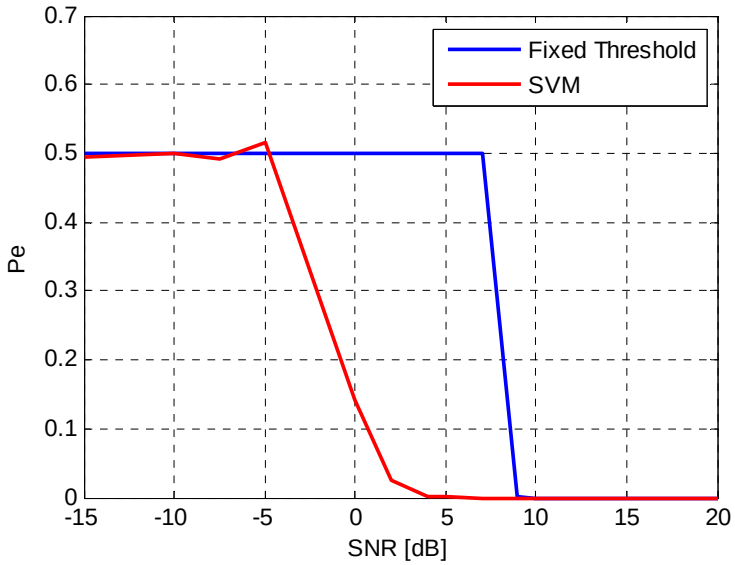
PROJECT OVERVIEW

The project is on the blind demodulation of MIMO-OFDM signals.

SUMMARY OF TECHNICAL EFFORTS

- We first searched the literature for possible modulation classification techniques. The methods studied in the literature can be classified as likelihood-based methods or feature-based. Likelihood-based modulation classification methods are generally complex in terms of computations. Feature-based methods require fewer computations and lower sample support. In these methods, modulation classification is carried out based on values of selected features. An important contribution in this field is a paper by Swami and Sadler, which some higher order cumulants of the signal to identify its modulation type. The main idea in the paper is to extract the higher order cumulants of the signal and compare it with a fixed threshold. On the other hand, as a machine learning approach Support Vector Machines use adaptive thresholds which are generated using training synthetic data.

- Due to the adaptive nature of threshold, we focused mostly on the support vector machine approach to modulation classification. With SVM, the machine learns the characteristics of the modulation by feeding it with synthetic data. When the training is completed, the machine predicts the modulation of data samples presented to it. We compared the performance of classification based on a theoretical threshold for the cumulant C40 with SVM classification using the C40 cumulant. The classification problem consisted of distinguishing between BPSK and QPSK. The below figure shows the probabilities of error in classification for the fixed threshold and for SVM.



Probability of error in classifying BPSK and QPSK using C40 with fixed threshold and using SVM.

We concluded that SVM provides much lower probability of error at SNR below 5 dB**.**

MAJOR DIFFICULTIES ENCOUNTERED

- No major difficulty is encountered.

ANTICIPATED EVENTS IMPACTING PROGRAM

-

WORK PLANNED FOR NEXT PERIOD

This month's work mostly was on modulation classification for only SISO systems. Moreover, it only considered the modulations types of QPSK and BPSK modulations. We are planning to extend this work to different modulations types and MIMO case.
Another future work will be the study of the blind channel equalization of MIMO systems.

PROJECT COST REPORTS

Project Summary

	Ceiling Price (Funded)	Through 31 Oct 08		01 Nov 08 - 30 Nov 08 This Period		Spent to Date as of 30 Nov 08				
		Hours	Cost	Hours	Cost	Hours	Cost	Obligated	Revised Total	Residual Ceiling Price (Funded)
Labor										
Materials										
Travel										
Miscellaneous										
Sub										
Totals:										

Ceiling Price (Funded) Expended: %

Period of Performance:

Invoiced to Date: $

Disbursements to Date: $

Labor - Detail

Labor Category	(A) All Previous		(B) This Period		(A+B) Spent to Date	
	Hours	Cost	Hours	Cost	Hours	Cost
Task #1						
Labor Category						
GRAND TOTAL						

Notes: