A Simple Automatic Modulation Classification Method using a Frequency Discriminator

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1 Introduction

An automatic modulation classification (AMC) has various military and civilian applications. There are several classifiers based on statistical moments [1], neural networks [2] and wavelet transforms [3], but these methods suffer from high computational costs. A simple classifier based on a frequency discriminator was proposed in [4]. We extend their method to M-ary FSK signals and evaluate the system performance.

2 Proposed Classifier

Our proposed classifier using a frequency discriminator is shown in Fig.1. For phase modulated signals, a phase is constant over each symbol interval and changes abruptly only at symbol boundaries. This causes the discriminator to produce a narrow pulse when a phase change occurs and a zero level otherwise. On the other hand, frequency modulated signals have a phase which is constantly changing. This results in a non-zero discriminator output, which can be easily distinguished from the output of a PSK signal. Also, the output level of a discriminator to M-ary FSK signals varies with the transmitted symbols. We can use this information to identify the levels in M-FSK modulated signals.

\[
P_c = 1 - \frac{1}{N_{mod}} \sum_{m=1}^{N_{mod}} P_c(m), \tag{1}
\]

where \( P_c(m) \) is the probability of correct classification for the \( m \)-th modulation format and \( N_{mod} \) is the number of potential choices of modulation formats.

When the number of symbols using in identification is 20, the average probability of identification error is less than \( 10^{-6} \) at values of SNR above 30dB. This shows that the performance of our method is good even in the presence of noise.

3 System Performance

The modulation formats considered here are 2-PSK, 2-FSK, 4-FSK and 8-FSK, but our method can easily be extended to M-ary signals. Fig 2 shows the average probability of identification error \( P_c \) defined by

![Fig. 1 Proposed Classifier](image1.png)

![Fig. 2 Average Probability of Identification Error \( P_c \)](image2.png)

4 Conclusions

We proposed a simple method to automatically identify PSK and M-ary FSK modulation schemes using frequency discriminator. Results from a digital implementation show that the performance of our method is good even in the presence of noise.

References


