

## Research on Blind Estimation and Synthesis of FM Speech Frequency Hopping Signal

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### Abstract

### Review Article

This paper mainly studies the blind estimation and synthesis of frequency hopping points of speech signals based on frequency modulation in the case of frequency hopping. FM voice frequency hopping signal transmitter and receiver are built based on MATLAB platform. The transmitter FM modulates the original signal and then performs frequency hopping processing; the receiver blind estimates the frequency hopping point of the received signal.

**Keywords:** FM modulation; MATLAB software; Frequency hopping signal; Blind estimation.

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## INTRODUCTION

Wireless communication is becoming more and more important in our life. Concealment and security are the characteristics of wireless electronic communication [1]. The emergence of frequency hopping technology improves the anti-interference ability of wireless communication. Blind estimation of frequency hopping signal parameters has become a hot topic.

YAO [2] proposed a fixed frequency interference removal algorithm based on time-frequency energy cancellation, and used the least square method to realize the blind parameter estimation of frequency hopping signal; GUO [3] proposed a method to estimate unknown frequency hopping signal parameters based on SPW time-frequency analysis; ZHAO [4] proposed a method to estimate the parameters of unknown frequency hopping signal by smoothing pseudo WVD time-frequency analysis; Fan<sup>[5]</sup> proposes a blind estimation method of frequency hopping signal parameters based on atomic

decomposition algorithm; Aiming at the difficulty of blind estimation of multi frequency hopping signal parameters in the case of frequency hopping mutual interference, Zeng [6] proposes a method of frequency hopping signal estimation under different speed frequency hopping mutual interference Parameter estimation method; Yan [7] analyzed the frequency hopping signal model and proposed an improved method based on sliding correlation and wavelet transform to better complete the detection and parameter estimation.

In this paper, a frequency hopping signal transmitter and receiver are built based on MATLAB platform, and the frequency hopping point of the received signal is estimated blindly by means of peak extraction and threshold segmentation.

### Design of communication system

The design flow chart of FM speech frequency hopping blind estimation is shown in Figure 1.

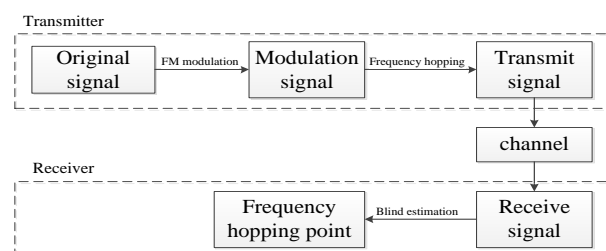


Fig-1: Design flow chart of FM speech frequency hopping blind estimation

The simulation process of blind estimation synthesis of frequency hopping signal is as follows: the fixed frequency signal is used to replace the speech signal and imported into Matlab for FM modulation. After frequency hopping, the hopping signal is transmitted from the transmitter to the receiver, and the receiver makes blind estimation of the frequency hopping point of the received signal.

The transmitter is mainly divided into two parts: 1. FM modulation of the signal; 2. Perform frequency hopping operation on the modulated signal. The essence of frequency hopping is the moving of signal spectrum [8], and its flow chart is shown in Figure 2.

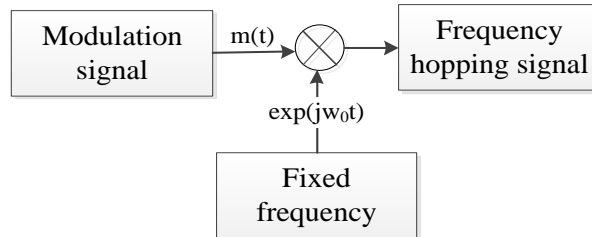


Fig-2: Frequency hopping flow chart

The expression of frequency hopping signal can be expressed as:  $S(t) = m(t) * e^{j\omega_0 t}$ .

Where  $m(t)$  is the modulated signal;  $\omega_0$  is the frequency hopping frequency, which is much larger than the center frequency of the carrier.

Blind estimation refers to the process of judging the parameters of the received signal without knowing any prior conditions. The peak extraction

function in MATLAB is used to extract the spectrum peak of frequency hopping signal, and the frequency hopping point can be determined according to the set threshold.

### SIMULATION ANALYSIS

The 500Hz sinusoidal signal is FM modulated to obtain the time domain diagram and frequency domain diagram of the modulated signal, as shown in Fig. 3.

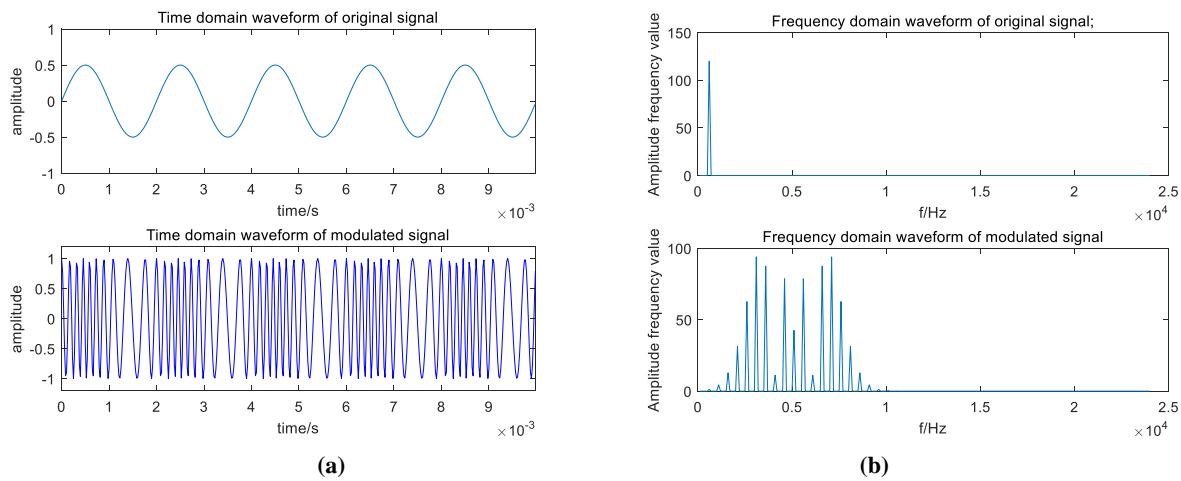


Fig-3: Modulated signal time/spectrum diagram

After obtaining the modulation signal, frequency hopping processing is performed on the modulation signal. We set the frequency hopping frequencies to 1000Hz, 1500hz and 2000Hz respectively. The frequency hopping frequency is used as the carrier of the modulation signal to obtain a frequency hopping signal that can propagate in space. The spectrum diagram of frequency hopping signal is shown in Fig. 4

Using the peak extraction function in MATLAB to extract the peak value of the signal, the frequency value of the frequency hopping signal can be obtained. The receiver knows the modulation frequency of the transmitter. Through demodulation, the receiver can obtain the frequency hopping point of the determined signal of the original signal, as shown in Fig. 5.

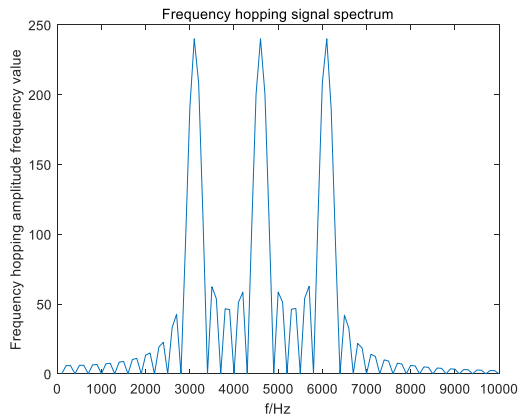


Fig-4: Frequency hopping signal spectrum

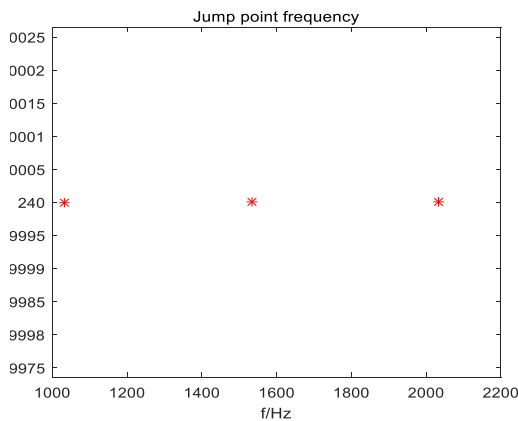


Fig-5: Spectrum diagram of jump point estimation

It can be seen from the observation of Fig. 5 that the jump frequencies of blind estimation are 1033Hz, 1533Hz and 2033Hz. It is basically the same as the set jump point.

## SUMMARIZE

The research on the blind estimation of frequency hopping signal parameters is a subject of great research significance. In this paper, a blind estimation model of frequency hopping point

parameters of frequency hopping signal is proposed and the model has the advantages of strong anti-interference ability, less computation and clear concept. The simulation results verify the effectiveness of the model and make a certain contribution to the research of blind estimation of frequency hopping points.

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