

# The Design of the UAV Ground Station and Radio Modulation

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**Abstract.** The take-off and landing stage in UAV, due to the complex terrain of landing and flight attitude control is difficult, the ground operators need to rocker landing on the ground controller to control the artificial take-off and landing aircraft. In order to make the aircraft landing task and high precision, high reliability, aiming at the status of the data exchange between ground stations and aircraft, and the transmission of the remote sensing image is done through the digital radio, choose suitable for the digital radio of the system are the main task of this paper. We will study of several commonly used modulation, through comparison and simulation to select out the way of digital modulation and digital radio.

## The Modulation Way

In digital communication systems, digital signal are through modulation function to the wireless transmission of high frequency band. In practical application, the choice of the modulation method for the situation of the project not only can realize the rapid transmission of information, can also adapt to the actual channel interference, when decoding get lower bit error rate, increase the anti-jamming ability and reliability of the communication system. So when you say, in the design of digital communication system, the choice of which digital modulation method is an important problem.

The following several kinds of commonly used modulation mode will be treated in research, and through comparison and simulation to select the comply with the requirement of the system of digital modulation methods and communication station. Modulation can be classified as analog and digital modulation, digital modulation of rf carrier usually refers to using the digital signal modulation, the modulation mode relative to the analogue modulation, with strong anti-interference ability, easy processing and encryption and other significant advantages. Similar to analogue modulation, digital modulation can modulating the amplitude, phase and frequency of the radio frequency carrier, but since the signal discontinuous respectively called amplitude keying (ASK), phase shift keying (PSK), frequency shift keying (FSK), etc.

ASK has the character of the constant envelope signals, not appropriate in the nonlinear and the existence of band-limited channel transmission, so generally does not directly used in wireless communication system.

BPSK modulation signal phase is continuous, and because the BPSK signal demodulation can't use the shunt filtering and envelope detection means, so generally adopt coherent demodulation, but the coherent demodulation in demodulation must have the same frequency synthetic synchronization of carrier, and easily when they are imperfect in synchronous phase ambiguity problem, cause reverse work, less so in actual application.

QPSK is a kind of linear modulation, signal amplitude modulation signal change, though it has high spectrum efficiency, but because of its discrete phase path feature, make the sidelobe roll-offs speed slow, large out-of-band radiation, to consider when choosing digital modulation way there are many factors that can influence, mainly has band utilization rate, error rate, out-of-band radiation, modulated signal envelope characteristics and so on. For any kind of digital modulation mode can't be in the advantage of all the factors, so the selection of modulation mode should be considered according to actual condition, choose suitable for the project of digital modulation mode. If to restrict sidelobe component in baseband signal into the higher cosine filter, its signal path passes through zero, envelope fluctuation is very big, the linear range of power amplifier is very

demanding.

MSK has the characteristics of constant envelope, continuous phase, and therefore there is no mutation of QPSK and envelope fluctuation problems. The modulation of amplifier with low dynamic range requirements, adjacent-channel interference is small, has a lower bit error rate, specific implementation is relatively simple. But although modulation signal has low sidelobe, but owing to lack of main lobe narrow, power spectrum is not compact, its spectrum utilization rate is not good enough.

GMSK modulation method is the improvement of MSK modulation mode, it also has the characteristics of the constant envelope and continuous phase. Compared with the MSK modulation, GMSK modulation is much more a gaussian filter, the input signal by gaussian filter, the first formed after the pulse envelope without steep edge is also a turning point, on the basis of MSK has been further smooth phase path, so GMSK signal power spectrum is more compact, improve the utilization rate of spectrum, spectrum characteristic is better. GMSK is another outstanding characteristic in nonlinear has better performance on mobile communication channel, and have high power efficiency.

Here we use the Matlab Simulink components of bit error rate, and several methods of modulation frequency characteristics are simulated.

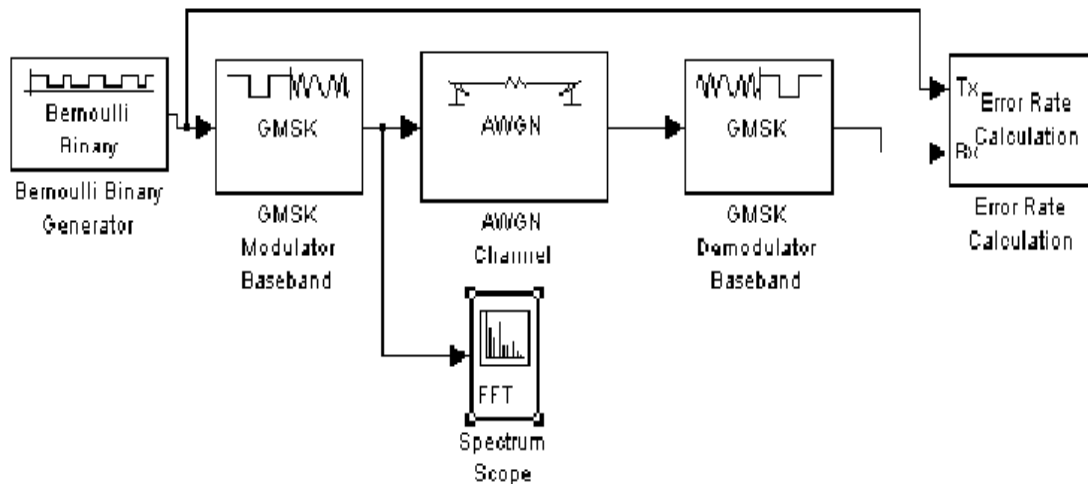


Figure 1. GMSK modulation mode simulation diagram

As shown in Fig.1, we use the most on the left side of the Bernoulli binary sequence generator signal generation, signal through a GMSK Modulator by white gaussian noise channel after demodulation signal, again after the last use of the Error Rate Calculation module can calculate the system bit Error Rate, other modulation methods. We get the bit error rate of each modulation scheme analysis diagram is shown in Fig.2.

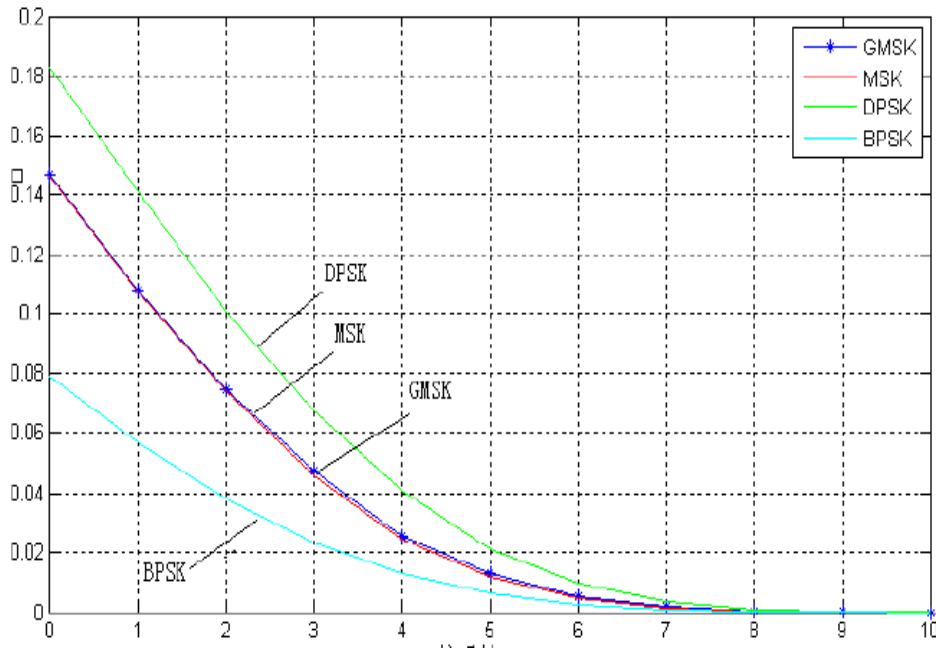


Figure 2. comparing with several methods error rate modulation

Curve can be analyzed by the picture that BPSK modulation ber is the lowest, followed by GMSK and MSK, both in the same bit error rate, DPSK is relatively high. Fig.3 is several methods of modulation spectrum diagram.

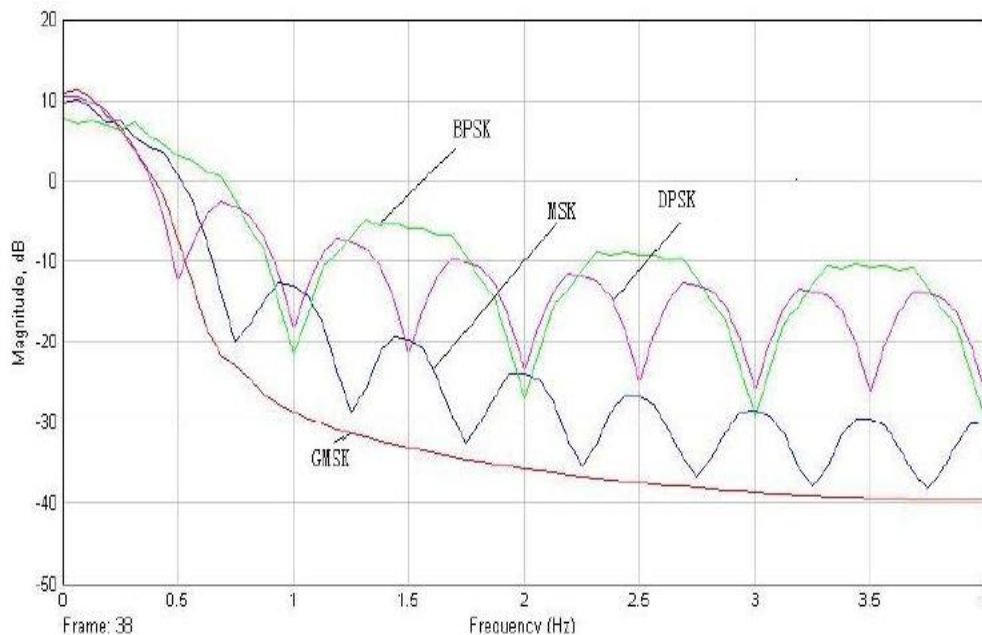


Figure 3. several methods of modulation spectrum diagram

According to the above two kinds of simulation and the analysis and comparison, in front of the analysis we draw the following conclusion:

ASK and the way of BPSK due to the constant envelope and phase fuzzy problems generally does not use in the practical application;

Although QPSK has good spectrum efficiency, but under the condition of nonlinear amplification, the performance of QPSK is very limited, the extent of change range is big, big envelope fluctuation, high demand for linear range of power amplifier, and power efficiency is low; GMSK and MSK have constant envelope, continuous phase, the dynamic range of the amplifier

requires a lower low, adjacent-channel interference, etc.

### **The Choice of Radio**

In front of the research and analysis of digital modulation, we selected the GMSK modulation mode as digital modulation way of communication system. In this project, we select a meets the system requirements of wireless digital radio - day ND250A, it has small volume, light weight, long transmission distance, high transmission reliability, etc.

### **Summary**

Although, by contrast, GMSK ber slightly tall, but GMSK modulation has good out-of-band power spectrum roll-offs characteristics, advantages, such as signal power is concentrated, making GMSK has better resistance to adjacent frequency signal interference capacity and spectrum efficiency. We select GMSK modulation radio as a digital modulation mode.

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