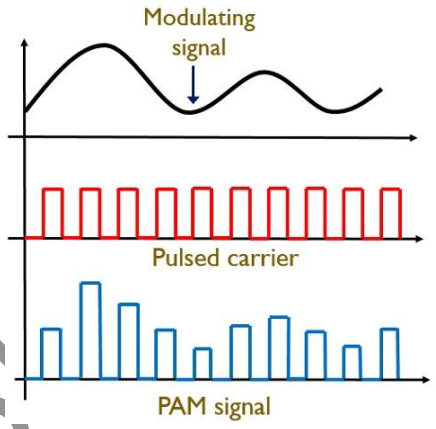
Analog Pulse Modulation: Basic Principles – PAM, PPM and PWM:

Analog modulation refers the modulation process of transferring or transmitting a low frequency (narrow band) analog data signal like an audio or TV signal or a Phone call using high frequency carrier signal in radio frequency band.

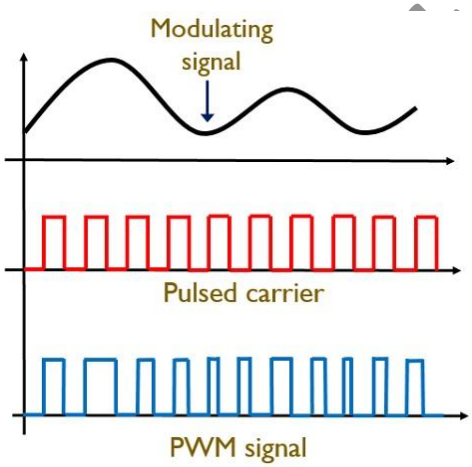
Analog Pulse Modulation is that modulation process through which a carrier wave as a pulse is used for exchange data or for transmission of data (here data signal is actually modulating signal) in analog form.



There are several types of pulse modulation because this can be done either through Amplitude modulation called Pulse Amplitude Modulation (PAM) or through phase modulation called Pulse Position Modulation (PPM) or through the modulation of width of the carrier pulse called Pulse Width Modulation (PWM).

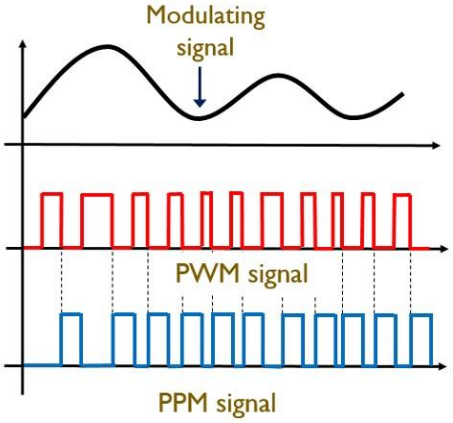
This pulse modulation is used for analog-to-digital conversion.

Pulse Amplitude Modulation (PAM) is an analog modulation process in which the amplitude of the pulse carrier varies proportionally to the instantaneous amplitude of the message signal or data signal or modulating signal. In this modulation process, the message information is encoded in the amplitude of a series of carrier pulses.



Since in this modulation process, the amplitude of the pulsed carrier signal is changed according to the amplitude of the message signal, we can see from figure as shown that the amplitude of the carrier pulses is varying with respect to the amplitude of analog modulating signal, like in case of amplitude modulation (AM). But the major difference is that unlike AM, here the carrier wave is a pulse train rather than continuous wave signal.

Pulse-Width Modulation (PWM) is that modulation process in which the width of the carrier pulse varies according to the amplitude of the message signal or modulating signal. In this technique the amplitude of the carrier signal is constant and only the width is varying. PWM technique is similar to frequency modulation (FM) because by the variation in the width of the pulses, the frequency of the pulses in the PWM signal shows



variation.

Pulse-Position Modulation (PPM) is a form of signal modulation in which message bits or message signal is encoded by transmitting carrier pulse in one of possible required time shifts.

Basically it is a technique in which the position of the pulses is changed in accordance with the amplitude of the modulating signal.

Here the carrier pulse amplitude and width both remain constants and these do not show variation with the amplitude of the modulating signal but only the position of carrier pulse shows variation. It is to be noted here that the position of the pulse changes according to the reference pulses. And these reference pulses are nothing but PWM pulses.

If we compare these three types of Analog Pulse Modulation, we can say that

1. In PAM amplitude of the pulse shows proportionality with the amplitude of modulating signal.

In PWM width of the pulses shows proportionality with the amplitude of the message signal whereas in PPM the position of the pulses is proportional to the amplitude of analog modulating signal.

2. PAM technique shows low immunity towards the noise. PWM and PPM has low noise interference factor because their noise immunity is high.

3. In PAM and PWM techniques, transmitter and receiver synchronization is not required. But PPM technique needs synchronization between transmitter and receiver section.

4. The transmission power in case of PAM and PWM is variable due to variation in amplitude and width respectively. However, it is constant in case of PPM because both amplitude and width are constant in case of PPM.

5. As the position of the pulses is changed in PPM, therefore it requires synchronization pulses. While both PAM and PWM do not require synchronization pulses.

6. All PAM, PWM and PPM show similarity in implementation with AM, FM and PM respectively.

7. The bandwidth requirement is low in case of PAM but is comparatively high in case of PWM and PPM.