

## PULSE MODULATION: AN IN-DEPTH REVIEW

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**Abstract:** In the communication system modulation is the important part. This paper reviews the concept of the modulation, pulse modulation in details and apart from that also focus on the categorization of the same.

**Keywords:** Pulse Modulation, Modulation, Demodulation.

### I. INTRODUCTION

Modulation is the way toward changing the qualities of the bearer signal as per the prompt estimations of the balancing signal ( message signal). Modulation is extensively arranged into two classes in particular simple modulation and the advanced modulation. Simple modulation is additionally isolated into two classes dependent on the criteria that in one sort the nonstop sinusoidal wave is utilized known as consistent wave modulation while in other rather than ceaseless wave pulses are utilized known as pulse modulation [1] Pulse modulation is the sort of simple modulation just in which the bearer is in the previous pulses as opposed to having the consistent sinusoidal wave. Pulse modulation is additionally grouped into three classes dependent on that which attributes of the pulse to change as PWM( pulse width modulation ) PPM ( pulse position modulation)and PAM ( pulse plentifulness modulation ).[1]

### II. PULSE WIDTH MODULATION

Pulse width modulation is the technique for decision to control present day power electronics circuits. The fundamental thought is to control the duty cycle of a switch with the end goal that a heap sees a controllable normal voltage[2]. To accomplish this, the exchanging recurrence or redundancy recurrence of the PWM signal is picked sufficiently high that the heap can't pursue the individual exchanging occasions. Exchanging, as opposed to direct task of the power semiconductors, is obviously done to boost the productivity in light of the fact that the power scattering in a switch is in a perfect world zero in the two states. In a commonplace case, the exchanging occasions are only a haze to the heap, which responds just to the normal condition of the switch.

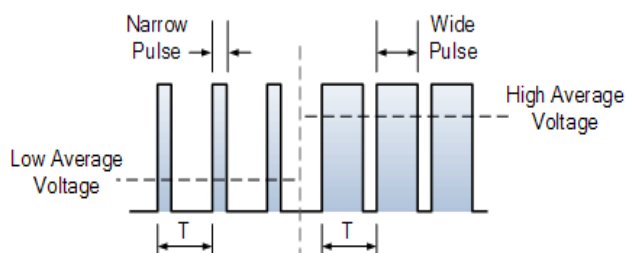


Fig 1. Pulse Width Modulation

There are various distinctive strategies to produce intermittent rectangular waveforms with a differing duty cycle[2] A standard strategy is the alleged transporter based PWM method, which analyzes a control signal with a triangle (or sawtooth molded) waveform. . By contrasting this signal and a reference level, which can shift somewhere in the range of 0 and 1 V, a PWM signal with a duty cycle somewhere in the range of 0 and 100% is created. Since of the triangular transporter, the connection between the reference level and the subsequent duty cycle is direct. This technique works great for duty cycles in the range from 5% up to 95% However, on the off chance that the reference signal surpasses 100% or falls beneath 0%, the subsequent PWM signal would be dependably on or constantly off, individually. This is called overmodulation. This routine must be maintained a strategic distance from by appropriate molding of the control signal. What's more, for control signals bringing about PWM signals with duty cycle esteems as high as 99% or as low as 1%, the switch may never completely achieve the contrary state and invest an undue measure of energy in changes. Subsequently, it is normally prescribed to confine the control signal to arrange, which maintains a strategic distance from overmodulation just as incredibly thin pulses. [3]

#### 2.1 Sinusoidal Pulse Width Modulation

Notwithstanding a DC reference signal, some other waveform could be utilized as the modulation signal as long as the most noteworthy recurrence of its AC parts are no less than a request of extent not exactly the recurrence of the transporter signal. To create a sinusoidal output voltage for an inverter, which is frequently wanted, the bearer can be adjusted with a sinusoidal reference signal. The proportion between the bearer recurrence and the recurrence of the modulation signal is lower than suggested for real implementation [4].

The subsequent sinusoidal PWM voltage drives one stage slack of an inverter. In the event that the voltage level is 1, the upper switch is on, and the other way around. In the wake of sifting through the exchanging recurrence segments, the subsequent output voltage has the shape and recurrence of the modulation signal. For the rest of the stage legs, a similar system, with reference signals that are stage moved by 120 and 240 degrees, is utilized. The adequacy of the output voltage can be controlled by fluctuating the proportion between the pinnacle of the modulation signal and the pinnacle of the transporter wave. On the off chance that the sufficiency of the modulation signal surpasses the adequacy of the transporter, overmodulation happens and the state of the key of the output voltage veers off from the modulation signal. Prior, in light of the fact that the distinction between

the exchanging recurrence and the key is a lot bigger. In this way, the bearer recurrence parts can be effectively evacuated with LC channels of little size [4]. Also, the adequacy of the output voltage can be controlled essentially by changing the plentifulness proportion between the modulation signal and the transporter. In the event that six-advance modulation is utilized, the DC transport voltage would need to be controlled so as to control the abundance of the output voltage.[4]

### 2.2 Space Vector Pulse Width Modulation

The Space Vector Pulse Width Modulation is a quick, progressed and productive Pulse width modulation method among all others for VSI sustained burdens with predominance of good DC usage voltage and less symphonious issues when contrasted with other techniques[4]. It has extraordinary on off exchanging succession of the upper three power gadgets of a three-stage voltage source inverters connected for 3phase loads. It is an all the more delicate procedure for creating sine wave that gives a higher voltage to the heap side with lower all out symphonious contortion. Space Vector Pulse Width Modulation is smarter to use in general for exchanging recurrence as opposed to picking separate modulator for each stage. As the Space Vector Pulse Width Modulation is more confused than SPWM than to its simple to use with modern DSP based control circuits for rising applications.

### III. PULSE CODE MODULATION

Pulse Code Modulation is first presented by Alec Reeves in the year 1937. In the pulse code modulation, Analog Signal is reproduced to digital signal for simplicity of transmission by utilizing the analog signal examples. In specialized terms, PCM will transmit the analog in a digital form, whose signal is tested at customary interims of time and quantized at same quantum levels to digital code. We realize that digital code is only parallel code which comprises of 1's and 0's that is logic1 and logic0. So we will transmit the digital information as 1's and 0's. At the point when the signal is gotten by the recipient, demodulator in the beneficiary will demodulate the parallel signal once more into pulses with same quantum levels like in modulator and these pulses are again utilized for recovering the required analog signal. [5]

#### Advantages of Pulse Code Modulation

- Pulse code modulation is utilized in media transmission frameworks, airport regulation frameworks and so forth.
- Pulse code modulation is utilized in packing the information that is the reason it is utilized in putting away information in optical plates like DVD, CDs and so forth. PCM is even utilized in the database the executives frameworks.
- Pulse code modulation is utilized in cell phones, typical phones and so forth.
- Remote controlled vehicles, planes, trains use pulse code modulations.[5]

### IV. PULSE AMPLITUDE MODULATION

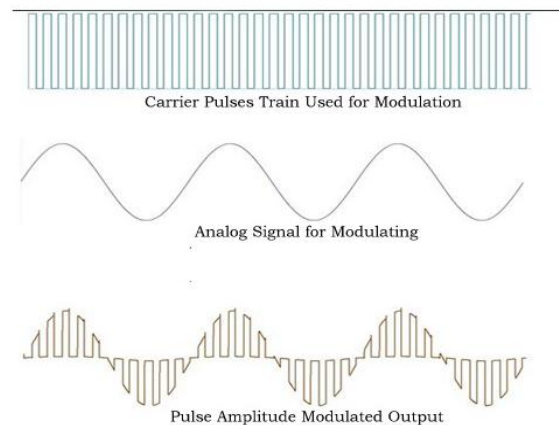


Fig 2. Pulse Amplitude Modulation

In pulse amplitude modulation, the amplitude of ordinary interim of occasional pulses or electromagnetic pulses is differed in suggestion to the example of regulating signal or message signal. This is an analog kind of modulation. In the pulse amplitude modulation, the message signal is tested at normal occasional or time interims and this each example is made relative to the extent of the message signal. These example pulses can be transmitted straightforwardly utilizing wired media or we can utilize a transporter signal for transmitting through wireless. [6]

#### Applications:

- It is for the most part utilized in Ethernet which is kind of PC arrange correspondence, we realize that we can utilize Ethernet for interfacing two frameworks and exchange information between the frameworks. Pulse amplitude modulation is utilized for Ethernet interchanges.
- It is likewise utilized for photograph science which is an investigation of photosynthesis.
- Utilized as electronic driver for LED lighting.
- Utilized in numerous micro controllers for creating the control signals and so forth.

### V. PULSE POSITION MODULATION

In the pulse position modulation, the position of each pulse in a signal by taking the reference signal is varied by the precedent estimation of message or tweaking signal quickly. In the pulse position modulation, width and amplitude is kept unflinching. It is a framework that uses pulses of a comparative breath and stature anyway is removed in time from some base position as demonstrated by the amplitude of the signal at the period of testing. The position of the pulse is 1:1 which is propositional to the width of the pulse and furthermore propositional to the brief amplitude of tried controlling signal. The position of pulse position modulation is basic when stood out from other modulation. It requires pulse width generator and monostable multivibrator. [7]

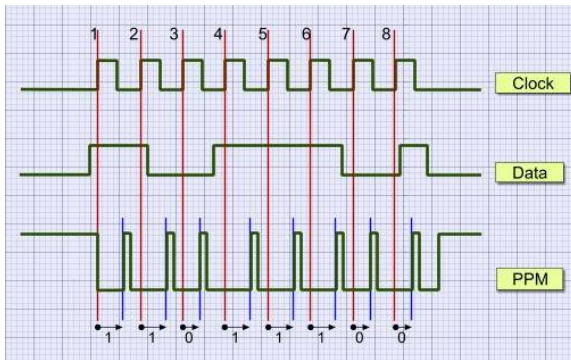


Fig 3. Pulse Position Modulation

Pulse width generator is used for creating pulse width modulation signal which will trigger the monostable multivibrator, here starter edge of the PWM signal is used for setting off the monostable multivibrator. In the wake of setting off the monostable multivibrator, PWM signal is changed over into pulse position modulation signal. For demodulation, it requires reference pulse generator, flip-flop and pulse width modulation demodulator.[7]

Applications :

- Utilized in non sound recognition where a collector does not require any Phase lock circle for following the period of the bearer.
- Utilized in radio recurrence (RF) correspondence.
- Likewise utilized in contactless keen card, high recurrence, RFID (radio recurrence ID) labels and so on.

## VI. PULSE WIDTH MODULATION

It is a sort of analog modulation. In pulse width modulation or pulse duration modulation, the width of the pulse transporter is differed as per the example estimations of message signal or adjusting signal or balancing voltage. In pulse width modulation, the amplitude is made steady and width of pulse and position of pulse is made proportional to the amplitude of the signal. We can shift the pulse width in three different ways [8]

- By keeping the main edge steady and shift the pulse width concerning driving edge
- By keeping the following steady.
- By keeping the focal point of the pulse steady..

Applications:

- PWM is utilized in media transmission frameworks.
- PWM can be utilized to control the measure of power conveyed to a heap without causing the misfortunes. Along these lines, this can be utilized in power conveying frameworks.
- Sound impacts and enhancements purposes additionally utilized.
- PWM signals are utilized to control the speed of the robot by controlling the motors.
- PWM is additionally utilized in mechanical technology.
- Inserted applications.
- Analog and digital applications and so on.

## VII. CONCLUSION

This paper provides the complete information about the concept of the pulse modulation and the various types of the pulse modulation techniques and also provides the clear idea about the concept and its applications.

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