2.3 Carrier-Based PWM Schemes

In the context of power electronics, **Carrier-Based PWM (CBPWM)** is a category of modulation schemes that compare a reference signal with a carrier signal to generate the switching pulses required for converters or inverters. These schemes are commonly used in AC motor drives, DC-DC converters, and other power electronic systems.

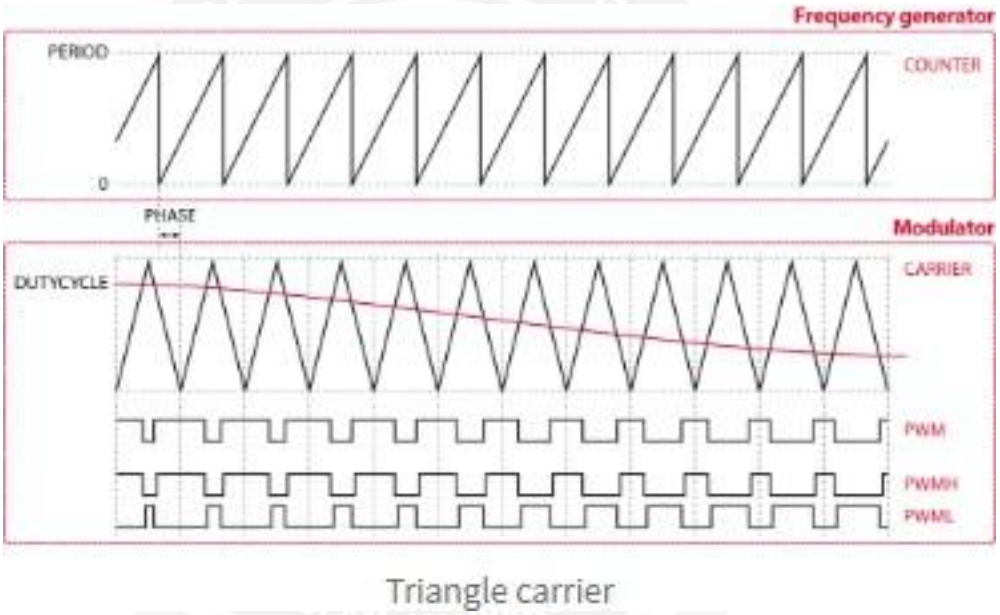

Figure 2.3.1 Carrier-Based PWM

[Source: "Power Electronics" by P.S.Bimbra, Khanna Publishers Page: 382]

Types of Carrier-Based PWM Schemes:

1. **Sinusoidal PWM (SPWM):**
   - **Concept**:In SPWM, the modulating (reference) signal is a sinusoidal wave, and the carrier signal is typically a triangular or saw tooth waveform. The switches in the inverter or converter are turned ON and OFF based on the comparison of the sinusoidal reference with the high-

frequency triangular carrier.

- **Applications**: It is commonly used in motor control and voltage - source inverters.
- **Advantages**: Simple to implement, provides good harmonic performance at moderate switching frequencies.
- **Disadvantages**: At high modulation indexes (close to the DC bus limit), the amplitude of the fundamental output voltage is limited.

2. **Space Vector PWM (SVPWM):**
   - **Concept**: SVPWM is a more advanced form of PWM, where the reference signal is represented as a space vector in a 2D plane.The switching states of the inverter are chosen to approximate the reference vector with optimal performance.

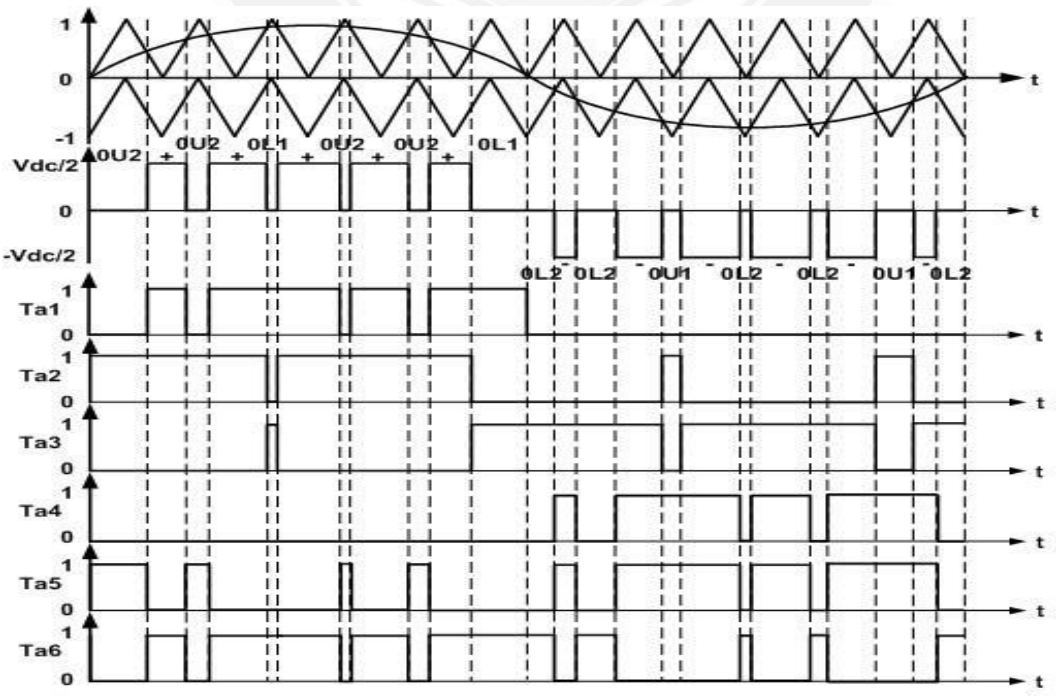

Figure 2.3.2 Space Vector PWM

[Source: "Power Electronics" by P.S.Bimbra, Khanna Publishers Page: 391]

Advantages: Higher efficiency, better utilization of the DC bus voltage compared to SPWM, and lower total harmonic distortion (THD).

3. **Hysteresis Band PWM (HB-PWM):**
    - **Concept**: In this scheme, the reference signal is tracked with in a hysteresis band. The switches turn ON when the actual current/voltage falls below the lower limit of the hysteresis band and turn OFF when it exceeds the upper limit.
    - **Advantages**: Fast response, simple implementation.
    - **Disadvantages**: Variable switching frequency, which can cause EMI issues.
    - **Applications**: Often used in current control applications for AC motors.
4. **Delta Modulation PWM:**
    - **Concept**: Delta modulation compares the instantaneous error between the reference signal and the output signal. The system responds based on whether the error is positive or negative, adjusting the PWM signal accordingly.
    - **Advantages**: Adaptive switching frequency depending on system requirements.
    - **Disadvantages**: Can lead to frequency variations, which might cause EMI.
    - **Applications**: Systems that need dynamic response adjustments.