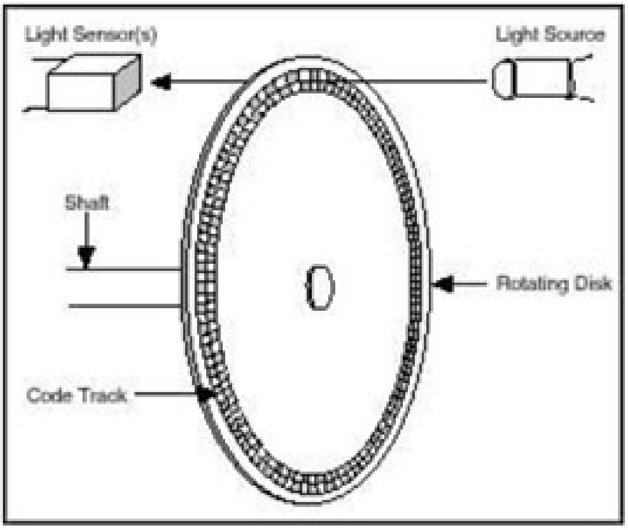
Photoelectric encoder

Basic principle:

The photoelectric encoder consists of three parts, including a light-emitting diode, a code disk and a light sensor on the back of the code disk.



The code plate is mounted on the axis of rotation and is evenly arranged with opaque and transparent fan areas. As the dial rotates, the opaque part blocks the light, while the transparent part allows light to pass through. The light sensor on the back of the dial periodically receives the light signal and outputs a series of square waves.

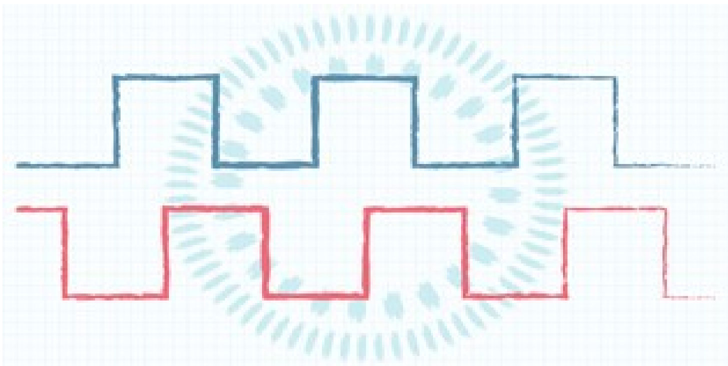
We know that the number of pulses output by the optical sensor is fixed when the code disk rotates once a time. By detecting the number of pulses received in a certain period, we can know how many turns the code disk rotates during this period, and then convert it into speed. For example, when a code disk rotates once, it outputs 100 pulses, and we receive 500 pulses within 0.1s, which means that the code disk rotates for 5 weeks within 0.1s, that is, the speed of the code disk is 50r/s.

But there is a problem. Suppose that the encoder outputs only A column of square waves (suppose A), how can we tell whether the code disk is spinning forward or backward? Because the same square wave is produced by either the forward or the reverse, and their contribution to the velocity is obviously opposite!

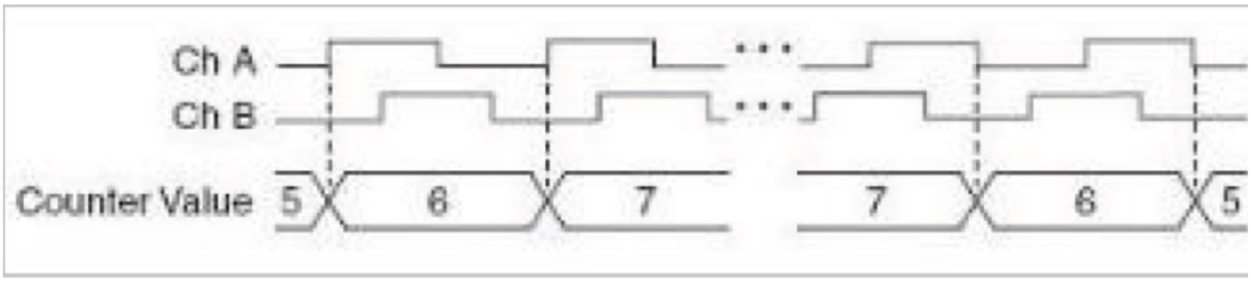
Let's take a look at how this problem can be solved:

As we have said above, the code plate is evenly engraved with both transparent and opaque fan regions, and we are evenly engraved with a circle of transparent and opaque fan regions within this circle. The difference is that the outer circle and the inner circle are "staggered". In other words, when the outer ring is in the light-tight region, the corresponding half of the inner ring is the light-tight region and the other half is the light-tight region. When the outer ring is in the pervious to light area, the corresponding half of the inner ring is the pervious to light area and the other half is the pervious to light area.

Therefore, when the code disk is rotated, the encoder will output two columns of phase difference of 90° square wave, the waveform is as follows:



The figure on the left below shows the waveform at positive turn and the figure on the right shows the waveform at reverse:



When the code plate is turning forward, square wave B is always at the low level along the rising edge of square wave A. When the code plate is reversed, the rising edge of square wave A and square wave B remain at A high level. By judging the level state of B when A is in the rising edge, the direction of code circling can be conveniently known.

Speed calculation:

Different types of encoders, the number of pulses output by code rotation is different. The number of pulses output by code rotation this time is 90, and the diameter of the car wheel is 75mm.

If the effective pulse number we counted in time T is S (positive rotation pulse number +1, reverse pulse number -1), the diameter of the car wheel is D, and the PI (about 3.14), then the speed conversion formula of the car is as follows:

$$V = pi*S*D / (90*T)$$

For example, we count the number of effective pulses every 1 s, and the number of effective pulses obtained at a certain time is 500, then the speed of the car at this time is:

$$V = 3.14*500*75*10^{(-3)}/(90*1) \approx 1.31 \text{ m/s}$$