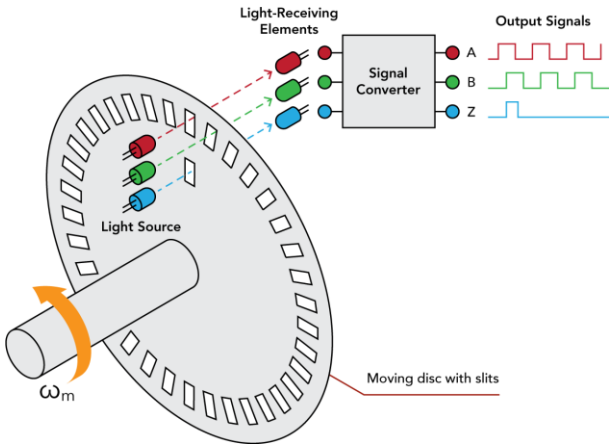
A quadrature encoder is an electromechanical device that converts rotational position into electrical signals. It is an incremental encoder that generates pulses in response to changes in position.



A quadrature encoder consists of a **disc** with slits and **two photoelectric sensors** (commonly referred to as channels A and B). The sensors detect the rotation of the disc by measuring light passing through the slits. These sensors are connected to a signal converter, which converts the rotational motion into electrical signals. The two signals are **phase-shifted by 90 degrees**, enabling the system to determine both the **speed** and **direction** of the rotation.

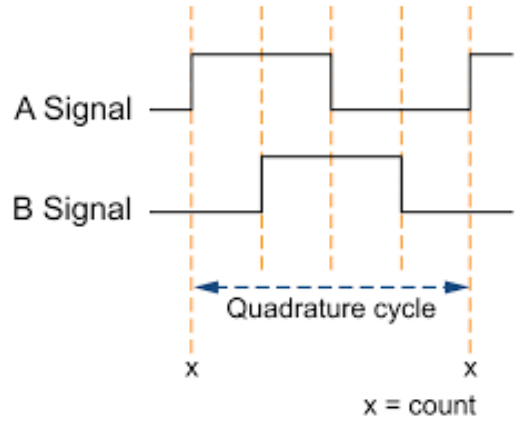
When the disc rotates, light passes through the slits in the disc, allowing the sensors to detect position changes. Using the **rising and falling edges** of signals A and B, the encoder can detect the direction of rotation. The system is typically programmed such that:

- If the **rising edge of A** is detected before **B**, the device is rotating **clockwise**.
- If the **rising edge of B** is detected before **A**, the device is rotating **counterclockwise**.

There is also a third signal, called the **Z signal** (or index), which provides a reference pulse once per revolution. This signal is used to mark a known position, which is useful for homing or resetting the position counter.

4 times the accuracy of an Encoder

As seen in the figure below we have taken an example of signal A and signal B. The encoder catches the four state of both signals phase shifted by 90 degrees.



The encoder catches 4 states of the signals mentioned below:

1. Rising of Signal A
2. Rising of Signal B
3. Falling of signal A
4. Falling of signal B

With capturing these 4 stages the quadrature encoder gets the 4x accuracy that is required.

Image References:

1. https://www.futek.com/Incremental-Encoder-Signal-Converter
2. **https://docs.baslerweb.com/encoder-control#**