EIPC
NEE-403
Unit-2
Velocity measurement

Transducers of velocity

By electronic differentiator or integrator

As far as we know the linear displacement, finding of velocity can be done by differentiator. If it is an analog signal, op-amp differentiator may be used. If it is a digital signal, then use numerical methods for the differentiation.

However, it is more usual to employ an acceleration transducer and an integrator, because differentiation accentuates the high frequency noise while integrating reduces the high frequency noise.

Induction method

If a coil is moving inside a magnetic field is moved to cut directly across the lines of flux, then a voltage is induced in the coil :

$$e = B * a * n * v$$

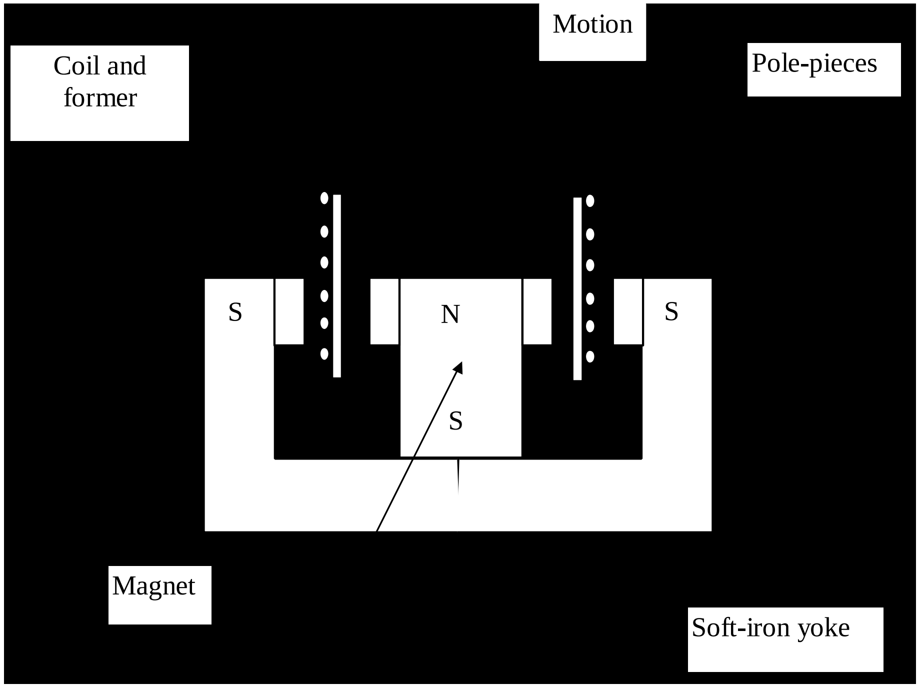
where B is the flux density

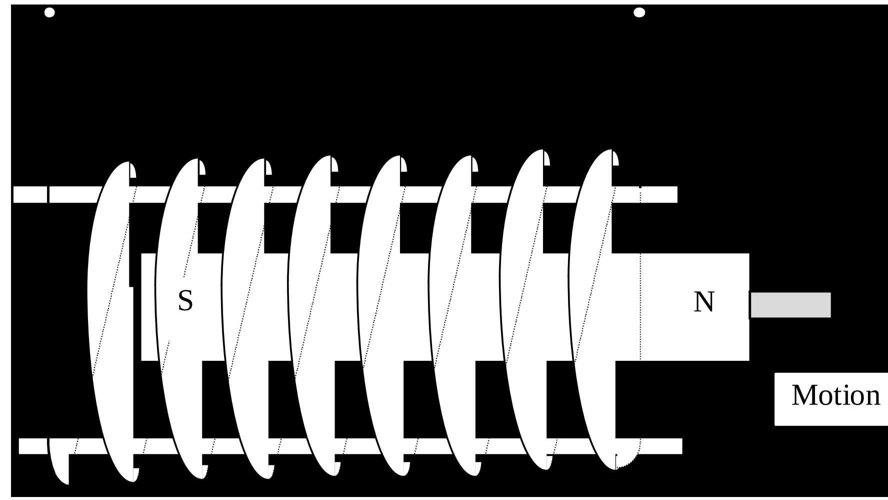
a is area of the coil

n is number of turn of the coil

v is relative velocity between the coil and the field

Therefore e is proportional to v, when other parameters are constant. There are mainly two types --- moving coil and moving magnet.





Moving coil transducer

Moving magnet transducers

Doppler effect

It is most common means of measuring remote moving objects. The police radar trap is a well known example of this technique.

The Doppler effect is a very effective and accurate means of measuring velocity. If a narrow radio beam or ultrasonic beam is aimed at an object the beam will be reflected back to the source. However, if the object is moving the frequency of the received signal differs from that of the transmitted signal.

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- The difference between the two frequencies being a measure of the velocity of the moving object. The received frequency will be higher than the transmitted frequency if the moving object is travelling towards the receiver and lower if the object is travelling away.

Digital methods

By counting the number of pulse per unit time from the incremental encoder linear encoder, we can know the linear velocity. Its principle is the same as the digital method in angular velocity, hence please refer to that section for details.

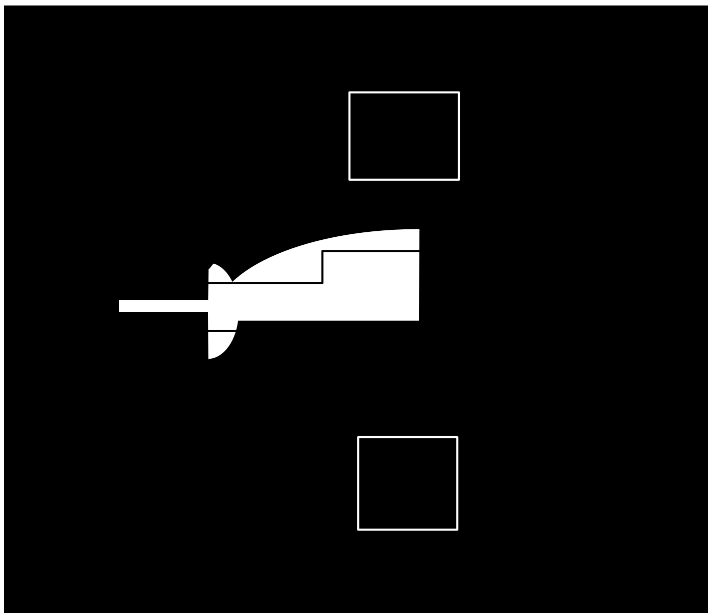
Angular velocity

Analog method

Tachometer. There are two main types -

- d.c. tacho and
- a.c. tacho.

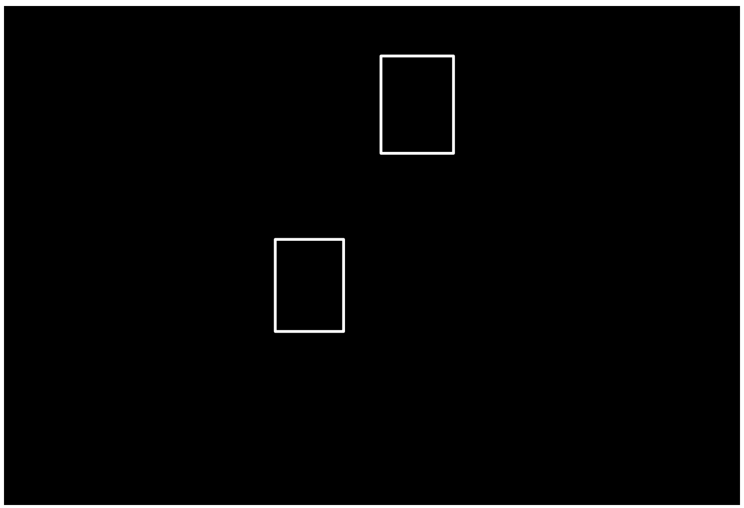
D.C. Tacho



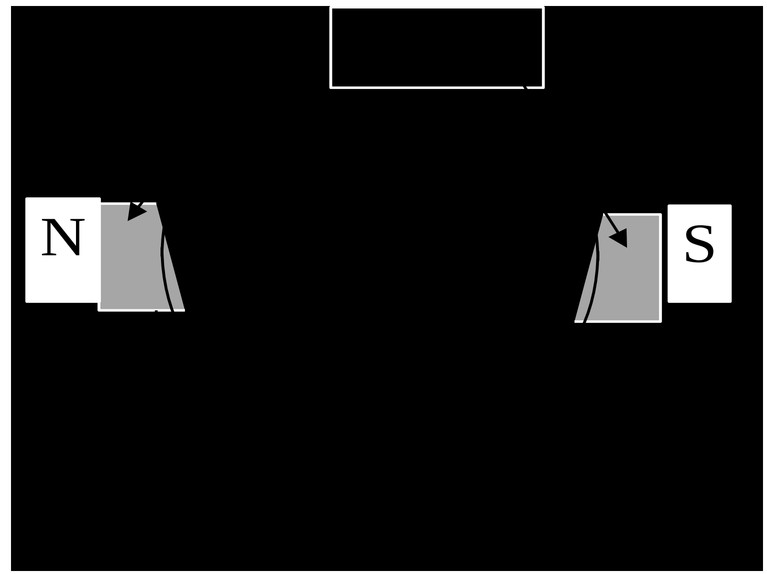
The device is very convenient and widely used in control systems where velocity feedback is required, but is unsatisfactory for precision measurement because of unavoidable ripple (due to the finite number of poles) and because of spikes due to the slip rings. The a.c. tacho is better in this respect.

A.C. Tacho

The below shows two a.c. tachometer in which both the magnitude of the generated e.m.f. and its frequency are proportional to the angular velocity.



A.C. tacho with moving magnet and stationary coils



A.C. tacho with stationary magnet and coils

Note: The direction of rotation is indicates by the sign of the DC voltage in DC tachometer, while AC tachometer does not indicate the direction of rotation.

Digital method

By counting the number of pulses per unit time from a digital angular displacement encoder.

The resolution depends on number of pulse per revolution of the encoder and the length of the unit time base.

Thank You