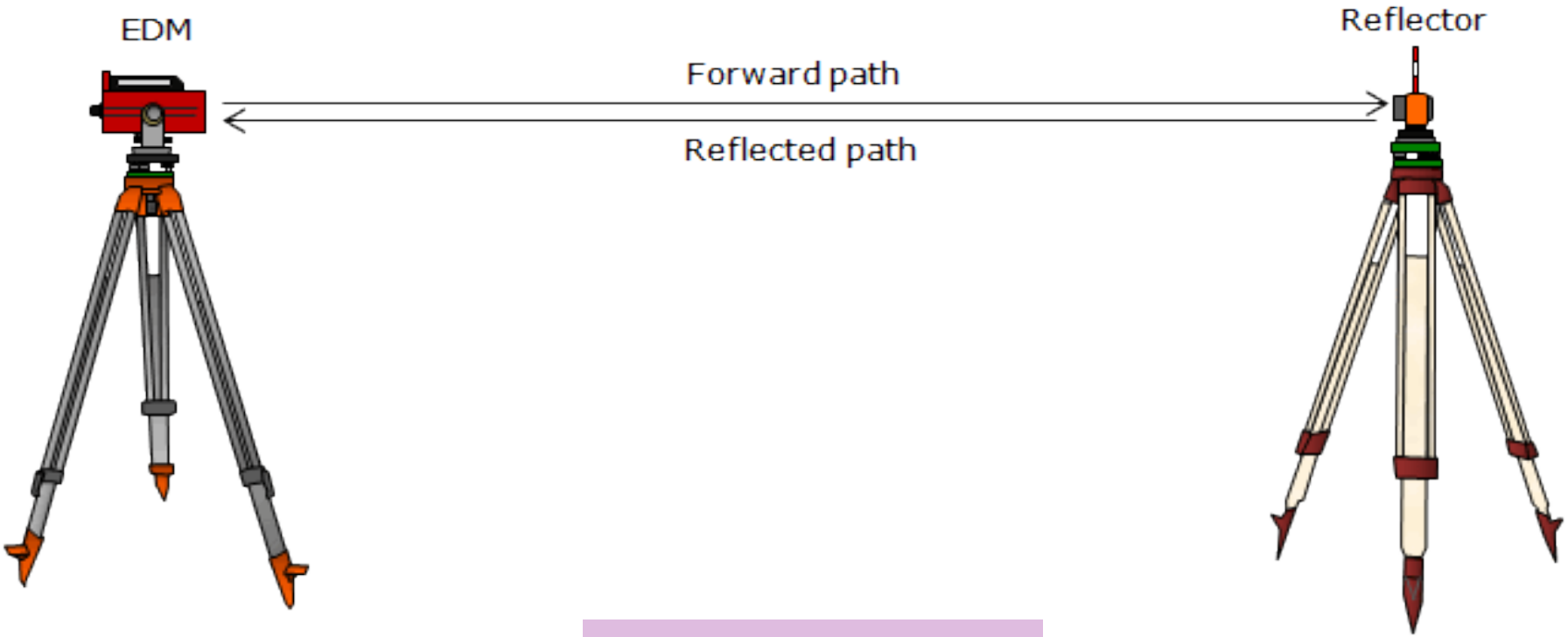
Survey Equipment

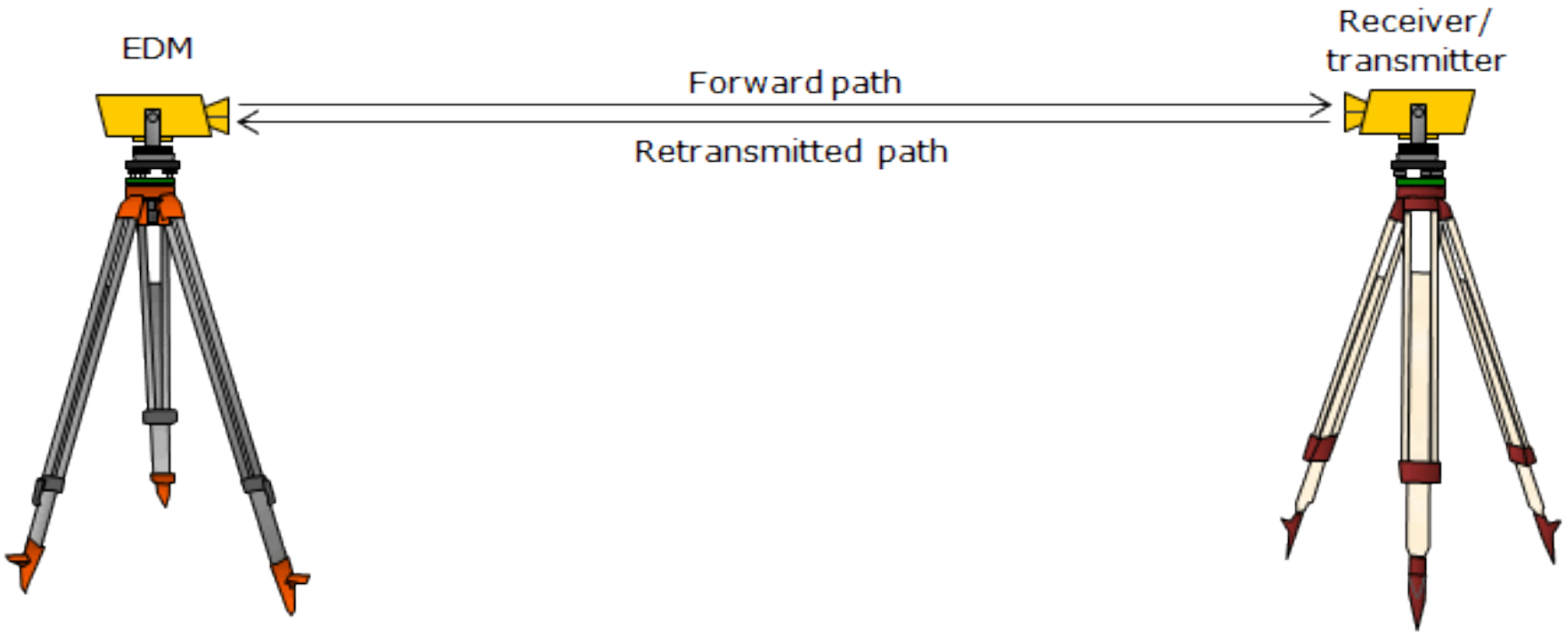
Introduction

- An Electronic Distance Measurement (EDM) uses electromagnetic energy to determine the length of a line.
- The energy originates at an instrument at one end of a line and is transmitted to a "reflector" at the other end from where it is returned to the originating instrument.
- The nature of the "reflector" is dependant on the type of EM.



Electro Optical System

If electro-optical (infrared or laser) EM is used then the "reflector" is typically a passive medium which bounces the signal back



Microwave system

If the EM is microwave, then the reflector is a second instrument which captures the incoming energy and re-transits it back to the originating instrument.

Functions Total Station

- Horizontal Bearing
- Horizontal Distance
- Slope Distance
- Vertical Bearing
- Vertical Distance

Formula of calculate the wavelength in the basic principles of Total Station

$$\lambda = c / f$$

Where λ = wavelength in meters

c = velocity in km/s

f = frequency in hertz

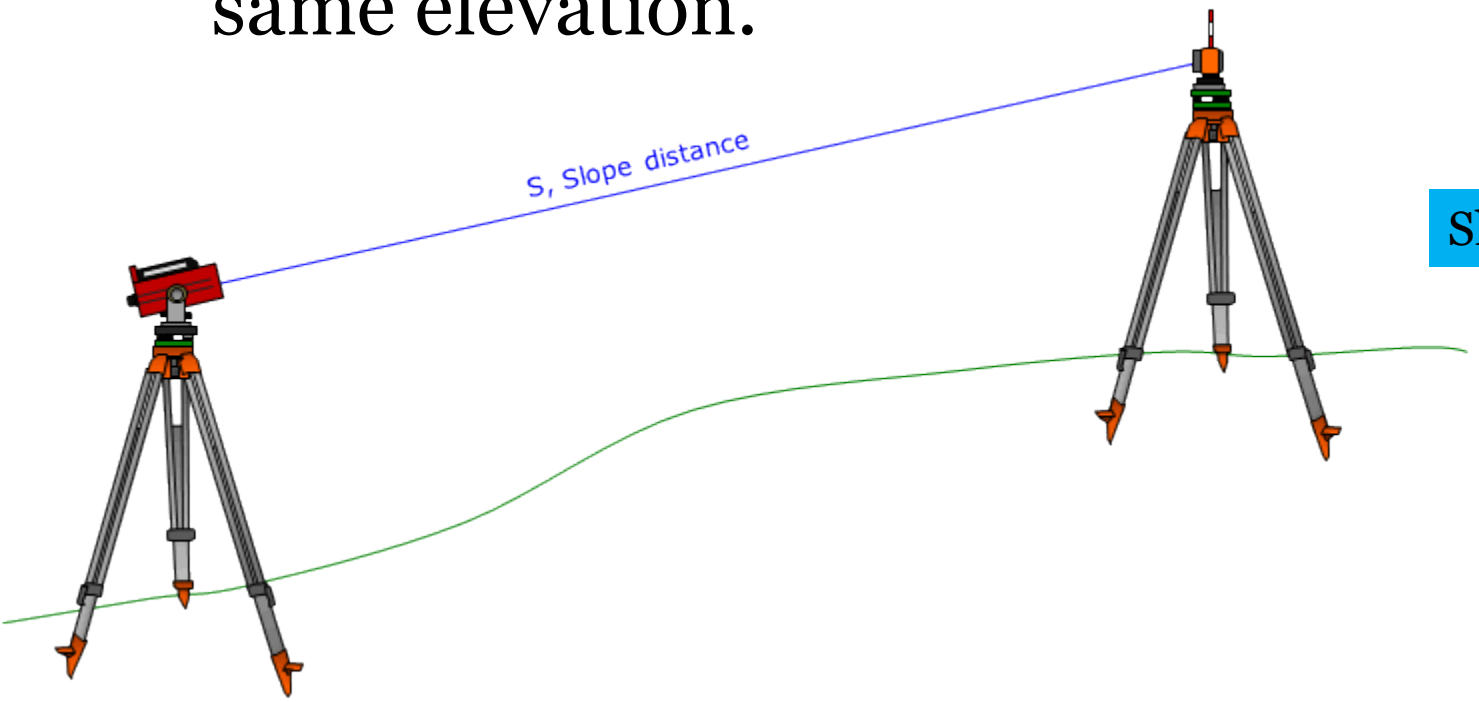
Calculate the wavelength if given velocity is 15km/s and frequency is 0.58 Hertz.

Calculate the frequency if given wavelength is 55.6m and velocity is 6km/s.

Calculate the velocity if given wavelength is 106 m and frequency is 1.39 Hertz.

Distance Reduction

- An EDM measures the line of sight distance between the instrument and reflector.
- This is a *slope distance* and not horizontal unless the EDM and reflector are at the same elevation.

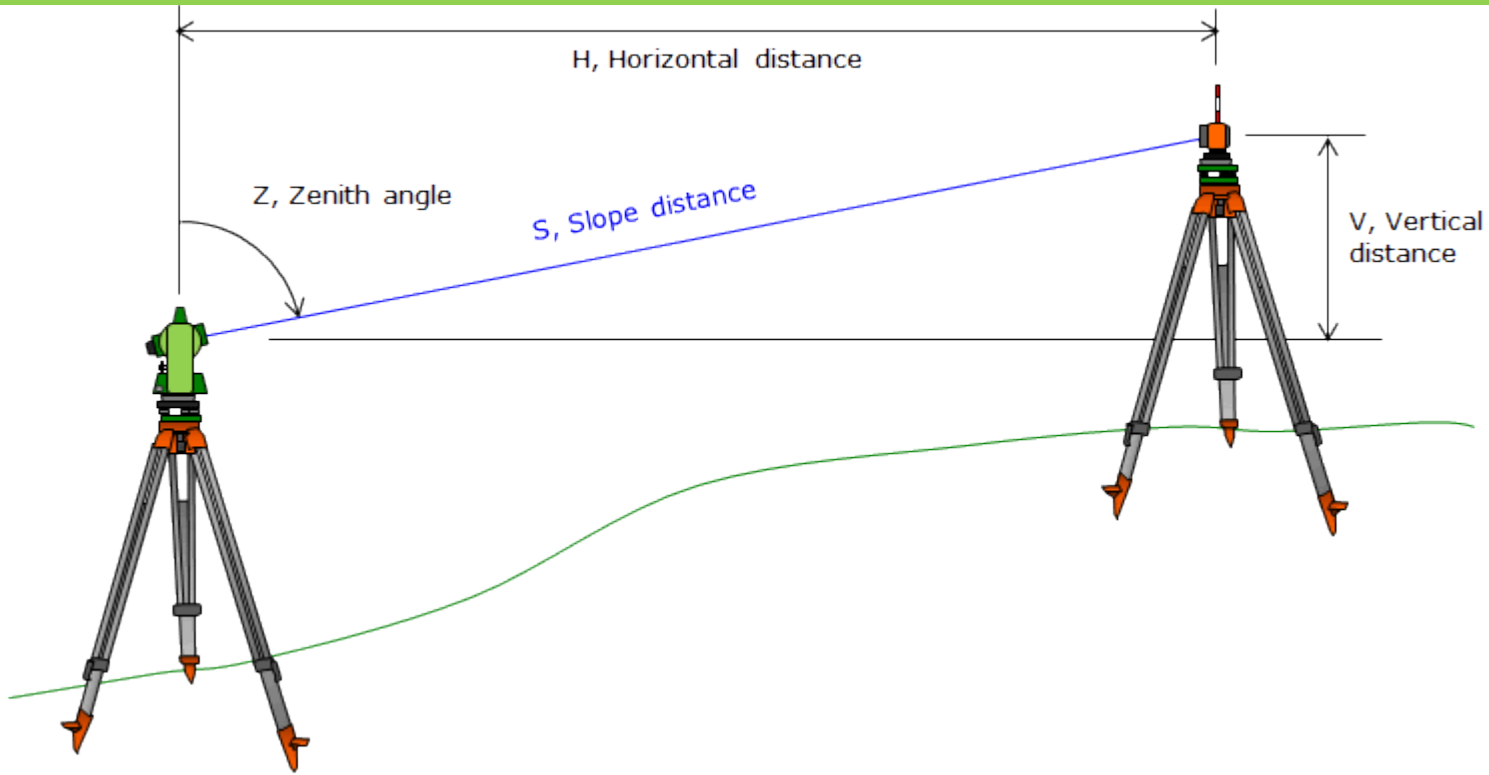


Slope Distance

In order to determine a horizontal or vertical distance additional information is needed.

Combining an EDM with a digital theodolite results in a *Total Station Instrument* (TSI).

When distance measurement is made, the TSI measures the slope distance and a *zenith angle*.



- From these two measurements, the Horizontal and Vertical distances are computed by the instrument:

$$H = S \times \sin(Z)$$

$$V = S \times \cos(Z)$$

Error

Human

- **Centering** - This involves how accurately the operator can center the TSI vertically over the ground mark. If using a hand held prism pole, how carefully the rodperson holds the bubble centered.
- **Height measurement** - If the TSI will be used for trigonometric leveling or topo data collection then the heights of the instrument and prism must be measured.
- **Atmospheric conditions determination** - Temperature and barometric pressure must be obtained for the time of measurement. If not available, then the operator should record the settings on the TSI so later on they can be compensated.

Instrumental

- **Leveling bubbles -** At the TSI, proper leveling techniques should be used to compensate for the plate bubble being out of adjustment.
- **Optical plummet -** Optical plummets on the TSI and prism tribrach are used to orient the instrument vertically over its ground mark. These should be checked and adjusted as necessary.
- **Prism height -** Prism pole height *does not* affect horizontal distance determination. Prism height doesn't matter since raising or lowering it will change both zenith angle and slope distance but still result in the same horizontal distance.

Natural

- **Atmospheric conditions -** Electro-optical EM signals are affected by atmospheric pressure and temperature. TSIs are generally standardized at a specific temperature and pressure.
- **Refraction and curvature -** The EM signal path is bent, refracted, as it moves thru the atmosphere. The degree of refraction depends on atmospheric density and the signal's direction thru it.

New technology of Total Station

New technology of Total Station

1. Smart Total Station

New technology of Total Station

2. Robotic Total Station

- Robotic total stations allow the operator to control the instrument from a distance via remote control. This eliminates the need for an assistant staff member as the operator holds the retroreflector and controls the total station from the observed point.

New technology of Total Station

3. Reflectorless Total Station
   - Measured distance without reflector

Error of Total Station

- Differential Field Test
- Calibration Test