Elevation Angle Based Trajectory Solution

Space Object Trajectories

Δt' and trajectory solutions presented so far, need '**θ**', which is **possible** for objects with **known** 'r' and 'v'.

However, there are **many objects** for which position and velocity **vectors** are not known.

E.g., we have **no knowledge** of 'r' and 'v' of **comets** and other helio-centric **objects** e.g. meteors that come **under** the influence of **earth** during their **orbits.**

Space Object Trajectories

Further, many **manmade** objects may either encounter **drift** or may re-enter with **unknown** conditions.

However, in **all** such cases, there is still a **need** to predict their **path**s in order to **know** about their future **locations,** and possible time of **arrival.**

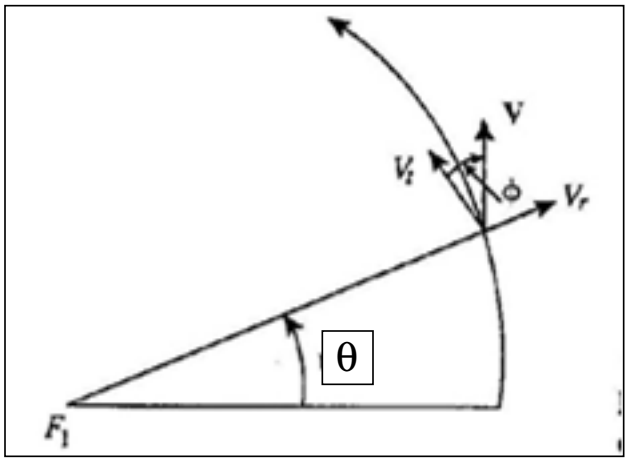
Space Object Trajectories

Therefore, we take **recourse** to identify an **alternate** angle**,** which can **serve** the purpose & is also **measurable.**

One such angle, called **elevation angle** (**ϕ**)**,** is commonly employed in place of **θ,** to set up the **trajectory.**

Elevation Angle Concept

'ϕ' is angle between '**v**' and local **horizon** & can be used as an **alternative** to θ, as shown below.



ϕ - θ Link

'ϕ', can be **expressed** in terms of **'e'** & **'θ',** as follows.

$$\tan\phi = \frac{V_r}{V_t} = \frac{\dot{r}}{r\dot{\theta}}; \quad r = \frac{p}{1+e\cos\theta}; \quad \dot{r} = \frac{pe\dot{\theta}\sin\theta}{(1+e\cos\theta)^2}$$

$$\tan\phi = \frac{e\,p\dot{\theta}\sin\theta \,/\, (1+e\cos\theta)^2}{p\dot{\theta} \,/\, (1+e\cos\theta)}; \quad \tan\phi = \frac{e\sin\theta}{(1+e\cos\theta)}$$

Elevation Angle Based Trajectory

As local **horizon** is normal to **'r'**, it is possible to define **'h'** with respect to the **'ϕ',** as follows.

$$h = rv\cos\phi$$

Summary

In **conclusion**, it can be seen that use of **'ϕ'** enables the complete **trajectory** definition.

From a **practical** perspective, 'ϕ' can be **measured** readily through astronomical **observations**, thus enabling the **trajectory** determination.