

Haversine method for clearing lunar distance

The lunar distance can be described by the spherical law of cosines as

$$\cos LD = \sin h \cdot \sin H + \cos h \cdot \cos H \cdot \cos RBA$$

In which LD is the lunar distance, h is the altitude of the moon, H is the altitude of the other heavenly body and RBA is the relative bearing angle (the angle in between the bearing towards the moon and the other heavenly body). In order to properly determine the lunar distance angle, the observed altitudes have to be cleared of parallax and refraction. (after having been corrected for semi-diameter) When correcting the altitudes for parallax and refraction, the RBA doesn't change, so that property is the constant factor to keep aside. Doing so means a division though, that is error prone when one wishes to perform clearing LD by hand calculations. Further, by transposing the equation into its all-haversine form, the number of multiplications is reduced to one and only a single two-sided table is enough for the second part of the calculation.

First step, transposing the equation into its haversine form:

$$\text{hav}(LD) = \text{hav}(|H - h|) + (1 - \text{hav}(|H - h|) - \text{hav}(|H + h|)) \cdot \text{hav}(RBA)$$

Second step, correcting LD, H en h for semi-diameter

Third step, determining $\text{hav}(RBA)$. This can either be done graphically (with limited precision) by means of the worksheet by Hanno Ix, by means of the haversine diagram proposed by me [JvdH] or (with much greater precision) by calculating the result of

$$\text{hav}(RBA) = \frac{\text{hav}(LD_{SD}) - \text{hav}(|H_{SD} - h_{SD}|)}{(1 - \text{hav}(|H_{SD} - h_{SD}|) - \text{hav}(|H_{SD} + h_{SD}|))}$$

Fourth step, correcting H_{SD} and h_{SD} for parallax and refraction.

Fifth step, calculate $\text{hav}(LD_0)$ with by

$$\text{hav}(LD_0) = \text{hav}(|H_0 - h_0|) + (1 - \text{hav}(|H_0 - h_0|) - \text{hav}(|H_0 + h_0|)) \cdot \text{hav}(RBA)$$

and from that LD_0 .

Use either a longhand calculation in combination with a haversine table or (with limited precision) the haversine diagram.