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PHYS 454

Professor Hedberg

HW#1

**Question 1**

a) The location, which is Huntsville, Alabama, has longitude -86.602O and latitude 34.74­­­O. On February 1st, 2024, the Sun is at its highest elevation at 18:00 (6pm CST or 7pm EST), as shown in **Figure 1**.

A graph with a dotted line

Description automatically generated

Figure 1: Sun Ephemeris (yellow dots) with highest elevation of Sun (blue cross)

Now the tower that is 100m away from us, being 40m tall and 10m wide, needs to be considered. Given these 3 dimensions, we can create trigonometric relationships and obtain the elevation and azimuthal coordinates of the tower. The side and top view are shown below in **Figure 2**.

A two graphs of a triangle

Description automatically generated with medium confidence

Figure 2: Top View (left) and Side View (right) of the tower (green) from the observer point of view defined at the origin

The equations needed are:

|  |  |  |
| --- | --- | --- |
|  |  | (1) |
|  |  | (2) |

**Equation 2** is needed for the left and right side of the tower with respect to the observer’s straight-line view of the tower, hence only half of the tower’s width being used. The elevation angle of the tower is calculated to be 21.8O and the azimuthal half angle as 2.86O. The plot of the tower with respect to the sun ephemeris is shown in **Figure 3**.

A graph with a curve and a line

Description automatically generated with medium confidence

Figure 3: Sun Ephemeris and Tower (green)

b) To find the tower height needed to block the sun from the observer’s perspective, we can work backwards using **Equation 1** by using the max sun elevation for elevation angle and solving for tower height. The max sun elevation, found using the np.max() function on the sun ephemeris elevation angles, is found to be 38.17O. The following calculation is done to find the tower height:

**Question 2**