# Explanation

In an attempt to ensure I am on the right track, let me back-engineer this problem to get to the jamming factor that is given. Let’s do these for four time frames starting at t = 0. During these time frames, the coordinates being traversed by the platform are as in table 1,

*Table 1: Co-ordinates of the platform from t=0 s to t=8 s.*

|  |  |  |  |
| --- | --- | --- | --- |
| Time (s) | X (km) | Y (km) | Z (km) |
| 0 | 0 | 3 | 14 |
| 2 | 0.4444 | 3.1667 | 13.6667 |
| 4 | 0.8888 | 3.3333 | 13.3334 |
| 6 | 1.3333 | 3.5 | 13.0001 |

The calculations to be done is for verifying the jamming factors of threats with ID #1 (threat type 8) and threat with ID #2 (threat type 10). These two threats have the following characteristics, as given in the table below,

*Table 2: Threats 1 and 2 Characteristics.*

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ID | Threat Type (Y) | x | y | z | Radar Range (km) | Projectile Velocity (m/s) | Weapon Range (km) | Countermeasure Resistance (CE) |
| 1 | 8 | 7 | 5 | 0 | 7 | 1400 | 5 | 0.2 |
| 2 | 10 | 6 | 6 | 0 | 6 | 1700 | 5 | 0.3 |

# Calculating the Elevation and Azimuth Angles

The elevation and azimuth angles depend on the rotational matrices; those have to be calculated first. These are calculated using the pitch, heading and roll angles.

The pitch is thus calculated at time t = 2 s using equation 3.3, given as,

Thus at t = 2, the pitch is,

And the heading angle is calculated using equation 3.4, given as,

In this case, since, the heading angle is calculated using the first case and this gives a value of,

The roll angle between those traversed points is 0, thus generating a table of these angles together with the coordinates of each threat relative to the platform’s axis, we end up with a table as below.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Time (s) | Roll | Pitch (β) | Heading (α) | Coordinate vectors (ID #1) | Coordinate vectors (ID #2) |
| 0 | 0 | n/a | n/a | n/a | n/a |
| 2 | 0 | -35.09 | 20.56 | [5.0227, 0.1717, -11.1835] | [4.2566, 2.6528, -11.1835] |
| 4 | 0 | -35.09 | 20.56 | [4.6822, 1.5605, -10.9107] | [3.9161, 2.4968, -10.9107] |
| 6 | 0 | -35.09 | 20.56 | [4.3417, 1.4045, -10.6380] | [3.5755, 2.3408, -10.6380] |

The co-ordinate vectors of the two threats relative to the platform’s axis were calculated from the following matrices,

Their original vectors, ω, are a vertical matrix of the difference between the threats coordinates and that of the platforms at time instances 2 s, 4 s, and 6 s. The equations for all these are 3.5 to 3.9.

Using these new coordinates, the elevation and azimuth angles for the time instances chosen can be calculated. The elevation angle is calculated from equation 3.10, given as,

The slant distance given here is the one calculated with the exact co-ordinates and not the relative co-ordinates.

At t =2, the elevation angle for threat with ID #1 is,