**Simulation on the quasi-equatorial-mount sun tracker and Trade Study on axes number**

1. **Simulate Sun motion**

Instead of elevation and azimuth, use **RA, hour angle, and declination** of the sun.

1. **Simulate solar panel motion**

Inspired by the sun’s coordinate and motion, use the **pitch** angle of the panel to correspond to the declination of the sun, controlled by motor 1-major motor; use the rotation angle around the north polar axis, **theta**, to correspond to the hour angle change of the sun, controlled by motor 2-auxiliary motor.

The **theta** angle is set as:

Theta= 90 + sun\_RA - 15\*hours\_after\_sunrise

The **pitch** angle of each day at solar noon (the highest point of the sun) is set as:

Local\_latitude - Sun\_declination

However, as the panel tracks the sun closer to the horizon, the tension in the strings in the pitch axis will cause the panel to move towards the south, and this effect can degrades the power efficiency as the incident angle of the sun can deviate from the panel’s normal.

1. **Estimate Power Generating Efficiency**

With a single axis rotating the plane to following the hour angle change, the efficiency depicted a decreasing-increasing-decreasing trend over a year. To be specific, the efficiency reaches its max around winter solstice (the end of a year) and reaches its minimum around summer solstice (the middle of a year). This is because, with single axis controlling theta, the panel will always shift towards south even when it is facing the horizon, where the sun could have gone to Northwest (sunset) or Northeast (sunrise), especially after vernal equinox (spring) and before autumal equinox, and this effect gets max at summer solstice and min at winter solstice.

**To-do:**

Find the ratio as function of the time of the year, 8 hours in the winter, 12 hours in the summer, what fraction of the day light the sun is at the north side, calculate each day’s north time/entire time, get the average

First case: Open-loop, no sensors, dual-axis with one minor change

Second axis: Open-loop: dual-axis tracking with one rapid change to compensate the north deviation, no sensors

Third case: with sensors, dual-axis, light-sensors,

Shadowing

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Axes  Eval. | 1 | 2 | 3 | Notes |
| Weights |  |  |  |  |
| Yearly efficiency | 0.8972 |  |  |  |
| Cost |  |  |  |  |
| Net power |  |  |  |  |
|  |  |  |  |  |