AE 502 – Homework Project 4

05/12/2023

Dr. Eggl

Sharath Yalla

Problem 1

The process undertaken here was not ideal, but does, I believe result in a best fit for the satellite's orbit. This process borrows heavily from code written by Curtis, Vallado, Beck, and a website called smallsats.org. They are attributed in the code as well but thought it appropriate to mention that first. The first was to use the process described and coded by Curtis to determine the initial best fit of the satellite's orbit given the right ascensions and declinations from the problem. Once the initial best fit was determined, the satellite was propagated forwards and backwards in time to find the states at t1 = 60055.13403_{MJD} through t9 = 60055.29_{MJD}. The states were then converted into right ascensions and declinations and compared against the observed right ascensions and declinations. Although I was unable to code up a Kalman Filter, I utilized the Matlab fmincon function to minimize the error given a certain constraint. This constraint was that the semi-major axis was greater than 0 and is only present as an ansatz. Without this constraint, fmincon was generating a hyperbolic orbit which is clearly not accurate for a OneWeb satellite. The state at t2 = 60055.28819_{MJD} is as follows:

Position & Velocity

r (km) = [-4270.25, -940.975, 6194.85]

v (km/s) = [5.89033, 0.774232, 4.15927]

Orbital Elements

Angular momentum (km^2/s) = 54991.1

Eccentricity = 0.00216847

RA of ascending node (deg) = 189.121

Inclination (deg) = 87.6691

Argument of perigee (deg) = 131.002

True anomaly (deg) = 283.848

Semimajor axis (km) = 7586.63

Additional Parameters

Periapse radius (km) = 7570.17

Period:

- Seconds = 6576.33
- Minutes = 109.606

Hours = 1.82676

Days = 0.076115

Bonus Section

With regards to the bonus, I was unable to properly do this, but given the image screenshot at the bottom of the homework and given that the times of revisit were 8:13 AM MT, 10:03 AM MT, 11:51 AM MT. I will wager to guess that the satellite in question is the ONEWEB-0110 satellite with a NORAD ID of 47260. The TLE of the satellite is

```
ONEWEB-0110
1 47260U 20100C   23132.73249356 -.00000243  00000+0 -71127-3 0  9993
2 47260  87.9037 215.4539 0002191  95.2637 264.8742 13.12444768116314
```

Compared to the ones generated by the orbit fitting process above, there are several items that make me convinced that this is the right satellite, such as inclination and revolutions per day that are similar to that generated by the satellite. However, for the most part, the TLE of the above satellite and that generated are dissimilar. This could be a function of the fact that the orbit has diverged from the model in the past month or, frankly, poor orbit fitting on my part.

Gitlab: https://github.com/syalla2/AE502_HW4