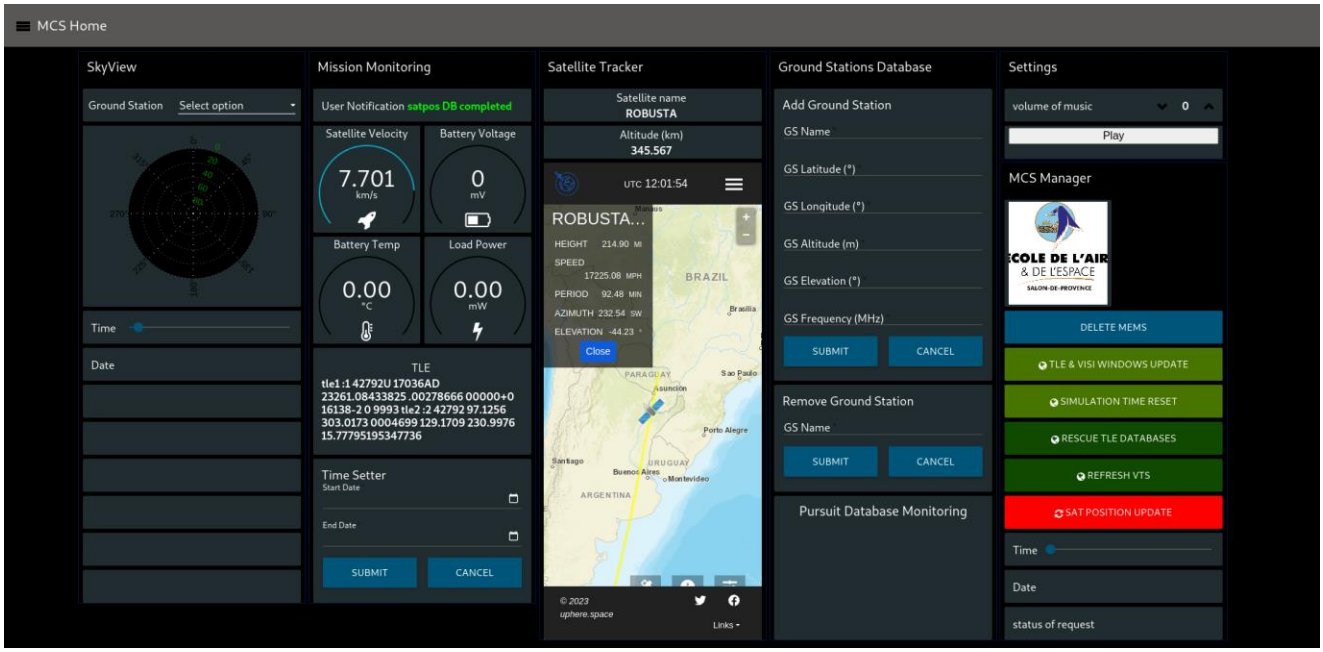
# Educational Space Simulator

## Starting procedure:

1. Click on the “Docker Jsatorb” shortcut represented by a EAE icon.


2. Click on the “Node-RED” shortcut represented by a Node-RED icon.

3. Wait for the voice message “situation updated” (30 seconds)
4. Click on the “VTS” shortcut represented by a VTS icon.

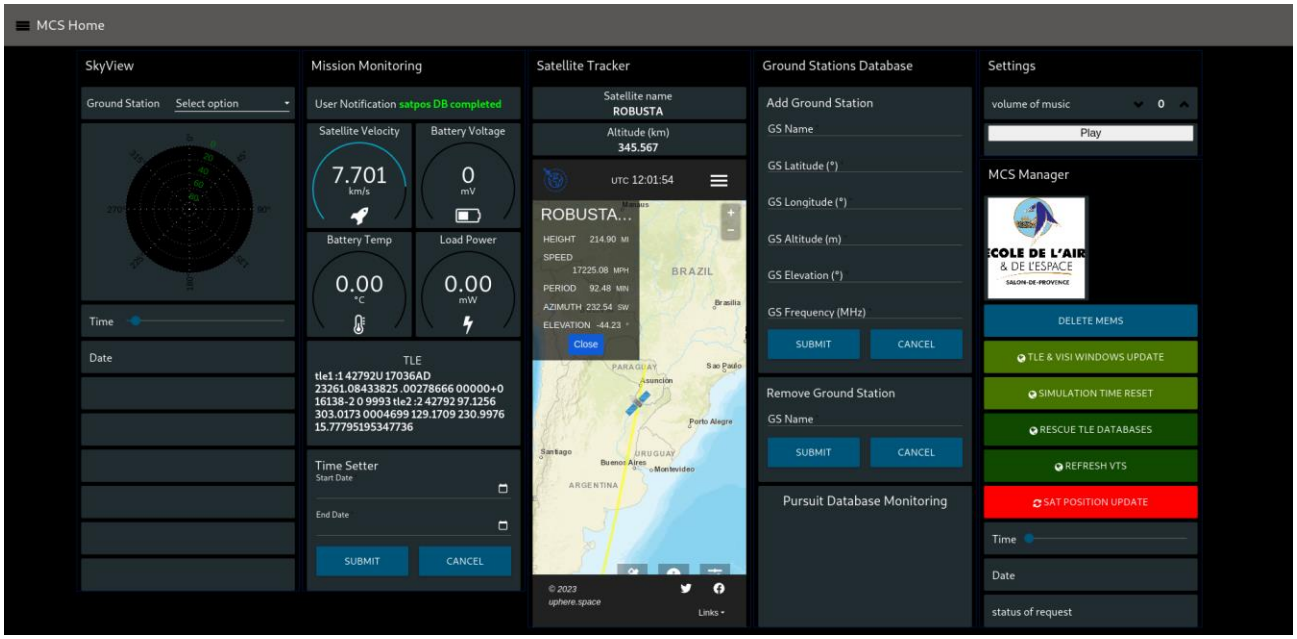



## Starting procedure (Rescue Mode):

1. Click on the “Docker Jsatorb” shortcut represented by a EAE icon.


2. Click on the “Node-RED” shortcut represented by a Node-RED icon.

3. (Rescue Mode Only) On the dashboard click on the buttons “SIMULATION TIME RESET”, “RESCUE TLE DATABASES”and“REFRESH VTS”
4. Wait for the voice message “situation updated” (30 seconds)
5. Click on the “VTS” shortcut represented by a VTS icon.

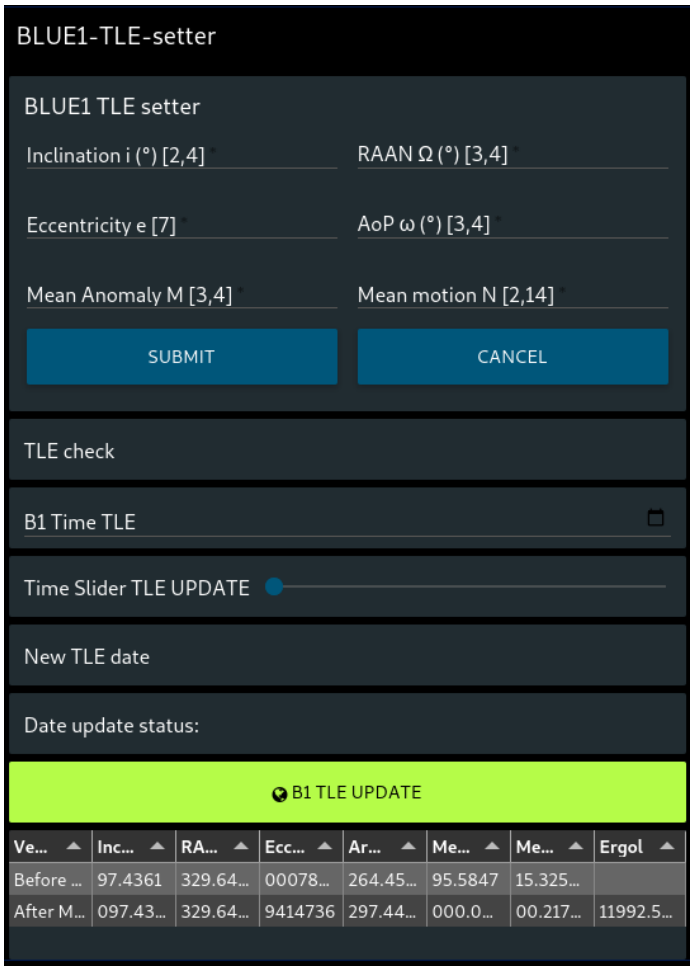



# TLE setting procedure:

1. After the starting procedure is completed.

2. Click on the “Menu” icon on the top left corner of the dashboard.

3. Pick the Manoeuvre Manager corresponding to the satellite you want to set.
4. Enter the parameters in the corresponding form (e.g., BLUE1-TLE-setter for BLUE1).
5. Click the corresponding SUBMIT button
6. If your parameters are valid, you will receive a message “TLE accepted” and the new TLE will be displayed in the appropriate table on the bottom left of the dashboard.
7. Choose the corresponding date, using the date picker or the time slider.
8. Click the “TLE UPDATE” button
9. After approximately 30 seconds you will receive the message “Situation updated” and the windows of Celestia and Surface View will refresh.

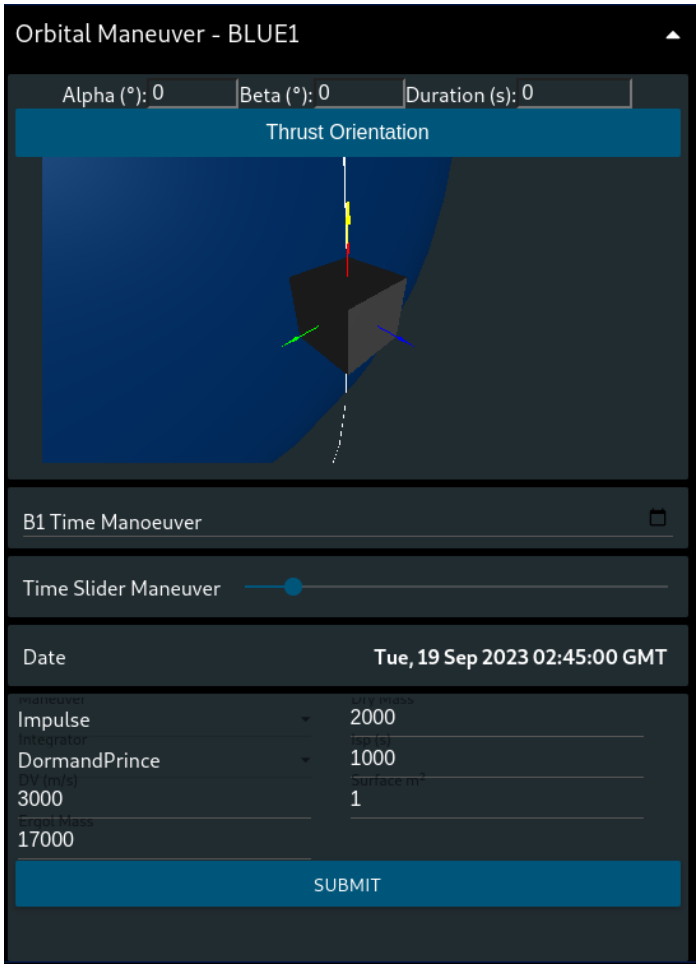



# Manoeuvre procedure:

1. After the starting procedure is completed.
2. Click on the “Menu” icon on the top left corner of the dashboard.
3. Pick the Manoeuvre Manager corresponding to the satellite you want to set.

4. In the middle column titled “Orbital Manoeuvre” first choose the orientation of the thrust.
    a. The yellow arrow indicates the resulting force direction
    b. The frame is the VNC frame (Velocity Normal Co-normal frame (X axis aligned with velocity in red, Y axis aligned with orbital momentum in green, Z orthogonal to X and Y in blue).
    c. Alpha is the rotation around Z in the plane XY alpha =0° for resulting force along X.
    d. Beta is the rotation around Y in the plane XZ beta = 0° for resulting force along X.
    e. Duration in second.
    f. Once you are set click the “Thrust Orientation” button.
5. Choose the date of the manoeuvre, using the date picker or the time slider.
    a. Using the time picker, you should hit “enter” key when finished in response the time slider should move to the corresponding position.
    b. Please be careful not to choose a manoeuvre date that is past relative to your previous manoeuvre that would lead to simulation errors.
6. For the vehicle parameter:
    a. First choose the model of your manoeuvre.
        i. Impulse is closer to the theory (e.g., for Hohmann transfers).
        ii. Continuous is closer to the reality of thrusters.
    b. The form will update depending on your choice for the model.
        i. Delta V is requested for an Impulse manoeuvre.
        ii. Thrust is requested for a continuous manoeuvre.
    c. Choose the integrator.
        i. Runge Kunta is faster but inaccurate and often fails.
        ii. Dormand Prince a little longer but more accurate and rarely fails.
    d. The dry mass corresponds to the mass of your structure, along with your surface these two parameters never change, except after the vehicle received damages (combat, collision…).
    e. The ISP is the specific impulse of your engine in seconds, can vary depending on the altitude or engine condition.
    f. Ergol mass should be updated if there was a previous manoeuvre with the remaining fuel indicated in the “TLE display” located in the left column of the dashboard.
    g. Finish the form and click “SUBMIT”

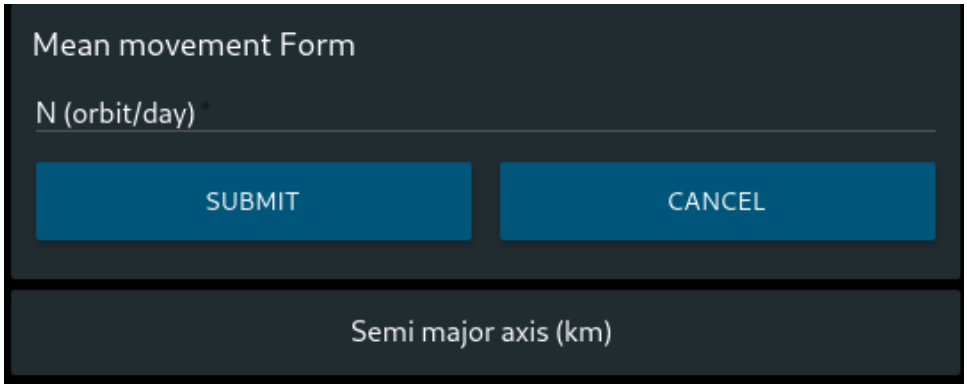
7. If the manoeuvre is successfully computed, you will hear the message “Manoeuvre successful” otherwise you will receive an alert if the manoeuvre is rejected. If the manoeuvre is rejected verify whether it is computable or not. If so, you should try a different integrator.
8. After approximately 30 seconds you will receive the message “Situation updated” and the windows of Celestia and Surface View will refresh.



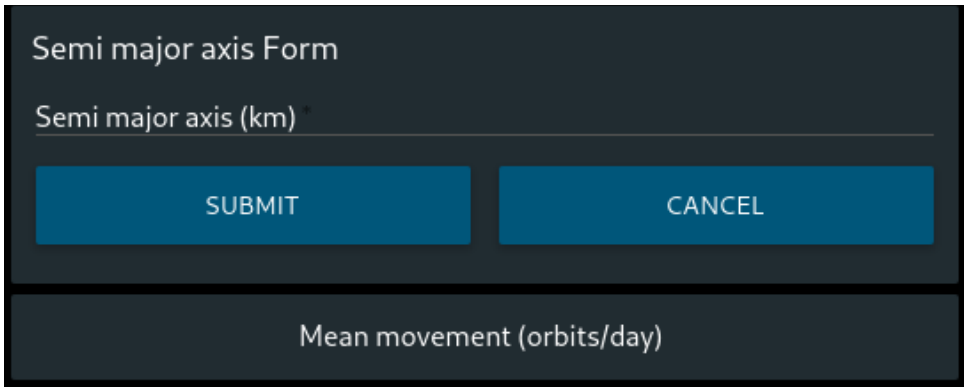

# Toolbox:

The Dashboard includes 4 calculation tools that are here to speed up your exercises.

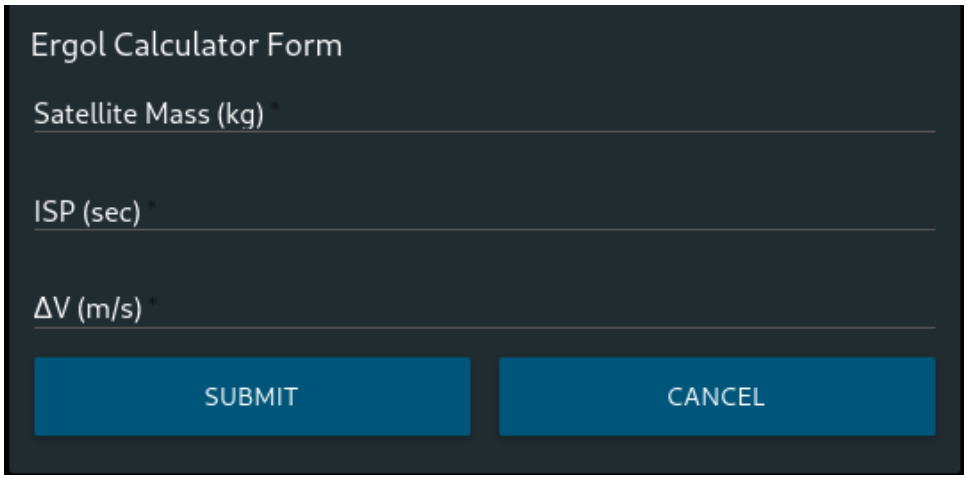
1. Mean Movement Form, awaits a Mean Movement in rev/day and returns a semi-major axis in km?



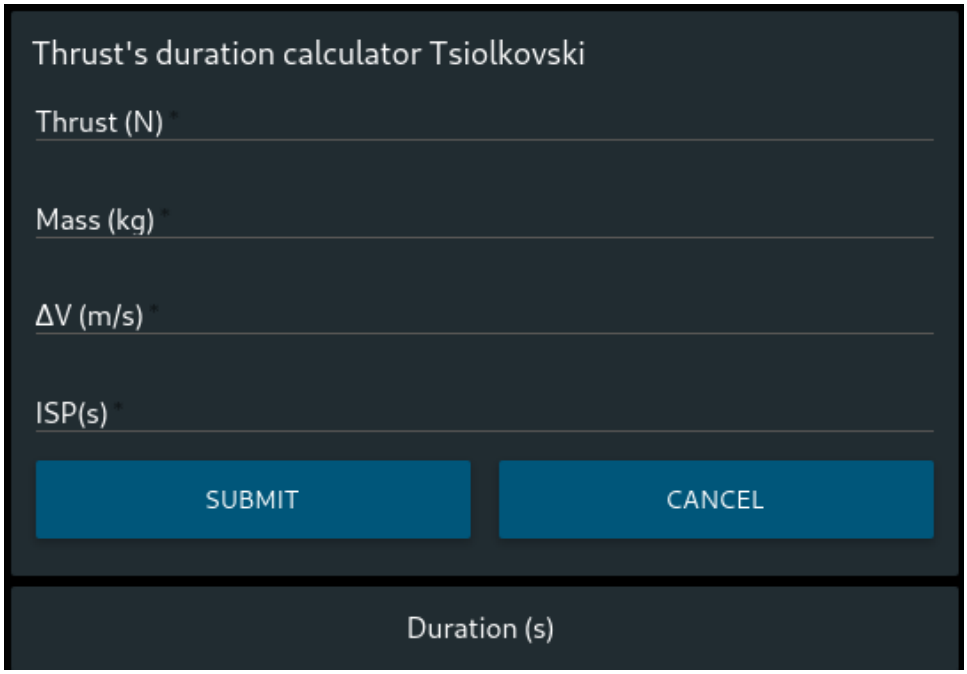

2. Semi-major axis form awaits a SMA in km and returns a mean movement in rev/day.

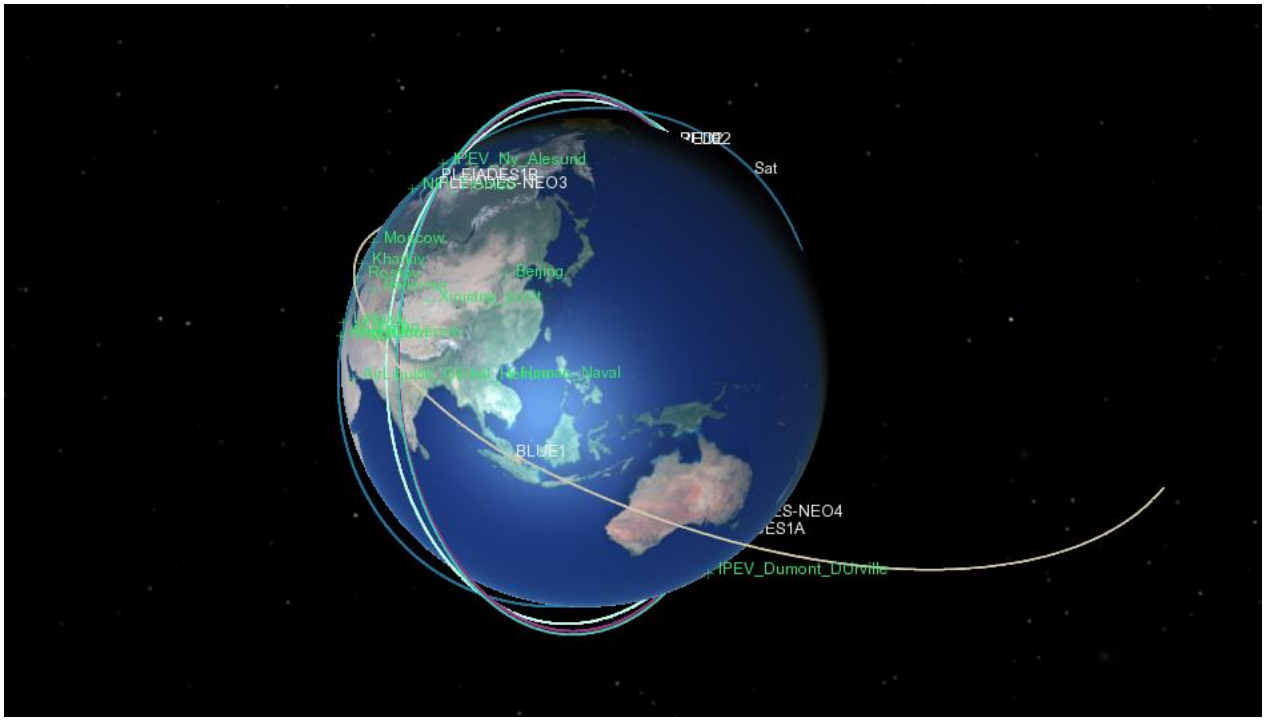



3. Ergol Calculator returns the cost in kg of fuel.




4. Thrust's duration calculator returns the duration of the continuous thrust computed from the Tsiolkovski equation.




# TLE RESCURE AIGLONS:

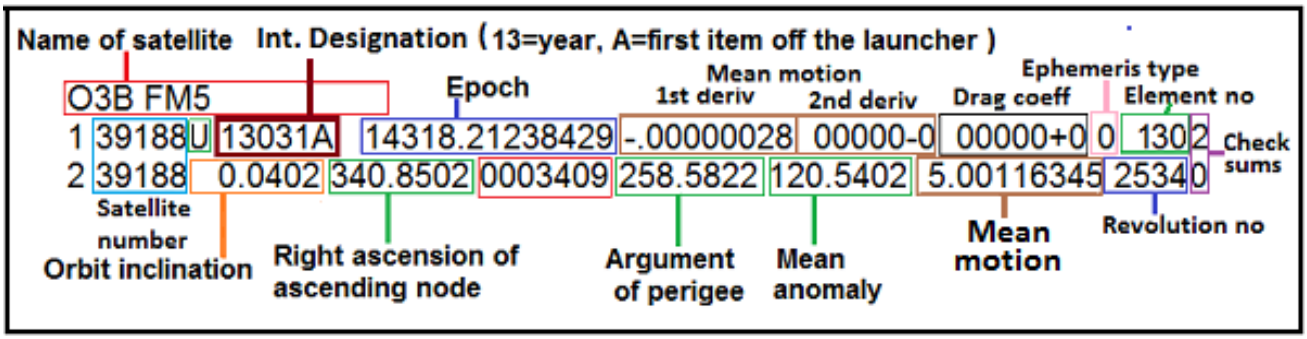
This mode allows the cadets to load a situation by filling up a file tle-latest.txt in your HOME directory and copying it into the container of node-red, by the docker command:

docker cp ./tle-latest-aiglons.txt ccc_nodered:usr/src/node-red/ tle-latest-aiglons.txt

Note that the file tle-latest-aiglons.txt should be in your current working directory when using the command.

Finally, if you press the button RESCUE TLE AIGLONS the situation described in the file will be loaded in the database and all storage files.

Here is how to fill up the file according to the situation you wish to see:




In your file you need to change the epoch according to today's date for example in the figure above the Epoch is set for the 318s day of the year 2014 , and the fraction of the day is 0.21238429 to understand the corresponding time of the day you multiply by 24 to obtain the hour as the integer part of the result that you subtract and multiply by 60 to obtain the minutes and so one as follows:

24* 0.21238429= 5.09722296 hour = 5h

5.09722296- 5 = 0.09722296 *60 = 5.8333776 minutes = 5 min

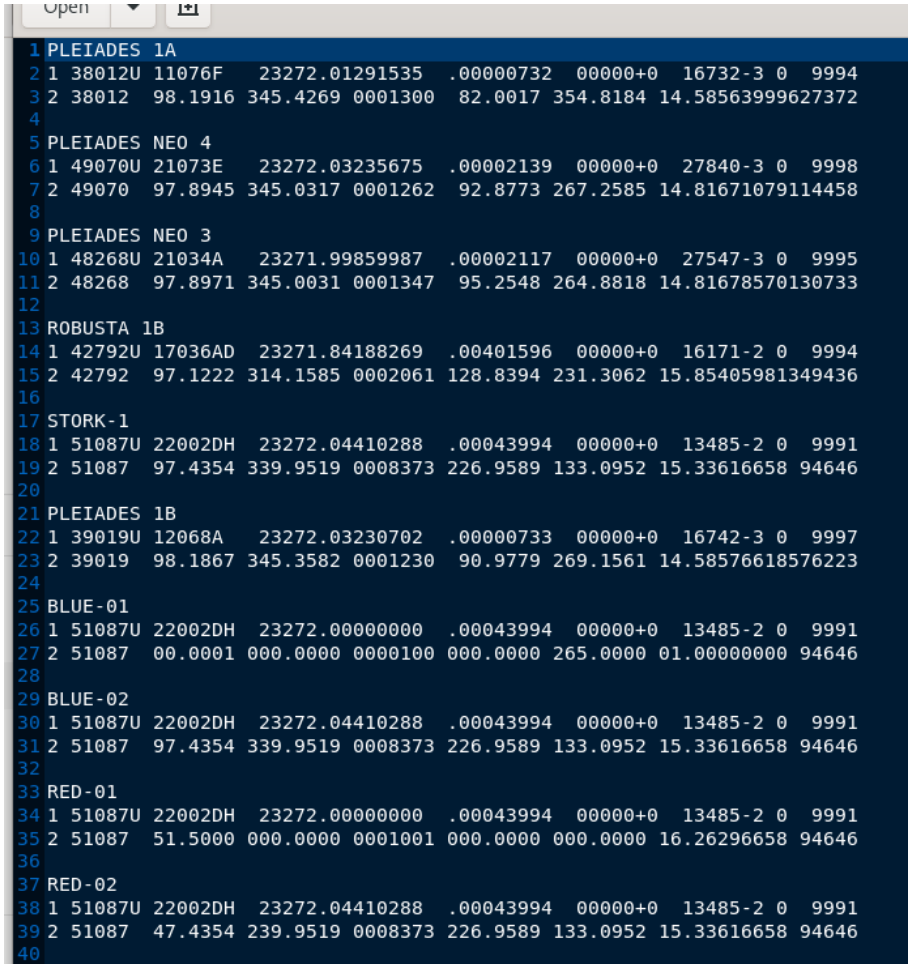
5.8333776-5=60*0 .8333776=50,002656 seconds =50

So it corresponds to 5h5min50s

And the website https://asd.gsfc.nasa.gov/Craig.Markwardt/doy2014.html tell us that the 318 th day of year 2014 was the 14th of November.

The parameters that you should enter carefully are the Satellite number they should match on the two lines, the epoch and the Keplerian parameters, on the line 2, Orbit inclination Right ascension of ascending node, argument of perigee, mean anomaly, mean motion.

Here is an example of file for the day 272, the 29th of September 2023:



```
PLEIADES 1A
1 38012U 11076F   23272.01291535  .00000732  00000+0  16732-3 0  9994
2 38012  98.1916 345.4269 0001300  82.0017 354.8184 14.58563999627372

PLEIADES NEO 4
1 49070U 21073E   23272.03235675  .00002139  00000+0  27840-3 0  9998
2 49070  97.8945 345.0317 0001262  92.8773 267.2585 14.81671079114458

PLEIADES NEO 3
1 48268U 21034A   23271.99859987  .00002117  00000+0  27547-3 0  9995
2 48268  97.8971 345.0031 0001347  95.2548 264.8818 14.81678570130733

ROBUSTA 1B
1 42792U 17036AD  23271.84188269  .00401596  00000+0  16171-2 0  9994
2 42792  97.1222 314.1585 0002061 128.8394 231.3062 15.85405981349436

STORK-1
1 51087U 22002DH  23272.04410288  .00043994  00000+0  13485-2 0  9991
2 51087  97.4354 339.9519 0008373 226.9589 133.0952 15.33616658 94646

PLEIADES 1B
1 39019U 12068A   23272.03230702  .00000733  00000+0  16742-3 0  9997
2 39019  98.1867 345.3582 0001230  90.9779 269.1561 14.58576618576223

BLUE-01
1 51087U 22002DH  23272.00000000  .00043994  00000+0  13485-2 0  9991
2 51087  00.0001 000.0000 0000100 000.0000 265.0000 01.00000000 94646

BLUE-02
1 51087U 22002DH  23272.04410288  .00043994  00000+0  13485-2 0  9991
2 51087  97.4354 339.9519 0008373 226.9589 133.0952 15.33616658 94646

RED-01
1 51087U 22002DH  23272.00000000  .00043994  00000+0  13485-2 0  9991
2 51087  51.5000 000.0000 0001001 000.0000 000.0000 16.26296658 94646

RED-02
1 51087U 22002DH  23272.04410288  .00043994  00000+0  13485-2 0  9991
2 51087  47.4354 239.9519 0008373 226.9589 133.0952 15.33616658 94646

```