Treat the satellite as a point mass but consider the Gyroscopic effects

Start at 3dof then move 6dof

Reading:

Modelling and simulation of aerospace vehicles- Peter Zipfel

Research and additional notes and ideas:

<https://www.sciencedirect.com/science/article/pii/S009457651731336X>

typical mass for a 3U cubesat is 4kg

the deorbit altitude is approximately 120km altitude

<https://www.unoosa.org/documents/pdf/psa/hsti/KiboCUBE/KiboCUBEAcademy2021/KiboCUBE_Academy_Day4/KiboCUBE_Academy_2021_UNISEC_4-1_Kuwahara.pdf>

typical relative velocity between a satellite in LEO and Earth is 7.7km/s

<https://www.cubesat-propulsion.com/wp-content/uploads/2017/08/X16038000-01-data-sheet-080217.pdf>

<https://cubesat-propulsion.com/wp-content/uploads/2019/08/Standard-MiPS-datasheet-080119.pdf>

* Vacco Micro Propulsion System (MiPS) offer cold gas thrusters with thrust levels ranging from 1mN to 25mN
* Commonly used in CubeSat missions for spin-up, attitude control
* NanoAvionics propulsion systems can also provide customisable thrust levels?

<https://conference.sdo.esoc.esa.int/proceedings/sdc3/paper/54/SDC3-paper54.pdf>

* Large spacecraft like Mir Space station reached around 0.125Hz as it descended through altitudes of approx 60km
* Automated Transfer Vehicle (ATV) had an intitial spin rate of approximately 0.028Hz during controlled re-entry
* Spin Rates Between 1 and 3 RPM (0.0167 to 0.05 Hz) are ideal
* This range is often used for re-entry experiments
* Spin rates lower than this might not provide sufficient rotational speed to achieve even heating across all surfaces of the satellite. Conversely, higher rates could be challenging to maintain and may lead to instability or mechanical issues, particularly if the CubeSat's thrusters or structure are not designed to withstand the resulting forces.
* The simulations are not accurate because it assumes a constant orbital velocity of 7.8km/s,resulting in it taking the cubesat on 0.6 minutes (36s) to go from ISS to the Earth’s atmosphere
* Realistically, the velocity will be varied, especially if we are performing a de-orbit burn to reduce the velocity enough for re-entry
* De-orbit burn can take anywhere between 30s and 10 minutes- really depends on the spacecraft
* The Space Shuttle typically completed its descent from orbital velocity (28,000 km/h=77.78) to landing in about 45 minutes from deorbit burn, which gives a good benchmark for many spacecraft
* During re-entry, we could use some kind of a feedback system to help the cold thrusters keep the spin rate constant
* This could be done using gyroscopes, so the sensors measure the spin rate and then feedback to adjust the controllers operation
* Either use a PID controller or an on/off method for the thrusters