**Politecnico di Milano**

**Prova finale: Introduzione all’analisi di missioni spaziali**

AA 2022-2023

**Docente:**

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**Elaborato n.**

**Codice elaborato**

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**Important:**

* *The text in red and grey font is given to ease understanding the contents of the report. Make sure it is removed before delivering your report.*
* *Make sure your report is no longer than 8 pages (from Section 1 to Section 5 included)*
* *Use your space to describe the work performed; do not explain the theory!*
* *Make sure the table in the Appendix is properly filled to allow an independent reproduction of your results.*

**1. Introduction**

Briefly describe the purpose of the assignment and how the team performed the activity and prepared the report and presentation.

**2. Initial orbit characterisation**

**2.1**

Determine initial orbital parameters from given position and velocity.

**2.2**

Discuss the result, evaluate other relevant orbit data.

**2.3**

Graphical representation of the orbit.

**3. Final orbit characterisation**

**3.1**

Determine final position and velocity from assigned final orbital parameters.

**3.2**

Discuss the characteristics of the orbit, evaluate other relevant orbit data.

**3.3**

Graphical representation of the orbit.

**4. Transfer trajectory definition and analysis**

**4.1.1 standard strategy**

It is possible to reach the final assigned point located on the final orbit, from the initial point on the initial orbit, through a standard strategy using a specific permutation of the three known manoeuvres between orbits. The chosen standard strategy is composed of, in sequence, a bitangent transfer perigee to apogee, a change of the orbital plane and a change of the pericentre anomaly. Each manoeuvre changes a specific set of orbital parameters.

To perform the first manoeuvre, it is needed to reach the first orbit’s pericentre, due to the nature of the bitangent chosen manoeuvre, where the first impulse is made, moving the satellite on a new orbit, that differs from the previous orbit with a new major semiaxis and a new eccentricity.

Once reached the apogee of the second orbit, through another impulse, the satellite is transferred to a third orbit with the same major semiaxis and same eccentricity as the final assigned orbit.

Given the finale inclination, it is needed to change the inclination of the orbit in a specific point. Through this manoeuvre the final inclination and final RAAN can be achieved, however it also changes the pericentre anomaly, that needs to be adjusted with the last impulse.

The final point is reached after a short travel on the final orbit.

**4.1.2**

Discuss the possible transfer strategies, motivate the selection of one orbit transfer strategy and calculate the transfer trajectory, the manoeuvres v and transfer time.

**4.1.3**

Graphical representation of the initial, final and transfer orbit.

**5. Conclusions**

Briefly compare and analyse the presented transfer trajectories

**6. Appendix**

Fill the table below for each transfer presented in Section 4. The first and last row correspond to the given initial and final points, respectively. All the other 2\*N rows report the time and the orbital parameters across the N impulsive maneuvers Δvi.

**Transfer 1 (standard strategy)**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| t (s) | a (km) | e (-) | i (rad) | Ω (rad) | ω (rad) | θ (rad) | Δv (km/s) |
| 0 | *init.point* | *init.point* | *init.point* | *init.point* | *init.point* | *init.point* | *-* |
| t1 | *before Δv1* | *before Δv1* | *before Δv1* | *before Δv1* | *before Δv1* | *before Δv1* | *Δv1* |
| *after Δv1* | *after Δv1* | *after Δv1* | *after Δv1* | *after Δv1* | *after Δv1* |
| t2 | *before Δv2* | … |  |  |  |  | *Δv2* |
| … |  |  |  |  |  |
| … | … |  |  |  |  |  | *…* |
| … |  |  |  |  |  |
| tf | *final point* | *final point* | *final point* | *final point* | *final point* | *final point* | *-* |

**Transfer 2**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| t (s) | a (km) | e (-) | i (rad) | Ω (rad) | ω (rad) | θ (rad) | Δv (km/s) |
| 0 | *init.point* | *init.point* | *init.point* | *init.point* | *init.point* | *init.point* | *-* |
| t1 | *before Δv1* | *before Δv1* | *before Δv1* | *before Δv1* | *before Δv1* | *before Δv1* | *Δv1* |
| *after Δv1* | *after Δv1* | *after Δv1* | *after Δv1* | *after Δv1* | *after Δv1* |
| t2 | *before Δv2* | … |  |  |  |  | *Δv2* |
| … |  |  |  |  |  |
| … | … |  |  |  |  |  | *…* |
| … |  |  |  |  |  |
| tf | *final point* | *final point* | *final point* | *final point* | *final point* | *final point* | *-* |

To be continued for each transfer.