VISUAL ORBIT DESIGN FOR NEXT MARS EXPLORATION MISSION

Ogura Satoshi[*], Yasuhiro Kawakatsu[†], Makoto Taguchi[‡] and Ayako Matsuoka[§]

This study objectives are to devise orbit design methods and propose orbits fulfilling orbit constraints. Design variables are 5 variables of orbital elements; semimajor axis, eccentricity, inclination, longitude of the ascending node and argument of periapsis. When these 5 variables are fixed, orbit is also fixed uniquely. We included J2 perturbation for the calculation because it is most significant impact in all perturbation affecting orbiters around Mars. J2 perturbation causes a monotonic increase or decrease depended on time, a, e and i to Ω, ω and f. We put the variations of Ω and ω in a figure.

When the initial conditions are given, J2 perturbation changes Ω and ω. In the plane, x-axis is Ω and y-axis is ω, we can comprehend the variation behavior of Ω and ω visually. We call the curved line ‘ orbit profile ’ . If a, e and i are fixed, it is possible to move parallel the original orbit profile by changing initial values of Ω and ω. After the translation, the general form changes slightly, but the direction of orbit profile is same as original.

It is possible to visualize the orbit constraint for given parameters; a, e and i. We observe a history how long and when a obiter experience good for the constraint during the mission period by adding obtained orbit profile to the visualized constraint map. It is possible to search a initial point to satisfy constraint using this map because orbit profile can move parallel. Through this process, Ω and ω are to be designed. The direction and norm of a orbit profile depend on the other three variables, a, e and i. We are able to design apoapsis altitude and i by choosing a form of orbit profile matching to the visualized constraint map. From the above, we can design orbits.

Finally a result of the application of the methods to orbit constraint A3 is shown. The ratio of fulfilling constraint A3 has been improved dramatically. The application to orbiter B is ongoing.

[*]Mr, Department of Physics, Rikkyo University, 171-8501.
[†]Prof, Department of Space Flight Systems, ISAS/JAXA, 252-5210.
[‡]Prof, Department of Physics, Rikkyo University, 171-8501.
[§]Prof, Department of Solar System Sciences, ISAS/JAXA, 252-5210.