

Trial examination and computer simulation of EDT system

Electrical and Electronic Engineering Course, YASUNAGA SHIRO

1. Background

Our earth is now being covered with space debris. Since this is a big problem for space developer, EDT system was proposed as a solution to this problem. The study about this system has performed. However, most study focused on a part of the system. Therefore, my study focused on not only a part but also the whole of the system. And, I performed ground test on matters of concern when the system operates. Also, I performed computer simulation to look for optimum conditions.

2. EDT システム

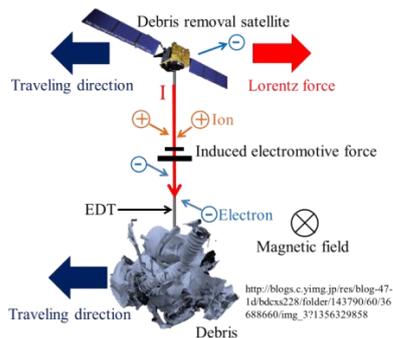


Fig. 1 Principle

At first, a debris removal satellite attaches electro dynamic tethers (EDT) into the space debris after the satellite caught the object. When the satellite and space debris crosses in the geomagnetic field, an induced electromotive force occurs on tethers. The tether collects much electrons and ions from surrounding plasma by this. As a result, a current flow through the tether and Lorentz force occurs. Lorentz force works in the opposite direction to the direction of movement of space debris.

3. Discharge examination on sample tether

This system will be occurred an induced electromotive force on the tethers. But, there is a possibility of discharge on the tether due to this voltage. The discharge is very danger for a precise instrument. So, I performed ground test of discharge on sample tethers which will be used in EDT system to check repetition rate of discharge and threshold value.

4. Potential fluctuation examination

This system is likely to be subject to the geomagnetic field. Tether current can't always flow by this. When this system can't work, inserted switches between tethers and system controller units will be turned off for safety. In the case that the switches are turned off, the satellite potential and tethers potential are not same. Therefore, the potential of the satellite will be fluctuated largely after turning on the switches because both potential is completely different. In this study, I verified how to change the

satellite potential.

5. Simulation

In this simulation, I calculated generated induced electromotive force, tether current and Lorentz force when this system goes around the earth fifteen times. Also, I looked for the optimum value of generation voltage in charge-discharge units.

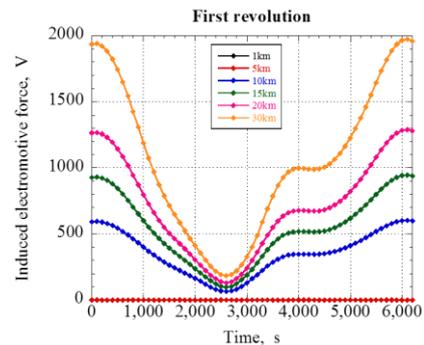


Fig. 2 Induced electromotive force

6. Summary

In discharge test, discharge was confirmed on sample tethers which the surface was hurt. There may be a possibility that the discharge melts the tether.

In potential fluctuation test, potential fluctuation was small when the larger resistance connected in series with switches.

In computer simulation, I concluded this result that the optimum value of generation voltage in charge-discharge units is 150V. When generation voltage is 150V and tether length is 30km, it is possible to remove space debris as soon as possible.

7. Performance of this study

- 1) S. Yasunaga, K. Toyoda, Y. Ohkawa, "DEVELOPMENT OF AN ELECTRICAL GENERATING SYSTEM BY TETHER FOR DEBRIS REMOVAL", International Symposium on Space Technology and Science, 2015
- 2) S. Yasunaga, K. Toyoda, Y. Ohkawa, "DEVELOPMENT OF AN ELECTRICAL GENERATING SYSTEM BY TETHER FOR DEBRIS REMOVAL", Spacecraft Charging of Technology Conference, 2016