Long-term orbital environment prediction by orbital debris evolutionary model

Report Number: R18EG3105
Subject Category: Research and Development
URL: https://www.jss.jaxa.jp/en/ar/e2018/9136/

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Abstract

Increase of space debris is a problem for reliability of future space activity. JAXA has researched space debris removal technology for space debris mitigation and environmental remediation. The guidelines for debris removal are researched based on the prediction of future orbital environment using the orbital debris evolutionary model (NEODEEM) jointly developed by JAXA and Kyushu University.

Ref. URL: http://www.kenkai.jaxa.jp/eng/research/debris/debris.html

Reasons for using JSS2

NEODEEM predicts the situation of over 200 years orbital propagations of more than 20000 elements and orbital events by using Monte-Carlo method. Therefore, JSS2 is used to reduce run time and to process a large amount of data. Only SORA_PP is used for compatibility with PC version (WINDOWS).

Achievements of the Year

Study of some indices expected to be effective in reducing future orbit debris performed using NEODEEM, to evaluate the effect of active debris removal (ADR). Figure 1. As a result, it was found that the orbital debris mitigation can be expected with about 5 ADRs per year if the appropriate PMD (Post Mission Deorbit) is carried out in future space mission.

In addition, it has been confirmed that even with future mega-constellation systems in which several thousand satellites will be in orbit, it is possible to suppress excessive debris increase by appropriate ADR. Figure 2

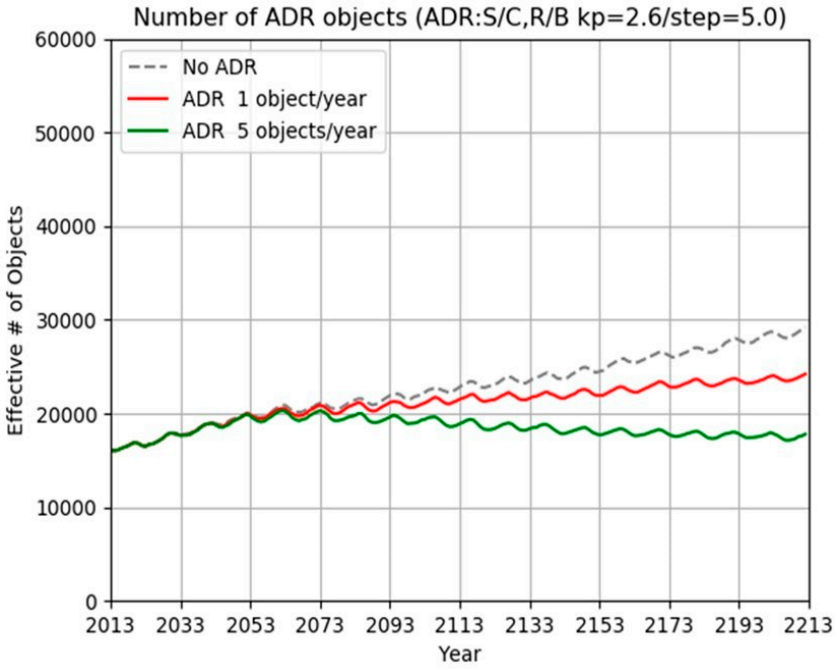

Fig. 1: Debris Effective Number of Orbital Objects (With ADR rate)

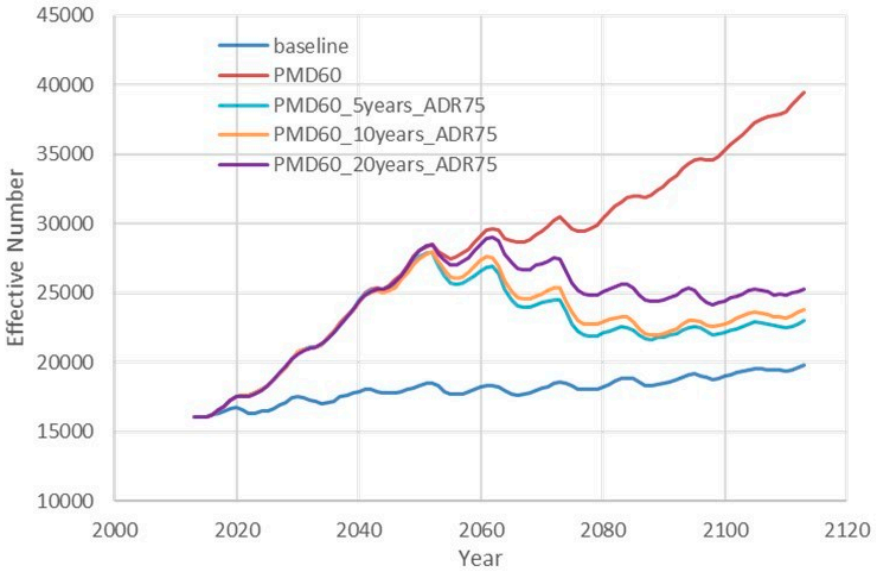

Fig. 2: ADR Effect after PMD Failure (Mega-consteration)

Publications

- Non peer-reviewed papers

1) S. Kawamoto, M. Higashide, S. Abe, T. Hanada, “Consideration on active debris removal target”, 5th European workshop on Space Debris Modeling and Remediation

2) N. Nagaoka, S. Kawamoto, T. Hanada, S. Abe, “Comparison of the mitigation effect of space debris by some removal indexes for orbital objects”, 8th Space Debris Workshop

Usage of JSS2

Computational Information

Process Parallelization Methods	Assigning Monte-Carlo runs with same initial conditions to multiple cores
Thread Parallelization Methods	N/A
Number of Processes	10
Elapsed Time per Case	60 Hour (s)

Resources Used

Fraction of Usage in Total Resources[*1] (%): 0.30

Details

Computational Resources		
System Name	Amount of Core Time (core x hours)	Fraction of Usage[*2] (%)
SORA-MA	0.00	0.00
SORA-PP	498,729.46	3.99
SORA-LM	0.57	0.00
SORA-TPP	0.00	0.00

File System Resources		
File System Name	Storage Assigned (GiB)	Fraction of Usage*2 (%)
/home	19.07	0.02
/data	190.73	0.00
/ltmp	3,906.25	0.33

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage*2 (%)
J-SPACE	0.11	0.00

[*1]: Fraction of Usage in Total Resources: Weighted average of three resource types (Computing, File System, and Archiver).

[*2]: Fraction of Usage: Percentage of usage relative to each resource used in one year.