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A composite optimization method for separation parameters of large-eccentricity pico-satellites

Key words: Pico-satellite; Satellite--rocket separation mechanism; Separation parameters; Parameters optimization

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Motivations

1. With the ever-increasing importance of highly accurate separation between the satellite and rocket, it is crucial to study the effects of separation performance on the separation system.

2. The existing optimization methods are too complex and they are not general applicability and not easy to operate in practical applications.

3, It is essential to develop an effective method for improving the separation accuracy of ZDPS satellites.

Main ideas

1. This paper presents a composite optimization method by combining external moments with angular velocities.

2. This optimization method can achieve less change in the separation mechanism.

3. The result is verified by offset gravity test system.

Methods

1. The influence of different spring positions on the angular velocity and external moments is designed by uniform design.
2. Combining the angular velocity with the external moments, the positions of the separation springs are optimized, and the regression models between the optimized parameters and multiple targets are established.
3. The accuracy of the regression models are verified by simulation analysis, and the optimization results are verified by ground test.

Major results

1. The simulation results show that the separation angular velocities have been greatly improved after optimizing the installation position of the separation springs.

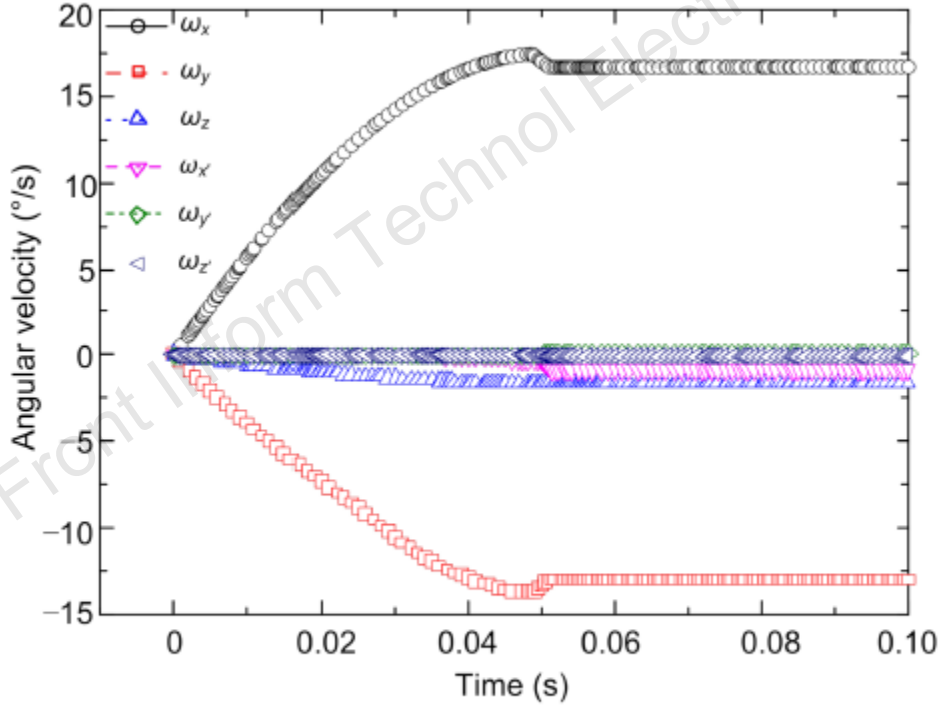

Fig. 17 Comparison of the simulation results before and after optimization

Major results (Cont'd)

2. The results of offsetting gravity separation experiments show that the angular velocities of separation have been greatly improved.

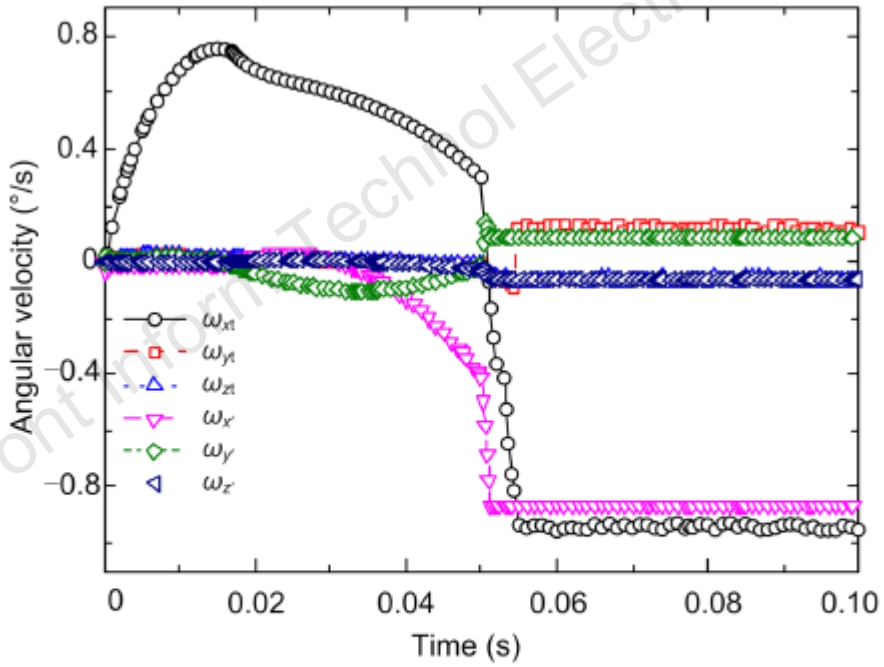

Fig. 19 Comparison of the simulation results after optimization and testing

Variables with subscript t refer to the tested results

Conclusions

1. A composite optimization method that combines the angular velocities with external moments for the separation parameters of large-eccentricity pico-satellites was proposed.

2. This optimization method was proved by a ground test in which gravity was offset.

3. The separation accuracy of a satellite was greatly enhanced through this optimization method, and it could avoid the over-large separation angular velocities that were beyond the control scope of satellite attitude.