EARTH OBSERVATION SYMPOSIUM (B1)
Future Earth Observation Systems (2)

Author: Dr. Liu Hongwei
Institute of Aerospace and Material Engineering, National University of Defense Technology, Changsha, China, liuhw05@163.com

Dr. Wang Zhaokui
School of Aerospace, Tsinghua University, Beijing, China, wangzk@mail.tsinghua.edu.cn
Prof. Zhang Yulin
School of Aerospace, Tsinghua University, Beijing, China, y.l.zhang@mail.tsinghua.edu.cn

THE CONSTRUCTION AND ANALYSIS OF GUIDELINE SYSTEM FOR INNER-FORMATION FLYING SYSTEM GRAVITY FIELD MEASUREMENT

Abstract

Inner-formation Flying System (IFS), proposed by Chinese scholars, is mainly composed of an inner-satellite and an outer-satellite, which aimed to measure Earth's gravity field with high precision by purely gravitational orbit. The outer-satellite has a spherical cavity with a high vacuum environment, and the inner-satellite is a spherical proof mass whose normal position is in the centre of the cavity. Because of the shield effect by the outer-satellite, external space interferences such as atmospheric drag, solar radiation pressure can't act on the inner-satellite. However non-gravitational interferences, for example universal gravitation by the outer-satellite, radiometer effect, thermal radiation pressure, residual gas damping, outgassing effect, measurement light pressure, electromagnetic forces, will act on the inner-satellite in the cavity. By effectively restraining non-gravitational interferences, a purely gravitational orbit of the inner-satellite can be constructed. By precise orbit determination data of the outer-satellite and relative position measurement of the inner and outer satellite, the inner-satellite purely gravitational orbit can be obtained, by which the Earth's gravity field model will be established. In IFS, factors affecting gravity field measurement performance contain orbit parameters such as orbit altitude, orbit inclination and satellite load parameters such as the outer-satellite orbit determination accuracy, relative position measurement accuracy of the inner and outer satellite and restraining accuracy of non-gravitational interferences on the inner-satellite. In this paper, by theory analysis and numerical simulations, the qualitative and quantitative relationship between gravity field measurement performance and its influence factors will be analyzed, and then the guideline system for gravity field measurement by IFS can be established. By abundant numerical simulations in the concerned scope of influence factors and fitting simulation results, an experiential formula expressing gravity field measurement performance and the guideline system can be obtained. This experiential formula can quantitatively describe the guideline system in IFS gravity field measurement, reflect the influence of system parameters on gravity field measurement as well as constraint relations between these system parameters, and get IFS design parameters rapidly and accurately, which is very important in IFS system analysis and design.