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Space objects orbital data specification

空间物体轨道数据规范

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Space objects orbital data specification

1 Scope

This document specifies the elements, format and description of orbital data of space objects.

This document applies to the characterization of orbital data of artificial space objects such as spacecraft, launch vehicles, space debris orbiting the Earth, and of natural space objects such as near earth asteroids orbiting the Sun. The characterization of orbital data of other spacecraft orbiting a celestial body in the solar system can also refer to this document.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

GB/T 7408, Data elements and interchange formats - Information interchange - Representation of dates and times

GB/T 29079, Classification and parameter symbols for orbits and trajectories of spacecraft

GB/T 32296, General coordinates for space vehicle

GB/T 34513, Space debris mitigation requirements

3 Terms and definitions

For the purpose of this document, the following terms and definitions, as well as those given in GB/T 7408, GB/T 29079 and GB/T 34513 apply.

3.1

astronomical unit; AU

A unit of length for measuring distances within the solar system, equal to the average distance between the Sun and the Earth, with a specific value of 149 597 870.7 km.

3.2

near earth asteroid; NEA

Asteroids orbiting the Sun in the solar system, whose perihelion is within 1.3 astronomical units of the heliocenter.

4 Abbreviated terms

For the purposes of this document, the following abbreviated terms apply.

CCSDS: Consultative Committee for Space Data Systems

GCRS: Geocentric Celestial Reference System

IAU: International Astronomical Union

ICRS: International Celestial Reference System

MPC: Minor Planet Center

OEM: Orbit Element Message

OMM: Orbit Mean-element Message

OPM: Orbit Parameter Message

UTC: Coordinated Universal Time

5 Artificial space objects orbital data specification

5.1 General

The artificial space objects orbital data is used to describe the state parameters of the orbit of the corresponding artificial space objects around a certain central celestial body, usually including orbital data and related dynamic parameters.

5.2 Space-time reference system

The time reference system uses UTC; the space reference system is defined according to GB/T 32296 and is based on ICRS: the coordinate origin is the center of mass of the central gravitational body, and the coordinate plane and coordinate axis point in the same direction as ICRS.

Note: Taking an artificial space object orbiting the Earth as an example, the corresponding coordinate system is GCRS. For the calculation of parameters such as precession and nutation related to the coordinate system, it is recommended to use the IAU1980 and newer models.

Appendix A

(Informative)

Method for converting orbital data of space objects orbiting the Earth into standard data recommended by CCSDS

A.1 General

CCSDS provides three recommended orbital data standards: OEM, OPM, and OMM.

The conversion methods between the orbital data format specified in this document and the OEM and OPM data formats are shown in A.2 and A.3 respectively.

A.2 Conversion with OPM

In OPM, EME2000 is used to represent the celestial coordinate system of the J2000.0 epoch. The orbital elements can be directly obtained by coordinate transformation using the data in this document. The difference is that in OPM, atmospheric drag and solar radiation pressure are represented by the drag coefficient/radiation pressure coefficient and the effective area, respectively, but the effective area can be calculated by giving the mass of the object and the drag coefficient. OPM data is usually for spacecraft that are effectively operating on orbit, so there is a reference value for mass.

A.3 Conversion with OEM

OEM is the orbital ephemeris information. The user of this document only needs to convert the six Kepler orbit elements into position and velocity vectors in the corresponding coordinate system or directly use the ephemeris data. In addition, this document provides covariance data as optional data, and its format is consistent with OEM.

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