

Appendix: Final Update of the IAU Division A Commission 4 Working Group on Standardizing Access to Ephemerides and File Format Specification

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Abstract. The IAU Commission 4 Working Group on Standardizing Access to Ephemerides recommends the use of the Spacecraft and Planet Kernel (SPK) format to provide a uniform format for the position ephemerides of planets and other natural solar system bodies, and the use of the Planetary Constants Kernel (PCK) for the orientation of these bodies. These formats are used by the SPICE system, developed by the Navigation and Ancillary Information Facility of NASA's Jet Propulsion Laboratory. The working group's final report is currently undergoing final preparations for publication. A long version of this report will be available at the IAU Commission 4: Ephemerides (or its successor) web site. This long version will contain a full description of that portion of the SPK and PCK formats required to duplicate these file types for this application.

Recommendations

To provide a uniform format for the position ephemerides of planets and other natural solar system bodies, the International Astronomical Union (IAU) Commission 4: Ephemerides Working Group on Standardizing Access to Ephemerides recommends:

(a) The use of the Spacecraft and Planet Kernel (SPK) format for the position ephemeris of a body.

(b) The use of the binary Planetary Constants Kernel (PCK) format for the orientation of a body.

(c) The use of the binary Planetary Constants Kernel (PCK) format for supporting data on the ephemerides, such as values of parameters, whether they are fixed or adjusted, and their uncertainties.

1. Introduction

Prior to the emergence of fast file distribution on the internet, the most widely distributed high-accuracy solar system ephemerides were the Jet Propulsion Laboratory's (JPL's) *Development Ephemerides* (DE) of the planets and the Moon. Nowadays, the Ephemerides of the Planets and Moon (EPM) from the Institute for Applied Astronomy (IAA), and the *Intégrateur Numérique Planétaire de l'Observatoire de Paris* (INPOP) from Institut de mécanique céleste de calcul des éphémérides (IMCCE) are also widely available.

The EPM file format differs from that used to distribute DE and INPOP ephemerides. In the summer of 2010, a common format for all high precision ephemerides was proposed. G. Kaplan, the chair IAU Commission 4: Ephemerides at that time instituted the Working Group on Standardizing Access to Ephemerides. This note is the working group's final status update.

2. Rational

The primary reasons for these recommendations are:

(a) These file formats were developed for and are used by the SPICE system, developed by the Navigation and Ancillary Information Facility (NAIF) of NASA's Jet Propulsion Laboratory.

(b) The SPICE system has become the *de facto* software package used by the aerospace industry for spacecraft mission planning and analysis.

(c) NAIF will continue to support and improve the SPICE system and the ephemeris formats.

3. Software to Read the Ephemerides

Most users will want to use either the SPICE toolkit or CALCEPH, developed by the IMCCE, to access ephemerides stored in these formats. The SPICE toolkit is available at <http://naif.jpl.nasa.gov/naif/toolkit.html>, and CALCEPH is available at <http://www.imcce.fr/inpop/calceph/index.php>.

Some users, such as ephemeris developers, may want to access the ephemeris files directly or construct ephemeris files in these formats using their own software. For those readers that require a detailed specification of the file formats, it is available in the full version of this report online discussed below.

4. Detailed Report

The working group has prepared a detailed report that is available at the arXiv.org (<http://arxiv.org/abs/1507.04291>) web site. A link to the report is also available at the IAU Commission 4: Ephemerides (<http://iaucom4.org/wgs.html>) website. The president of the new IAU Commission C.A3: Fundamental Standards has offered to post the detailed report in future.

Acknowledgements

The working group acknowledges the help of NAIF in adapting SPICE to meet its requirements. Nat Bachman of NAIF also provided help in reviewing the detailed report to assure the specification of the file formats is correct.