HQ Space Operations Command (SpOC)
DCG-T/S9I
Astrodynamics Standards Engineering Group

Astrodynamics Standards

Release Notes

Version 9.2

September 2023

1. Background

Version 9.2 (v9.2) is a minor release of the U.S. Space Force, Space Operations Command, Astrodynamics Standards software library. The Astro Standards are delivered as a collection of shared libraries (DLL/so/dylibs for Windows, Linux, and Mac respectively). The libraries can be run on 64-bit, x86/x64 platforms, and version releases include wrappers and drivers to support a variety of customer/user preferred languages. Starting with v9.0, MacOS is supported for the M1 architecture. Within this document, the term "Library" is used to refer to either a Windows DLL, Linux so, or a Mac dylib. The Library algorithms are designed to be compatible with systems and astrodynamics algorithms implemented into space operations and used by Warfighters and Analysts, including those of 18 Space Defense Squadron (18 SDS). The Astro Standards are also used to Verify and Validate (V&V) equivalent algorithms of these operational space- domain systems such as those that run at the 18 SDS at Vandenberg AFB, and other operational locations critical to the National defense.

2. Highlights

V9.2 includes a build of aarch64 Linux libraries. The libraries were built on a CentOS 8 VM hosted on an M1 Mac. Since extensive testing has not been done on them, they are considered experimental. Any feedback is apprectiated.

The Zig language is fully supported in v9.2.

For the SGP4/SGP4-XP Propagator:

1. The fastest way to obtain SGP4/SGP4-XP is by creating an account on https://www.space-track.org, and downloading it directly from there. No approval is required, but permissions will need to be granted by the administrators of space-track.org.
2. SGP4 is one unique Astro Standards library in the suite of Astro Standards libraries available in that it is U.S. Space Force, Space Operations Command-approved to "share with the world."

Other Applications within the Astro Standards Library (including SGP4/SGP4-XP):

1. For the balance of the Astro Standard Applications, use https://halfway.peterson.af.mil/SARP. The requestor must have a U.S. Government-issued CAC card and be logged into *NIPRnet*. This website cannot be accessed from the Internet.
2. Once logged-in to https://halfway.peterson.af.mil/SARP obtain additional details by referring to the document, "***Instructions for Requesting Astrodynamics Standards Software.pdf,"*** available upon logging into the SARP website.

Figure 1. Astrodynamics Standards Distribution

3. Tally of Bug Fixes / Improvements for Releases

Item	Current Release	Previous Release
Bug Fixes	*22*	*20*
New Features /Improvements	*58*	*53*
Target / Final Release Date	*Sept 2023*	*May 2023*

See AstroJiras_v9.2.html for full list of changes.

AOF
- No Changes

AstroFunc
The modules for handling JPL ephemeris have been moved to AstroFunc and exposed to the user. In the future, this will allow SGP4-XP to use JPL lunar solar positions instead of the current analytical theory increasing the accuracy for XGEO and cislunar satellites.
- JplSetParameters **–** New. Set JPL parameters used by SP and anything that requires access to JPL data
- JplGetParametrs – New. Gets current JPL parameters
- JplCompSunMoonVec – New. Computes the position magnitudes and unit vectors of the Sun and Moon from JPL ephemeris
- JplCompSunMoonPos – New. Computes the position vectors of the Sun and Moon from JPL ephemeris
- RemoveJpl – New. Removes the JPL ephemeris from memory.

Bam
- No Changes

BatchDC
BatchDC had a bug where light time was always corrected regardless of the LTC flag
- No New APIs

Combo
- No Changes

DllMain
- No Changes

ElComp
- No Changes

ElOps
- AddManeuverVPStr – New. Add impulsive maneuver to specified elset, using VP card format
- AddManeuverVPArr – New. Add impulsive maneuver to specified elset, using VP array format

EnvConst
- EnvGetGeoConst – Mod. Added XF_GEOCON_MU option to get gravitational parameter

ExtEphem
- No Changes

Fov
- No Changes

Lamod
- LamodSenSatVisible – Mod. Fixed a bug that caused crash

Obs
Documentation of P and V observations had the values swapped. SLR obs computed range fixed.
- No Changes

ObsOps
- No Changes

Rotas
- No New APIs

SpVec
- No Changes

Saas
- No Changes

SatState
- No Changes

Sensor
- No Changes

Sgp4Prop
- Sgp4LoadFileAll – New. Loads SGP4 related parameters such as prediction controls and JPL settings (XP future use)
- Sgp4SaveFile – New. Saves currently loaded SGP4-related parameters

SpProp

The JPL module internal to SpProp has been moved to AstroFunc and some functionality has been exposed to prepare for using JPL ephemeris in SGP4-XP. JPL files can now be loaded with JplSetParameters in addition to the 4P card.

- No New APIs

Tle

- No Changes

TimeFunc

- No Changes

Vcm

- No Changes

4. Future Capabilities and Changes

- Add Position, Partials, and Time Version 3 (PPT3) Navy propagator to Sgp4Prop in a future Release. This will allow Astro Standards to be compatible with the Navy theory. This will also allow creation of PPT3 elements. These will be distinguished by *element set type "3"*.
- Ability to use Right Ascension and Declination Rates in ROTAS and BatchDC.
- Replace analytical theory of Sun and Moon position with JPL ephemeris for SGP4-XP for very deep space satellites
- Add capability to use TDOA/FDOA observations

5. Contact Astro Standards

For reporting issues, contact the Astro Standards development team at:

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