Standardized Astrodynamic Algorithm Library V7.8 Release Notes

- What's new
  - We are pleased to announce that all Astrodynamic Standards software from V7.beta6 has been removed from beta stage
  - We have added seven new DLLs/SOs to this V7.8 suite: Aof, Fov, Coco, ElComp, Saas, ElOps, and Bam. In these, Aof and Fov were ported from V5.4.2. The rest were added to this suite for the first time
  - V7.8 suite currently has 25 dlls and close to 500 APIs
  - SGP4 is no longer under ITAR control and now available to the public. Because of this change, the users are now required to have a license file "SGP4_Open_License.txt" for the SGP4 dll to work
  - Thread-safety issue has been improved in all Astro Standards software

- Bug Fixes and Enhancements:
  - Overall bug fixes:
    - All xxxLoadFile() methods (e.g. TleLoadFile, SpVecLoadFile, VcmLoadFile, …) will now skip any bad input records and continue on reading. The previous version stops reading as soon as it encounters first bad input record
    - All xxxSaveFile() methods will now write records to the output file with the appropriate string lengths. The old version always write the 512-character strings, without trimming them, to the output file
    - All xxxSaveFile() methods will now create a file even if there is nothing to write to it. In this case, there will be an empty file
    - Improve accuracy for xxxGetField() methods when field value is small (<1e-10)
    - Corrected array initialization to return zero instead of very large negative number (e.g ExtEphXten, SensorGetBS, SensorSetBS, Sgp4PropAll)

  - Aof:
    - Newly add to this V7.8 suite from V5.4.2
    - Can handle more complex configurations
      - New configurations for overflight satellite: donut, butterfly, left butterfly, right butterfly, etc.
      - New configurations for defended area: polygon (up to 120 points)
    - AofReset modified to correctly reset data loaded by AofGetDataFrInputFiles

  - AstroFunc:
    - Fix computation of satellite velocity in RAEToECI()
    - Provide a more accurate way to compute height in EFGPosToLLH() and XYZToLLH()

- In functions PosVelToUUVW() and PosVelToPTW(), the resulting U, V, W are now normal vectors instead of unit vectors

- BatchDC:
  - Add new method: BatchDCLoadFileAll(), BatchDCInitSat(), BatchDCRemoveSat(), BatchDCIterate(), `BatchDCGetVcm(), BatchDCGetSpVOut(), BatchDCSetSpVOut(), BatchDCResetAll()`
  - BatchDC is now returning DC data for each iteration like V5.4.1 does

- Combo:
  - Add new method: ComboLoadFileAll()
  - Fix bug in writing to 7P card
  - When VCM is used with global timing constants loaded, make sure the returning UTC times are computed from the VCM's own timing constants and not the global ones
  - Fix bad extra entry/exit times when those times are outside of the user's requested time span
  - The entry/exit times could be zeros which indicates that the entry/exit times are not available. Modify the C driver code to handle such cases appropriately

- DllMain:
  - Add new method GetInitDllNames () to returns a list of names of the Astro Standards DLLs that were initialized successfully

- EnvConst: No significant changes

- ExtEphem:
  - Accept Evolved Expendable Launch Vehicle (EELV) external ephemeris file
  - Accept latest ITC file format which includes consider parameter
  - ExtEpheGetLoaded sort order modified to be consistent with SpVec, TLE and VCM
  - Data validation for valid external ephemeris points added to ExtEphAddSatEphem, ExtEphemAddSatEphemCovMtx, and ExtEphAssSatEphemExt

- Fov:
  - Newly add to this V7.8 suite from V5.4.2
  - Added input validation for start/stop times, azimuth, elevation, ascending node and declination

- Lamod:
  - Add new method: LamodLoadFileAll(), LamodGenObsAtTime(), LamodComputeLookView()
  - Fix bug in LamodGenObs()

- For bounded-cone tracker sensors (view type 2), compute the exact entry/exit times when satellite goes in/out of sensor coverage. The old version only estimates the times when satellite is above/below the horizon
- Fix bug for orbiting sensor with "NO LIMIT" specification
- Modify the C driver code to show diagnostic information when a sensor/satellite pair fails the illumination test

- Obs:
  - Add new methods: ObsLoadTwoCards(), ObsAddFrB3CardML(), ObsAddFrTTYCards(), ObsAddFrTTYCardsML(), ObsAddFrFieldsML(), ObsAddFrArray(), ObsAddFrArrayML(), ObsDataToArray(), ObsFieldsToObsKeyML(), and ObsResetSelObs()
  - Handle ob type 8 and 9 with range correctly
  - Multiple corrections in routine that creates TTY card from obs data
  - Improve accuracy for writing right ascension to B3/TTY card (replace truncating with rounding routine)
  - Fix bug when writing range data to B3/TTY card when range is less than 100km
  - Fix bug in routine that reads TTY/ob type 5 and 9 when year of equinox is different than date of observation
  - Fix bug in routine that reads TTY/ob type 8 (the EFG position starts at column 39 instead of 38)
  - For P, V obs, store the actual sensor number available in the record instead of assigning 999 to it
  - For P, V obs, GetTTyCard prints on one line to match documentation
  - For obs type 5 and 9, allow equinox indicator to be entered via ObsAddFrFields(), ObsAddFrFieldsML(), ObsAddFrArray(), and ObsAddFrArrayML()
  - Fixed ObsGetB3Card rounding of right ascension seconds to minutes
  - Fixed FieldsToB3Card to distinguish properly between types 8 and 18, and types 9 and 19

- ObsOps (Iomod):
  - Add new method: IomodLoadFileAll()

- Rotas:
  - Add new methods: RotasLoadFileAll (), RotasResetAll(), RotasCompObResDirect()
  - Put back the option to use Delta 427M residual computation method
  - The Az/El residuals were mislabeled in the old version. They are actually the RA/Dec residuals. Modify the C driver code to reflect this change
  - Returned observation residual data is now having more fields: Az/El observation residuals, observation RA/Dec, delta position, delta velocity, computed observation range (for angle only observations), and velocity angle delta, and for ob type 4 and V: angular momentum delta

- Synthesized Range algorithm in SPECTR has been used to replace the old algorithm to compute range for space-borne angle-only sensors

- SatState:
  - No significant changes

- Sensor:
  - Add new methods: SensorGetBS(), SensorSetBS(), SensorGetBSField(), SensorSetBSField()

- Sgp4:
  - Add new methods: Sgp4SetLicFilePath(), Sgp4GetLicFilePath(), Sgp4PropAll()
  - Sgp4 now only accepts WGS-72 as valid geopotential model, anything else will be treated as an error
  - From V7.7 on, Sgp4 requires an accompany licensed file for it to work
  - Deprecate Sgp4GetSatPtr() and Sgp4PropMseQuick() methods for unsafe direct memory access issue
  - Add new simple driver code examples as a tutorial tool for new users

- Sp:
  - Add new methods: SpLoadFileAll(), SpAddFluxRec(), SpPropAll()
  - Add new options to SpGetCovMtx()
  - Fix the computation of accelerations for thrust models

- SPVEC:
  - Add new methods: SpVecAddSatFrLinesML(),SpVecAddSatFrFieldsML(), SpVecGetSatKeyML(), SpVecFieldsToSatKeyML()
  - Fix bug in SpVecUpdateSatFrFields () and SpVecSetField() where satNum and epoch were erroneously reset

- TimeFunc:
  - Add TConAddOne() to load timing constants via API calls instead of loading data from a file
  - Correct ut1Rate unit in UTCToTConRec() from sec/day to msec/day
  - DTGToUTC() also accepts “YYYYMonDDHHMMSS.SSS” as valid input date time group
  - TimeComps2ToUTC() allows input year to be either 2-digit or 4-digit year
  - Fix bug in TConSaveFile() that missed writing dd-Mon-yy strings to the output file

- TLE:
  - Add new methods: TleAddSatFrLinesML(),TleAddSatFrFieldsGP2(), TleAddSatFrFieldsGP2ML(),TleUpdateSatFrFieldsGP2(),TleAddSatFrFieldsSPML(),TleGetAllFieldsGP2(),TleGetSatKeyML(),TleFieldsToSatKeyML()

        - Fix bug in TleUpdateSatFrFieldsGP(), TleUpdateSatFrFieldsSP(), and TleSetField() where satNum and epoch were erroneously reset

    - VCM:
        - Add new methods: VcmAddSatFrLinesML(), VcmAddSatFrFieldsML(), VcmRetrieveAllData(),VcmGetSatKeyML(),VcmFieldsToSatKeyML()
        - Add data validation to VcmLoadFile, VcmSetField, and VcmUpdateSatFrFields

    - Bam, Coco, ElComp, ElOps, Saas are added to Astrodynamic Standards V7.8 suite for the first time

- Known issues:
    - BatchDC is not thread-safe yet

- Past Releases:
    - V7.7- Public Release of SGP4 only on Windows(32/64) and Linux(32/64) on 15 March 2016
    - V7.beta6 - SGP4, SP, LAMOD, COMBO, ROTAS, IOMOD, BATCHDC on Linux (32/64): 28 October 2014
    - V7.beta6 - SGP4, SP, LAMOD, COMBO, ROTAS, IOMOD, BATCHDC on Windows(32/64): 27 October 2014
    - V7.beta5 - SGP4, SP, LAMOD, COMBO on Windows(32/64): 25 August 2014
    - V7.beta4 - SGP4, SP, LAMOD, COMBO on Linux(32/64): 25 September 2012
    - V7.beta4 - SGP4, SP, LAMOD, COMBO on Windows(32/64): 17 September 2012
    - V7.beta - COMBO on Windows: 28 October 2011
    - V7.beta1 - LAMOD on Windows: 28 Jun 2011
    - V7.beta - LAMOD on Windows: 02 Jun 2011
    - V7.beta3 - SGP4, SP on Windows: 21 March 2011
    - V7.beta2 - SGP4, SP on Linux: 06 October 2010
    - V7.beta1 - SGP4, SP on Windows: 27 July 2010
    - V7.beta - SGP4, SP on Windows: 08 December 2008