Readme file for paper AIAA 2006-6753

Revisiting Spacetrack Report #3

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Based on the original NORAD 1980 Spacetrack Report #3



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Notes and Change Summary for AIAA-2006-6753

Revision Notes:

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• Updates to make the application more compatible with the AFPSC implementation based on user inputs. Specifically, the GHA (sidereal time) was set back to the older way of processing. This introduces sub-mm differences. Also, there were a few operations where the original code had used user written functions (mod, atan2). These functions returned certain quadrants and in some places in the code, the results were used without a trigonometric argument. Thus, the quadrant became important for those cases to matching the same answers. We did not resurrect the older approaches, instead because there were only a couple of instances of this, simple conditional statements were inserted to simulate the intended behavior.

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- Updates for manual operation. The program uses a verification mode (with additional parameters at the end of the second line in the .tle file containing the start/stop/delta minutes from epoch (mfe) information) to permit quick checks of relevant times and spacing of ephemeris generation. The catalog mode lets the user test an entire satellite catalog for a two day span centered on the epoch time of each element set. The manual operation gives three additional options entering the start/stop/delta mfe information, entering the YMDHMS information for the start and stop times, or entering the year and dayofyr for the start and stop times. This should give enough flexibility to permit various uses for the tool.
- Constants were re-worked to use the machine precision available. For instance, pi, twopi, rad2deg, deg2rad, etc. can be calculated from pi, which is defined in some languages. Where it is not, 4.0*atan(1.0) is used. In addition, mathematical and astrodynamic constants were separated.
- Misc formatting to correct typos, misspellings, etc.
- Removed the "ildm" variable in DPPER as it was not being used. It was originally used during development of the 2006 paper as a Lyddane choice switch, but had later been made obsolete.

August 2006

· Original version baseline for the paper

Language Notes:

Each language has files (debug1.m, debug1.cpp, debug1.for, debug1.pas) to facilitate debugging the values as a program executes. They are disabled in the codes as shipped, but may be enabled if needed.

<u>C++</u>

The C++ executable needs a Borland C++ specific DLL to run (cc3260mt.dll). If you do not have Borland C++, simply recompile the code with your specific compiler.

Lee Barker has prepared a more object oriented version of the C++ code.

Contents:

testcpp.cpp Main program for example use sgp4unit.cpp (.h) sgp4 mathematical theory

sgp4io.cpp (.h) I/O routine for TLE data (twoline2rv conversion)

sgp4ext.cpp (.h) Additional routines needed for the test program (jday, rv2coe, etc)

debug*.cpp Debug routines to print out intermediate variables at the end of each function call

FORTRAN

Contents:

testfor.for Main program for example use sgp4unit.for sgp4 mathematical theory

sgp4io.for I/O routine for TLE data (twoline2rv conversion)

sgp4ext.for Additional routines needed for the test program (jday, rv2coe, etc)

astmath.cmn Math constants (not a common in the usual sense)
sgp4.cmn sgp4 common variables (near earth and deep space)
lksgp4.bat makefile for Lahey FORTRAN compiler/linker

debug*.for Debug routines to print out intermediate variables at the end of each function call

Java

Joe Coughlin and Kurt Motekew have converted the code to Java. It has not been fully tested against these versions yet.

Matlab

The Matlab version is due to Jeff Beck who performed the original translation. He provides the following notes. The code is a line-by-line translation of Vallado's C++ version of 28 Jun 05. The files are grouped below according to the "unit" "io" "ext" files in the other languages.

Matt Schmunk has provided a vectorized form of Matlab that should run significantly faster. It has not been fully tested against the other approaches yet.

Contents:

testmat.m Driver script for testing and example usage

sgp4.m Main sgp4 routine

sgp4init.mInitialization routine for sgp4initl.mInitialization for sgp4dsinit.mDeep space initializationdspace.mDeep space perturbationsdpper.mDeep Space periodics

dscom.m Deep Space common variables

twoline2rv.m TLE conversion routine

angl.m Find the angle between two vectors

constmath.m set mathematical constants

days2mdh.m convert days to month day hour minute second

getgravc.m Get the gravity constants gstime.m Find Greenwich sidereal time

invjday.m Inverse Julian Date jday.m Find the Julian Date mag.m Magnitude of a vector

newtonnnu.m Kepler's iteration given eccentricity and true anomaly

rv2coe.m Convert position and velocity vectors to classical orbital elements

debug*.m Debug routines to print out intermediate variables at the end of each function call

To verify your installation, execute the testmat script in Matlab. At the input type prompt, enter "v". At the input elset prompt, enter "sgp4-ver.tle". The elset numbers will scroll down the screen and some error messages will appear. When execution is complete, do a file comparison of your output file "tmatver.out" with "tmatver.af80" (or "tmatver.gsfc" if you elected to comment out the AF80 inclination selection in dpper).

To generate debug output, execute the following lines in Matlab before executing sgp4test:

global idebug idebug = 1;

If you have any corrections, comments, or suggestions, please feel free to contact me at beckja@alumni.lehigh.edu. Also, if you develop any supplemental routines (e.g. a GUI driver or an orbit display) and would like to share them, I'll be happy to include them with future versions.

Jeff Beck, beckja@alumni.lehigh.edu, 19 Oct 2005

Pascal

The Pascal code was developed using Borland's Turbo Pascal. As such, it should be compatible with most Pascal compilers, but there may be some I/O routines that will be different. The underlying mathematical operations should be consistent.

The NewDelay unit is needed for some older DOS applications that try to use Turbo Pascal on faster computers. Essentially, NewDelay slows the processing down to permit operation on modern computers.

The Borland extended type is advertised as a 10-byte solution whereas the other codes are all 8-byte operations.

Contents:

testpas.pas Main program for example use sgp4 mathematical theory sgp4unit.pas

I/O routine for TLE data (twoline2rv conversion) sgp4io.pas

sgp4ext.pas debug*.pas Additional routines needed for the test program (jday, rv2coe, etc)

Debug routines to print out intermediate variables at the end of each function call