MODIS Aqua Ground Based Attitude Determination Science Processing Algorithm (GBAD_SPA) User's Guide

Version 2.7

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GODDARD SPACE FLIGHT CENTER
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General

The NASA Goddard Space Flight Center's (GSFC) Direct Readout Laboratory (DRL), Code 606.3 developed this wrapper software for the National Polar-orbiting Operational Environmental Satellite System (NPOESS) Preparatory Project (NPP) In-Situ Ground System (NISGS) and the International Polar Orbiter Processing Package (IPOPP).

Users must agree to all terms and conditions in the Software Usage Agreement on the DRL Web Portal before downloading this software.

Software and documentation published on the DRL Web Portal may occasionally be updated or modified. The most current versions of DRL software are available at the DRL Web Portal:

http://directreadout.sci.gsfc.nasa.gov

Questions relating to the contents or status of this software and its documentation should be addressed to the DRL via the Contact Us mechanism at the DRL Web Portal:

http://directreadout.sci.gsfc.nasa.gov/index.cfm?section=contact%20us

Algorithm Wrapper Concept

The DRL has developed an algorithm wrapper to provide a common command and execution interface to encapsulate multi-discipline, multi-mission science processing algorithms. The wrapper also provides a structured, standardized technique for packaging new or updated algorithms with minimal effort.

A Science Processing Algorithm (SPA) is defined as a wrapper and its contained algorithm. SPAs will function in a standalone, cross-platform environment to serve the needs of the broad Direct Readout community. Detailed information about SPAs and other DRL technologies is available at:

http://directreadout.sci.gsfc.nasa.gov/index.cfm?section=technology

Software Description

The Aqua Ground Based Attitude Determination (GBAD) Science Processing Algorithm (SPA) creates ephemeris and attitude files from data packets in the Aqua spacecraft telemetry downlink. GBAD reads a Level 0 CCSDS Spacecraft Bus Telemetry Packet File containing Aqua APID 957 packets and stores the reformatted data in EOSDIS Science Data Processing (SDP) Toolkit-compatible ephemeris and attitude files. These ephemeris and attitude files are required input to Geolocation and other higher-level Aqua data products. The GBAD_SPA functions in two modes: Standalone, or as an IPOPP plug-in.

GBAD partially emulates the Aqua Spacecraft Ephemeris and Attitude Data Preprocessing (DPREP) to provide a quick-look capability. Therefore some algorithms are different from, or use approximations, to DPREP, and some statistical fields and quality checks are not implemented.

Software Version

Version 1.1 of the DRL algorithm wrapper was used to package the SPA described in this document.

This version of the GBAD_SPA has been enhanced to eliminate dependency upon a Two-Line Element (TLE) file. Specification of a TLE file is optional.

This software will execute on 64- and 32-bit computers, and has been tested with the following operating systems: Fedora 14, CentOS 5.6, Kubuntu 11.04, and openSUSE 11.4.

Credits

The Aqua GBAD production code (Version 2.7, July 2011) was developed by the DRL at NASA/GSFC.

Prerequisites

To run this package, you must have the Java Development Kit (JDK) or Java Runtime Engine (JRE) (Java 1.5 or higher) installed on your computer, and the bin directory of your Java installation in your PATH environment variable.

Program Inputs and Outputs

The program input is a Level 0 CCSDS Spacecraft Bus Telemetry Packet File containing Aqua APID 957 packets. The input packet file can be created by the Real-time Software Telemetry Processing System (RT-STPS), using raw telemetry data received from Aqua. (Refer to the User's Guide included with the RT-STPS package, available for download at http://directreadout.sci.gsfc.nasa.gov). A DRL Two-Line Element (TLE) file can optionally be specified as an input. The optional TLE file provides minor orbital information. Not specifying a TLE file will not affect the quality of the MODIS downstream data. If you wish to use a TLE file, please use the DRL TLE files available from the DRL ftp site at: ftp://is.sci.gsfc.nasa.gov/ancillary/ephemeris/tle/. The names of these files begin with "drl.tle*".

The program outputs are ephemeris and attitude files that are SDP Toolkit-compatible.

Installation and Configuration

This section contains instructions for installing an SPA in a standalone configuration. SPAs may also be installed dynamically into an IPOPP framework; instructions for this type of installation are contained in the IPOPP User's Guide.

Download the GBAD_2.7_SPA_1.1.tar.gz and GBAD_2.7_SPA_1.1_testdata.tar.gz (optional) files into the same directory.

Decompress and un-archive the GBAD_2.7_SPA_1.1.tar.gz and GBAD_2.7_SPA_1.1_testdata.tar.gz (optional) files:

```
$ tar -xzf GBAD_2.7_SPA_1.1.tar.gz
$ tar -xzf GBAD_2.7_SPA_1.1_testdata.tar.gz
```

This will create the following subdirectories:

```
SPA
    gbad
        algorithm
        ancillary
        station
        wrapper
        testscripts
        testdata
```

For convenience, this package contains 32-bit binaries statically pre-compiled on an Intel-compatible 64-bit computer running under Fedora 10, using gcc 4.3.2. The binaries should work on most Linux OS/platforms. If you get an error message while running the testscripts (refer to the next section, "Software Package Testing and Validation"), you may need to recompile the software for your platform/OS combination. Refer to Appendix A for instructions on recompiling the software.

Software Package Testing and Validation

The testscripts directory contains test scripts that can be used to verify that your current installation of the SPA is working properly, as described below. Note that the optional GBAD_2.7_SPA_1.1_testdata.tar.gz file is required to execute these testing procedures. The test scripts included in the testscripts subdirectory are named ‘run-gbad’ and ‘run-gbad-with-tle’. The ‘run-gbad’ script will test the operation of GBAD without TLE input. The ‘run-gbad-with-tle’ script will test the operation of GBAD with TLE input, which is included in the GBAD_2.7_SPA_1.1_testdata.tar.gz file.

To test operation of GBAD with either test script:

Step 1: cd into the testscripts directory.

Step 2: Run the 'run-gbad' script by typing:

$./run-gbad

(*or, you may instead execute* 'run-gbad-with-tle')

If everything is working properly, the scripts will terminate with a message such as:

Output aqua.gbad_eph is
/home/ipopp/SPA/gbad/testdata/output/P1540957AAAAAAAAAAAAAA11210081111001.eph

Output aqua.gbad_att is
/home/ipopp/SPA/gbad/testdata/output/P1540957AAAAAAAAAAAAAA11210081111001.att

You can cd to the output directory to verify that the attitude and ephemeris files exist. Test output product(s) are available for comparison in the testdata/output directory. The output products serve as an indicator of expected program output. Use a comparison utility (such as diff, hdiff, etc.) to compare your output product(s) to those provided in the testdata/output directory. Locally generated files may differ slightly from the provided output files because of differences in machine architecture or operating systems.

If there is a problem and the code terminates abnormally, the problem can be identified using the log files. Log files are automatically generated within the directory used for execution. Their names start with stdfile* and errfile*. Other problems may be caused by incompatibility between your system and the binaries provided with this software package. In that case you may need to recompile the software for your platform/OS combination. Refer to Appendix A for instructions on recompiling the software. Please report any errors that cannot be fixed to the DRL.

Program Operation

In order to run the package using your own input data, you can either use the run script within the wrapper directory, or modify the test script within the testscripts directory.

To Use the Run Script

Identify the 'run' script: The SPA/gbad/wrapper/gbad directory contains the 'run' script. Execute the 'run' to execute the GBAD_SPA. Note that to execute 'run', you must have java on your path.

Specify input parameters using <label value> pairs: To execute the 'run' script, you must supply the required input and output parameters. Input and output parameters are usually file paths. Each parameter is specified on the command line by a <label value> pair. Labels are simply predefined names for parameters. Each

label must be followed by its actual value. Each SPA has its own set of <label value> pairs that must be specified in order for it to execute. Some of these pairs are optional, meaning the process would still be able to execute even if that parameter were not supplied. There are two types of <label value> pairs that the GBAD_SPA uses, as follows:

a) Input file label/values. These are input file paths. Values are absolute or relative paths to the corresponding input file.

b) Output file labels. These are output files that are produced by the SPA. Values are the relative/absolute paths of the files you want to generate.

The following table contains labels, and their descriptions, required by the GBAD_SPA.

Input File Labels	Description
aqua.gbad.pds	Level 0 CCSDS Spacecraft Bus Telemetry Packet File containing Aqua APID 957 packets.
tle (optional)	DRL-generated Two-Line Element (TLE) file (choose the TLE file that is temporally close to the scan being processed).
configuration file (optional)	A configuration file that can be used to set various parameters. In general there is no need to use a configuration file unless you want to change a configuration parameter. (Refer to Appendix B for instructions on parameters that can be set using a configuration file).
Output File Label	**Description**
aqua.gbad_eph	Aqua ephemeris output file.
aqua.gbad_att	Aqua attitude output file.

Execute the 'run' script: The following is an example of a command line to run GBAD_SPA from the testscripts subdirectory. You can run it from the directory of your choice by using the correct paths to the 'run' script and your datasets.

```
$../wrapper/gbad/run \
aqua.gbad.pds ../testdata/input/P1540957AAAAAAAAAAAAAA11210081111001.PDS \
aqua.gbad_eph ../testdata/output/P1540957AAAAAAAAAAAAAA11210081111001.eph \
aqua.gbad_att ../testdata/output/P1540957AAAAAAAAAAAAAA11210081111001.att
Output aqua.gbad_eph is
/home/ipopp/gbad/testdata/output/P1540957AAAAAAAAAAAAAA11210081111001.eph
Output aqua.gbad_att is
/home/ipopp/gbad/testdata/output/P1540957AAAAAAAAAAAAAA11210081111001.att
```

If execution fails, you will receive an error message indicating the cause of failure (e.g., a file cannot be found, or a label cannot be recognized). Correct the problem and run again. The problem can also be identified using the stdfile* and errfile* log files. Log files are automatically generated within the directory used for execution. Other problems may be caused by incompatibility between your system and the binaries provided with this software package. In that case you may need to recompile the software for your platform/OS combination. Refer to Appendix A for instructions on recompiling the software.

To Use the Script in the testscripts Directory

One simple way to run the algorithms from any directory of your choice, using your own data, is to copy the 'run-gbad' script from the testscripts directory to the selected directory. Change the values of the variables WRAPPERHOME, INPUTHOME and OUTPUTHOME to reflect the file paths of the wrapper directories and the input/output file paths. Then modify the input/output file name variables. Run the script to process your data.

Appendix A

Instructions for Recompiling the GBAD_SPA Software

In order to build the entire program, cd into the SPA/gbad/algorithm directory. First remove all compiled libraries and object files by using the command:

```
make -f Makefile clean
```

Now build the entire program using the command:

```
make -f Makefile build
```

NOTE: Messages stating that "linker input file unused because linking not done" are to be expected.

Appendix B

Configuration File Keywords

The GBAD_SPA can take a configuration file as an optional input. The configuration file is used to specify various parameters in keyword-value pairs. The keywords and their default values are listed below. (A sample configuration file is included in the GBAD software package. See SPA/gbad/testdata/input/configfile.)

Keyword	Default	Description
-version	"1.0"	Version number to appear in Ephemeris and Attitude File Headers.
-station	"GSFC"	Name of station generating dataset.
-noradsatname	"AQUA"	Satellite name in TLE file (do not change this for AQUA gbad processing).
-sdpsatname	"EOSPM1"	Satellite name in Outputfile.
-listconfig	"yes"	List program configuration.