Ring Occultation Data Analysis Tool (ROCCDAT)
User's Guide

Introduction:
The ROCCDAT program is written in the Interactive Data Language (IDL) and makes use of NASA NAIF software via the "ICY" dynamically loaded module (DLM). ROCCDAT was written to read in raw UVIS High Speed Photometer (HSP) data files in NetCDF format from the UVIS internal team data website and generate a standard IDL vector of data numbers with associated time tags. The program also has some capabilities for binning and plotting data. However, the primary use of ROCCDAT within the UVIS team was simply to convert the raw data for the HSP into usable IDL vectors with time tags. ROCCDAT also has the capability to generate a simple set of geometry data for ring occultations. For HSP observations of other bodies, other software, primarily Geometer within the UVIS team, was used to generate relevant geometric data.

The primary function of ROCCDAT is to read in raw HSP data and create a single IDL data vector and associated time vector in Ephemeris Time (ET).

Installation:
ROCCDAT runs in IDL. It makes use of the following IDL source files:

Roccdat.pro
Hsp_concat.pro
Hsp_binner.pro

These files should all be compiled within IDL.

In addition there is an IDL binary template file that is used to read in HSP auxilliary timing files. This template file (hsp_time_template.sav) is used by hsp_concat.pro when reading in the raw data and assigning time tags to each data point. The location of this file is hard-coded into hsp_concat.pro near the top of the file and should be edited to reflect the lcoation of this file on the computer where ROCCDAT is running.

The auxilliary timing files must be present for ROCCDAT to correctly assign times to the data.

In order to calculate ring occultation geometer, the star data file "GeometerStars.txt" must be present.

A directory path for the raw HSP data is also hard-coded into the routine hsp_concat.pro in the first line of code of this file. This path should be edited by the user to reflect the location on the local file system where raw HSP data files are located.

Two additional file paths in hsp_concat.pro should be edited by the user to reflect the location file system: the location of the HSP auxilliary timing files is referenced in two lines of hsp_concat.pro on lines 81 and 110 of the hsp_concat.pro text file (version 7.0).

A single path is hard-coded into roccdat.pro to specify the location for saving computed geometry vectors for ring occultation data. This can be edited by the user, and is in the 'SaveOcc' branch at line 280 of the file (Version 2.0).
ROCCDAT requires the the IDL interface to the NAIF SPICE toolkit, dubbed ICY, is installed and loaded. See naif.jpl.nasa.gov/naif/toolkit.html for information about the SPICE toolkit in IDL.

ROCCDAT requires that any kernels necessary to carry out data processing tasks are loaded. At a minimum this will be the NAIF leapseconds kernel and the Cassini spacecraft clock kernel. Any geometric calculations will also require one or more SP kernels and PC kernels for the time span covered by the data to be loaded. Prior versions of ROCCDAT had the capability to search through a local directory system to find the appropriate SP kernel and PC kernel for the particular HSP observation that was loaded into ROCCDAT. However, since the creation of a single merged SP kernel for the entire mission, this part of the code has been commented out, and it assumed that the necessary kernels are loaded before running ROCCDAT. If the kernels needed are not loaded, ROCCDAT will stop send a SPICE error message signaling insufficient data.

ROCCDAT is launched after compilation by typing roccdat at the IDL prompt:
IDL> roccdat

This will launch the ROCCDAT graphical user interface (Figure 1).

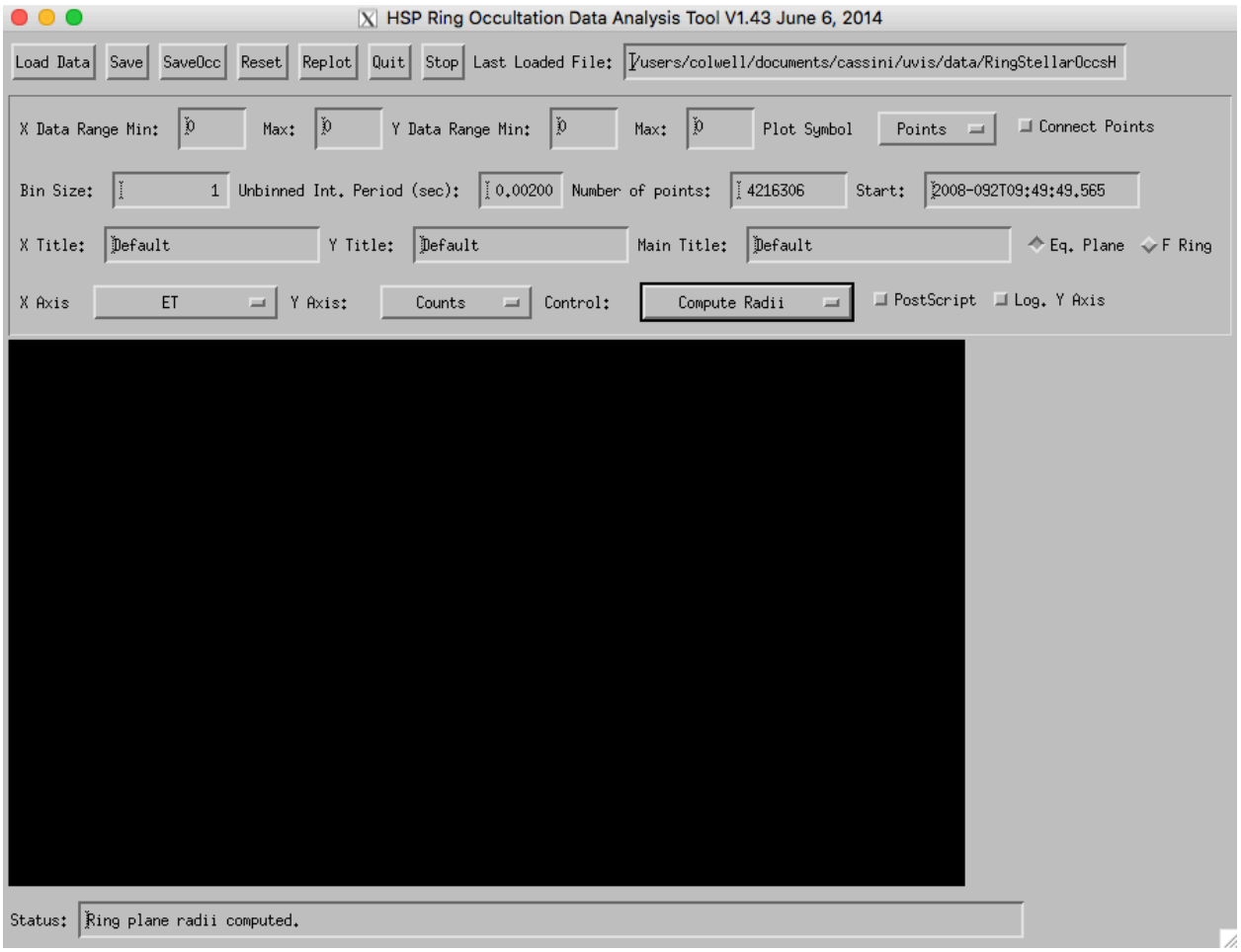

Figure 1: The ROCCDAT graphical user interface.

Operation:
Launch ROCCDAT from the IDL prompt:
IDL> roccdat

When the GUI appears (Figure 1), click the "Load Data" button to open a file requestor. Select all the HSP raw data files to be loaded. These files must all be in a single directory. ROCCDAT is only tested to handle data files that make up a single observation. It should not be used to load HSP data files from multiple observations. Single observations may be broken up into multiple raw HSP data files if there were interruptions during downlink. In some cases more than 100 data files comprise a single observation. ROCCDAT can load all these files at once and concatenate them into a single IDL data vector and associated time vector.

Each HSP observation has an associated HSP Auxilliary Timing File with a filename of the format:
Science-s29-20071112040-20071121356.dat.hsp_timing.txt
The filename indicates the period of validity for the timing file. In the example above, the data span 2007-111T20:40 to 2007-112T13:56, where 111 and 112 are days of year. ROCCDAT

searches a directory of auxilliary timing files to find the file whose data match the time of the observation. If it fails to find this file, it will prompt the user to manually select an auxilliary timing file. Without the correct timing file, there will be timing errors associated with the data.

When the data have been successfully loaded a message will be displayed in the Status window at the bottom of the GUI. At this point ROCCDAT has created an IDL vector with HSP counts called “data” and a vector of ephemeris times in the J2000 system called “et”. If these are the only outputs desired they can be saved by clicking the “Stop” button and then manually saving the data and et vectors at the IDL prompt.

To calculate ring occultation data, select “Compute Radii” from the “Control” dropdown menu. You will be prompted to enter the name of a star. This name must match the names in the star data file “GeometerStars.txt”. ROCCDAT will search for this file on the local machine, and if it is not found will prompt the user to find it via a file selection dialog. Typically star names in this file are three characters to designate the star and three to designate the constellation. A space separates the two. The entry is not case sensitive. Thus “Alp Vir” is entered for the star alpha virginis (also known as Spica). After entering the star name ROCCDAT will compute the ring plane intercept radius, inertial longitude, and azimuthal look angle for every data point. This may take several minutes. A message will be displayed in the Status window when complete. At this point the user may save the data, time, and geometry vectors by clicking the “SaveOcc” button or by clicking “Stop” and manually saving. The vector names in IDL are: data, et, lon, radius, ringoccphi.

The data may be binned by entering a number of raw data points to include in a bin in the “Bin Size” text entry of the ROCCDAT GUI. The binned data (dbin) and corresponding time vector (etbin) can be saved manually or by clicking the “Save” button.

The ROCCDAT GUI includes several other plotting controls that are self-explanatory.

Notes:
See the UVIS User’s Guide for additional information on the HSP instrument and data. The raw data are organized into records of 945 points and read in as 2-dimensional arrays. ROCCDAT assembles the array into a single vector of data. If the observation ended before the end of the 945 data point record, the remaining points in that record are filled with zeros. Because zero can be either a filler value or an actual measurement, ROCCDAT deletes the zeros from the data vector. Each record has a spacecraft clock time associated with it. However, at a typical data collection rate of 1000 Hz, this corresponds to about 1 second of timing uncertainty. The auxilliary timing file indicates which data point was being recorded in each data record when the spacecraft clock tick was registered. This is how ROCCDAT combines the auxilliary timing file with the raw data files to get an accurate time vector at the level of an individual measurement.

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