Using the NASA Planetary Data System of IOTA Asteroid Occultations

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Introduction

IOTA is working with the scientific community to ensure that our treasure trove of occultation observation data is safely stored and available for use by the scientific community into perpetuity. In this effort, David W. Dunham, Dave Herald, Eric Frappa, Tsutomu Hayamizu, John Talbot, J., and Brad Timerson once each year (or more often if needed) publish an updated database file that includes both a summary and detailed information about every observation ever made by IOTA observers. The data is published under the title: Asteroid Occultations V10.0. EAR-A-3-RDR-OCCULTATIONS-V10.0. NASA Planetary Data System, 2012. The data is found at the URL: http://sbn.psi.edu/pds/resource/occ.html.

If you access this link, you quite possibly might find the format and organization to be unrecognizable or even daunting to use. However, with some basic tutoring, the use of this database should be easily accessible by everyone in IOTA, as well as those in the scientific community that already know how to access such databases. This paper provides some rudimentary tutorials on how to access and use the database.

Veteran IOTA members may already access this information using Occult4 and hence may not need to ever access the NASA PDS. In fact, the PDS data is merely a reformatted version of the AsteroidObservations.dat file maintained within Occult4. .However, others do not regularly use Occult4 and therefore might find the use of the NASA PDS easier and more efficient. It is hoped that if you are in the latter category, you will find this paper of use.

Database Organization

The format used is the NASA Planetary Data System (PDS). This data set is intended to include all reported timings of observed asteroid, planet, and planetary satellite occultation events as well as occultation axes derived from those timings. The data is stored in Versions, with each new Version containing the data from previous versions, corrections to previous versions, and updates of the most recent data. The current V10.0 is complete and updated through February, 2012.

Details of reading the PDS files are explained at:
http://pdssbn.astro.umd.edu/howto/understand.shtml

When you click on the URL where the data is stored: http://sbn.psi.edu/pds/resource/occ.html; you will find a Root Directory containing the following files and folders:

- ***aareadme.txt***: A brief text description of the file structure, much like what is shown below but with less detail.
- ***catalog/*:** A required directory containing files with very high-level information used to populate the central PDS catalog for searching. You typically will not need to access this subdirectory.
- ***data/*:** You will find the data files in a subdirectory called *data/*. Data sets will have multiple data directories under the root directory, named as follows:
  - `occlist.lbl` column labels for asteroid occultation data
  - `occlist.tab` asteroid occultation data
  - `occsatlist.lbl` column labels for planetary satellite occultation data
  - `occsatlist.tab` planetary satellite occultation data
  - `occsatsummary.lbl` column labels for planetary satellite summary of occultations
  - `occsatsummary.tab` planetary satellite summary of occultations
  - `occsattime.lbl` column labels for planetary satellite occultation individual observer timings
  - `occsattime.tab` planetary satellite occultation individual observer timings
  - `occsummary.lbl` column labels for summary of occultations by asteroid number
  - `occsummary.tab` summary of occultations by asteroid number
  - `occtimings.lbl` column labels for asteroid occultation individual observer timings
  - `occtimings.tab` asteroid occultation individual observer timings

  Each of the above data directories are hypertext links if you are viewing this document in electronic format. Unspecified (blank) values are indicated by filling the field with 9s
- ***document/:*** An optional directory containing document files that provide detailed descriptions and explanations of various topics related to the data, like calibration procedures, instrument descriptions, observatory logbooks, etc.
- ***index/*:** A required directory containing files called *index.tab*, which contains the PDS manifest for the data set, and *checksum.tab*, which has MD5 checksums for everything in the data set. You typically will not need to access this subdirectory.
- ***voldesc.cat***: A text file with technical volume description. You typically will not need to access this subdirectory.

Note for Windows Users

Files with an extension of .cat and are simple text files. If you are a Windows user you may have to force Windows to open them with a specific file editor, because Windows has reserved the .cat extension for security catalog files and gets nervous when ordinary users start messing with .cat files. Use the "Open with" right-click option in your Windows Explorer window to select an editor for viewing the files. Notepad and WordPad usually work well. If you're trying to look at a .cat file in Internet Explorer, you will be stymied by

the browser. You will have to download the file (right-click and "Save target as") to your hard disk and then open it with any text editor. Alternately, you can use some browser other than IE. Google Chrome, for example, seems to be quite happy to display .cat files on Windows systems.

Using the Database

The most recent version of the database is always listed at the top. The easiest way to use the database is to 'Browse'. In this manner, you can see the data you want, highlight, cut and paste, or save the entire file if you wish. You may also 'Download' the database and save the entire file to your computer.

If browsing an occlist.tab file, the screen will look like this:

```
0001 1958-02-19      3 Juno              -          TYC 0110-00632-1 05 01 43.3782
0002 1961-10-02      2 Pallas            -          TYC 5237-01223-1 22 47 34.0622
0003 1975-01-24    433 Eros              -          HIP 37740        07 44 26.8960
0004 1977-03-05      6 Hebe              -          HIP 12706        02 43 18.2599
0005 1978-05-29      2 Pallas            -          HIP 84772        17 19 40.0315
0006 1978-06-07    532 Herculina         -          HIP 73350        14 59 23.1136
0007 1978-07-19      3 Juno              -          HIP 99050        20 06 36.2421
0008 1978-10-25     12 Victoria          -          TYC 6281-01615-1 18 49 44.2562
0009 1978-12-11     18 Melpomene         -          HIP 31694        06 37 51.5021
0010 1979-04-06     39 Laetitia          -          HIP 17040        03 39 10.8422
```

Note that the start of each line is a sequence number in chronological order (SEQ_NUM). This number is also used in the occtimings.tab file as shown below:

```
0001   1 P. Bjorklund/S. Muller, Malmo, SE       12.950000  55.580000 -9999 * -99999
0002   1 Uttar Pradesh S. Ob, Naini Tal, India   79.465833  29.387639   587 * -99999
0003   1 Phil Dombrowski, Newington, CT         -72.735556  41.669444    40 * -99999
0003   2 D. Yard, New Britain, CT               -72.766389  41.691667    60 * -99999
0003   3 D. R. Morrison, Unionville, CT         -72.882778  41.766111   100 * -99999
0003   4 R. Dragon, New Britain, CT             -72.812778  41.677778   100 * -99999
0003   5 R. Gurka, Burlington, CT               -72.925000  41.745000   100 * -99999
```

In the above case, the first and second sequential occultations recorded have only one observation each, while the third sequential occultation has multiple observations.

The occsummary.tab file will look like this:

```
 1 Ceres            959.5   2.3     908.0   4.2      62.1   3.0   4  1984-11-13
 1 Ceres            960.0 -99.9     960.0 -99.9       0.0 -99.9   2  2010-10-30
 2 Pallas           553.5   1.6     528.4   3.9     -39.0   6.6   3  1978-05-29
 2 Pallas           528.6   1.0     512.3   2.7     -31.7   4.3   4  1983-05-29
 2 Pallas           531.8  34.1   -9999.9 -99.9   -9999.9 -99.9   2  2001-06-09
 2 Pallas           515.0 -99.9   -9999.9 -99.9   -9999.9 -99.9   2  2006-06-12
 3 Juno             289.6   1.1     249.5   2.2      80.5   1.7   4  1979-12-11
 3 Juno             236.0   6.9   -9999.9 -99.9   -9999.9 -99.9   2  2000-05-24
```

The listing summarizes all the 'events' recorded for any asteroid, in order of asteroid number.

The .lbl files are important to understanding the column layout for each file. Here are two examples:

First the occlist.lbl file:

```
OBJECT                          = COLUMN
 COLUMN_NUMBER                  = 1
 NAME                           = "SEQ_NUM"
 DESCRIPTION                    = "A unique sequence number for the
       occultation event.  This sequence number is used in the timings file
       as well, to identify which occultation a given observation pertains
       to."
 DATA_TYPE                      = "CHARACTER"
 START_BYTE                     = 1
 BYTES                          = 4
 FORMAT                         = "A4"
END_OBJECT                      = COLUMN
```

Second the occtimings.lbl file:

```
OBJECT                          = COLUMN
 COLUMN_NUMBER                  = 3
 NAME                           = "SITE_NAME"
 DESCRIPTION                    = "Name of the observing site.  The name of
       the observer is sometimes included."
 DATA_TYPE                      = "CHARACTER"
 START_BYTE                     = 10
 BYTES                          = 37
 FORMAT                         = "A37"
END_OBJECT                      = COLUMN
```

The occtimings.lbl example is for the third column of data. The column is labeled “Site Name”. The column format is “CHARACTER”. The column starts at the 10th byte in the row and runs for 37 bytes. While this level of detail is necessary for the proper parsing of the data files, a shortcut listing of all the column names for each .tab file are shown in Text Boxes 1, 2, and 3.

Issues If Running SKYPE

One curious thing when browsing the tables using Internet Explorer is that if you have Skype installed, Skype inserts annoying messages into the data:

```
0326 2001-12-16    334 Chicago          -          TYC 0665-01037-1 03 58 03.3622 -
0327 2001-12-19    712 Boliviana        -          TYC 0717- 00435-1 06 04 56.5206  +
0328 2001-12-21    569 Misa             -          TYC 1832-00585-1 04 56 56.5717 -
0329 2001-12-28    712 Boliviana        -          TYC 0716- 00821-1 05 55 38.3875  +
0330 2001-12-30    144 Vibilia          -          TYC 5258-00552-1 23 45 27.6358 -
```

These Click to Call phone dialing scripts show up even if you quit Skype. The annoying embedded Skype messages can be eliminated by turning off Skype Click to Call feature in Internet Explorer. If other issues are found when using the NASA PDS, please report to Tony George triastro@oregontrail.net so this tutorial paper can be updated and issues reported to Dave Herald.

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Text Box 1 -- occlist.lbl and occsatlist.lbl Data Labels

1. SEQ_NUM
2. OBS_DATE
3. AST_NUMBER or SAT_DESIG
4. AST_NAME or SAT_NAME
5. PROV_DESIG (not used in occsatlist.lbl)
6. CATALOG_STAR_DESIG
7. STAR_RA_HOURS
8. STAR_RA_MINUTES
9. STAR_RA_SECONDS
10. STAR_DEC_SIGN
11. STAR_DEC_DEGREES
12. STAR_DEC_MINUTES
13. STAR_DEC_SECONDS
14. TIME_ZERO
15. AST_RA_MOTION
16. AST_RA_MOTION_2ND
17. AST_DEC_MOTION
18. AST_DEC_MOTION_2ND
19. AST_PARALLAX or SAT_PARALLAX
20. UPDATE_DATE
21. EDIT_DATE
22. STAR_V_MAG
23. AST_V_MAG or SAT_V_MAG
24. AST_DIAM or SAT_DIAM
25. ELLIPSE_CENTER_X
26. ELLIPSE_CENTER_Y
27. MAJOR_AXIS
28. MINOR_AXIS
29. MAJOR_AXIS_PA
30. STAR_SEP
31. STAR_PA
32. FIT_QUAL_CODE
33. MAJOR_AXIS_SD
34. MINOR_AXIS_SD
35. MAJOR_AXIS_PA_SD
36. STAR_SEP_SD
37. STAR_PA_SD
38. ELLIPSE_CENTER_X_SD
39. ELLIPSE_CENTER_Y_SD
40. MISS_FLAG
41. MAJOR_FLAG
42. MINOR_FLAG
43. MAJOR_PA_FLAG
44. SEP_FLAG
45. STAR_PA_FLAG
46. CIRC_FLAG
47. PLOT_UT
48. GEO_EVENT_X
49. GEO_EVENT_Y
50. GEO_CONJ_X
51. GEO_CONJ_Y
52. GEO_CONJ_DIST
53. CONJ_TIME
54. GEO_CONJ_SEP
55. GEO_CONJ_PA
56. CONJ_SEP_ERROR
57. CONJ_TIME_ERROR

Text Box 2 -- occsummary.lbl and occsatsummary.lbl Data Labels

1. AST_NUMBER or SAT_DESIG
2. AST_NAME or SAT_NAME
3. MAJOR_AXIS
4. MAJOR_AXIS_SD
5. MINOR_AXIS
6. MINOR_AXIS_SD
7. MAJOR_AXIS_PA
8. MAJOR_AXIS_PA_SD
9. FIT_QUAL_CODE
10. OBS_DATE

Text Box 3 – occtimings.lbl and occsattime.lbl Data Labels

1. SEQ_NUM
2. SITE_INDEX
3. SITE_NAME
4. SITE_LONG
5. SITE_LAT
6. SITE_ALT
7. DATUM_CODE
8. TEL_APERTURE
9. TEL_TYPE
10. STABILITY
11. TRANSPARENCY
12. TIME_SOURCE
13. DISAPP_TIME
14. DISAPP_EVENT_CODE
15. DISAPP_TIME_ACC
16. DISAPP_PE
17. DISAPP_TIME_WEIGHT
18. REAPP_TIME
19. REAPP_EVENT_CODE
20. REAPP_TIME_ACC
21. REAPP_PE
22. REAPP_TIME_WEIGHT
23. METHOD_CODE
24. PLOT_CODE
25. TIME_ADJ
26. COMMENT