Peer Review of Voyager-2803 CD: Radio Science Ring Occultation Data set

Essam Marouf, 13-June-2004

Data Archived: Voyager radio occultation observations of Saturn's Rings in 1980 and of Uranus' Rings in 1986 yielded two distinct types of data sets. The first relates to measurement of the narrowband direct, or coherent, signal component, used to derive ring optical depth and signal phase-shift profiles. The second relates to measurement of the broadband near-forward scattered signal component, used to determine the distribution of ring particle sizes and to constrain other physical ring properties such as ring thickness and packing fraction. The data archived on this CD is limited to the first data type only.

General Assessment: The CD goes a long way towards preserving the direct signal data subset initially archived by the Stanford group and extending it in ways that make the set more accessible to ring investigators.

For Saturn, the initial binary formatted (VAX) files that combine geometric, calibration, and data information are separated out and conveniently reformatted to be accessible on more common computational platforms (still in binary format). In addition, easily accessible text formatted optical depth profiles over a range of radial resolutions are provided together. Software to resample the data at other resolutions, if desired, is provided. This is indeed very useful for quick access to the optical depth profiles by the casual user.

For Uranus, a parallel approach is used. The data files generated are primarily based on the original Stanford text files of the complex signal amplitude versus radius for individual rings at several spatial resolutions. As for Saturn, easily accessible text files over a range of resolutions are provided together with a program to resample the data if needed.

The Stanford geometry calculations for both the Uranus and Saturn cases are checked against independent calculations by Phil Nicholson and found to be in good agreement. Geometry files based on both calculations are provided, with the small differences being primarily due to slight pole orientation update.

The authors of the CD have done a comprehensive and admirable job making this important data set more accessible to a broader range of ring investigators that vary from the casual user to the deeply interested.

In working with the CD over a period of time, several issues to improve on an already significant effort became apparent to this reviewer. They are summarized below and may be considered in preparation of the final release version of this CD.

Specific Comments:

1- The directory structure of the CD as it is now leaves much to be desired in terms of reorganization. To work my way around the various subdirectories to find the information I felt needed, I had to make a detailed directory "tree," with notes stating what to expect at the end of each tree branch. I'm not sure what would be an alternative better organization. One approach is not to mix different types of information in different subdirectories. That is, use the seven subdirectories at the root, namely, Catalog, Document, Index, Software, Spice, Geometry, S_Rings, and U_Rings (and perhaps an added Calibration directory) as the root source of all information related to the name of the corresponding subdirectory. It proved very confusing, for example, to track programs, geometry, and calibration information that are scattered in various directories. Although the logic behind the CD directory structure became more apparent after working with the CD for a while, I alwys needed my "tree" chart every time I stopped working on the CD for a few days.

RESPONSE: We have retained the existing structure for a variety of reasons, but primarily because all of the alternatives have weaknesses that make them no more transparent than the current structure, while the current structure has the advantage of mirroring as much as possible the structures in the companion volumes for the Voyager Ring Occultation Volume set.

To make the structure clearer, we have provided extensive details in the file DOCUMENT/TUTORIAL.TXT. This file is now highlighted near the beginning of the top-level file AAREADME.TXT. In addition, both files now prominently direct users with unsophisticated needs to the EASYDATA subdirectories.

Also, to reduce the likelihood of confusion over directories of the same name, we have renamed several subdirectories of DOCUMENT:

DOCUMENT/CALIB -> DOCUMENT/CALDOC
DOCUMENT/CALIB/SDATA -> DOCUMENT/CALDOC/SCALDATA
DOCUMENT/GEOMETRY -> DOCUMENT/GEODOC
DOCUMENT/GEOMETRY/SDATA -> DOCUMENT/GEODOC/SGEODATA
DOCUMENT/GEOMETRY/UDATA -> DOCUMENT/GEODOC/UGEODATA

2- Thanks for preserving the pre-inversion as well as post-inversion Saturn data in the converted binary RAWDATA files. It is important for any investigator that may want to revisit with the diffraction reconstruction process to have access to both data forms. Unfortunately though, most geometric parameters related to the inversion process were left out in the corresponding tabulated geometry file (RS0G1B.TAB). Fortunately, the details are preserved in the individual RAWDATA files and can be accessed by a "determined" user. It would have been nice to have more complete easily accessible geometry file that includes information about the Fresnel-scale and other geometric parameters more or less similar to the files SRINGINT.OUT and SRINGINT.LOG generated by Phil's program in the subdirectory /Document/Geometry/SDATA/.

RESPONSE: We agree that this data set does not contain extensive information about the inversion processing. While it is critically important for that data and expertise to be preserved, we simply have no access at this time to anything but processed data. We have endeavored to make this point clearer now by re-writing the introduction to AAREADME.TXT, including this sentence in all caps: "ONLY HIGHLY PROCESSED, DERIVED RING OCCULTATION PROFILES ARE PROVIDED ON THIS VOLUME."

3- For Uranus, only the diffraction corrected files are archived, likely a limitation of the data provided by Stanford to PDS (partly my fault). It would have been more complete here to also archive the pre-inversion data, as for the Saturn Case. It may be late at this stage to include the original diffraction limited data in this archive, but that would make the archived data certainly more complete.

RESPONSE: We would have been delighted to archive the pre-inversion Uranus data as well, but it was not available to us.

4- Inclusion of the Spice SPK kernels for the Voyager trajectories in the archive is a great idea. The Spice toolkit routines likely will provide the foundation for geometric calculations related to future Cassini ring occultation observations and it may be important to redo the Voyager calculations based on the toolkit for checks and comparisons.

5- I had difficult time compiling the Profile Library and the Examples in /Software/Profile/Examples on a Mac OS X 10.2.8 (the OAL Library compiled without difficulty). After trying a few things without success, I finally changed the cc compiler directive in the MAKEMAC.COM file to use gcc instead and things seemed to fall in place.

Again here, the OAL and Profile directory structure is not "clean" and could significantly benefit from some reorganization that separates the src, lib, exe, and doc subdirectories, perhaps following the model of the Spice Toolkit directory organization.

RESPONSE: We regret to learn that you had trouble building the tools, although you did, apparently, succeed. PDS has long noted the impossibility of archiving software, given variations in user environments, operating systems, and compilers, and the inevitable changes in all of the above over time. We have added a note to SOFTWARE/OAL/AAREADME.TXT, as follows: "All PDS source code is necessarily provided 'as is'; we cannot guarantee that it will run on a given platform."

We also updated the file SOFTWARE/OAL/AAREADME.TXT and added a file SOFTWARE/OAL/SOURCE/AAREADME.TXT, which contain further details about the source code and the build process.

6- The FORTRAN program SRSSRESA.FOR provided to generate re-sampled text data files (EASYDATA) is indeed useful for quick and easy generation optical depth profiles

at various desired resolutions. Surprisingly, the related example programs in /Software/Profile/Examples relate to averaging and re-sampling of the Voyager PPS stellar ring occultation data and not the Radio Science ring data. I understand that they are included here as examples for the process. However, it's straightforward to make the examples more relevant to the radio data set at hand. For example, they can easily be modified to replace the program PPSRESAMP.FOR by the program SRSSRESA.FOR. Indeed a test of such modification generated an executable SRSSRESA, which when executed correctly generated the SRSSRESA.OUT file given in the /Software subdirectory. I think it would be useful to implement the change in the final CD.

RESPONSE: The example programs in SOFTWARE/PROFILE/EXAMPLES are part of the Profile Library delivery package, which was not specifically customized for this data set. As you note, we also provide example programs that are specifically related to this data set. These programs are easy to find, inside the top-level SOFTWARE subdirectory.

7- The two programs DUMPOC1.FOR, .C and DUMPGS3.FOR, .C appear to be missing on the provided CD (see /Software/Softinfo.txt). The description given in SOFTINF.TXT show them to be useful for extracting binary data, one thing I wanted very much to try but never had the time to complete. It would be useful to include them in the revised CD.

RESPONSE: Unfortunately, this was simply an editing error. DUMPOC1.FOR and DUMPGS3.FOR were a part of the PPS data set, volume VG_2801. We have deleted the references to these files from SOFTINFO.TXT.

8- Finally, archiving only the optical depth and phase-shift profiles may be justifiable by the fact that this is the data component most ring investigators easily relate to and are perhaps interested in. However, to really preserve the full value of the Voyager Saturn and Uranus ring occultation data sets, it is important that similar future endeavor be devoted to also archiving the scattered signal part of these two data sets.

RESPONSE: We strongly agree! We will support Dr. Marouf and the Cassini RSS team in their efforts to do so.