

Resent-Date: Wed, 17 Mar 2004 11:00:47 -0800
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Date: Wed, 17 Mar 2004 11:00:02 -0800 (PST)
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To: mgordon@mail.arc.nasa.gov, rsimpson@magellan.Stanford.EDU,
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Subject: VG_2803
X-Junkmail-Status: score=0/60, host=arc-relay1.arc.nasa.gov

Mark and Mitch:

I printed a selection of text files from VG_2803 and took those with me to the LPSC meeting. I took the CD, but have not had much chance to look at it in detail. In particular, the directory/file structure and contents more than 2-3 levels deep remains largely unexplored.

I think my impressions may represent those of a novice, biased somewhat by my recollections of participating in the data collection and early analysis phases 20 years ago. I had very little role in the production of the files on this CD, however. That work was done almost exclusively by Tyler, Marouf, Zebker, Rosen, and Gresh.

I will mail you the pages I printed and marked up. Although you may have problems with my handwriting, I think this is a more practical approach than attempting to type the comments into a separate message or make annotations on the electronic files. I'll plan to keep a photocopy of the material I mail and you can call with questions if any arise. For the most part, my mark-up comments are editorial. I'm off to Germany today; will take the CD and continue the review.

1. My first general comment is that an archive of reduced data usually includes a significant discussion about the analysis procedures used to take the raw data to the finished product. With the exception of a few allusions to "diffraction correction" and the importance of selecting resolution at the beginning of processing, there is almost nothing about the effort invested by Tyler, Marouf, and a couple generations of graduate students in this work. Virtually all of the documentation centers on the techniques developed at the RINGS Node to resample the Stanford results and adjust them to the J2000 reference frame. This is important; but it should not be the central point of the archive. I suggest you consider extracting the relevant parts from ATLNOTES.PDF and inserting them into DATASET.CAT, with an abbreviated version for AAREADME.TXT. You need a text-only version of ATLNOTES.PDF anyway; this just provides additional motivation.

RESPONSE: There appears to be a mismatch between the volume that we have archived and the expectations of the reviewer. We have revised AAREADME.TXT to make this point very clear, and to reduce the chance that future scientists might have unrealistic expectations about what this volume contains:

The ring profiles contained herein are the end result of extensive processing by the Voyager Radioscience team at Stanford. A phase-locked,

continuous-wave signal at two wavelengths (S-band and X-band) was transmitted from the spacecraft as it passed behind the rings, as seen from Earth. On Earth, Deep Space Network (DSN) ground stations received the raw signal. Afterward, extensive processing was required to remove the effects of diffraction through the rings and retrieve a fine-resolution profile of opacity and phase shift. The details of that processing can be found in several publications:

[MAROUFETAL1982] Marouf, E.A., G.L. Tyler, and V.R. Eshleman, Theory of Radio Occultation by Saturn's rings, *Icarus*, 49, 161-193, 1982.

[MAROUFETAL1986] Marouf, E.A., G.L. Tyler, and P.A. Rosen, Profiling Saturn's Rings by Radio Occultation, *Icarus*, 68, 120-166, 1986.

ONLY HIGHLY PROCESSED, DERIVED RING OCCULTATION PROFILES ARE PROVIDED ON THIS VOLUME. The contents are based on a set of highly processed ring profiles obtained from Voyager RSS team members. We have updated the geometry and have developed some tools to enable limited re-processing of the data to different spatial resolutions. Our focus has been on preserving these ring profiles in a form that will make the usable to the widest audience possible. This volume does not contain the raw data or other information a user would need to re-process planetary ring profiles from the raw sources.

We have also updated DOCUMENT/TUTORIAL.TXT with as similar statement.

2. That the RINGS effort is the true focus is re-enforced by the somewhat arbitrary labeling of the Stanford data as "source" and "raw". I think better titles might be STANFORD, REFORMATTED, J2000_CORRECTED, and EASYDATA - or something along those lines. I acknowledge that this may require a significant effort on your part to revise the documentation. But a poor choice of names at RINGS should not be forced onto the user community when it is so misleading. The Stanford data are simply not "raw"! Those are the files you should be spending the most time describing.

RESPONSE: We have renamed "raw" data as "low-level" data, in directories named "LOWDATA". We believe the term "source data" is still accurate. Various documents try to make the meaning of each of these terms as clear as possible.

3. When I'm trying to understand what is on a CD, I usually start with AAREADME.TXT, then go to DATASET.CAT. In each of those I found that these data came from the Voyager ring radio occultation experiments; but, except for some references to "processing", there wasn't much more. Only when I got to TUTORIAL.TXT did the pieces start falling into place. Although TUTORIAL.TXT is a longer document, I think you would do better to take its contents and move those to DATASET.CAT and then put summary information into AAREADME.TXT. You need clearer statements of what you have; the present arrangement spreads this information over too many files - and the most useful is not likely to be found very early by the novice user. With the exception of the recommendations at the very end, I didn't find much in TUTORIAL.TXT that would help "guide" me through the volume; so I don't think it lives up to its billing anyway.

RESPONSE: We believe that, by clarifying the purpose and content of this volume, we have mitigated the need for a wholesale reorganization. We also note that other reviewers found both AAREADME.TXT and TUTORIAL.TXT to be helpful.

4. The appearance of multiple CALIB, GEOMETRY, DOCUMENT, and other directories throughout the volume is confusing. I can understand why you might prefer to keep Saturn calibration documentation with the Saturn data; but you should give the directories unique names. It is very hard for the reader, when you mention the "geometry" files, to know whether you are talking about files in S_RINGS/GEOMETRY, U_RINGS/GEOMETRY, /DOCUMENT/GEOMETRY, or even /SPICE. This may seem like a trivial "context" relationship to you; but I've not put these directories together and don't have the background to understand your context.

RESPONSE: We only ever one subdirectory named "DOCUMENT". We renamed some of the DOCUMENT subdirectories to reduce the possibility of confusion, so the only "CALIB" and "GEOMETRY" subdirectories are found inside "S_RINGS" and "U_RINGS", where their contents are functionally identical.

I will make the same comment about careless use of "data," "data set," and "supported." If you are going to refer to the contents of S_RINGS and U_RINGS as THE data files, you should be very clear and consistent in using that terminology. For example, do the contents of S_RINGS/CALIB and S_RINGS/GEOMETRY also fit within that title? All other files are then presumably "ancillary". All files in the volume are part of THE "data set" - the ancillary files do not SUPPORT the data set, they are part of the data set. There is at least one place where the Saturn and Uranus files are described as separate data sets (see markups). Finally, what does it mean to have "supported" software and "supported" data or data sets? Some of the material on the CD is apparently NOT supported, and I don't know what that means.

RESPONSE: We have reviewed all occurrences of the words "supported" and "ancillary", and we believe that they are entirely conventional. Files are there if the user wants them. If a file is "supported" and the user has a question, we can provide it. If a file is "unsupported", then the user is welcome to do what they wish with the contents of that file, but we cannot promise anything. "Ancillary" files are those that are useful in the analysis of the RSS data, but are not actually RSS data.

5. I assume you used VG_280{1,2} files as templates for this volume. You need to root out remnants from those earlier data sets - file names starting with "U", references to "emissivity", etc. You also need to get a little clearer on the meaning of "transmissivity," which I take to be ratio of powers. You use it in the sense that it has a phase, which is not possible with power (see markups in DATASET.CAT). This is a term that could probably be used more carefully in a lot of places; but let's be accurate here, since we're talking about fundamental definitions.

RESPONSE: All occurrences of "emissivity" are now "transmissivity", or "complex transmissivity", as was our original intent. We have now defined it

more carefully in DATASET.CAT and TUTORIAL.TXT. Here is the excerpt from DATASET.CAT:

Some files contain the complex transmissivity of the ring, which is based on the change in the complex field strength of the coherent radio signal due to the crossing of the ring. Specifically, it is the complex ratio of the field strength after crossing the ring to the field strength that would have been received in the absence of a ring. Complex transmissivity is related to ring opacity and phase shift as follows:

Note that it is a complex ratio of field strengths, not power.

6. Your confusion about resolution versus sampling may be reconciled by recalling that Rosen resampled the original inversions to obtain a uniform radial scale (see AATLNOTES.PDF). If you have complex samples, your Nyquist spacing will be the SAME as your resolution - each complex sample value contains two pieces of information (one real, one imaginary) so you need to sample only half as often as with real samples. In order to achieve uniform radial resolution, Paul may have chosen to OVERSAMPLE in the original inversion; then he wouldn't have to worry about whether his resampling pressed the information limits around the Nyquist rate. I think it's very likely that this was deliberate and was done to provide a buffer during his resampling. It's not surprising that you find very little spectral content at frequencies above 1/res; if there were any, Paul's buffer wasn't doing its job. This doesn't explain the factor of 8 difference in RU2 and factor of 4 in RU3; but it covers the factors of 2. Maybe the others were just experiments.

In response to the comment, we have added the following short paragraph to TUTORIAL.TXT, following the mention of Nyquist sampling:

Note: Formally, only one sample per spatial wavelength is required for complex signals, such as the transmissivity values stored in the "EDITDATA" files (discussed below, section 2.2. However, the derived ring profiles (aka "EASYDATA" files, section 2.1), have been converted to real values of opacity and phase shift, and so require the 2x finer sampling provided.

7. You have invested a lot of effort in providing binary files in several formats; binary saves something like a factor of 3 in storage over ASCII, depending on how cleverly you represent the ASCII. If you have three binary versions, however, you've lost the advantage; in addition, you have lost the intrinsic simplicity of the ASCII. You might want to reconsider; would a single ASCII version instead of these multiple binaries be a better choice in the long run?

RESPONSE: All data volumes are modest, so we see no reason to remove files that might be useful.

Regards,
Dick Simpson