

To: FAME project
From: J.D. Phillips
Subject: Error budget documents
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D:\U\USNO-AST\Error\approach2.wpd

Here is a suggested list of error budget documentation, for comments by project members. Substantial revisions are possible.

The documents listed below should be readily available, probably on the website. They will be working documents, and archive copies of them should be made from time to time (CDR, PDR, etc.).

- a) Flowdown from science requirements to instrument and spacecraft requirements, *via* centroiding and spiral (and perhaps global) stages of data reduction.
- b) Outline of significant effects, giving numerical values.
- c) Outline of *insignificant* effects, giving numerical values.
- d) Text which
 - Explains estimates of magnitudes in b & c, giving physical basis for the effect, citing relevant publications and project documents.
 - Gives algorithms for estimating parameters of models of items in b, in most cases using the science data. This includes specification of the stage in the data reduction at which the model parameters are estimated, and the numbers of parameters likely to be required, taking into account variation with time, location in focal plane, stellar magnitude, and variation with other parameters. (The parameter counts are collected into a table in this document.) Some of the estimates of numbers of parameters will be uncertain by significant factors, perhaps until the behavior of the instrument and spacecraft on orbit are known.
- e) Scratch code implementing the algorithms, written, tested, and delivered to production code team.

Tree-style diagrams, such as those from the viewpoints of instrument error or of errors introduced by spacecraft motion, are helpful presentation aids. They are tied to the outlines (b & c), and the project may choose to consider them as auxiliary to the primary documentation set.

Some error effects have been considered that are too small to concern ourselves with further. These will be recorded in a separate list of insignificant error sources, so that it is known that we considered them. There will be a pointer to a discussion in the error budget document, or to some other document showing how small these items are.

Any error that is significant before modelling should go in category b), even if it is completely insignificant after modelling. This is true even if the model can be built and its parameters estimated *a priori*, e.g., the aberration model, which will probably be built using spacecraft tracking data and no science data.

I think the outlines (Items b & c, above) are important guides to the text. A new version has been prepared (10/24/00), although not yet divided into significant and insignificant categories, and is available for comment.

I find it essential in producing the numerical estimates for the text to have a separate document in which they're calculated. This document is driven from a master list of assumptions (an augmented version of the "Quick Facts" in the CSR). I currently do this in Mathcad, but I'm willing to do it in Excel or other ubiquitous software if I need to exchange it with people. The advantage of Mathcad is that one can attach units to a quantity, and have automatic conversions with error checking. With some extra effort, Mathcad could be made to write a table readable by standard spreadsheet software. This would be a set of inputs or outputs, not the entire Mathcad worksheet with calculations.