Error Model Sub Committee

September 24th, 2025 - Anchorage, Alaska

Attendees (in person)

Ian Walker	Tyler Longreau	Aaron Matheson	Mike Attrell	Nathan Szanto
Victoria Loepp	Melvin Rixse	Maria French	Carl Healy	Matt Weber
Steve Grindrod	Batyr Amanov	Robert Wylie	Adrian Ledroz	Chad Hanak
Andy McGregor	Tim Allen	Austin Pile	Jocelyn Comte	Darren Aklestad
Eric Marchand	Denis Reynaud	Brett Van Steenwyk	Andreas Romanus	Tyler Marr
Anne Holmes	Bagus Sudiro	Rustam	Georgy Rassadkin	Ben Hawkinson
Marc Willerth				

20 additional people called online

Rotating Survey Tool Code Feedback Discussion

Discussion of Feedback received prior to the meeting

1. Tool code description changes

- Initial feedback includes several “bookkeeping type” adjustments have been proposed for the rotating error model such as updating error descriptions to include a call out for “Rotating”.
- These suggestions also point to gaps that exist in current error models descriptions where they may need to be updated as “Static”. This could be something to be tackled in a rev 6 when one is necessary
    - Note: There is no current plan for a rev 6, but we can begin compiling a list of items to consider for inclusion
- Broadly the group agrees that adding “MWD Rot:” to the descriptions is something we should do for clarity.
- Additionally there are some errors where the error code does not directly align with the description provided e.g. AN1 is described as shock and vibration instead of accelerometer noise. We should try to align the descriptions with the abbreviations.

2. Error Code Name Feedback

- Some of the new errors have a “-ROT” callout to distinguish them from similar, but not identical errors that appear in the traditional MWD model. Should we add “-ROT” to other terms?
- A similar convention has been done for gyros, so there is a precedent for doing this
- Looking at the older gyro models, the convention is to have it as a prefix then underscore.
- Additionally, having certain special characters that are easily confused (dash vs. hyphen vs. minus sign) is annoying. Other (such as commas) can break file parsers.
- Group agrees that ROT will be added as a prefix with an underscore, and all dashes will be removed.
- Sidenote – Some software has a 10-character limit for error codes, if possible try to keep names under this amount

3. Weighting function names and re-using existing weighting functions when possible

- Some weighting functions for new errors end up being directly equivalent to existing error source weighting functions. Even if there is a new error code, should we reuse the existing weighting functions?

- Using the same weighting function name can reduce confusion around having identical formulas. It can also help a reader's intuition by acknowledging "Error type A functions the same as Error Type B".
- Additionally, this clarification is primarily aimed at software *developers* who must actually code these errors in, the developers in the meeting who have to do this are broadly in favor of function reuse.
- Some software directly parses functions from a file and so the weighting function name is irrelevant to them.
- Related question: some weighting functions differ from existing functions only by a constant, should these have the constant rolled into the magnitude to reduce the number of weighting functions we need?
    a. If the constant is a result of a mathematical transformation (e.g. combining measurements from 2 sensors) we should leave it explicitly in the formula so there is additional clarity for a reader.
    b. Having artificial scaling of error magnitudes would increase the amount of tribal knowledge required to properly build a new tool code for a vendor, and having error magnitudes relate as closely to the physical phenomena they represent would be preferred (e.g. a "Sensor bias" should reflect the sensor performance, not a scaled performance that results from averaging 2 sensors' biases).

4. An outstanding action that would be worth reconsidering at some point is pipe squat, or better depth handling in general
- This is a fair point, but outside of scope for the current discussion aimed at capturing the errors that occur due to rotation. This likely would be something for a rev6 that covers all the error models that may need it

<u>Floor Opened for Additional Feedback in the meeting</u>

Singularity handling with the DSC Term:

- There is a sine azimuth dependency in the current singularity handling for DSC.
- Normally terms that have a relationship like this have a paired term with a cosine term, resulting in a cone-type error around the singularity. DSC has no such pair
- Should we replace the current term with simply a 1?
    - Or at least some other constant that will properly scale with the error magnitude. Group agrees *a constant* is likely correct, but *which* constant requires investigation

    - Action – Chad Hanak and Andreas Romanus to investigate the appropriate constant and as long as they are aligned, the tool code can be updated without need for further discussion.
- Similar question, not necessarily just related to Rotating surveys, some singularity handling has inconsistent use of absolute values (it appeared in some versions, disappeared in others)…is this important? Is it even needed if the errors get squared anyway?

Final Call for Objections / Feedback yielded no additional comments. Group agrees that the error model can be published once the following changes are made:

- Updating the error descriptions (adding "Rot" and linking to error code)
- Updating the error code names with "ROT_"
- Changing weighting function names to existing functions where possible
- Changing the DSC singularity handling to the appropriate constant

Discussion on Guidance Document for Rotating Surveys

Previous decision by the Rotating Survey Workgroup was that along with the publication of the error model, a 1-page guidance document should be provided to clarify its intent and usage

- There were concerns about confusing new rotating 6-axis surveys with legacy single axis "continuous surveys" that have been produced for many years
- There is likely to be a more diverse range of operating conditions for a rotating survey and there may be a larger number of pitfalls when compared to traditional MWD survey
- There were concerns that a document exceeding 1-page would not be widely read

Discussion opened with a historical note on magnitudes:

- The original proposed error model had magnitudes intended to approximate an EoU the same size as the traditional MWD EoU
- This was a target spec that a particular vendor wanted to achieve with their service
- This would also smooth out operational concerns about combining static and rotating MWD Surveys.
- Discussion was had within the rotating survey workgroup about trying to magnify these values to make a conservative error model, however that proved challenging given that tool-specific errors rarely dominate the error budget for MWD.

- Additionally – future discussions will likely revolve around procedures for comparing static surveys to rotating surveys for the same sensor in the same BHA, having alignment on accuracy could help clarify / streamline these procedures
    - Open Question about whether this type of validation is work for the Error Model Committee or whether
    - Need to emphasize that in practice magnitudes should come from vendors who have done their own validation…technically this is the assumption expected of the existing generic error models but in practice that rarely holds true.

Open Discussion on the Guidance document

- Broad agreement that communication should emphasize this was a physics exercise intended to capture novel error sources that arise from taking a rotating survey
- This is not intended to describe any particular vendor's tool, and it is up to the operator and the vendor to have a discussion around expectations when using specific tools
- There are a wide range of topics that will vary vendor to vendor:
    - What operational conditions are expected (what is "rotating" vs. "not rotating")
    - What style of low-pass filtering is being done and how to guarantee accuracy?
    - Other various concerns about hardware and firmware
    - What drilling mechanics would impact survey accuracy?
    - What limitations are there on ROP, Stick-Slip, Etc?
    - What is the expected survey frequency? Can you survey too much?
    - How are rotating and stationary surveys to be combined in a survey set?
    - How should a RIP test be performed properly, given most errors are correlated?
    - How can we make sure various procedures are actually followed in the field?
- Along with the guidance document there will need to be diagnostics to ensure software has implemented the error model as expected
    - This should include corner-case testing to ensure the model doesn't blow up with extremely short course length and other strange scenarios
    - It is not believed that there should be any strange behavior that comes out of the changes made for rotation, but there are some cases that are challenges for Rev 5 in general, such as inconsistent course lengths. For the purposes of this testing we're only concerned about things not already an issue in Rev 5.
- Open question – do we need an example spreadsheet similar to exists for the MWD model where a full diagnostic can be produced?
- Decision from the group: Guidance document will likely have 3 broad sections:

1. Scope / Introduction – Explaining the aims of the error model and what it is/is not to be used for
2. Key assumptions and limitations of the error model as published
3. Key points that aim to *facilitate the discussion between vendor and customer* rather than try to directly answer the above questions directly.

People interested in contributing or reviewing the Guidance Document should reach out to Marc to be added to the working group.

OSDU Collaboration

Discussion within the OSDU have identified a need for exchanging error model information in a uniform fashion. Rather than making a new format on their own, they have reached out to the ISCWSA to provide them with a format. A workgroup has been formed to put together this format and in the near future the ISCWSA hopes to sign an agreement with the OSDU aiming to deliver this format in early 2026.

- This is not intended to change any of the information contained in the error model or how error model calculations are performed, it is to simplify transfer of information about what ISCWSA standard error models are being used
- Currently handling custom and legacy tool codes is out of scope, though where reasonable the group should try to enable those workflows to be as smooth as practical

Kyle Rickey has put together a github for the ISCWSA and has been working on a JSON schema that could serve as a definition for a standard transfer format

- What about existing file types, such as IPM? IPM's nature where they are easy to create and modify have led to significant splintering even on things thought to be standardized
- The hope is that this effort minimizes the possibility of breaking / accidentally modifying a "Standard" tool code, while still allowing groups that do customization to operate.
- The JSON schema definitions may also enable things like standardizing weighting functions across the board.
- Tool code files that follow the general standards / schema will become essentially self-documenting and will have automatic validation tools available.
- This could also be an opportunity to standardize meta-data that it not always transferred with all tool code formats.
    - "Tags" for error model type (Sag, MS correction, Tool Type, etc)
- While modifying the current format is out of scope, if possible it could be good to add "hooks" for things we know the committee wishes to do in the future:

    - Mixed Mode surveying
    - QC criteria within the error model
    - Geographic dependencies for error terms
    - Etc
- Work will primarily be done through the github, contact Kyle for access. There is also a regular meeting of the working group, contact Marc to be added to that list.