Error Model / Collision Avoidance / QAQC Sub-committees

March 06, 2025 Stavanger Norway

Attendees

In-Person:

Darren Aklestad	Adrian Ledroz	Barry Smart	Nicholas Robertson	Jon Bang
Christian Hansen	Carl Healy	Craig Sim	Kyle Rickey	Phil Scott
Inge Edvardsen	Morten Gertsen	Josh Albright	Chad Hanak	Ken Miller
Jerry Codling	Batyr Amanov	Brett Van Steenwyk	Stephen Grindrod	Ellen Clarke
Ryan Kirby	Peter Kvandal	Tor Jan Eriksen	David Erdos	Hans Dresig
Marianne Houbiers	Bente Jacobsen	Andy McGregor	Lyla Ait Rahmane	Guanren Wang
Marat Zaripov	Joel Dunn	Ildiko Langaker	Matt Weber	Sofya Sizova
Makito Katayama	Ian Walker	Denis Reynaud	Phil Harbidge	Koen Noy
Benny Poedjono	Marc Willerth			

Online :

Dalis Deliu	Mike Attrell	Kevin Sutherland	Anne Holmes	Austin Pile
Harald Bolt	Jiang Lu	Mohamed ElGizawy	Yvonne Oguh	Jin Peng
Saleel Kolakkadan	Tyler Milford	Stephen Winchester		

Error Model Meeting:

Rotating Error Model term discussion

- Andreas has recalculated some of the terms has a question about sqrt(2), and question about error magnitudes

- Should phase shift and lump sum terms be put together?
    - More conservative
    - Radian conversion is not needed
    - Weighting functions as shown – Should it be a factor of 2 or SQRT 2?
        - Question for Rotating workgroup

Recap of how we got here –

- Chad brought error terms to group for discussion
- Used terms like angleX that aren't readily available in other software
- If you have this dynamic world, here's the new dynamic terms…is this complete?
- Similar to gyro, you can list a lot of terms, but not all will apply to all gyros.
- Chad – sqrt 2 on accel xy unsure…on the mags…there was orignally a ½ on the X and Y terms that were identical, so we multiplied them when combining them together into one shared term
- Questions about depth – do we need to consider compression?
    - It's outside of scope for the first round, but a known gap…this could be covered in the documentation
- Looking at terms – what do we expect from a vendor?

Prototype Rotating model

- Should we create one? There are challenges with environmental terms. We've tried making the sensor errors conservative….but they would have to be *really* conservative

- It's worth creating a one, saying "it should look like" "here's all the elements"
    - Can we leave the new one's blank?
    - We should do something conservative, but then we need to have a software test with diagnostics
    - Koen – at the end of the day, publishing the models, what helps operators is a standard, to provide some guidance…Whether or not ISCWSA publishes standards, we're seen as that way. There are so many self-developed IPMs, the landscape is a mess. You need to deliver something
- Hans – there is a push to have a standard or at least an anchor….here's what we propose, if you make it conservative, or if there are new magnitudes how do you validate it? Can you validate the rotating survey against a static survey.

- Andy -- Given what we said about environmental issues…what's the concern about not being conservative enough. We could be comfortably conservative…so maybe this is safer ground. Maybe put guidance on how suppliers meet that, but physics might help us

We need a model, WE need numbers, we can investigate conservative things

- Eddy currents is different…almost like running speed of a gyro, where it's an environmental factor that must be done.
    - It's an added complexity when you have a motor, or if you have stick slip .
    - Is stick slip another term? Or is it covered in noise? It's similar to DSI

Guidance Document-

- Can we have a wish list for what will be in a guidance document?
    - This might be a near mirror on the gyros? There wasn't a guidance document
    - Should there be one for gyros?
- Chad is mostly done with a SPE-ish paper
- What about misalignments and randomization?
    - Jerry has some second thoughts: There's really 2 misalignments, do we need to have instrument to collar and instrument to borehole?
    - The larger error was primarily collar to hole misalignment?
- We could have a conservative validation process?
- Would we be the expectation for how we lump survey legs?
    - There should be mixed modes treated as one more from Jerry
- If you've done the RIP test….can we just call it MWD?
    - The other mode is used for validation and we don't need a new tool code ?
- Chad – a rip test answers the question with a CHI square test…it would fail at X level
    - There could be some validation and then running just a continuous
- To Koen's point…we're not a standard's body, but we are a good practice group….We're a benchmark group

- Guidance document should talk about how we us these surveys, if we have gaps, mention there's not a single axis – things for the guidance document

- Doesn't the current MWD model assume that you have the QA/QC …..shouldn't having a new model imply that the QA/QC is different?

- Darren has a comment to support Bill – We should correct for bias, but nobody does

Guidance Documents –

- Need gaps in current error model
- Should we have guidance on how often you need a static survey
- Do we need guidance on how often to perform checks (like building angle, etc)
- Is this validation of the tool vs. validation that the tool meets an error model?
    - There's a difference between validating a tool system (as a vendor)
    - Vs. validating a survey set
- Similar guidance to minimum MSA

There is an assumption that rotating continuous surveys are more frequent, but is that a requirement?

Mixed Mode Surveying

Previous discussion had talked about the complexity of combining the suveys

- The preference for an error model is to use one survey error model per section. With mixed mode it's complex, GMD + MWD…mixing the survey legs together gets excessive randomization
- Additionally, a number of instruments have the legacy issue of "mode switching" like continuous gyro vs. gyrocompass or now static vs. rotating MWD
- Many times you want *some* errors correlated but not all
- Some software can have a station type. So you can have one survey leg with many types. This is also a problem where you have short sections of magnetic interference and use blind.
- Interpolated azimuth could be another option
- The requirement is to add a couple of columns – Do IF / Not IF

The current inclination based method has problems, because it's hard to know about running procedures.

- There could be more than 2 modes, this could take more work
- Adding things at the station level could be challenging….sharing with imports

Q&A and more general discussion –

- Adrian – We might do multiple modes that are all static
- Yeah there could be several levels

- Could there be a way to let a header configure number of modes?
- We also have the question of “am I estimating position?” or “am I estimating tangents that I want to combine

- Andy totally supports this.

- Could we split out the “survey leg” classification to cover multiple codes?

- Could there be problems with planning? How do you know what they will do?
    - Probably have to do something conservative, then you can update when they become conservative

- Marianne – For the record, this is about mixing error models….you don’t have overlapping, you have one type then the other…you don’t average the survey.

Questions for the group, when you’re running continuous MWD – do you use depth errors that are different? Current workgroup has punted on this.

More work will be done soliciting data!

Big REV 5 vs. 5.1 Discussion in QA/QC

Collision Avoidance Meeting

- Review of the history of the Separation rule
- Questions about need
- Next, we want to look at probability of collision, for risk management on non-HSE
    - This is to help make some things easier for low-level folks to comprehend risk when making a decision
    - Avoid need to always trigger the exemption process
    - Hans – We need to get HSE and non-HSE, because that's the question
    - Darren – it's entry point to a risk matrix…you have probability and consequence
    - Benny – To follow up on Hans, this has been an topic in OWSG, to talk about risk. CA limits probability, but we want to limit the "Likelihood"

- Back to probability: Have focuses on some options, revisiting standard AC profiles…software vendors seem to be doing the same things…there's still subtle setup things that effect it. Hope is to share all the results.

- We should publish the results for standard profiles with AC just like we do for error models
    - Trying to standardize on probability of collision…not saying it's the best, but it's usable

- Do we know the sensitivity to results vs. parameters?
    - We're hoping to publish something on that…here's what it took for 4 vendors to match and here's where it can be slightly off
    - For sensitivity there will be some differences but should keep you in the ballpark – it should be functionally the same as matching SF
    - Software can match close on SF…but people using SF often struggle to match, so there might be some other guidance there
    - That could be tough

- Jan - Do we need to define "collision"? Is it destroying the well or crossing the well? These are very different
    - Jerry- we're looking at non-HSE direct hit, not crossing

- Benny – How bad of a collision?
    - Jerry – Touching, same premise as SF with casing size…..but on with the presentation!

- Probability of Collisions ---
    - Reduce it to a linear calculation that uses same inputs as SF
    - There's a lot of history in probability calculations

- Going back to using probability calculations – you need a risk matrix.
    - You may want to use it on high-risk things, but if you want to make an exclusion zone…it's really more about minor risk decisions. Major decisions there is the existing SF based rule
    - For slight damage to assets, that could be cost of re-working two wells.
    - The yellow zone usually means you mitigate.

- Risk of collision generally goes down with depth, chart is colored in with common SF rules

- There are 3 main decisions for this calculation, Distribution Integration, Error vector – selected in Red
    - A lot of existing data for survey comparisons to use for predicting a distribution
    - The integration is inside of casings to outside of casings (2 diameters)

--Q/A

- Is there a complete crossing assumption?
    - Yes, if you have a more complex simulation you should probably simulate

- What is this risk matrix? Is it a hazard and risk control ?
    - It's a general risk matrix, just shown as an example

- Jon – Thanks Jerry, can I get a copy?
    - I disagree with some comments about Pedal Curve looking at the 1D probability integration, you are integrating in 1 dimension – the Offset well exists in 3D
    - Looking at the "Dark side" it looks at everything past it that is the representation of the 3D volume
    - How do you represent the 3-dimensionality? What is the probability distribution you are using? Have you tried crossings that are not aligned along a principle axis?

- It will be shared…Regarding the 3D – it's a big assumption that is made, but the assumption is that for high angle of incidence it matches the Monte Carlo.

- The goal was to say "How can we take data we always have to get a reasonable answer" it's intended to be simple

- Maybe you should represent the wellbore as a slab

- Kyle Rickey – You said that for angle of intercept > 2 degrees you should use this method…..What about <2 degrees
    - When wells are parallel…you can do it, but the projected vector is not as stable because it's a cross product. It's not going to be simple, and there is a reason there are parallel that makes it more complicated.

- Q: If you start thinking about distance and distribution…it's an integration of a probability…if you are far, there may be a large volume. You assumption about normal distribution could be reasonable, but why are we even thinking about normal distribution?
    - Original papers used normal distribution, but that hasn't been borne out in reality

- Mike - Have you looked at doing segment level risk assessments rather than point level assessments?
    - The simple case for a relatively high angle crossing, each crossing can have it's risk assessed reasonably well at the highest probability point, you can add up the multiple segments

- Darren question to the audience – How many operators are using probability based methods
    - Jerry – we have at least two companies using probability based rules. There is one who is using probabilistic methods to avoid CA calculations in batch drilling

- Is this a good tool?
    - For Equinor, it's often asked for, if there's no industry standard they say we can't use it. Having something available would be good. Currently we have no standard tool but we use monte carlo.

- Does this method compute correctly for sidetrack?
    - Assuming you have done the relative uncertainty calculations correctly, this will do the probability calculation

- For top holes you must use monte carlo?
    - Actually in top hole the EoUs are circles so this can work better

- Petyr AkerBP
    - We use a probabilistic approach, how does compass compare to BP's probability method?
    - Jerry – generally you can get the probability and the shapes on the TC plot come from the old Williamson formula.

- Any vendors who haven't seen this or want to see more, please contact Darren and he can provide some materials.

- There will be more work on these topics…there will still be sometimes you have to use Monte Carlo…but we want to have this tool in the tool box.
    - Marianne – It might be nice to have the different tools in the toolbox! This and Monte Carlo
    - Darren – at a certain point it's a sensitivity analysis
    - We're also limited by the assumptions that even go into the EM there's an inherent inaccuracy

- Benny - Are the Probabilities on the plot correlated to SF?
    - Not for 2-sided integration

- Phil – have you looked into this method for CAM / automatic updating data and having the changing probability Real-time?
    - It could be challenging…it changes so fast…you really just need a fixed line in the sand for them to react to

- Darren - Friendly request, we need volunteers for minutes in the General meeting
    - Kirby is filling in for Tim.

Pending items

- We've been remiss in updating test cases…we are working on that now. Especially with the geomagnetic correlated terms

- Once Jerry's notes are integrated and we'll work through the discrepancies…anyone who wanted to work with that group reach out.

- Probably do a rev 5 without the geomag breakout…then add another one that has the breakout

- There's a request to make the test trajectories purely planned…so they can test interpolations

- Make a note about sensitivities on setting difference systems up…looking at differences and knowing where they can come from.

Discussion on New business list

Q&A

- Andy – We had a new sidetrack method…has anyone implemented it? Are there diagnostics?
    - There's still discrepancies in there…it's the one spot 4 pieces of common software don't totally overlap
    - Yeah there's the old discrepancies, but there was also a completely new way to propose handling them with relative correlations…has anyone implemented the new way?

QA/QC Meeting

- Social event reminder, Thanks for Erdosmiller and Gunnar Energy
- QA/QC was set up to define minimum data for QCing any survey, then tasked with editing the Gyro, MWD, and MWD Survey records sections of API RP 78
- The API RP 78 had recently gone to balloting, it is open for comment, but that is closing soon
- The remaining material is available and the goal is to make it into an Ebook
- Looking for volunteers to help write and edit
- Will engage with the technical writer the wellbore intercept subcommittee has used