ISCWSA / SPE Wellbore Positioning Technical Section

Error Model Maintenance Work Group

Minutes of the Meeting at ISCWSA #54, Online, 21st October 2021

Present

Andy McGregor	H&P	Manoj Nair	NOAA
Jon Bang	Gyrodata	Pete Clark	Chevron
Harry Wilson	Baker Hughes	Jerry Codling	Halliburton
Darren Aklestad	SLB	Jonathan Lightfoot	Occidental
Susan Macmillan	BGS	Anne Holmes	Halliburton
Mike Attrell	Mostar	Gary Skinner	Baker Hughes
Eric Maynard	EQT	Mike Calkins	Three Sigma
Ciaran Beggan	BGS	Harald Bolt	Depth Solutions
Phil Scott	DGI	Mahmoud ElGizawy	Schlumberger
Denis Reynard	Pathcontrol	Scott Farmer	H&P
Chad Hanak	SuperiorQC	Hans Dreisig	Total
Craig Sim	DGI	Adrian Ledroz	Gyrodata
Dalis Deliu	Conoco Phillips		

Side-track Errors

Work of the side-track group is on-going. There is agreement on the approach of using relative uncertainty as described in SPE-67616. A document detailing recommended practices for side-tracks has gone through several revisions almost complete.

There is however disagreement about whether side-tracks require special handling of uncertainty before the side-track. This is be will evaluated via some simple test cases. The discussions highlighted that there was some confusion over how the relative uncertainty calculations work and that further examples on the website would be useful.

The side-track group will produce some numerical tests cases to validate software implementations.

ACTION: Side-track working group to report back to next meeting.
ACTION Jon Bang & Erik Nyrnes to write up the matrix summation method.
Lead- Harry Wilson, also Andy McGregor, Erik Nyrnes, Jerry Codling and Darren Aklestad.

Breaking Models into Component Blocks

This working group has not met since the last sub-committee meeting. Andy McGregor handed over lead of this group to Darren Aklestad.

ACTION: Darren to arrange a meeting. The group comprises Andy McGregor, Steve Grindrod, Adrian Ledroz, Craig Sim, Darren Aklestad, Jonathan Lightfoot, Jerry Codling

Add Reference Terms for QA\QC to Error Model

We generally state that QA\QC criteria should be derived from the error model. However, reference terms which do not influence position may be missing from an error model. For example, total field does not affect MWD position uncertainty and so does not appear in an MWD model – you have to look to the MWD+Axial model to get the appropriate magnitudes. It was suggested that the appropriate magnitudes could be added to the error model, perhaps with a null weighting function. This could tie in with the action to break the model into component blocks and should be considered by that working group.

The discussion also considered the need to add uncertainty for the Gravity reference field magntiude.

ACTION: Component model working group to consider this item.
ACTION: Chad Hanak to write up some work he has done gravity reference.

Depth Model

Actions arising from the previous sub-committee meeting which discussed the depth model.
Andy McGregor has still to write a summary of the depth derivation in Roger Ekseth's thesis to be included in the Definition Document. Harald Bolt offered to assist with this. Jon Bang has contacted University of Trondheim to clarify that they do not have any rights to Roger Ekseth's PhD thesis. If Roger is willing, then we would like to make his thesis available via the ISCWSA website.

ACTION: Adrian Ledroz to contact Roger Ekseth.
ACTION: Andy to produce write up, with input from Harald.
ACTION: Andy and Darren to collaborate on repeating Roger's calculations.

Rev5 - XYM3/4E Course Length Adjustment

To prevent the new random XYM3/4E terms disappearing for high rate surveys a compensating function was added to the definition. This was defined as

$$F = Max(1, sqrt(MisalignmentMinCourseLength/(Md2-Md1)))$$

Where the MisalignmentMinCourseLength defaults to 10m.
Under some circumstances with very short survey intervals, this formula blows up. For Compass Jerry Codling has replaced the simple formula with some logic to avoid this issue. This needs to be disseminated to the group.
ACTION: Andy to liaise with Jerry to get details of the solution in Compass and circulate by email.

Rev5 - Guidance for Management Slides

From the main meeting it was suggested that we produce a brief, PowerPoint presentation, to explain to management the reasons for the move to rev5. Some operators have already started on this.

ACTION: Scott Farmer to pull this together and produce an ISCWSA slide deck for the website. Any operators willing to share, to send their spreadsheets to Scott.

Rev5 - Long Course Length (XCL) Terms

Chad Hanak spotted a typo in the XCL Technical note on the website. A sin(Inc) term was missing in the XCL azimuth term. This has now been corrected.

Chad also has reviewed the derivation of the XCL terms and the XCLA term should use $\sin(A_k - A_{k-1})$ rather than just the difference in azimuth.

So, the XCLA term is now

$$XCL_a \quad e_{i,L,K} =$$

$$\sigma_{xcll}(D - D_{k-1}) \, max\big(\text{abs}(\sin(A_k - A_{k-1})), \text{T}(D - D_{k-1})/\sin I_k\big) \begin{bmatrix} -\sin I_k \sin A_k \\ \sin I_k \cos A_k \\ 0 \end{bmatrix}$$

This was discussed and agreed by the meeting.
ACTION: Andy to update the website documentation and add Chad's derivation document.

Rev5 - Relative Instrument Performance (RIP) Test

Jon Bang had noticed that the rev5 random misalignment terms make a much weaker test when comparing two surveys in the same section of well. In an inclination test example that he presented the test limits increased by a factor of 4.5.

This was discussed, but the group felt that that this was a natural outcome of the new terms and would be correct in top hole. Deeper in the well at smaller hole angles, smaller misalignment values might be appropriate for the RIP test. However, this doesn't have a strong effect on the position calculation. To avoid making the model dependant on hole size, we discussed how the RIP test might be modified – either to do it at co-ordinate level or by changing the misalignment values or the tolerance used in the RIP test to be hole size dependant.

ACTION: Jerry Codling to look into some data he has on this and discuss with Jon Bang.

Gyro Moding Flowchart

As part of an error model implementation, Andy McGregor and Scott Farmer produced a detailed flowchart of how the error model works with across multiple mode changes, when the transition inclinations are and are not included in the survey listing. This version is more complex than the flowchart in the gyro spreadsheet and could be added to the definition document, but first requires a detailed review by gyro company.

The additional complications are related to cases where there are multiple mode changes or re-initialisation in-hole. There are on-going questions about how often these cases occur in practice and

whether they needed to be modelled. This may depend on the running procedures from different companies.

ACTION: Jon Bang to check if Adrian Ledroz will review for Gyrodata.
ACTION: Andy McGregor to start a discussion with Gyrodata and SDI, questioning whether more complex moding models are required.
ACTION: Scott Farmer to send diagnostics from this work to Gary Skinner.

Site and Slot Uncertainty

In Q&A before the main ISCWSA meeting, a question was raised about handling site and slot uncertainty. To date, ISCWSA has not published any guidance on this although it was included in RP-78 work. A recommend practice document could include: how surface uncertainties are combined with downhole survey errors, how site and slot uncertainties differ and when site/slot values are used in anti-collision between a pair of wells and possibly some default values or guidance on magnitudes. Some of this may have been covered in the RP-78 draft material.

ACTION: Jerry Codling to forward the RP-78 material to Harry.
ACTION: Harry Wilson to take the lead on this, with Gary Skinner and Andy McGregor to review.

Blind Drilling

Older blind models using BLA/BLI terms which expand exponentially and at depth can produce ellipses greater than measured depth. Our generic model is cone based does not behave in that way. Blind models are useful in the database as a warning marker but cause consternation. Perhaps they could be scoped back.

The original Blind Implementation was designed for the last portion of well drilling beyond the last survey station but has been co-opted for use in un-surveyed wells. In these circumstances an operation (field, drilling equipment) specific, un-surveyed vertical model is best. Mike Attrell is studying this issue and offered to share his findings with the group. Jerry Codling stated that certain majors had done something similar in Texas but had found that the results varied county by county.

Harry Wilson noted that because of tie-on randomization the blind drilling model reduce errors compared with continuing to use the standard models and hence may not even be useful for its intended purpose.

Although this point was considered worthy of a further guidance document on utilities models however with a full list of work items, it was decided to leave this to be handled at a future date.

Summary of Action Items

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