ISCWSA / SPE Wellbore Positioning Technical Section

Error Model Maintenance Work Group

Minutes of the Meeting at ISCWSA#46, San Antonio, Texas, 11th October 2017

Present

Andy McGregor	AJC	Chad Hanak	SuperiorQC
Jerry Codling	Halliburton	Steve Sawaryn	Consultant
Darren Aklestad	Schlumberger	Sergey Shabanov	Total
Andy Sentence	DGI	Lee Roitberg	Bench Tree
Andy Brooks	Independent	Dan Flores	Bench Tree
Adrian Ledroz	Gyrodata	Randy Riggs	QDC
Pete Clark	Chevron	Alejandro Bello	Statoil
Laura Pirie	SDI	Dalis Deliu	Conoco Phillips
Phil Harbidge	Pathcontrol	Neil Bergstrom	MagVar
Erik Nyrnes	Statoil	Marc Willerth	MagVar
Jon Bang	Gyrodata	Gunnar Tackmann	BHGE
Steve Grindrod	Copsegrove	Manoj Nair	NOAA
Stefan Maus	MagVar	James Ang	Bench Tree
Jonathan Lightfoot	Occidental	Mahmoud ElGizaway	Schlumberger
Brett Van Steenwyk	SDI		

Long Course Length Models

Jerry Codling had a paper (SPE187249-MS) in the main ATCE meeting on the work he has done on the effect of survey interval and of misalignment on survey errors. He gave a brief overview, since much of this work has already been presented at previous error model committee meetings.

The group voted to accept Jerry's XCL error source into the standard model. This new version will be revision 5. The OWSG have also decided to incorporate these terms and the OWSG will skip two revision numbers so as to also be at revision 5.

It was highlighted in the discussion that users should be warned that if their drilling practices cause any repeated patterns in the shape of the well within the measured survey interval, then the survey errors may still be outside the values calculated by the model. Note this change also means that users will need a method to define the expected survey interval at the planning stage. For example, this might be included as an option in the survey program.

Since the XCL weighting functions consist of an azimuth and an inclination dependant term, it was noted that inclination only surveys will need a slightly modified formulation to ensure the XCL term creates a circular effect.

ACTION: Andy M to update guidance on Rev5 on the website and the error model documentation.
ACTION: Steve Grindrod to create diagnostic datasets and upload to his website.
ACTION: Jerry, Andy M, Steve to determine best way to handle Inc only surveys

Hole Misalignments

From the same SPE paper referred to above, Jerry also presented an analysis he has done on the size and effect of misalignment errors.

We believe that some components of the misalignments will randomise with toolface and along hole depth, yet the error models have generally used systematic misalignment as the more conservative option. With the rev4 increase to 0.1° operators have seen previously acceptable slot spacings now contravene anti-collision rules.

In the discussion, a distinction was drawn between the misalignment of the tool within the drill string (which is will vary with rotation) and misalignments due positioning of the collars in the open-hole geometry (which will be constant during drill string rotation).

Jerry's analysis compared MWD and gyro surveys. From this he suggested increasing the XYM3/XYM4 terms to 0.3° and changing these terms to random propagation.

There were some questions as to whether this was really an open-hole versus cased hole comparison.

The discussion also questioned on whether there was any systematic component still to be considered, due to torsion or systematic toolface. The group did not feel that there was sufficient evidence to make a decision on the hole misalignments at this stage.

Jerry agreed to do further analysis if he could be supplied with more data.

Action: Jerry to define and circulate what sort of data he would like to see to continue the misalignment analysis.
Action: The group to then provide Jerry with further data if available.

Website/Documentation

The (rev 4) error model definition document is complete but is not yet up on the website. It was noted that the website is quite confusing and needs better organisation.

An ISCWSA document template would make our publications look more professional.

There was a suggestion that the content be more easily searchable and that possibly a more modern hypertext\wiki style might be better than rigid documentation. Possibly, the error model definitions could be held in machine readable transfer format rather than the existing Excel sheets. This might tie-in with the proposed extended P7 format or the work being done by DSATS.

It was also noted during the morning's anti-collision meeting that there may not be an obvious and clear definition of the covariance matrix and error ellipsoid within the existing published information. If this is the case, then the omission should be rectified.

ACTION: Phil Harbidge and Andy McGregor to ensure the website is updated.

ACTION: Phil to work with committee chairs to produce a document template.
ACTION: Andy McGregor to contact DSATS group.
ACTION: Andy M. to check for existing definitions of error ellipsoid and covariance matrix.

Gyro Model Verification

No progress since the last meetings, it is still the case that more verification data is needed to ensure that the gyro models can be correctly replicated.

ACTION: Steve Grindrod, Adrian Ledroz and SDI to look into what is needed.

Effect of Error Correlation on Uncertainty Value

Andy McGregor give a progress report on the mathematics for handling partial correlation of error sources between wells. Jon Bang has run some simulations to verify the work that had been previously reported. Andy has extended this work. Previous methods were rather unwieldy and would have require a significant change to existing model implementations, but after running a series of numerical simulations, a much more tractable solution has been identified which only requires that cumulative error vectors for the correlated error sources be passed to the anti-collision routines.

Action: Andy McGregor and Jon Bang to verify that the mathematics is correct.
Action: Andy McGregor to write up the methodology.

Geomagnetic Look Up Tables

Jerry Codling presented some work that is being done in Compass to automatically read the error magnitudes for the geomagnetic reference terms from online sources. For example this would allow the software to automatically access BGGM lookup tables or location specific IFR uncertainties.

In the discussion it was pointed out that the existing fixed values were still useful at the planning stage, before a decision had been made on what type or provider of geomagnetic reference values is to be used.

Some concerns were expressed about possible confusion when comparing anti-collision results between contractor and operator – possibly using different software. A suggestion was made that the reference uncertainties values should be quoted in the uncertainty report along with the geomagnetic references themselves.

There were also questions about whether all parties using the data would be able to access the websites providing this data since accounts and passwords may be required.

Jerry clarified that in Compass these values are stored at site level and once obtained would be encoded to the transfer data files sent to the field.

ACTION: None

Surface Tie-Ons

As discussed at the last meeting there is some variation in how errors are handled in the first survey interval from the slot to the first downhole survey point. Some software ignores the effect of misalignments at surface over the first half survey interval, other implementations carry the effects of the first downhole survey all the way back to surface.

The group decided that this latter method, ensuring the uncertainty at the first survey carry all the way back to surface should be adopted. This can equally be accommodated by adding a dummy survey point, immediately below the slot.

ACTION: Andy McGregor to add to error model write-up.

Rotating Error Models

Chad Hanak gave an overview on some work he has done on error models for continuous, rotating tools. The application of these involves changes to the magnitude of some existing MWD terms and also the addition of some new error sources. This work will be published in a future SPE paper. A possible outcome is that the group will need to consider adding some new error sources to the model framework in the future.

ACTION: Chad to report back when there new sources for the committee to consider.

Demonstrating MWD Tool Meets Error Model

The MWD error model is designed to model the performance of tools in-hole. Generally, both environmental and tool/sensor uncertainties are combined into one value for the error magnitude.

Randy Riggs has been trying to work back from the MWD error model to demonstrate from calibration data that his tools conform to the model. He has tried to un-lump the magnitudes but this has led to values which do not seem to be realistic.

It was agreed that this was an important concern for many tool manufacturers and that committee should look into it and provide some guidance. This might also include a description of the tests which a manufacturer should follow to demonstrate conformance.

ACTION: A workgroup was formed consisting of Andy McGregor, Randy Riggs, Gunner Tackman, Chad Hanak, and Marc Willerth. This group to review Randy's calculations and progress from there.