

## **46<sup>th</sup> ISCWSA Meeting – San Antonio, TX, USA – October 12, 2017**

### **Introduction**

(Son Pham)

- Election of Program Chair and 2 Director at Large positions today. At the end of the meeting, Jonathan will become Chairperson of the ISCWSA.
- This is Son's last meeting as Program Chairperson.
- Encouragement to use the group as a knowledge network, with special appreciation for the work of the sub-committees.
- Highlighted Roger Goobie and Steve Sawaryn for meeting major sub-committee milestones.

### **Schedule and Program Review**

(Jonathan Lightfoot)

- Overview of the agenda.
- Safety briefing. No fire alarms are scheduled. Exits and muster areas were identified.
- Anyone who runs for program chair that is not elected (prior to lunch), will have an opportunity to run for Director at Large in the afternoon session.
- 103 people attending. 47 service providers, 13 operators, and several other categories (see slides for a full breakdown; very detailed information).
- Surveys sent out prior to the meetings have provided a list of topics most valued by the community. Please participate to help make these meetings as useful as possible.
- Steve Grindrod was awarded the ISCWSA Distinguished Service Award at the last meeting. He will be put up for an SPE award.
- Thanks to all the sponsors for this event.

### **Keynote Presentation - Well Collision Avoidance - Separation Rule, SPE 187073 Review**

(Steve Sawaryn)

- This paper is the culmination of more than 10 years of work by the Collision Avoidance Sub-Committee. SPE 187073-MS is the second part of a 2-part paper series on the topic.
- Some of the products defined by the paper are the Minimum Allowable Separation Distance (MASD), Allowable Deviation from Plan (ADP), and Separation Factor (SF).
- The first paper was presented at The Hague in March (SPE 184730). Its focus was management practices. The focus of this paper was defining the actual calculations for MASD, ADP, SF, etc.
- Modeling the ellipsoids of uncertainty correctly is a necessary precondition for these calculations. With the position uncertainty defined, the Pedal Curve method is used to calculate allowable separation. There are other methods in addition to the Pedal Curve method. However, the calculations are straightforward, and there is peer-reviewed literature for the method which was a pre-condition for any practices recommended by the sub-committee.

- The presentation contains a summary of existing separation rules, with the chosen rule highlighted.
- None of the collisions examined by the sub-committee resulted from an insufficient separation rule. Rather, it was lack of adherence to proper management practices that were the cause (hence the need for the first SPE paper).
- Also looked at the error distributions. Typically Gaussian distributions are assumed, but the data shows that a Student's t distribution with 6 DoF is a better fit due to fat tails in the data. The implication is that there is a significantly higher crossing probability at SF = 1.
- SF = 1 gives MASD. It results in a "do not cross" line. Some useful graphics are presented in the presentation for visualizing these no-go zones.
- Assurance and Verification: There is a reference well and 11 offset wells that have been added to the ISCWSA website which can be used to verify your implementation for the separation rule.
- The sub-committee has now completed the assigned work. It will be given to the API RP78 effort as an input and can be used as a starting point for future work.
- The work of the members of the Collision Avoidance Sub-Committee was greatly appreciated in this effort.

(Questions)

- Son Pham - This was identified as the top industry priority in our survey on the matter, and this is an excellent response to that need.
- Kevin McCaird - The projected ahead parameter is 0.5. Is that fixed or can it be varied. Answer – It's a constant that was carefully chosen.
- Mahmoud Elgizawy – You mentioned the probability of crossing the line vs. hitting the other well as the criteria. Can you elaborate on the impact on the probability numbers of this choice? Answer – Crossing the line in the example in the slides might be 1 in 5000, whereas the probability of hitting the well would be considerably less. But the math is much easier to work out across scenarios. Mahmoud – Do we not need to add additional safety factors to the SF, or should we just use 1? Answer – There is a safety factor built in, but the papers have additional recommendations. We wanted it to be simple so it would be remembered and used.
- Jonathan Lightfoot – At Oxy, we use SF=4 for reporting, below 2 requires auditing of the wells, lower we consider surveying more frequently or correcting, and 1 is stop drilling. Do you have any thoughts on such a framework? Answer – Within the paper there are additional thresholds mentioned that are somewhat common throughout the industry. It's a good precaution. But the bottom line we want everyone to remember is that SF=1 means stop drilling. The rest will come in time.

**Sub-Committee Activity Report: Collision Avoidance**

(Steve Sawaryn)

- With the completion of the two papers, we are starting to think about next steps. We are looking at a 1 day event at the next meeting.

- SPE 184730 and SPE 187073 are both out for peer review. We are hopeful they will be a reference for the API RP78 effort.
- Future work was grouped into 1) clean-up efforts, 2) standard definition of ellipsoids, 3) facilitated implementation of software, and 4) standard AC report definition. The 2<sup>nd</sup> task was offloaded to the Error Model Sub-Committee. Items 3 and 4 are considered high priority for the sub-committee in the near future.

(Questions)

- Benny Poedjono – In the planning stage, we need to create the ADP as well. This is an important part of the plan and it gives a distance metric.
- Bill Allen – All the stuff that happens before you get to SF=1 is the management piece of the work. That's where weakness is and needs to be a focus.
- Neil Bergstrom – I believe collisions are much more common than what is reported in official statistics based on experience. Answer – People were asked to submit anonymous examples for the first paper. Based on the response, I would agree. It's probably an order of magnitude higher than the official statistics.

#### **Update on the OWSG Standard Error Models and a progress report on the IOGP P7/17 Directional Drilling Format**

(Steve Grindrod)

- The original work of the Error Model Sub-Committee was the ISCWSA MWD (+AX, +SAG) model in 2000.
- Rev 1 (2007) updated the misalignment terms.
- Rev 2 (2007) fixed depth term values.
- Rev 3 (2009) went to the toolface independent model.
- Rev 4 (2015) is the most recent revision
- The OWSG has several sets of models. The sets are labeled A through O, and the current revision number is rev 2 (2015).
- The OWSG Rev 2 set corresponds to the ISCWSA Rev 4 format.
- Set E has additional evaluation sets (MWD+HRGM+MS, Dual Inclinometers, and XCL).
- One area of work is on a tool model transfer format (P7 format is under consideration).
- Planned changes for the OWSG models is to include the XCL (course length) term to all the models generate a rev 3. Misalignment terms will be updated at a future date.
- The ISCWSA models will also have the XCL term added.
- The OWSG revision number will jump to rev 5 to be consistent with the ISCWSA models.
- The P7 format is a wellbore positional format. Originally devised for operators in the UK for the purpose of delivering data to regulatory bodies.
- Adoption outside of the UK generated a need for a revision in 2000 (P7/2000).
- Current work on a new version (P7/17) involves the ability to include raw data, multiple wells, position uncertainty data, magnetic reference data, etc.

- P7/17 is a data exchange format not intended for real time data. The format will be ASCII comma delimited. Common header elements will be incorporated.
- The presentation has a list of additions to the current P7/2000 format that will be included in P7/17. It also has plots of the P7/17 object hierarchy (with animations).
- A first attempt at a P7 (or equivalent) format for tool error models was conducted by rearranging the current Excel spreadsheet Error Model definition files and exporting to a CSV file. The first attempt didn't quite work due to the presence of commas within some of the cells, but removing them is relatively straightforward.
- If anyone would like to help produce comments on the P7/17 format, contact Steve Grindrod.

(Questions)

- Aubrey Holt – Despite the disclaimer of committee that the numbers provided with the model are generic numbers, many people don't understand that those numbers might not be representative of what is currently available. Would it be possible to put obviously wrong numbers in the error models for download to force users to put tool specific numbers in that are representative of tools currently? Answer – The OWSG sets are what we feel are reasonable typical numbers for downhole, telemetered data currently.
- Andy McGregor – Are you including the weighting functions in the P7 format or identifying them? Answer – We are trying to duplicate the spreadsheets, so they would be included.

## A Public Web API to Provide Dynamic Quality Control for the ISCWSA Error Models

(Stefan Maus)

- The uncertainty in the wellbore position is computed from tool error models that make up front assumptions about the performance of our tools and the reference field accuracy. We need to verify the tool is performing to these specifications.
- The criteria used to QC the data should be directly derived from the error models, rather than being arbitrary limits on B\_total and Dip.
- The presentation contains a list of SPE papers covering previous work.
- The tool codes didn't originally contain all the information needed to quality control the measurements. For instance, some of the systematic and random components for the magnetic reference field were originally missing from the tool codes (they have since been added).
- The objective is to provide a simple criteria for checking survey qualifiers against a tool code and make it available to the industry.
- There are six parameters that can be computed from the raw data: Inc, Az, toolface, B\_total, Dip, and G\_total. The last 3 of these parameters are used in the QC process. The web API uses these qualifiers, the selected tool code, and reference values to determine if a survey actually passes QC. A 3D ellipsoid is generated from this data, and the measurement error vector is compared to this ellipsoid.
- A more accurate gravity reference model is often a missed opportunity to improve the reliability of this QC method.

- There are 5 different levels of geomagnetic models accounted for in the OWSG models, with the least accurate being IGRF and the most accurate being IFR2.
- Additionally, there are tool codes that account for the application of various corrections on your surveys.
- One thing that is not obvious is that the QC parameters actually depend on the orientation of the wellbore. For instance, if you have axial interference and you are drilling East/West, you won't see that in B\_total.
- Another thing to consider is that the error sources are correlated. That means the same error source can affect both Dip and B\_total at the same time, for instance. This correlation must be taken into account when generating the QC ellipsoids.
- The Mahalanobis Distance is used to determine if a survey qualifier error vector is too far outside the ellipsoid. However, because of this, it can be difficult to determine which qualifier caused the survey to fail. You can define various regions of influence as a remedy for this.
- G\_total offsets are often seen because tools are not actually calibrated to on-site gravity. This is a missed opportunity because it means that larger qualifier limits must be used, making it harder to flag noisy accelerometers.
- Surveys fail QC because of badly calibrated tools, drill string interference, interference from an offset well, or inaccurate reference model values.
- An example of a magnetic field change of 500 nT over the 10,000' length of a lateral was provided.
- The interface for the web API was depicted in the presentation. You can actually create software that queries the API directly. This API is public and will be kept that way.

(Questions)

- Robert Estes – There are at least suppliers who provide magnetometers not calibrated to an absolute reference and there are those provided accelerometers not calibrated to an accurate reference. Answer – In my experience the magnetometers are usually very well calibrated.
- Angus Jamieson – A lot of people only run QC checks at the start of the run. This should shine a light on that. Also, people are not considering the impact of the correlations between the qualifiers. After running MSA, do you think a survey could go from failing to passing? Answer – It is important to adjust the green area if you have made survey corrections. This would make the green area smaller.
- Marc Willerth – This is an attempt to simplify the upcoming recommendations arising from API RP78.

### **Sub-Committee Activity Report: Well Intercept**

(Roger Goobie)

- There was average participation in the meeting yesterday. No new members were added to the team.
- The meeting covered a recap of progress to date, a topical presentation on a newer (acoustic) ranging technology, and the way forward.

- The ranging e-book is in near-finished form, pending incorporation of some final edits. Timeline is 1 to 2 weeks.
- We are looking to dissolve the sub-committee with the publishing of the e-book, in order to release our members to participate in the other sub-committees.
- SPE 187313 covered the topic of active acoustic ranging. This technique is especially beneficial when ranging in salt is required. This topic will be added to the e-book in 10 days or so as an important contribution to the state of the art.
- At the 43<sup>rd</sup> annual meeting, we set out to create an e-book that brought together the various products that the sub-committee had worked on up to that point. As of today there is a link on the ISCWSA site. It will be hooked up to the e-book within 10 days or so.
- Thank you to Halliburton to allowing us to extract information from their guide to relief well drilling. We fulfilled our commitment to let Halliburton review the material prior to publication thru Pete Schiermeier.
- The e-book contains 8 chapters covering technology and practices, and also includes a lexicon and bibliography. The purpose of the lexicon is the standardize terminology as much as possible.
- The committee decided that there was no need to create a new SPE paper out of the e-book. The sub-committee thought it would be unnecessarily duplicative.
- Thanks for the opportunity, and now we recommend dissolution of the sub-committee.

(Questions)

- Jonathan Lightfoot – Is there an opportunity to get the e-books published in hardcopy? Answer – I would love to see this happen. I am going to join the education sub-committee to continue to push this along.

### **Elections for the 2018-2019 Program Chair**

(Chad Hanak)

- Candidates are Heather Vannoy - EOG, Ross Lowdon - Schlumberger, Neil Bergstrom - MagVAR, Ludovic Macresy – PathControl, DrillScan.
- Voting is limited to SPE members, and a maximum of 2 votes from any one company.
- Ross Lowdon won the vote count and will be the new Program Chair, effective at the end of the meeting.

### **New Capabilities of NOAA's High-Resolution Geomagnetic Reference Models**

(Arnaud Chulliat)

- The NOAA GEophysical Data System (GEODAS) contains marine and airborne trackline data with more than 3000 surveys.
- EMAG2v3 has been created based on a different and fully independent algorithm. It uses no a priori data and more trackline data (added since 2010).

- There is a global map of uncertainties included in the presentation. It reflects the heterogeneity in survey data quality.
- NCEI790 is a spherical harmonic model ( $n = 790$ ) inverted from EMAG2v3. The comparison with HDGM (crustal field) shows few large differences at low latitudes. There are larger differences near the poles.
- The Swarm Constellation launched in 2013 and has greatly improved the data of quality available.
- Additionally, most ground-based observatories are now part of INTERMAGNET, and the quality of the data is improving.
- The model presented today captures the lower latitude elements of the ionospheric current system. The polar current effects are not yet captured because they are more irregular in their variations due to coupling with the magnetosphere.
- The new model does capture coupling of ionospheric currents with the Earth interior.
- A real-time magnetospheric field model has been created from CHAMP data, with a cloud based implementation.
- The bottom line is that you can follow the daily variation in addition to temporal effects due to magnetospheric disturbances.

(Questions)

- Phil Harbidge – The uncertainty map showed -200 to +200 nT, but we discussed today a well where a larger gradient was observed over a 10,000 foot well. Answer – We had to use a scale that would still show detail in the majority of the map where the differences are only a few nanoTesla.
- Pete Clark – How will the diurnal variation effect the passive magnetic ranging community? Neil Bergstrom – If the variations are important, you would need a magnetic observatory nearby.

### **Database and Survey Enhancement Applications: Optimizing Project Development Through Data Integrity and Real-time Corrections**

(Lee Pendegraft)

- People should ask themselves “What does my database contain?”
- Once data is populated into a database, the next question is whether or not the data is accurate. Do you have a picture of the surface location, for instance?
- Null data in your imports are also a regular problem.
- Fixing these issues requires putting your database through assessments and audits. Your first look (assessment) results on various values may indicate the need for an audit. Audits may be focused, such as a look at wells within a specific area. Ideally, findings should be formalized in a report for future reference.
- One potential productivity gain comes from ensuring your database is complete so that your well planners don’t have to spend hours a day entering offset wells each time they want to run anti-collision on a new well. Filling the database all at once can help ensure there are not differences in the way wells are entered between different people.

- Another purpose of a focused assessment and audit is to make your asset drillable again. You may be able to refine error models with additional information you find, allowing for reduced anti-collision concerns.
- Survey enhancement techniques can be utilized to extend the length of the lateral in a pay zone, or possibly even fit more wells in a field with reduced spacing.
- Database audits can be combined with survey enhancements to get even more allowable drilling space in a given field.

(Questions)

- Gary Skinner – When you speak of old wells, do you have a method of dealing with them when there is nothing in the file? Answer – You want to take the conservative route. If there's no information, there's not much you can do. If you have no information, apply a BLIND error model. You could look for consistent in-field behavior if you have a number of wells drilled at the same time with the same tool that exhibit similar characteristics, if the customer requests it.
- Jonathan Lightfoot – Elaborating on that comment, we had a field with several hundred well with no data. We did have some gyros and MWD surveys that we could pull from. Excluding steered wells, we were able to come up with a field specific error model based on statistical departure per 1000 feet. That helped quite a bit. Do see any potential for software in the future to have that capability by default? Answer – I am not a software developer, but I hope so.
- Michael Donahue – Have you worked with companies where different departments in a company have different databases, and there is disagreement over which database will be the main database? Answer – Not really, when you step into it first and gather information on what is desired.
- Roger Goobie – Land surveys have certified surveyors that sign off on the survey. Do we need something like that for wellbore surveys? Answer – I think that standard procedures would be great for that, including archiving the six axis data for future reference.
- Keith Kenny – Compass has the ability to store six axis data, either directly or as a link to a different database.
- Phil Harbridge – Marc and I are going to open up the QA/QC subcommittee to document what would be good to collect in order for future audits corrections. Contact Phil if you want to contribute.

### **Sub-committee Activity Report: Education**

(Carol Mann)

- We nominated Steve Sawaryn to the SPE for his work on the anti-collision rule. We should find out this weekend if he is one of the 30 distinguished lecturers for 2018.
- We had a topical luncheon on Tuesday that was sold out. It has a varied audience and was a great success.
- For 2018 we are looking at IADC possibly, and definitely one at ATCE in Dallas next Fall. Also possible ADIPEC in November.

- We had a webinar in June on anti-collision. Angus Jamieson is giving one on October 25.
- We are also working on one for the Ranging E-book with Roger Goobie.
- Will probably have 2-3 in 2018.
- Could not get the e-book into the SPE bookstore, but we have made e-book postcards. Distribute liberally.
- We are also finishing a series of 5 slides you can add to your presentation to help raise awareness.
- We will not be doing an ATW in the Spring.
- We do have a presence on LinkedIn. I encourage you to post on our LinkedIn site and share things that other people post.
- We are not on the Tweeter, but feel free to share.
- There are some ongoing website improvement initiatives, including a quiz to raise awareness.
- The e-book has had over 20,000 downloads. There are 2 new chapters. We are looking towards reorganization, as it is becoming more than just an introduction.
- The UHI Survey Competency course has put about 65 students through the course.
- Please contact Carol if you want to join the Education Sub-Committee.

(Questions)

- None.

### **Wellbore Positioning Pub Quiz Contest**

(Angus Jamieson)

- Check slides for quiz.
- There was a tie-breaker question: What does OWC stand for? Andy Brooks answered correctly first. Pete Clark also got the answer correct, .... 15 seconds later.

(Questions)

- None.

### **Sub-committee Activity Report: Operator Wellbore Survey Group (OWSG)**

(Pete Clark)

- API RP78 continues to make progress, but it is slower than what was maybe anticipated. Some sections are effectively complete, while others are more or less only a title at this point.
- It's appropriate to expect a first draft of the comprehensive document prior to the next ISCWSA meeting.
- The model is being created in a series of technical silos, so the RP78 committee will review it and look for gaps.
- We do have some fairly detailed procedure information that will either be an annex of the RP78 document, or will be broken out in a separate document.

- There was a concern that the USGS geomagnetics capability was going to be defunded. The issue was raised with BSEE, and there may be hope on that front.
- Regarding continuous inclination and azimuth, there are a variety of measures and a corresponding variety of accuracies. The OWSG would like to categorize them in a generic way. Hopefully this effort will be complete very soon.
- Regarding drilling advisor applications, we discussed how they pertain to wellbore positioning. This is becoming a fairly generic term.
- Jordan w/ Noble Energy helps with the operation of the OWSG. Send Pete Clark or Jordan an email if you wish to contribute to the OWSG.

(Questions)

- Steve Sawaryn – The SPE are very keen to identify some possible textbooks. Is there an opportunity to highlight surveying in the textbook effort by pulling from API RP78 and the multiple e-books this committee has developed? Steve would be happy to help out. Answer – I don't have an answer for you. I want to reinforce that the job of API is to set standards and document proven practice. There's an overlap between that and education, but that's a challenge to manage.
- Son Pham – Anything that we publish under the SPE, there will be a charge for that. So we couldn't then contribute to distribute our e-book free of charge and also publish it with the SPE, for instance.

### **ISCWSA Distinguished Service Award: Recognition of Angus Jamieson**

(Andy McGregor)

- Angus has been coming to ISCWSA meetings for almost 2 decades.
- He was the originator of the COMPASS software.
- He developed the Marine IFR method.
- He has several SPE papers on depth accuracy, IFR, and the expansion ellipse method.
- He was the lead author for the ISCWSA e-book.
- He started the UHI training course, among other accomplishments.

### **Elections for the 2 Director at Large Positions**

(Chad Hanak)

- Carol Mann and Andy McGregor are in the middle of their terms. This election is for the other two positions.
- Candidates are Jim Oberkircher – IADD, Heather Vannoy - EOG, Neil Bergstrom - MagVAR, Ludovic Macresy – PathControl, DrillScan, Adrian Ledroz – GyroData, Robert Estes - Halliburton.
- Voting is limited to SPE members, and a maximum of 2 votes from any one company.
- Heather Vannoy and Adrian Ledroz were elected to 2 year terms for Directors at Large.

## **Sub-Committee Activity Report: Education**

(Andy McGregor)

- Long course length models – SPE 187073-MS captures some work by Jerry Codling on evaluating the effect of course length on survey error. Yesterday, the sub-committee agreed to accept Jerry's proposed term. It will result in Rev. 5 of the ISCWSA error models.
- The new XCL term has a magnitude of 0.167 and is based on the larger of the survey interval DLS or a constant tortuosity value.
- There is a strong caveat that if you do something systematic when you are drilling and don't survey frequently enough to observe the effect, this term won't save you.
- There was a discussion of the size of the systematic misalignment values in Rev. 4. Jerry Codling presented some analysis. The sub-committee decided there needs to be a little more investigation before committing to a change.
- On the website, some products are completed. They include a definition document for the error models and spreadsheet examples, but these have yet to be posted.
- In terms of relative position uncertainty, it was determined that adding the covariance matrix of each well, implicitly assuming all errors are uncorrelated, was too conservative. Significant correlations can exist in the geomagnetic terms. We have honed in on a software implementable method for properly handling the correlations. The remaining point of consideration is what correlations to use. That has been thrown back over to the Anti-Collision Sub-Committee.
- Surface tie-ons were also discussed. Current implementations in software can underestimate the amount of error growth between the survey tie-on and the first survey.
- A rotating survey error model was discussed, with an upcoming SPE paper planned. We will probably have to add some weighting functions to accommodate the new terms.
- Randy Riggs brought up the ill-defined term "ISCWSA Error Model compliant tool/calibration." We have some work to do there.

(Questions)

- Gary Skinner – Going back to the correlation discussion in magnetic field reference values, how do massive changes in geomagnetic models factor in? Answer – That is the problem in practically defining how to use the correlations. Stefan Maus came up with correlations, but determining how to use them is the challenge.
- Marc Willerth – The formula for the XLC had DLS in there. Is it DLS or absolute dog leg? Answer – It's the actual change in angle, not normalized by a specified course length. That will be changed in the slides.
- Ross Lowdon – On the calibration stuff, I think it's very important to get that out there because we get questions on this from all over the world. Answer – We've had a couple of manufacturers ask about this in the past, and I think it's worth pursuing.

**Webmaster's Report**

(Phil Harbidge)

- We have 1,917 registered members per the SPE website.
- Our biggest contingent in our membership is from the Middle East. The Gulf Coast section is the second largest contingent.
- We are getting a steady flow of people continuing to join every month.
- A detailed breakdown of the makeup of our membership is available in the presentation.
- There is also a list of useful links.
- The main website is [www.iscwsa.net](http://www.iscwsa.net), which we continue to develop.
- Search engine optimization is one area of current focus.
- BenchTree is going to help with the website optimization.
- Any website requests, please contact Phil Harbidge.

(Questions)

- Stefan Maus – One thing that is going on in the scientific publishing world is the use of DOI (digital object identifier) numbers. Also, all authors can register with an organization to get an identifier as well (ORCID). That makes it much easier to find documents in searches. The major documents we produce should have DOI numbers.

### **Treasurer's Report**

(Chad Hanak on behalf of Robert Wylie)

- Thanks to our sponsors BenchTree (lunch/coffee), Baker Hughes (lunch), and GyroData for sponsoring the networking event.

(Questions)

- None.

### **Secretary's Report**

(Chad Hanak)

- Send me your new email if it has changed.

(Questions)

- None.

### **Closing Statement**

(Son Pham)

- Thanks to all of the sponsors and attendees for participating.
- The date and location of the Spring 2018 meeting is TBD.

(Jonathan Lightfoot)

- Thanks to Son for his service.
- The slides will be converted to PDF and published on the website quickly. If you have any issues as an author, raise them quickly.