SPE Wellbore Positioning Technical Section

Collision Avoidance Work Group

5th meeting, Sheraton Hotel, Denver, 24th Sep 2008

Present:
Darren Aklestad, Bill Allen, Jon Bang, Andy Brooks, Bjorn Bruun, Clint Chapman, Blaine Dow, Mark Michel, Shola Okewunmi, Stuart Sargeant for Jerry Codling, Torgeir Torkildsen, Harry Wilson, Dave McRobbie, Anas Sikal for Regis Studer

Apologies:
Jerry Codling, Steve Grindrod, Stein Havardstein, Angus Jamieson, Wayne Phillips, Regis Studer, Jim Towle,

Lexicon maintenance
Approved recent changes. Harry will pass to Steve for publication.

Bibliography maintenance
Andy will provide Harry with two new references and Harry will pass to Steve for publication.

StatoilHydro commissioned thesis on error distribution
Bjorn Bruun presented Tony Gjerde results; "A heavy tailed statistical model applied in anti-collision calculations".

Using three axis geomagnetic data from the Tromso observatory, parameters were estimated fitting a normal inverse Gaussian (NIG) distribution to observed values of Bt, dip and declination.

NIG distribution parameters include skewness and kurtosis in addition to mean and standard deviation. However, the distribution cannot be conveniently expressed in an analytic form, so Monte Carlo modeling is required in order to see its effects. This analysis was undertaken in order to compare the NIG and normal distributions for models containing standard ISCWSA terms. For all 3 parameters; Bt, dip and declination, the asymmetric NIG distribution gave a better fit than the normal distribution.

Effects on position error were then examined. The data showed an excessive number of points lying outside the 3 sigma Gaussian ellipse. Modeling data with the NIG distribution produced probability density contours which were no longer elliptical.

These methods were then applied to anti-collision calculations using a 3D closest approach separation factor. The NIG distribution produced a smaller separation factor and a slightly different separation between wells, which resulted from skewness.

Harry pointed out that the original analysis was based on time dependent data, but we may not be justified in applying the resulting distribution to the ISCWSA declination term, much of which is not time dependent, particularly the dominant crustal anomaly contribution.

Bjorn presented the following conclusions:

- The NIG distribution gives a better fit to the geomagnetic data than the normal distribution.
- It produced different results with respect to both positional uncertainty and collision avoidance.
- Results were usually more conservative than those based on the normal distribution.
- Differences between the two methods vary with wellpath geometry.
- The need to use statistical simulation makes the generation of NIG distributions time consuming.

And the following recommendations:

- Development of a standardized heavy tailed distribution
- Study whether use of a normal distribution is appropriate for sensor errors
- Consider including heavy tailed distributions in ISCWSA models
- Consider writing a paper on the topic, including effects on axial magnetic interference

Torgeir suggested that service companies could look at sensor error distributions from calibration data, and distributions of axial magnetic interference. Harry volunteered to provide Baker Hughes data and make it available to Bjorn.

Harry suggested that the same task ought to be performed for crustal anomaly data. Torgeir said that a 1997 study indicated similar heavy tailed distributions. Dave volunteered to approach BGS for assistance.

New Methods

Andy presented his paper “A New Look at Wellbore Collision Probability” (SPE 116155). The paper describes a new approach to computing probability of collision which is intended to be more flexible than previous methods. It can accommodate curved well paths and variations in relative uncertainty. Examples show that it can be used in high angle crossings and parallel well situations.

For high angle crossings where the wells are both straight and there is little variation in uncertainty, the method collapses to the one dimension integral method currently in use within the Industry.

For parallel wells where the relative uncertainty is constant, the method returns a zero collision probability. This is entirely reasonable because constant relative uncertainty indicates that additional surveys are not adding uncertainty. Surveys must therefore be error free and if such surveys indicate that the wells are parallel then no collision can occur.

The method can also accommodate variable uncertainty. Results for parallel wells with uncertainty caused by systematic misalignment errors give excellent agreement with Monte Carlo analysis. If the uncertainty is consistent with random misalignment errors there is a small discrepancy between the calculations and Monte Carlo analysis, which requires further study.

The 3D calculation is a good candidate for a new general probability of intersection method.

Current Common Practice document
Agreed on proposed changes and on two or three more additions, one of which is to include a statement on common scanning intervals. Darren, Dave and Harry to provide.

Intend to publish with no further changes.

Discussion of future Group activity
It was agreed that it is desirable to investigate the possibility of defining a new probability of collision calculation; one that improves on the current standard method. This task would include investigation of error distribution functions. A core group was identified to do this work; Andy Brooks (team lead) and Jerry Codling (volunteered by Dave) and Wayne Phillips (volunteered by Darren).

Harry reported that he had received suggestions from a couple of Section members that our group should focus on defining recommended standard collision procedures. It was agreed that this was appropriate, and a second core group was formed to do the work; Bill Allen (team lead), Dave McRobbie, Benny Poedjono (volunteered by Darren) and Harry Wilson.

These groups should work “0n-line” and meet independently of the Work Group or Section meetings. The next meeting of the Work Group is likely to coincide with the spring Section meeting in Amsterdam.