54th General Meeting
6 & 7 of October 2021
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Error Model Maintenance Committee Update

Andy McGregor

H&P

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Speaker Bio

- Andy McGregor
- Technical Director, H&P UK.
- Inverness, Scotland
- 25 years in navigation and positioning
- 15 years in wellbore survey
- Previously with Tech21, Weatherford, AJC
- Specialised in survey management, algorithms, error modeling,

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Error Model Sub-committee Meetings

- Autumn sub-committee meeting will be in two weeks:
  - 21st October

- Since last main ISCWSA
  - Meeting specifically on depth model (12th April)
  - Several meetings of Side-track Uncertainty Working group

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Depth Meeting

- Current depth model comes from work by Roger Ekseth
  - Documented in his PhD and in SPE-95611

- Simulated 14 sources of error in drill-pipe and 11 in wireline
  - Finite element breakdown of errors

- Many input parameters not well known, particularly at planning stage

- Lumped these into four terms with simple weighting functions
  - Reference (Random & Systematic), stretch, scale
  - Gave accuracy of 80% his detailed simulation
  - Considered fit for purpose (??)

- Generic models use same magnitudes for all wells globally.

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Alternative Suggestion #1

- Operator should be able to specify required depth accuracy for their needs
  - Service provider have a range of options to meet that requirement
  - Underpinned by accurate uncertainty modelling.

- Models should be well specific

- Meet needs of all users
  - Not just focused on position and collision avoidance for drilling phase
  - Meet the needs of G&G
    - Well logging tools

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Alternative Suggestion #2

- Current model over simplified and lumping of terms confusing
  - Contributions due measurement technology and calibration / correction mingled.

- No range of model options provided
  - Doesn't cover well variations
  - Doesn't cover depth correction options

- Proposed new structure
  - Ref stability, measurement methodology, calibration, correction model and its fit.

- Model should be based on actual measurement and well uncertainty values.
  - Unique polynomials based on specific quantities measured in well

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Conclusion

- Committee decided not to change the depth model

- Existing model considered sufficient for current purposes
  - Principally collision avoidance when drilling

- Users are free to vary current magnitudes if needed.
  - Generic models are exactly that.

- Existing documentation could be expanded to assist with that
  - Make Ekseth's thesis available on website
  - Add to section to definition document
  - Example repeating his calculations determining lumped magnitudes

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Handling of Errors in Side-tracks

- Collision avoidance test set includes a side-track well.

- Inconsistency in handling errors for that well.

- Setup a working group to recommend best practice.

- Writing a document describing our conclusions

- Will create test cases

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Calculation of Sidetrack Relative Uncertainty

- Existing method of calculating relative uncertainty will apply.

- Repeatedly we found that there isn't much special about side-tracks.
  - Most factors apply equally well to independent offsets.
  - Simple RSSing of pedal curve radii does not manage global terms correctly

- Some confusion over how to do this.
  - Will create explicit examples/test cases for website

- Should have zero relative lateral uncertainty at the side-track point
  - Discussion about whether this requires specific handling
  - Creating a worked example to clarify.

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Calculation of Relative Uncertainty

- One method is described in SPE 67616 and the Error Model Definitions document
  - Add covariance matrices
  - Subtract product of error vectors of the globally propagating sources.
- Erik Nyrnes and Jon Bang presented the Matrix method
  - an alternative to the error summation formulation in SPE 67616
- Both implementations handle Global terms correctly, and give the same results
  - Matrix method will be added to definition document as alternative.

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Other Considerations

- Depth stretch
  - for drill-pipe is generally global propagation (DSTG)
  - New term for wireline depth stretch with systematic propagation (DSTS)
- Md/TVD in (DSF/DST) weighting functions is from surface (not from side-track)
  - Unless physical depth matching used (PIP tag)
- Should handle case where continuous gyro initialises above side-track point.
  - Needs care if zeroing uncertainty at side-track
- Software must ensure that any special handling ONLY applies to parent/side-track
- Clear procedures to handle expect failure of CA rule immediately after side-tracking.
  - Also expected magnetic interference.

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Questions

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