Error Model Maintenance Group Update

October 2nd 2019

ISCWSA #50, Calgary

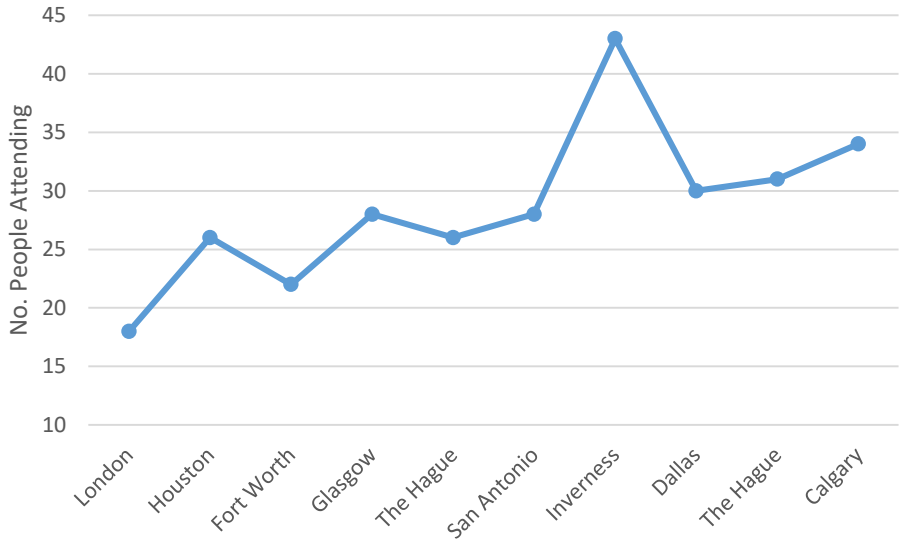
Speaker Bio

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

Attendance

- 34 attendees
- 10th meeting as chair
- 83 different people

- Steady growth
- 3 at all 10 meetings



Revision 5 – Previous Decisions

- Agreed to add XCL Terms into Model
- Agreed to expand Geomagnetic Terms for Correlation
- Tentatively agreed Misalignment and Sag Changes
  - Working group to consider Pathcontrol alternative
  - Concern about random misalignments ‘vanishing’ for high rate data

XCL Models

- Proposed formulae for XCL

- $XCL_h \quad \sigma_{xclh}(D - D_{k-1}) max\left(\text{abs}(I_k - I_{k-1}), \text{T}(D - D_{k-1})\right)$

- $XCL_a \quad \sigma_{xcll}(D - D_{k-1})\, max(\text{abs}(A_k - A_{k-1}), \text{T}(D - D_{k-1}) / \sin \text{I}_k)$

- SAG = $\sigma_{sag}\ (\sin \text{I}_k)^{0.25}$

- Misalignments XYM3 & XYM4
  - Magnitude goes from 0.1° to 0.3°
  - Propagation random
  - Minimum survey interval equation

DECG

Description	Code	Prop	WtFn	IGRF WMM	Standard Models	High Def Models	IFR1	IFR2
MWD: Declination - Global	DECG	G	AZ	0.43	0.36	0.3	0.15	0.15
MWD: Declination Uncorrelated Errors	DEC-U	W	AZ	0.29	0.16	0.16	0.11	0.11
MWD: Declination Crustal Commission HD Models	DEC-CH	G	AZ			0.13		
MWD: Declination Crustal Commission IFR Models	DEC-CI	G	AZ				0.09	0.09
MWD: Declination Crustal Omission Standard Models	DEC-OS	G	AZ	0.24	0.24			
MWD: Declination Crustal Omission HD Models	DEC-OH	G	AZ	0.20	0.20	0.20		
MWD: Declination Crustal Omission IFR Models	DEC-OI	G	AZ	0.05	0.05	0.05	0.05	0.05

Rev 5 - Actions

- Resolve Misalignment
  - Tele-con go with sin(I)^0.25
  - Sag guidance note
- Further Test Cases
  - High rate and Irregular
- Documentation

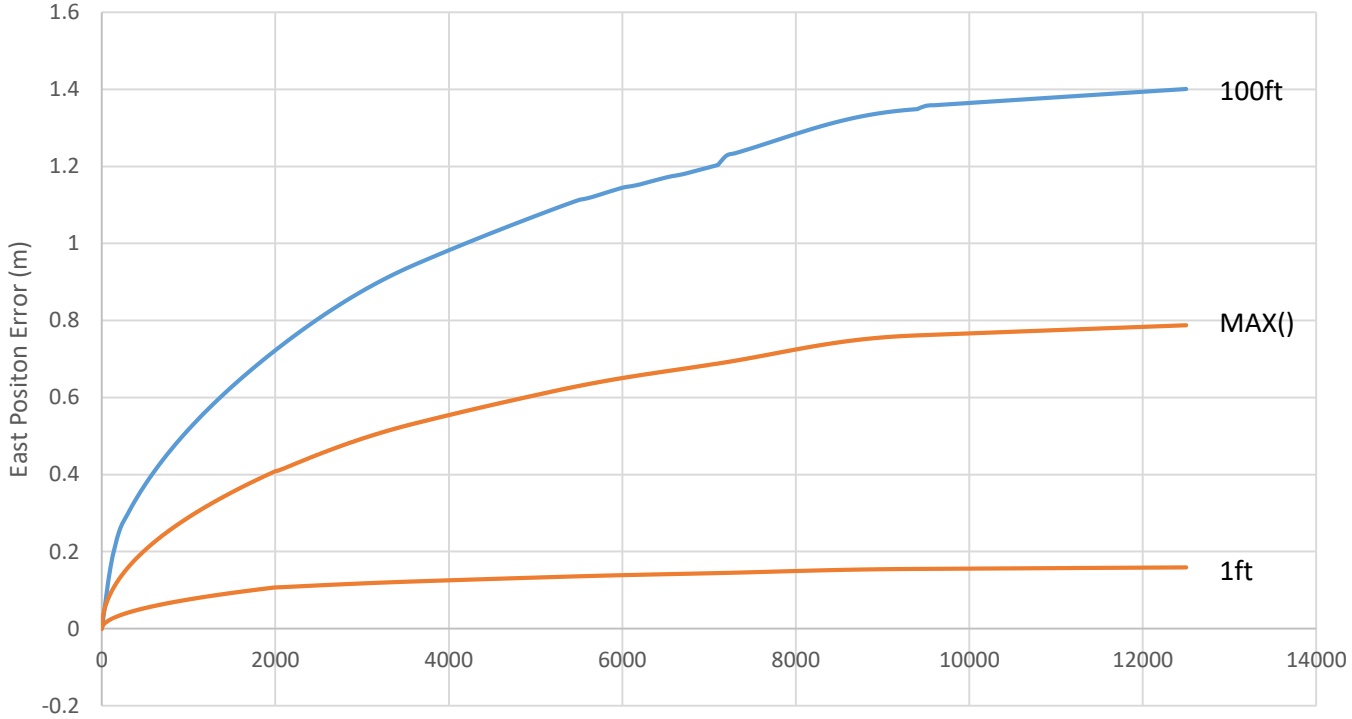
High Rate Data

- Concern that effect of random misalignments would very quickly ‘vanish’
- Jerry suggested modification to weighting function.
- Modify current w34 to

MAX[1, sqrt(10 / dMd)] * w34

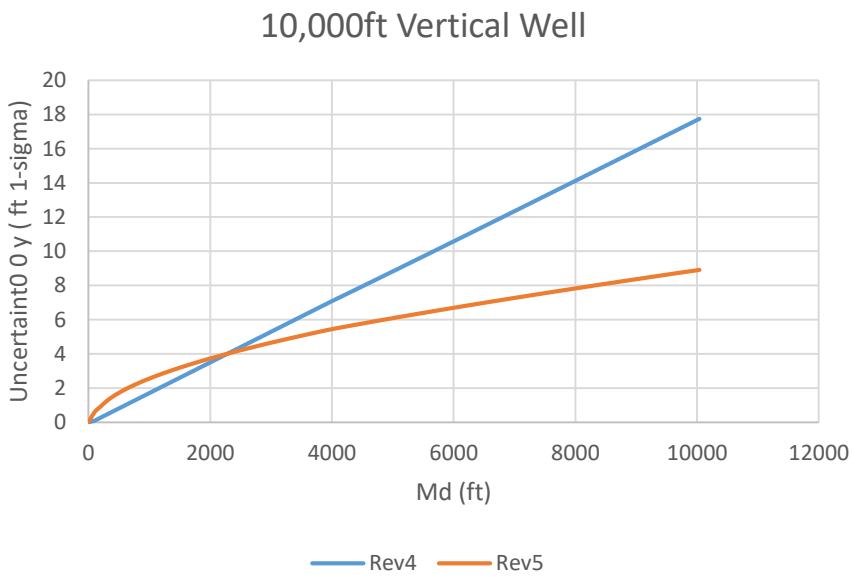
Where dMd = 10m

XYM4L with dMin=10m



Effect of Rev5 – Vertical Well

- For a 10,000ft vertical well
  - Rev4 gives 18ft ellipse at TD
  - Rev5 gives 9ft ellipse at TD
  - Rev5 larger to 2,250ft
- When planning and assuming vertical, some of buffer from error model is gone
- Consider drill-ability and a-c rule



Documentation

- Note on XCL Models – DONE
- Note on Correlated Error Sources – DONE-Draft
- Create release note identifying changes – DONE-Draft
- Update error model definition document – **DRAFT 80%**
- Update spreadsheet defining 8 ISCWSA MWD models – MWD Done
- Update ISCWSA example calculation spreadsheets - **DONE**
- Place on website

OWSG Models

- Set of models have filled a gap
- Increasingly accepted and used by industry
- Details used to be on copsegrove.com
- Unavailable for several months
- OWSG less active than previously

Considerations

- 100 models in Set A & Set B
  - Maintenance and upgrade is a significant task
  - Particularly rev5 release since all models affected
  - Funded task?

- Place Set A & Set B OWSG spreadsheets and diagnostics on ISCWSA.net
  - Suitable supporting documentation
- Separate page for links to contractor models
  - Appropriate disclaimers
  - All contractor models off-site

Parent Side-track Tie-Ons

- No survey point at side-track
  - Evaluate error model as normal?
  - Insert interpolated point

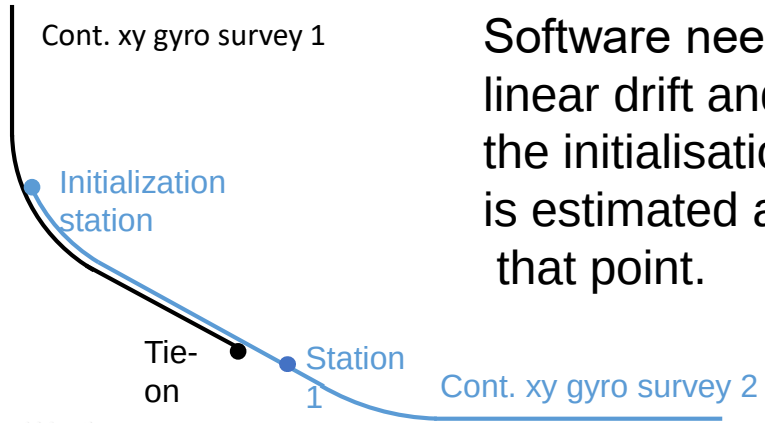
Gyro Model Consistency

- Long standing action to consider gyro test cases
- Agreement of diagnostics less tight
- Details of initialisation/re-initialisation can be complex
- Number of pitfalls, not clearly highlighted
- Update to Error Model Definition Document
  - Review

- New gyros needing new modelling?

Propagation of Cont. Gyro Errors for Tie-Ons at Higher Inclination than the Init. Inclination

- Not covered in the '*Definition of the ISCWSA Error Model*' document.
- Is it handled correctly in commercial software?



Software needs to 'understand' that the azimuth uncertaint
linear drift and random walk must be accumulated all the w
the initialisation point to Station 1. Also that the initializatio
is estimated at the initialisation station, and stays constant
that point.

BGGM2019 error web service

- Total errors output by BGGM software
- Split into G(lobal) and R(andom) terms and label as DEC, DBH (0), MDI and MFI for use with ISCWSA error model
- Available as a web service, with web browser point-and-click map access at geomag.bgs.ac.uk/bggm.html