Introduction to Drilling Data Analytics

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RAPID R&D Focus Areas

- Automation Control Systems
- Modeling & Simulation
- Big Data Analytics
- Intelligent Mechanization, Robotics

Undergraduate Programs

Logos of various companies and organizations are shown on the right side of the diagram.
Big & Messy Data Analytics

• We are at the dawn of using big / messy data analytics in well construction and operation
• Key hurdles associated with data quality, reliability, security, communication, novel sensors, etc. still need to be addressed
• Complexity arises because Mother Nature is highly unpredictable, but........
• There is an incredible amount of value to be obtained from data mining, machine/statistical learning, pattern recognition, AI, etc.
• “The Future is Data ... Resistance is Futile”
Working with Operators on Value Creation

- Drilling and production improvement from in-depth data analysis
- Using unused/under-utilized datasets by operators
- Messy data-problem: data is structured/unstructured, static/dynamic, low/high frequency etc.
- Data issues:
  - Data quality (requiring cleaning/curation)
  - Data security and confidentiality
  - Data storage and organization
  - Data processing, visualization, etc.
Key enablers:
• Unique infrastructure (Real-Time Remote Collaboration Center, Drilling Simulator)
• High quality grad/undergrad students & senior scientists
• Strong ties to industry with access to field datasets
Really Big Field Data Sources

Wells drilled in the Bakken formation in summer 2015

- Downhole, surface and directional data
- Over 100 GB of sensor data
- Over 20 million rows of data
- 588 listed channels per well
- 6+ GB CSV files
- Daily Morning Reports (DMRs)
- Well plans
- Well surveys
- Formation tops
- Etc.

Typical Example: a 2.5 month data analytics project in the Bakken Shale identified $57.5MM in potential operator savings
Can Data Analysis Be Accelerated?

Which drilling assembly was the best for the vertical hole section?

Which BHA was the best for the lateral horizontal hole section?

Which rig followed the best connection practice?

How well did the directional driller do?

Which was the best drilled well?

Which drilling crew performed the best?
UT’s Storyboarding Approach

1. Data Curation
   - Well Site Records
   - BHA and Run Data
   - Survey Data
   - Geology Data
   - Well Plan

2. Data Visualization
   - SCRIPTS to import, process and visualize the data
   - Easy to tweak, control and modify!

3. Storyboard

Structured & Unstructured Data Sources
Answering Tough Questions with Visuals

- Formation Tendencies
- Wellbore Quality
- Drilling Tendency
- Time-Based Data
- 3D Visualizations
- Well Trajectory
- Drilling Dysfunctions

And many more relevant plots......
An Example...Finding the Best Well Drilled

- Trajectory Comparison
  - DWOB/SWOB
    - 0.49
    - 0.48
    - 0.47

- Vibration Comparison
  - DTorque/STorque
    - 0.61
    - 0.54
    - 0.51

- 38.86 ft
- 40.37 ft
- 41.26 ft
- 3.71
- 4.26
- 4.41
Storyboarding

- Pre-selected visuals to answer commonly asked questions
- Organizing visuals in a sequence to tell a story
- The sequence is decided based on the application
- Around 4 to 10 visuals per question

Performance Questions

- Which BHA was the best in the vertical section of the hole?
- Which well on the pad had the best lateral?
Drilling Data Acquisition for Completion Optimization

- Deliberate formation evaluation and data-acquisition during drilling for stimulation optimization: “which zones are best to perforate and hydraulically fracture?”
- Drilling parameters (ROP, MSE, mud losses etc.) used to characterize relevant rock/fracture parameters for optimized hydraulic fracturing
Since the first pilot in the Fall of 2014, more than 30 undergraduate students have graduated from the RAPID data analytics program.
A Plethora of Stakeholder Benefits

• **Industry Operators**
  – Detailed data-analysis of unused/under-utilized data
  – Performance/cost opportunities identified
  – Aiding future workforce development!

• **Students**
  – Better, more active learning on field cases
  – Acquiring relevant data analytics skills
  – Interact with real field data
  – Interact with future employers

• **University**
  – Better teaching
  – Excellent student / workforce development
  – Great applied R&D results, stronger ties to sponsors

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