KING OF DIAMONDS
Drill Bit Forum

iadd International Association Of Directional Drilling

Thu, March 30, 2023
8 a.m. - 5 p.m.
Reception to follow

Spring Reception Hall
100 Cypresswood Dr. Suite 1300
Spring, TX 77388

Embedded High-Frequency Drilling Dynamics Sensors

SANVEAN® TECHNOLOGIES
A Business Unit of Turbo Drill Industries, Inc.

30 MARCH 2023, King of Diamonds Drill Bit Forum, Spring, TX, USA 77388

https://sanveantech.com

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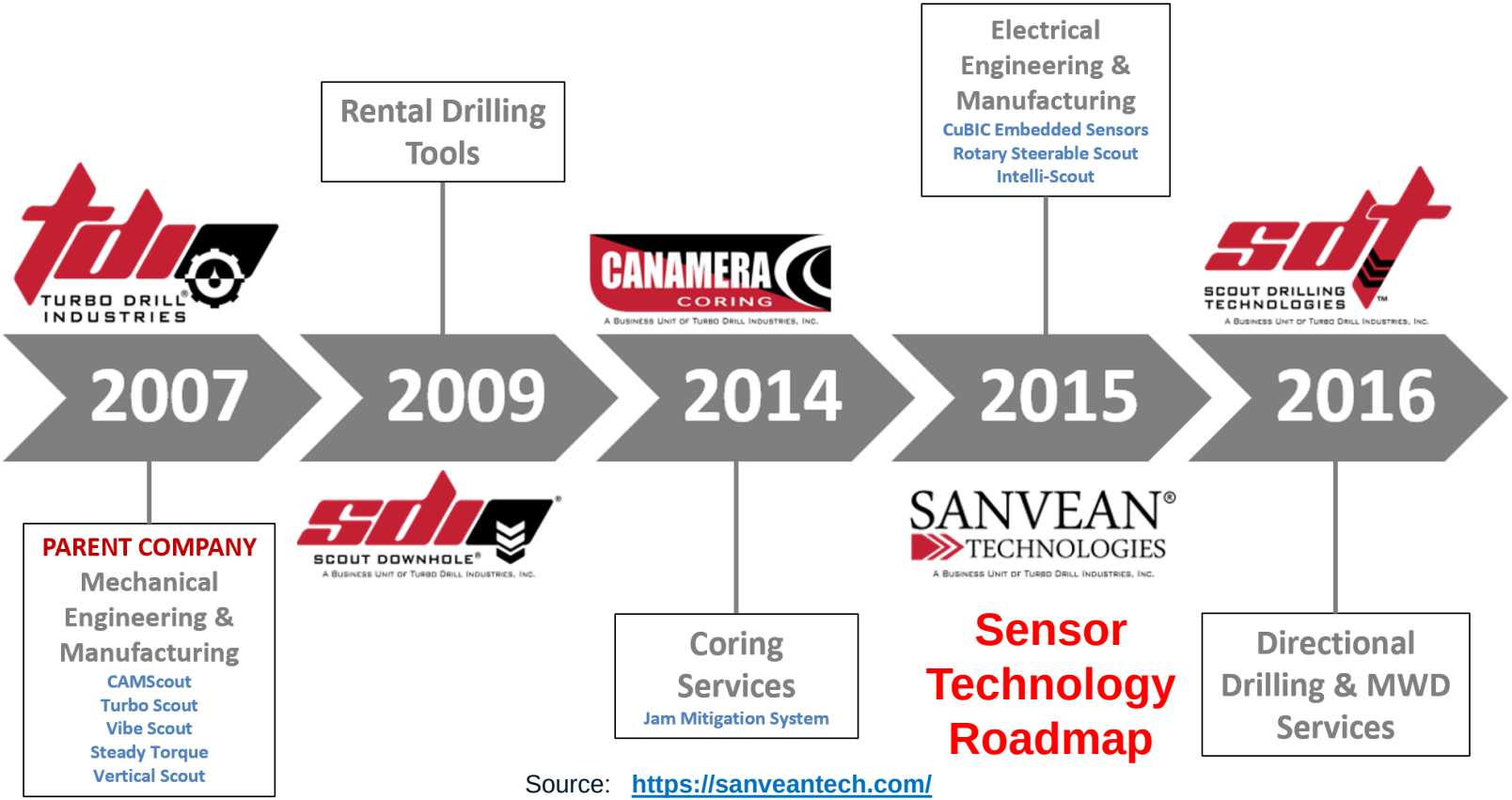
Speaker Bio

- **Junichi Sugiura**, VP, Sanvean Technologies, UK

- Chartered Engineer (CEng), Chartered Petroleum Engineer, Chartered Energy Engineer, Fellow of the Institution of Engineering and Technology (FIET) and Fellow of the Energy Institute (FEI).
- Ex-SLB Principal Engineer in the UK
- Interests: sensor technologies, artificial intelligence, data analytics, drilling dynamics/mechanics, directional drilling, geothermal drilling, and completions optimization.
- 70 external publications/presentations and +100 patents/pending patents worldwide
- 2019 SPE ATCE Vice-Chair in Calgary and 2020 SPE ATCE Chair in Houston, Texas.
- SPE Distinguished Member (2020), SPE Distinguished Lecturer (2021-2022), SPE Europe Regional Drilling Engineering Award Winner (2021), and SPE Europe Regional Service Award Winner (2022).
- Executive Editor for Geoenergy Science and Engineering (AKA: JPSE), Associate Editor for SPE Drilling & Completion, and Technical Editor for SPE Journal, having reviewed more than 600 engineering and scientific articles.

Source: https://sanveantech.com/about-us/leadership

Organization

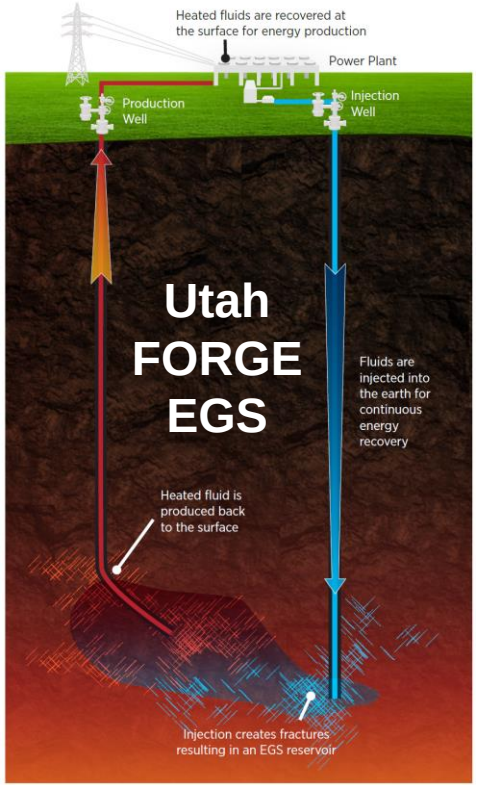


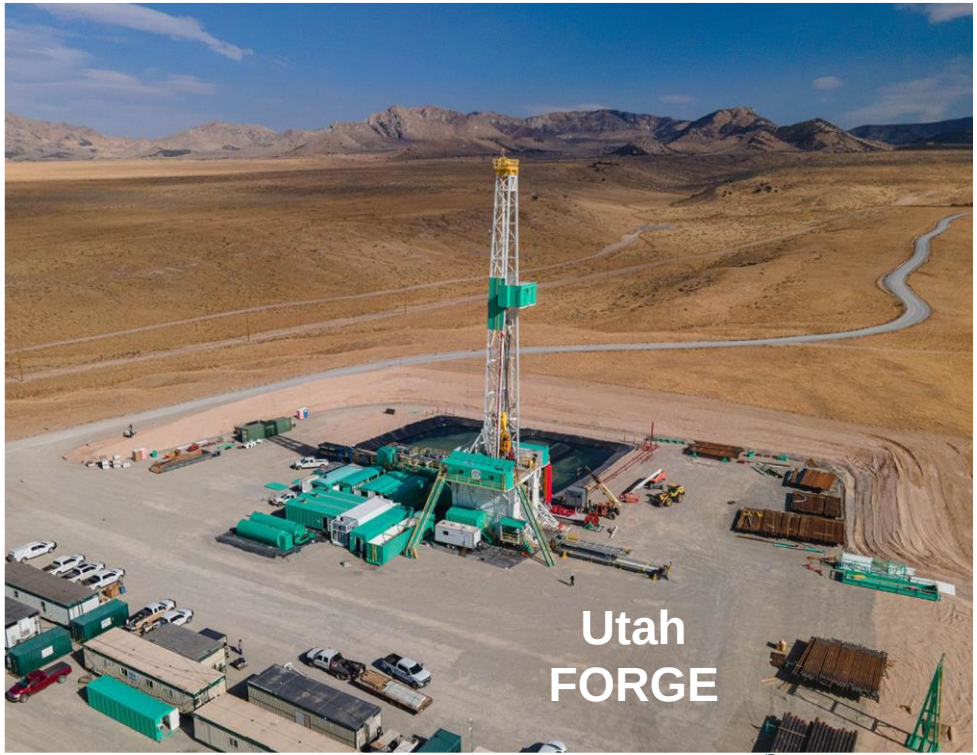
Source: https://sanveantech.com/

Agenda

- High-temperature embedded drilling dynamics sensors
  - 175C/347F for high-temperature wells, e.g. Haynesville (355F)
  - Diagnostics for PDC bits and high-temperature directional drilling tools (FORGE, GLADE, and Closed Loop)
- Sensor placement
  - Motor back-drive dynamics, HFTO, etc
- High-frequency drilling dynamics (memory-based) to:
  - Pseudo rock-mechanics parameters
  - Pseudo formation-evaluation parameters
- Real-time data from in-bit and near-bit drilling dynamics sensors
  - Advanced drilling dynamics (e.g. MBDD)

Geothermal Anywhere (EGS and Closed Loop)





Source: SPE-205965-MS: “Drilling Optimization of Unconventional Geothermal Well Drilling” by Sugiura et al.

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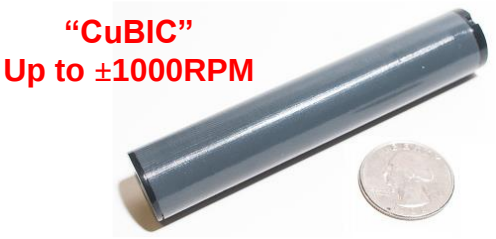
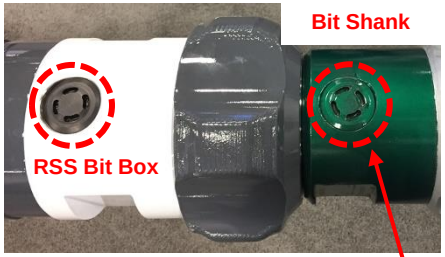
High-Temperature (175C) Sensors and Tools

Source: SPE-199658-PA: “Simulation and Measurement of HFTO/HFAO” by J. Sugiura & S. Jones

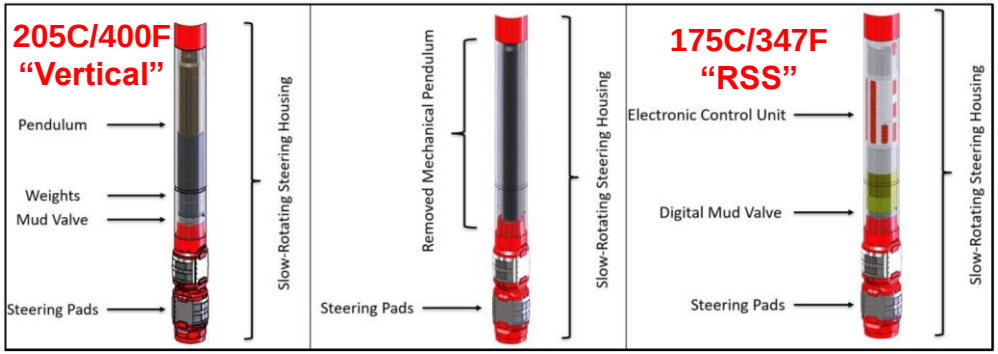


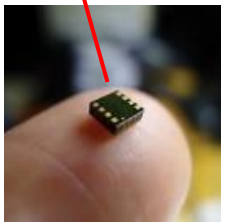
The sensor package in a pressure barrel

“Hockey puck” shaped sensor.



A Sensor in the RSS bit box.

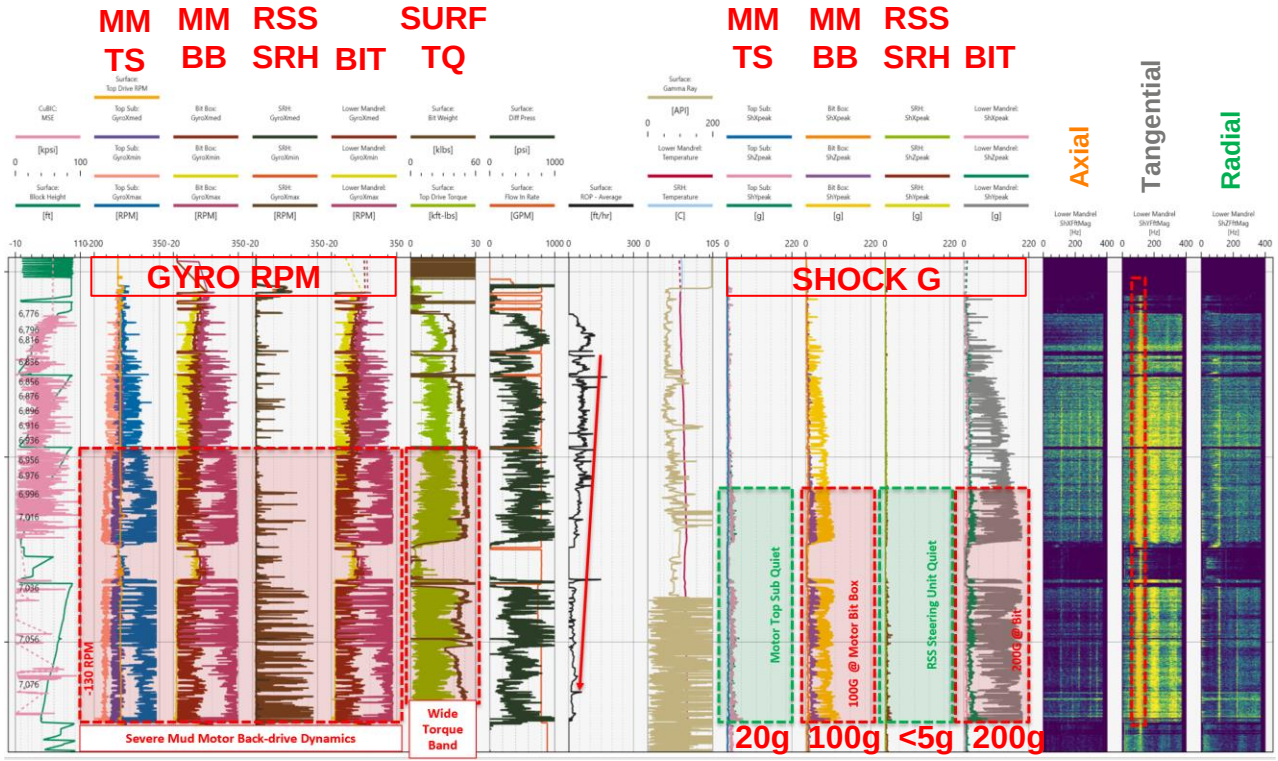




3-axis accelerometers
3-axis gyros
3-axis magnetometers

Source: SPE-213707-MS: “Mechanical Vertical Drilling tool to Digital RSS” by S. Jones & J. Sugiura

Back Drive & HFTO: RSS & MWD below a Mud Motor



Source: [SPE-212467-MS](): "Rotary-Steerable Drilling Dynamics" by S. Jones, J. Sugiura, & DW Johnson

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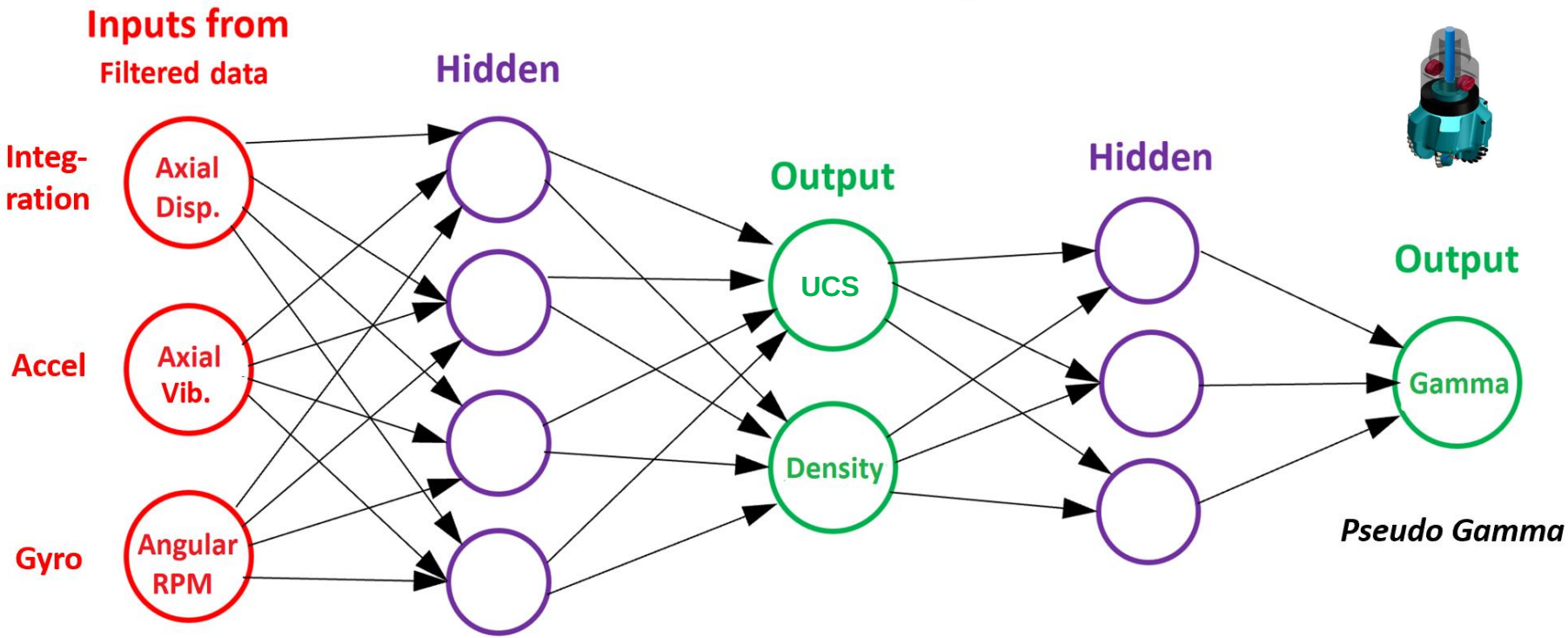
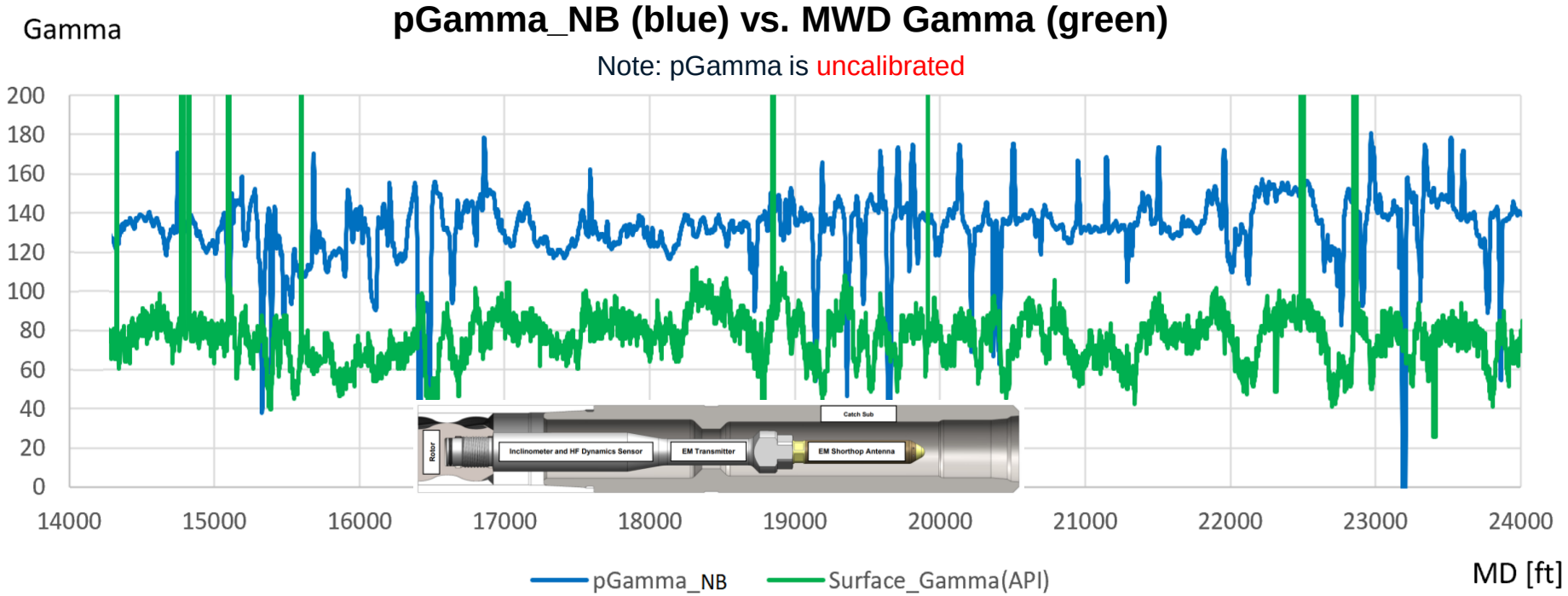
ANN Example to Calculate Pseudo Gamma



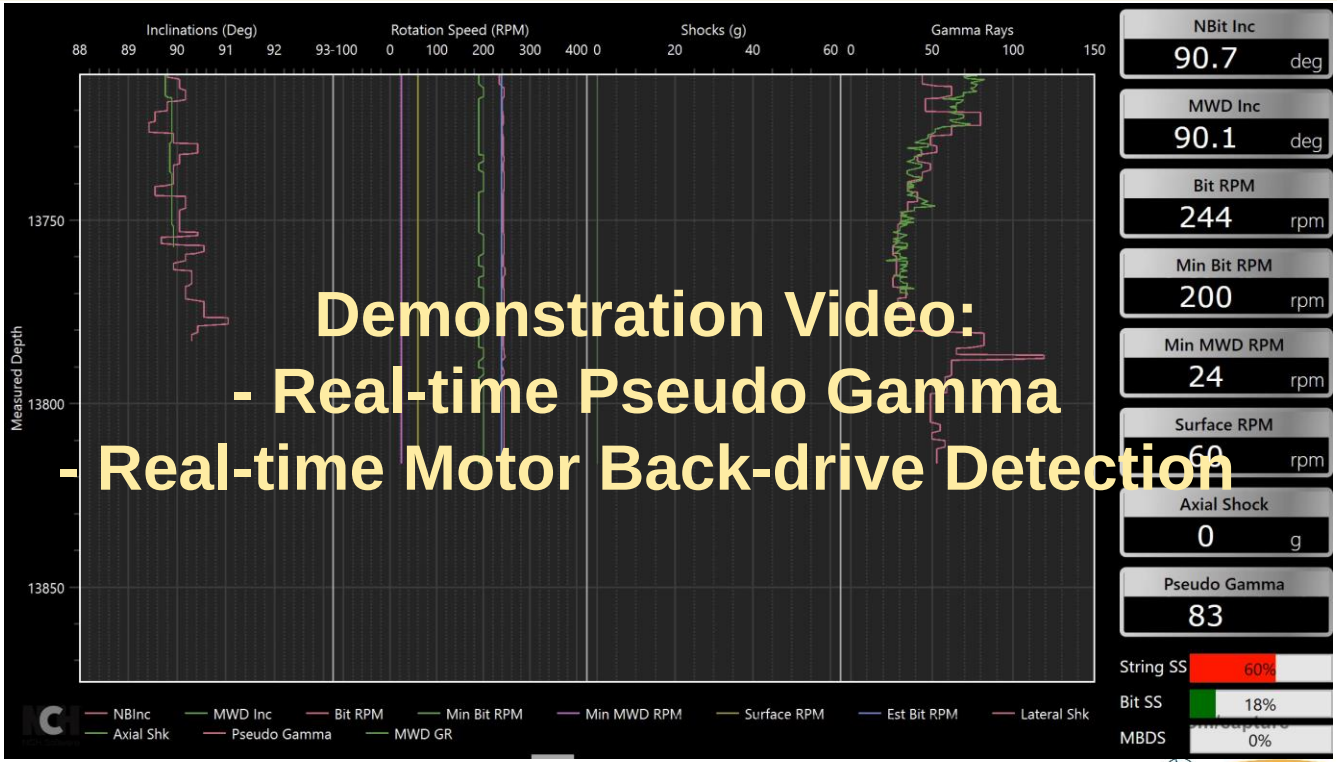
Source: [SPE-213650-MS](): “Real-time Pseudo Gamma Measurements” by J. Sugiura & S. Jones

A Horizontal-Section Example (West Texas)



Source: SPE-213650-MS: "Real-time Pseudo Gamma Measurements" by J. Sugiura & S. Jones
Source: SPE-201551-MS: "An Instrumented Wired Drilling Motor" by S. Jones & J. Sugiura

Pseudo Gamma and Advanced Dynamics Data



Demonstration Video:
- Real-time Pseudo Gamma
- Real-time Motor Back-drive Detection

Source: SPE-213650-MS: "Real-time Pseudo Gamma Measurements" by J. Sugiura & S. Jones

Conclusion

- Sensor placement
  - Motor back-drive dynamics, HFTO, etc.
- High-temperature embedded drilling dynamics sensors
  - 175C/347F for high-temperature wells, e.g. Haynesville (355F)
  - Diagnostics for PDC bits and high-temperature directional drilling tools (FORGE, GLADE, and Closed Loop)
- High-frequency drilling dynamics (memory-based) to:
  - Pseudo rock-mechanics parameters
  - Pseudo formation-evaluation parameters Use a drill bit as an FE sensor
- Real-time data from in-bit and near-bit drilling dynamics sensors
  - Advanced drilling dynamics (e.g. MBDD)

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Thank You

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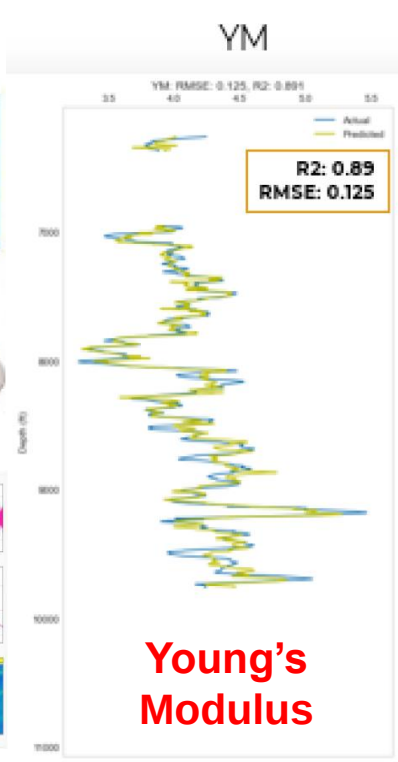
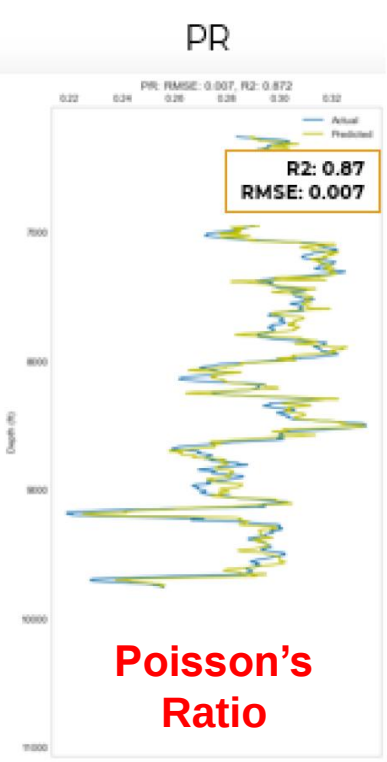
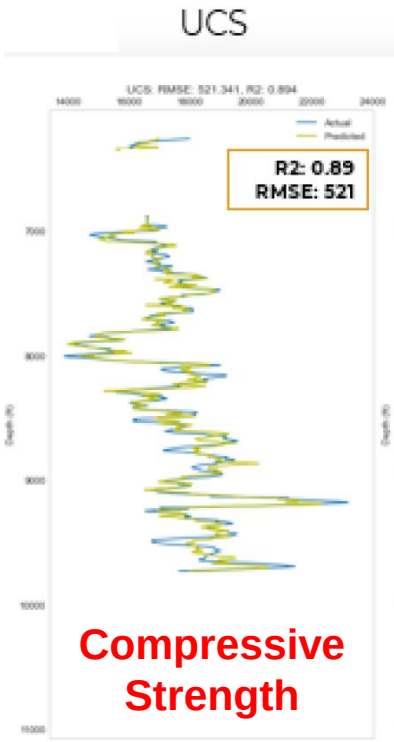
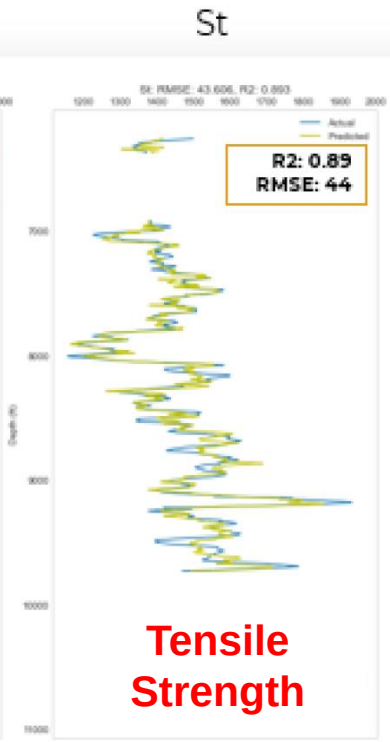
Back-up: Rock-mechanics using Vibration Sensors









Source: "Utilizing Downhole Drilling Dynamic Data to Characterize Geomechanics of Enhanced Geothermal Reservoirs at FORGE" by Gentry et al.

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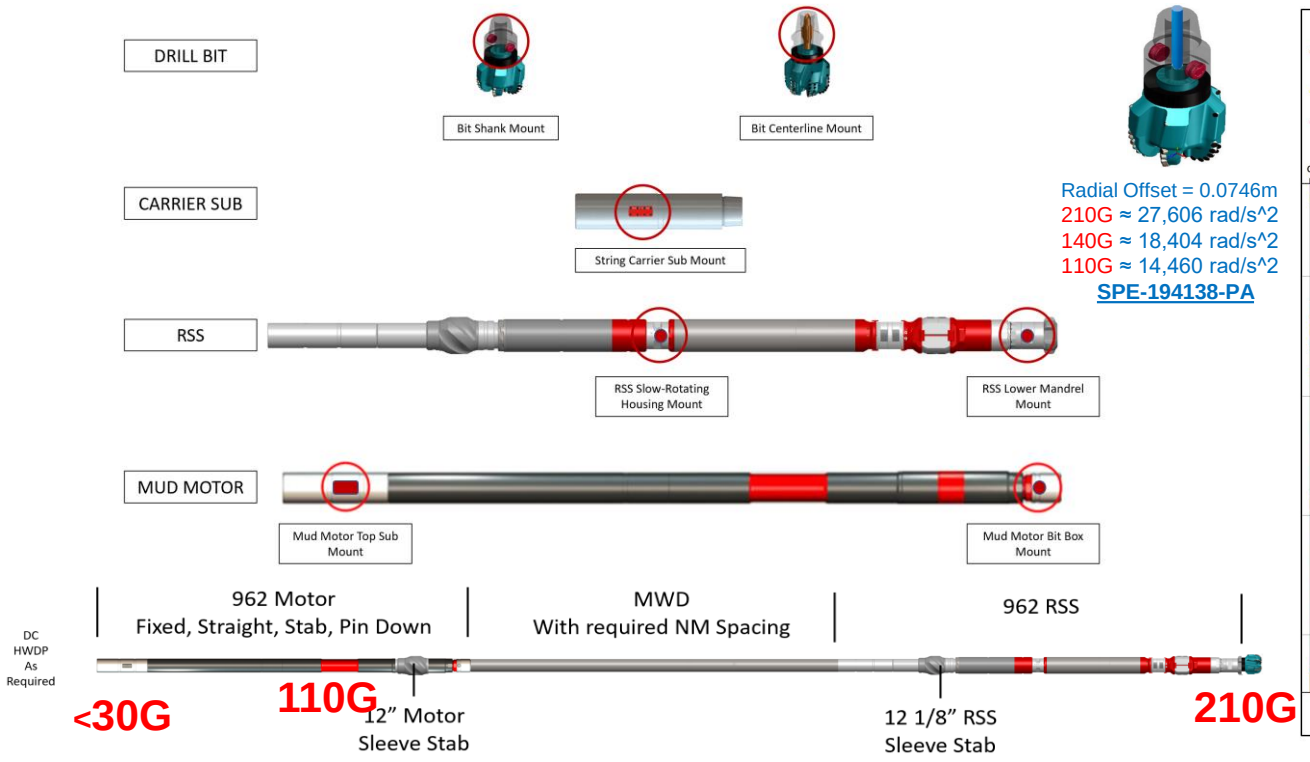
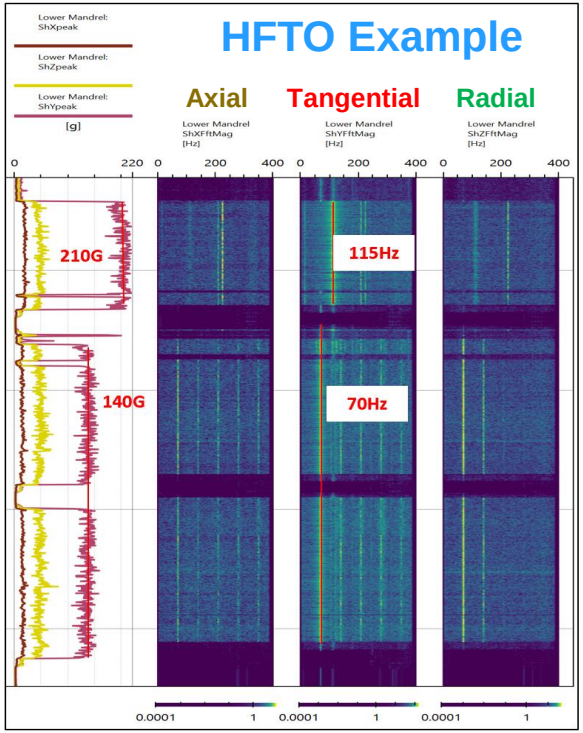
Back-up: RSS & MWD below a Mud Motor



Radial Offset = 0.0746m
210G ≈ 27,606 rad/s^2
140G ≈ 18,404 rad/s^2
110G ≈ 14,460 rad/s^2
SPE-194138-PA



Source: SPE-212467-MS: "Rotary-Steerable Drilling Dynamics" by S. Jones, J. Sugiura, & DW Johnson

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