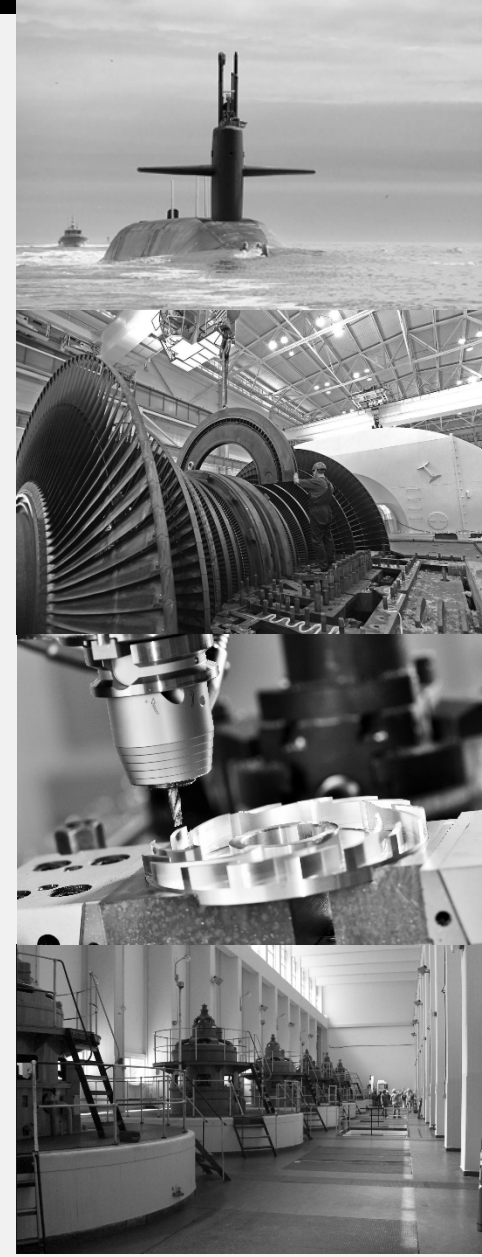
integral analytics™

Panel 2 - Quantum Computation for Machine Learning, AI, and Optimization

Aaron Hussey, P.E.



ABOUT US

Aaron Hussey, P.E., Founder & Principal

Howard Nudi, MBA, Senior Consultant

Core Business

- Analytic modeling for industrial equipment
- Interface between developers & end-users
- Integrate expertise with diagnostic systems

MACHINE LEARNING

Big Data (storage & retrieval)

- **Challenge –** expert today must carefully manage data files (which expand/contract based on amount of history and sampling intervals)
- **Solution –** improve computational power such that key features are extracted from raw data for use in “traditional” computation systems
- Enables machine learning algorithms to be focused on uncompressed data (full-featured)

Comparison to 1st Principals

- Real-time comparison of sensed parameters to possible physics-based states, validating data or creating virtual sensors
- Enables machine learning algorithms to utilize “calculated” parameters that cannot be sensed, but must be within certain bounds

Goal: Transform Big Data into Small (meaningful) Information

BIG DATA – STORAGE & RETRIEVAL CHALLENGE

Number of Points	Sample Interval	Duration	File Size
100	24-hour	6-years	2 MB
100	1-hour	18-months	11 MB
100	1-minute	1-month	30 MB
100	1-minute	18-months	420 MB

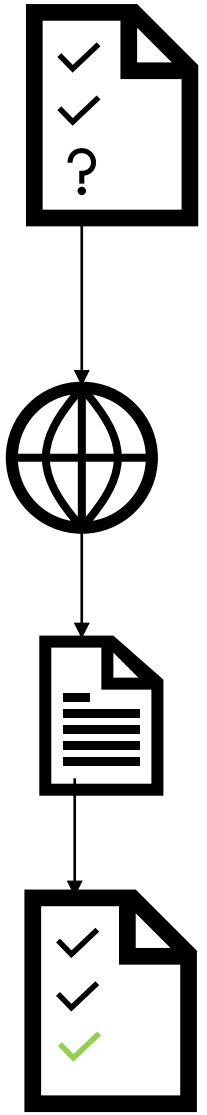
Can we process individual records through a quantum reduction program that keeps data fidelity but reduces the number of records drastically (similar to current compression algorithms)?

In a fossil fired boiler, we might be interested in 1000 points for 5 years at 1-second intervals!

ARTIFICIAL INTELLIGENCE

Diagnostic knowledge from “Big Text”

- Can we structure information that can be presented back to a user about a specific problem (e.g. troubleshooting a pump)?
- Troubleshooting requires processing as much knowledge as possible (start with generic) adding new information when uncertain.
- Humans do not have time (or budget) to know when to look for new information and where to look for it.
- Could Quantum calculations determine most optimal new information source (most relevant).



OPTIMIZATION

Emissions Reduction

- Can we model emissions profile at atomic level and optimize combustion/reduce emissions?
- Model molecular interactions
- Measure samples in flue gas
- Feedback controls to combustion optimization; environmental control equipment

Maintenance Optimization

- Prognostic models – convergence of prediction horizons – based on results of ML apps, compute likelihood of different paths (like hurricane path forecasting)

Better understand uncertain calculations by improving model fidelity

THANK YOU

Aaron Hussey

+1 980 248 5841

aaron.hussey@int-analytics.com

www.int-analytics.com

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