



Tales of a quantum theorist in aerospace testing

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About Me

- PhD in theoretical physics (quantum condensed matter)
- Research in unconventional quantum computing
- Tenured professor in Physics Department, Dalhousie University (since 2002)
- President and co-founder of Quantum Research Analytics (QRA), young start-up writing a model-checking tool (SMT-based)
- [running a company is *very* different than running a research lab, but it's not orthogonal]

A recent history (likely editorialized)

- 2007: Approached by LM Chief Scientist to help them with quantum computing. (“I think you’re crazy, but okay.”)
- 2010: Met with flight control and testing group in LM Aero, Ft Worth.
- 2011: LM buys quantum computer from D-Wave sys.
- 2011: QV&V of CPS (source code, program slicing)
- 2012: Model-based design; commercialization transition begins (QRA begins operations 12 months later)
- 2013: NASA/Google buy another machine (LM upgrades)



- Began operations Nov 2013
- Raised \$1.2M in commercial financing (LM R&D contract + Gov't financing)
- Currently 8 people, raising capital
- Goals:
 - 1) to build a commercially viable, industrially relevant, model-checking toolkit, plus associated services.
 - 2) to be “quantum ready.”
 - 3) to evangelize the merits of model-checking approaches

QRA Founders



Jordan Kyriakidis

PhD quantum condensed matter physics
Strong industry relationships

Leadership, day-to-day operations, product vision



Dean Tsaltas

MSc software engineering
Microsoft, BlackBerry, numerous startups

DevOps, architecture, UX, data management/interface



Micah McCurdy

PhD mathematics (category theory)

Computation, algorithmics, hardware

Core team

We are hiring!
(Email me, seriously.
jordan@qracorp.com)



Mike Kirkup, VP Business Development

Director BlackBerry, Director UWaterloo Velocity, numerous startups



Ken Duck, Lead Developer, Platform

Nortel, Klocwork, KDM Analytics



Eduardo Vaz, Customer Development

PhD quantum condensed matter physics, numerous startups



Douglas Staple, Infrastructure

PhD physics of complex systems



Christy MacDonald, Project Manager

Legal editor, admin, communications, chief staff organizer

Model checking is trending upwards...

- Aerospace (at least) is bleeding money
- Education/awareness is growing
- Internal formal methods projects inside several companies:
 - Thales, Lockheed Martin Aero, GE Aviation, Rockwell Collins (with UMinn), Rolls Royce plc
- High performance, low cost computing available

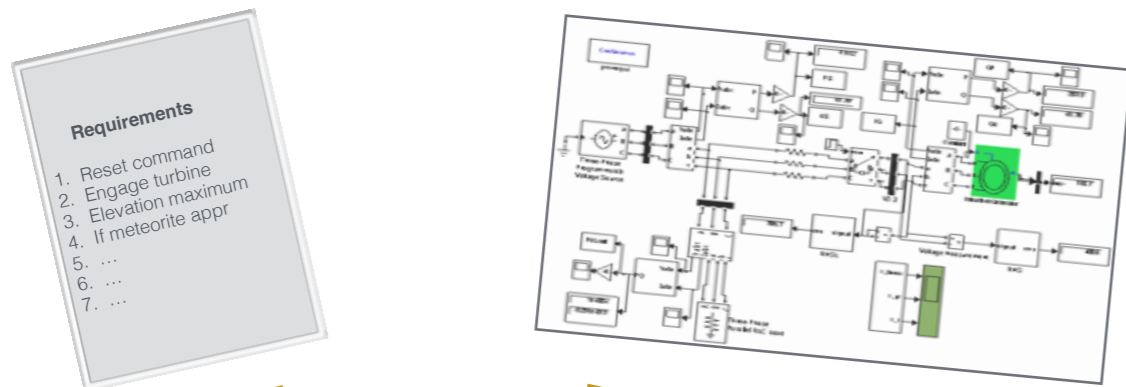
...but is not yet mainstream

- Business case needs to be made (better)
 - bottom-up approach could work
- Technical demands too high
 - “roomful of PhD’s problem”
- Research tools exist, but very few products
- Tool fatigue (“New language? No.”)

What engineers have told us

- Design errors **are** found in late-stage development process
 - LM, Bombardier, Thales, GE Aviation, GE Power and Water, ESA, LMS Siemens
- We need an **integrated** tool that is:
 - “easy” to use
 - scalable
 - has breadth of applicability
 - an actual **product**, not a research tool
- Focus on low-level requirements are okay

Technology: QVTrace



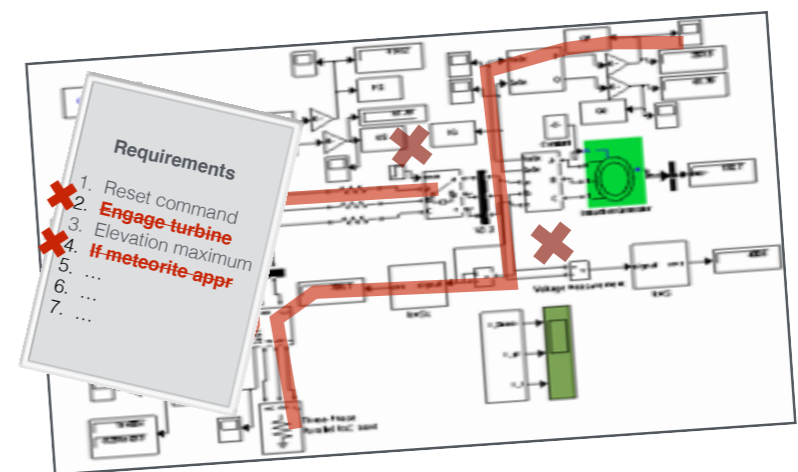
and



or

Validate design models with guarantees

or show where faults are





Find Faults Fast, Early

QVTrace Screenshot

QVTrace v0.1.1—25 April 2014

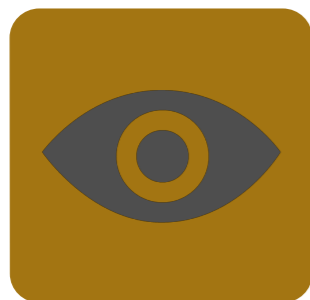
The QRA approach

Find faults at the **design** phase, using a three-pronged approach:



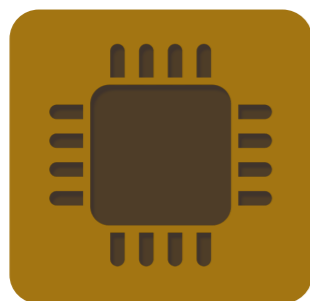
Translation

textual docs to logical constraints, interactively



Visualization

View model and constraints, interactively



Computation

Integrated hardware/software platform



Currently seeking **partners** with which to work.

What's next?

(unadulterated speculation)

- Current formal methods work is just beginning
- This is not **just** a certification issue
- This is not **just** a safety-critical issue
- This is a systems engineering **development** issue
- This is a technology development, and societal issue

... just around the corner

- Internet of Things
- Industrial Internet
- The Programmable World
- Blurring of software and hardware (FPGA's writ large)
- Frictionless manufacturing (e.g., 3D printing)
- API's for the physical world

Thank you



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We have a monthly newsletter. Email me to join it.