Unmanned Autonomous V&V

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Domain-Specific Languages (DSL)

- Mathematics for engineering domains each have special syntax, functions, etc.

- Programming for the domain should feel like writing the mathematics
  - The boilerplate software should be abstracted out
  - The specification then becomes the program

- Examples:
  - Yacc, a parser-generator for compiler front-ends
  - Cryptol, a language for specifying cryptographic protocols
Light Weight DSLs (LwDSLs)

- Also known as *embedded* DSLs in the literature.

- Think of LwDSLs as
domain-specific libraries + domain-specific syntax
  (but a little goes a long ways)

- Why LwDSLs over DSLs?
  - Don’t need to write your own compiler
  - Multiple DSLs in the same host language (*composable* DSLs)
  - Tool and library reuse

But don’t take our word for it...
Industrial LwDSLs Today

- (Research for) **Boeing**: a LwDSL for component configuration in real-time embedded systems. Resulted in 30x reduction of spec size & hundreds of errors caught.

- **Eaton**: LwDSL for describing safety-critical behavior of hydraulic hybrid vehicle control.

- **Antiope**: simulation of ultra low power radio chips.

- **Xilinx**: high-level hardware description language.
Let’s use Haskell (a popular functional language) as a concrete example:

- **V&V tools**
  - Semantic types.
  - Automated testing (QuickCheck) and coverage analysis.
  - Code coverage
  - Translators into FV tools

- **Synthesis tools**
  - Efficient compiler (oftentimes comparable to C)
  - Multicore support
  - Profiling support
  - Someone (else!) maintains the compiler

- And you can easily roll-your-own new tools.
LwDSLs for Mixed-Criticality Systems?

- Composable DSLs
  - Composition is easy---it’s all hosted in the same language.
  - Composition in multiple contexts---compilation, testing, and formal verification.

- Fast prototyping of mixed systems for simulation
  Can use as your requirements for a C implementation

- Targeted V&V as appropriate for the level required
  Test/verify different functions together