INCOSE International Symposium
Philadelphia, PA
June 24-27, 2013

Structural Modeling in Biomedical and Product Engineering

Henson Graves

Algos Associates

Modeling Is Used In Biomedical and Product Engineering For

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- Design of manufactured products
- Analysis and verification of system properties
- Classification of molecule structure
- Diagnosis of disease from symptoms

What Can Each Field Learn From The Other?

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- Are there common best modeling principles, common pitfalls?
- How are they different?
- How well do the modeling tools used in each field work in the other field?
- Does comparison suggest any tool improvements for each field?

Informal Experiment (SysML vs OWL)

- Use SysML for modeling molecules & human heart
  - SysML is common for product modeling
- Use OWL to model an aircraft
  - OWL is commonly used for biomedical modeling

Model Of Water - Using SysML

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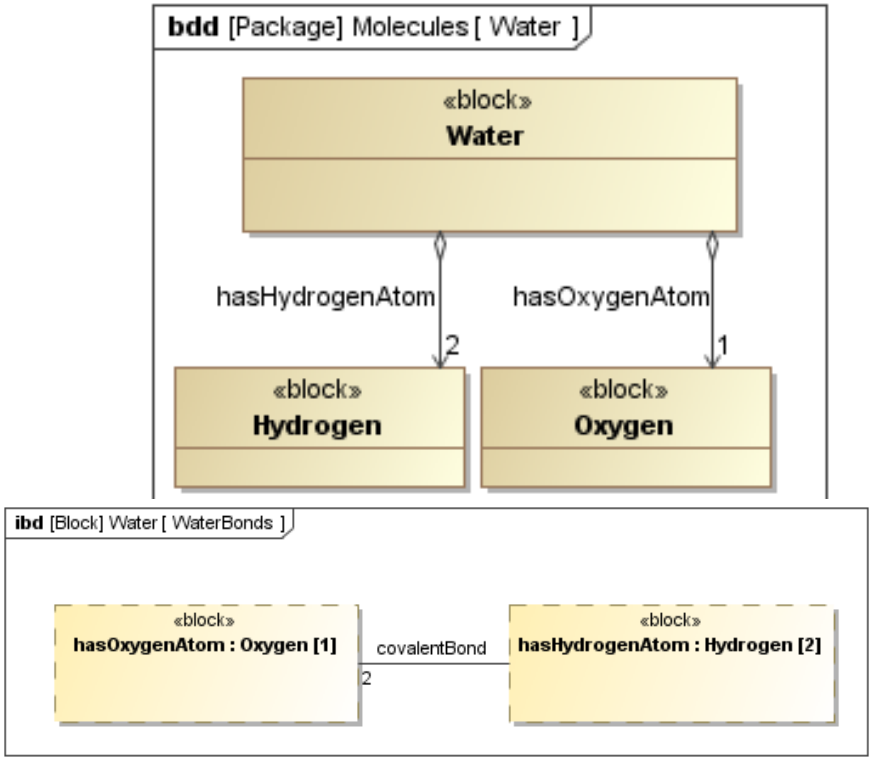
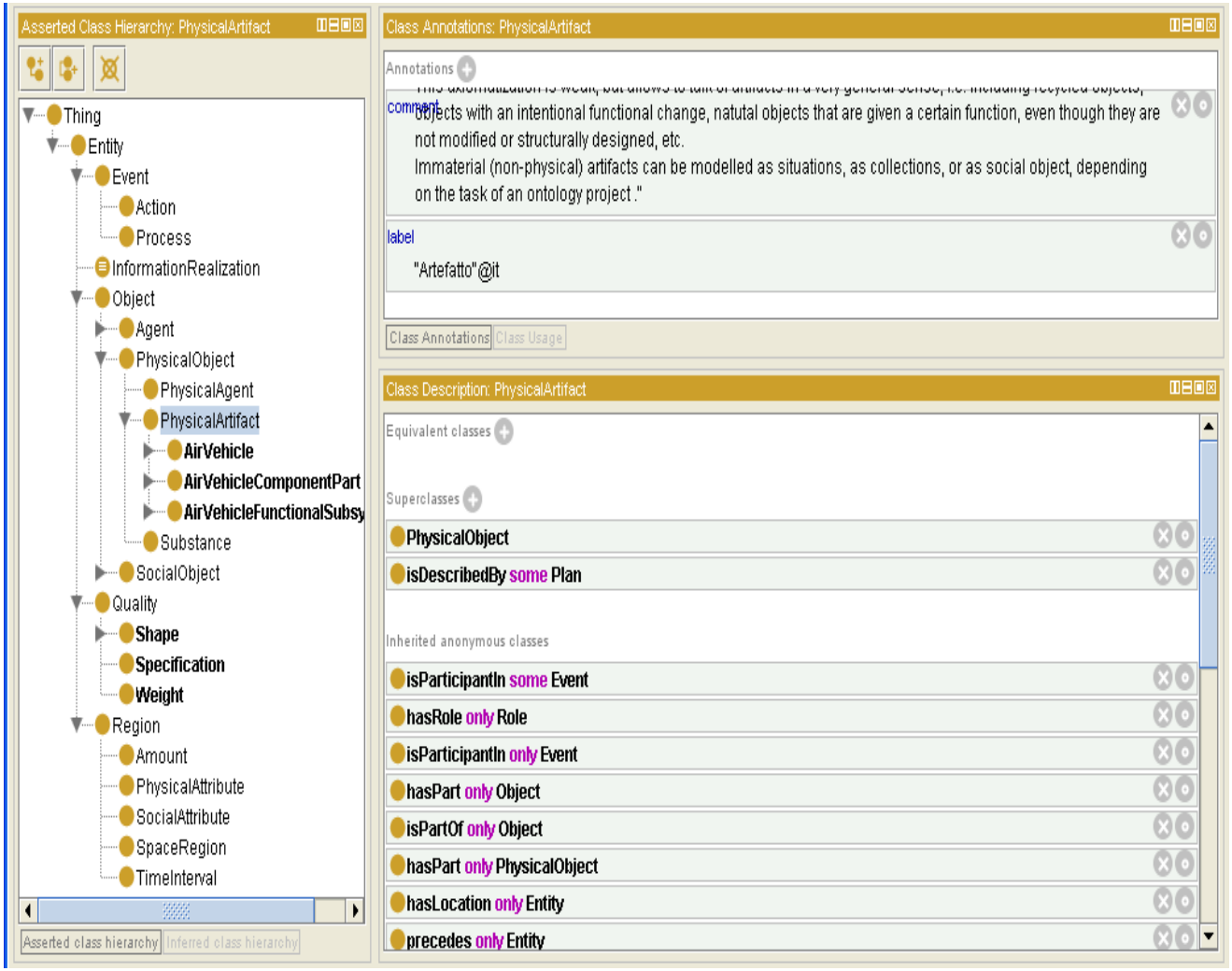
A Top Level of Water Model



Used To

- **Generate 3D Visualization of implementation**
- **Answer questions about mass, size, geometrical shape, …**

Model of Aircraft – Using Protégé (OWL)



…use of a foundation ontology saves a lot of time

What Can Be Learned

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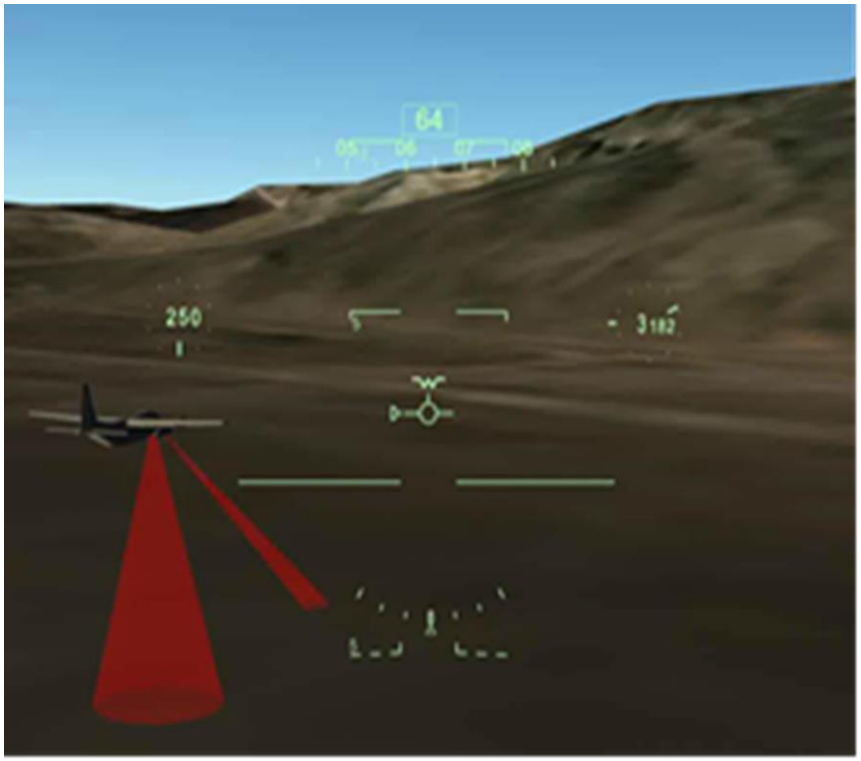
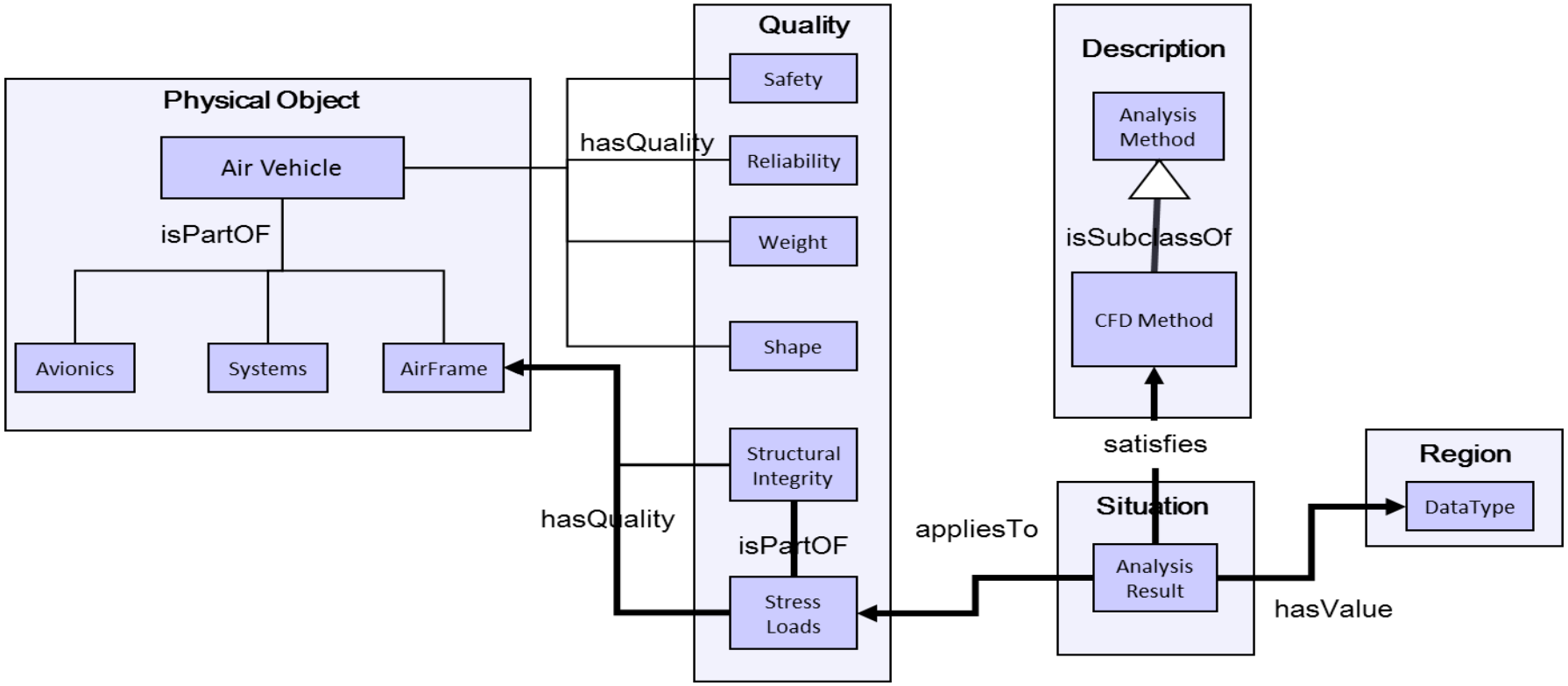
- Full MBSE requires modeling system in context of operating environment
- Both fields can use upper ontologies to save work and integrate models
- Automated reasoning can be used to solve practical problems in both fields
- SysML and OWL each have features needed in both fields

Full MBSE



Not just system models but integration with context of operating environment

Use of Upper Ontology



- Saves work through reuse
- Enables semantic integration of modeling from different groups & enterprises

Automated Reasoning (Both Fields)

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- Need modeling languages integrated with automated reasoning
- Much analysis translates into logic questions that can be answered with automated reasoning

Tool Pluses And Minuses

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- SysML
  - Graphics
  - Language constructions for parts and connections\
  - Behavior constructions
  - No formal semantics
  - No integration with reasoning
- OWL
  - Formal Semantics
  - Integration with reasoning
  - Integration with upper ontologies
  - No Graphics
  - Insufficient part and connection language
  - No behavior constructions

Suggestions For Improvement

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- Extend SysML
  - SysML is a much richer language than OWL
  - Include OWL class constructions
- Provide SysML with a formal semantics
  - Need this to integrate reasoning successfully
  - Build on OWL
- MBSE community needs to adopt upper ontology standards

Survey

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