Model-Based Test and Evaluation
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Why another model-based “thing”?

• Test and Evaluation (T&E) is in SE’s purview
  - Largely a “document”-based effort
• Rigorous and precise
  - Integrated with the system model
  - Consistent vocabulary
  - Semantically precise definitions
  - Maintenance and reuse of information (i.e. Don’t Repeat Yourself (DRY) principle)
• Transparent and Analyzable
  - Resource scheduling and procurement conflicts
  - Design “gotchas”
  - Impact analysis
• Resilient
  - Personnel change
• Front-end SE dividends finally pay off!
Some factors to consider when planning and conducting a test

- **Why** is the test being conducted? **How** do we know if the test is successful?
- **What** requirements are being verified?
- **How** do we arbitrate the test, i.e. how do we render a verdict? **What** are the verification criteria?
- **What** WBS id(s) or assemblies/subassemblies/components is/are being tested?
- **What** test equipment are required? **When** is it available? **Where** is it coming from? **How** will it be acquired?
- **What** test support items (emulators) are required to aid in the “realism” of the test?
- **When** and **where** will the test be conducted?
- **Who** are the test personnel executing/assisting in the test?
- **How** will the test be conducted? **What** are the test cases? **What** are the procedures? **What** are the pre/post conditions, constraints, hazards, etc.? **What** are the valid test conditions?
- **What** data was to stimulate the test, **what** data was recorded, and **what** was the resultant?

In other words, the **who, what, when, where, why, and how** of a test?
Conceptualizing the problem

• Considerations fall into four bins/aspects:
  - Configuration – what was the setup of the test (interfaces) and what resources are required?
  - Arbitration – what can we learn from the test?
  - Data – what data was used to drive the test, what was measured and recorded, and what was the resultant?
  - Procedure – how was the test performed?

• The elements comprising the four bins form the basis of a test architecture

• Execution and evaluation of the test would be an instance of the test architecture
Attacking the problem

- Extends the approach described in “Model-Driven Testing: Using the UML Testing Profile” by Baker, et. al.
  - Developed for software but can be extended to systems and large scale T&E

- Formal description uses SysML as the foundation language in combination with concepts used directly and extended from the UML Testing Profile (UTP)
Test Architecture
Test Configuration
Reconfigurable System Under Test
Test Resources
Test Resource Utilization
Resource Certification
Binding Data to Test Interfaces
Test Procedure

- TestConfigurationContext
  - operations
    - testCase() : VerdictKind
  - owned behaviors
    - testCase() : VerdictKind
- Future work will define methods to formally express hazards, deviations, safety instructions, etc.
- Postcondition
  - APostCondition
- Precondition
  - APreCondition
Test Case Arbitration
Summary and Future Work

• Test architecture description addresses T&E considerations in all four conceptual aspects
• Baker’s UTP approach extended beyond strictly software testing to systems test and evaluation
  - Reconfigurable SUT through bound references
  - Additional test resource definitions
  - Resource utilization, acquisition, and certification through association blocks and helper activities
  - Data bound to test interfaces via binding connectors
  - Use of embedded requirements such as requirement constraint blocks

• Future Work:
  - Possible explosion of SUT configurations representing integration steps
    • Need better “helper” mechanisms to manage configurations
  - Define methods to formally express test procedure hazards, deviations, safety instructions, etc.
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References


