Airspace Management Decision Tool

Validating the Structure & Behavior of Software Design

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Introduction

- World of Air Traffic Control (ATC) is a constantly changing environment
- NO COMPROMISES!! SAFETY CRITICAL!!
- What happens during a shift change? How do controllers “inherit” situation awareness?
Solution

- Create a tool that models airport situations
  - Enable outgoing controller to enter current state
  - Enable incoming controller to enter pilot requests
  - Program outputs controller action and updates the current state
Validation of Behavioral & Structural Model

[Diagram]

Behavioral Model

- Architecture-level design
- Physical design

Structural Model

Implementation
- Select objects and classes
- Select interfaces and component connections
- Assign operations to HW/SW

Test and Evaluation
- Validation of correct behavior for scenarios

Feedback
System Validation & Verification

- Verify:
  - Program structure enables desired behavior
  - System behaves as expected
  - Spatial constraints are not violated
  - Safety is guaranteed by the system
LTSA

- Verification tool for concurrent systems
- Models Finite State Processes as Labeled Transition Systems
- Animation feature simulates system behavior
LTSA

Constraint checks:

- Verify no more than one plane allowed in any position at a given time

- Verify that all aircraft progress through each airport phase in order

- Verify that controller-issued orders meet pilot-issued requests
System Validation & Verification

- Limitations
  - Does not account for human error
  - Does not cover invalid scenarios
  - Does not cover validation of avionics, communications, or surveillance systems
Software Behavior
Example

- Generate scenario using MATLAB code
- Use validation tables (from 642) to calculate expected outcomes
- Use LTSA animation to verify outcomes
<table>
<thead>
<tr>
<th>Current State</th>
<th>Input</th>
<th>New State</th>
</tr>
</thead>
<tbody>
<tr>
<td>[1,1]</td>
<td>Enter Holding Pattern ‘E’</td>
<td>[1,1]</td>
</tr>
<tr>
<td>[1,1]</td>
<td>Takeoff ‘T’</td>
<td>[1,0]</td>
</tr>
<tr>
<td>[1,0]</td>
<td>Enter Holding Pattern ‘E’</td>
<td>[1,1]</td>
</tr>
<tr>
<td>[1,1]</td>
<td>Land ‘L’</td>
<td>[0,1]</td>
</tr>
<tr>
<td>[0,1]</td>
<td>Takeoff ‘T’</td>
<td>[0,0]</td>
</tr>
</tbody>
</table>
Questions?