STANDARDS APPLICATION – CERTIFICATION OF ADAPTIVE SYSTEMS

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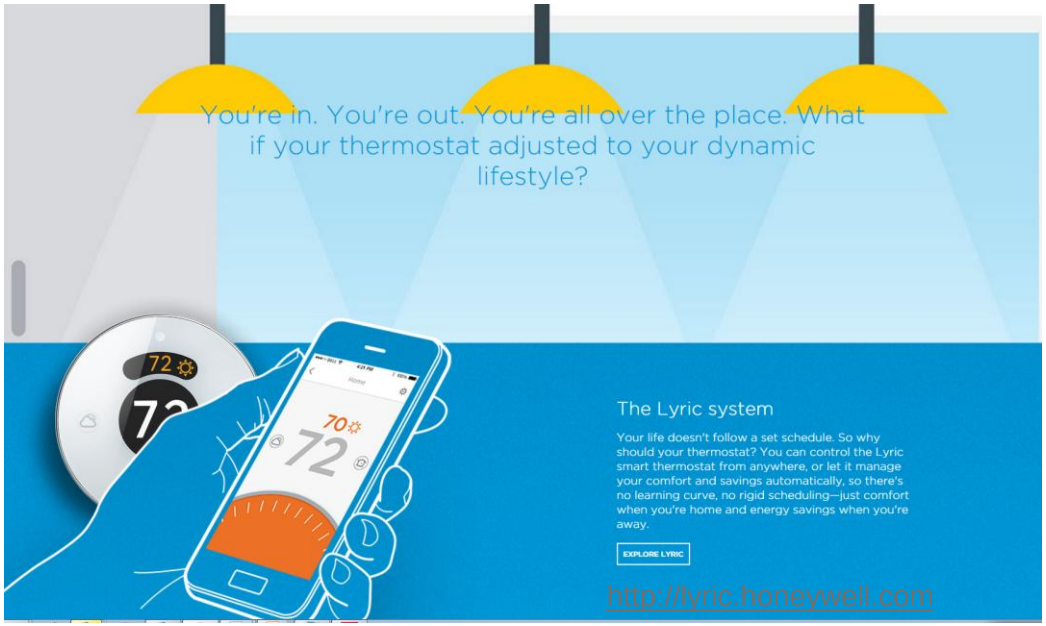
Adaptive Systems



- Adaptive Systems are all around us
- Search engines and phone make recommendations, thermostat learns, vacuum cleaners move around objects and pets on the floors
- Lot of work has been done on Autonomy in aerospace yet there are no certified Adaptive Systems

Approach for Adaptive System Certification

- Reviewed several types of adaptation and adaptive system
- Focused on a generic and representative adaptive flight control. Excluded gain scheduled AS.
- Defined some basic principles for a system and software design assurance to assure safe use
- Concluded that using only DO-178B would not be adequate – could not meet our principles
- Expanded our investigation to DO-178C and supplements
  - Could those methods address the identified difficulties and follow our principles?
  - Revised our list of objectives to DO-178C Annex A
- Defined what system level functional and safety properties would be needed for example AS– list constraints, convergence, fail safe policies
- Defined what activities and techniques could be used to satisfy the DO-178B/C objectives

http://ntrs.nasa.gov/search.jsp?N=0&DocumentID=20140000469

Conclusions

- Software design assurance alone is inadequate to assure the safe application of adaptive systems
- The safe use of adaptive systems begins at the system level with the constraints on the architecture and permitted adaptation
- The constraints assure that the adaptive system exhibits certain safety properties and assures an acceptable level of safety
- Need to establish and satisfy system safety objectives that are AS-specific
- AS must exhibit certain system level properties to ensure an acceptable level of safety that can be represented mathematical (Model)
- Model should express requirements for functional and safety properties

Encode behavior in mathematical models

Recommendations

- Software design assurance using DO-178C and MBD, FM supplements
- Use DO-330 TQ compliant tools
- Multi-layered verification methods are necessary involving test, analysis/simulation
  - Certification process will need to accept non-traditional means of compliance with certain 178C objectives
    - More reliance on formal analysis/simulation than test
  - Learned state space is too rich to adequately test
- MBD/FM does not obviate testing but can usefully
  - Highlight corner test cases
  - Identify pass/fail criteria, predict expected results
- DO-178C supplements do not need additional or changed content

Existing methods can be used

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