Reactive Model-Based Testing Design for Embedded Automotive Software

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Research Area
SPL

Project Title
Reliability and Safety of Embedded Automotive Software

Software Testing in Automotive

Automotive software development process typically revolves around hardware/software/system–in-the-loop practices.
- Heavily relying on simulation.

Testing based in models of the system and preference for automated test strategies.

Model-based testing is well established in the automotive.
- Reliant on specification based functional models of the system.
- Model typically built from specification in a black-box fashion.
- Preference for automatically generated executable test cases.

Complexity of automotive software not matched by development and test processes for automotive embedded software.
- Need for sophisticated automated on-line model-based testing methodologies which capture reactive behaviour.

Solution Approach:

Enhance the AVFs approach to cater for reactive behaviour and merge it with the CTMEMB methodology for test data design/generation.

From functional requirements to test data generation:

Fig 3: Suggested Test Architecture

- If P a A (i) increases AND & is constant THEN P_aDrive decreases
- If P a A (i) decreases AND & is constant THEN P_aDrive increases
- If PBBC is constant AND & is constant THEN P_bDrive is constant
- IF P a A (i) increases AND & decreases AND P_bDrive decreases
- IF PBBC is constant AND & is constant THEN P_bDrive is constant
- If P a A (i) is constant AND decreases AND P_bDrive is non-negative THEN P bDrive does not increase.

Fig 4: Suggested Test Data Generation Architecture

Selected Related Work:

Classification Tree Method for Embedded Systems (CTMEMB) (Conrad, 2006):
- deals with the design methodology of tests and test automation, does not handle test strategies which are reactive to the system’s outputs.

Fig 1: Defining Test Sequences (Conrad, 2005)

Automotive Validation Functions (AVFs) approach (Zander-Nowicka, Schieferdecker and Perez, 2007):
- deals with test evaluation design, does not deal with reactive behaviour.
- test evaluation and test data generation share the same data.

Fig 2: AVFs Approach Test Architecture (Zander-Nowicka et al, 2007)

Results to Date:

AUTOSAR analysis (including journal paper, internal report, co-authored report for the European Space Agency).

Analysis of capabilities of CTMEMB.

Analysis of capabilities of Testing & Test Control Notation (TTCN-3) regarding reactive behaviour.

Analysis of capability of relevant toolsets.

Preliminary results.

Next Steps:

Complete model-based testing methodology.

Validate methodology in cooperation with company working on embedded software.
- Agreement with company already in place.

Continued publication of work on peer reviewed conferences and journals.