The MUSICC Project:
Representing and storing scenarios for certification

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Principal Technologist | 14th May 2019
Regulatory challenge

- CAVs present a challenge for regulators
- Historically had a limited set of clearly defined tests, with clear pass/fail criteria
- Scenario-based testing is a way to bridge from there to CAV certification

DfT and UNECE WP.29

- WP.29 has a Working Party called GRVA, focused on CAVs
- Key sub-group: Verification Methods for Automated Driving (VMAD)
- Addressing:
  - Closed-road tests
  - Real-world test drive
  - Audit and simulation
Catapults – a force for innovation and growth

A network of world leading centres designed to transform and accelerate the UK’s capability for innovation and future economic growth.
Accelerating the industrial strategy

The Industrial Strategy outlines four Grand Challenges which places must address in delivering successful growth, but which also represent commercial opportunities for innovators. These are:

- The Future of Mobility
- Clean Growth
- Ageing Society
- AI and Data

With population and development both concentrated in urban areas, innovation in and around the places we live promises to positively impact each of these challenges, with the fourth (AI) playing a vital enabling role.
Objectives and approach

Objectives:
• Create a language to describe scenarios, aligned with industry standards
• Build an open and extensible library for CAV certification scenarios

Approach:
• Proof-of-concept project, Apr 2018 – Mar 2020
• Close collaboration with vehicle manufacturers, ADS developers, organisations with expertise in CAV validation, and regulators
• Focus on simulation testing environments
MUSICC scope and context

Incoming scenarios

Scenario library

Export API

Web Interface
- Browse scenarios
- Support for import
- Basic editing

Regulatory testing

Simulation tests

Physical tests

UNECE WP.29
### Scenarios for certification

**Neutrality / Fairness**
- Work with all ADS architectures and implementations
- Work with all sensor types
- Not be influenced by commercial goals
- Shouldn’t constrain OEM USP features

**May not require the full scope of development testing**
- Different objectives and targets (safety focus)
- Results presented for different users
- Should support both randomisation and repeatability

**Must work within the wider regulatory regime**

**Must work equally well across different regions**
- For example, the UK drives on the left, signage differs
Scenario representation and consultation

Scenario representation and the Scenario Description Language (SDL) are critical to MUSICC.

- We acknowledge a significant intellectual debt to the PEGASUS project for setting the agenda here
- Functional / logical / concrete (diagram on right) is becoming the accepted terminology

We also consulted a wide range of stakeholders at the first MUSICC workshop in September 2018.

Adapted from PEGASUS Symposium 2017
Should we store the logical scenarios (with randomisation) or concrete scenarios?

- **Store only concrete scenarios**
- **Store logical scenarios, with specified ranges for variables**
- **Store a hierarchy of scenarios (functional plus logical plus concrete mix)**
- **No vote**

Legend:
- Test Experts
- Assurer
- Sim Tools
- Other ADS-D
- OEM
How rich should the modelling environment be?

- Test Experts: 20
- Assurer: 10
- Sim Tools: 5
- Other ADS-D: 5
- OEM: 25

Categories:
- No environment
- Buildings, trees as bounding boxes etc.
- Fixed, reference set of buildings, trees etc.
- 3D model format for scenery

Outputs of September 2018 Workshop #2
The Scenario Description Language (SDL) is a key part of MUSICC’s deliverables.

- Defines a format for representing scenarios (fields and data structures needed)
- Stakeholders will be more willing to engage if a standardised or widely-compatible format is used
## MUSICC system demo

![MUSICC system demo interface](image)

### Details:
- **Description**: Filter options for CountryCode, DriveOnRightOrLeft, UseCase, ScenarioType, and Exposure.
- **Table**:
  - **CountryCode**: GB
  - **UseCase**: Urban
  - **ScenarioType**: Logical
  - **Exposure**
  - **Columns**: id, label, updateDateTime
  - **Rows**:
    - 10: UK TSC-Demo, highway_test_double_lane_change-61, 2015-07-26T10:00:00
    - 18: UK TSC-Demo, highway_test_double_lane_change-153, 2015-07-26T10:00:00
    - 62: UK TSC-Demo, highway_test_double_lane_change-161, 2015-07-26T10:00:00
    - 72: UK TSC-Demo, highway_test_double_lane_change-85, 2015-07-26T10:00:00
    - 81: UK TSC-Demo, highway_test_double_lane_change-37, 2015-07-26T10:00:00
    - 145: UK TSC-Demo, highway_test_double_lane_change-15, 2015-07-26T10:00:00
    - 163: UK TSC-Demo, highway_test_double_lane_change-179, 2015-07-26T10:00:00
    - 199: UK TSC-Demo, highway_test_double_lane_change-124, 2015-07-26T10:00:00
    - 203: UK TSC-Demo, highway_test_double_lane_change-162, 2015-07-26T10:00:00

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Context: Regulatory certification – near-term suggestion

Longer term, we anticipate an independent body will run the simulation tests.
MUSICC Symposium – 24th June

Major stakeholder event, Monday 24th June 2019

MUSICC Symposium: The pathway to certification of HAVs
Milton Keynes, UK

https://www.eventbrite.co.uk/e/musicc-symposium-the-pathway-to-certification-of-cavs-tickets-61868884499

Provisional programme:

• Keynote on the regulatory agenda for HAVs
• MUSICC vision
• MUSICC system demo
• Presentations from representatives of:
  – HAV developers
  – Test centres and proving grounds
  – Simulation tool vendors
• Break-outs for requirements gathering
Future plans

We anticipate handover to the regulator starting in January 2020

Before then, we aim to:

• Continue user trials and stakeholder engagement
• Create / acquire a limited number of scenarios to populate the library
• Develop the curation interface for scenario management
• Interface with existing simulation toolchains
• Enhance the SDL
  – Specification for smart actors
  – Include pass / fail criteria
Thank you

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