Automated Testing for Autonomous Cars?

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Agenda

• Introduction

• Wireless Fault Injection

• Automated Autonomous Test

• Conclusion
INTRODUCTION

Distributed events – new challenges
Classic test setup

- ECUs inside a car are connected to different
  - bus systems
  - sensors
  - actuators
- These are all inside the car
New test setup

• Car is wirelessly connected to
  ▪ other cars
  ▪ intelligent infrastructure

• Car processes more and more events happening outside the car
WIRELESS FAULT INJECTION

Use of a real-time wireless bridge
Idea

- Be able to wirelessly connect to a (driving) car for testing purposes
  - e.g. via XCP
- Use existing toolchains
  - e.g. CANape®
- Synchronize time of distributed events
  - common time-base
Concept

- Development of a wireless bridge
  - Deterministic data transfer
  - 1ms real-time capability
  - GPS timestamp
Implementation

• Simulation driven development
• Automatic code generation
• Real-time Linux, FPGA and SDR based
• Layered structure
  ▪ Adaptable to different toolchains
• Optimized for aspects of testing
Wireless Fault Injection

- Using a deterministic wireless bridge enables to:
  - remotely access an ECU, even in a driving car
  - inject faults to a specific time
  - remotely observe the fault reaction
AUTOMATED AUTONOMOUS TEST

A future test method?
Wireless HIL-Techniques

- Example of an automated test of an autonomous car

1. Trigger red light
2. Optional: inject fault
3. Measure internal car response
4. Evaluate function
5. Adapt parameter
6. Reset test conditions

car can “test itself”

1. Wireless connection to traffic light
2. Wireless connection to car
3. Wireless connection to car
4. Local test script
5. Wireless connection to car
6. Wireless connection to car and traffic light
Added Benefits

• External control of functions in a self-driving car during development
• Automated real-world test of autonomous cars, controlled by a HIL-like system
• Automated generation of test-data for machine learning purposes
CONCLUSION

key-takeaways
Summary

• Testing, especially automated testing, of wirelessly connected cars is challenging
• Testing functionality depending on distributed events needs synchronization

• Use of a self developed wireless bridge to
  ▪ create a common time base for testing
  ▪ enable the use of existing test tools and methods for automated tests
Thank you for your attention!

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