SYSTEM DEVELOPMENT CHALLENGES OF AUTOMATED DRIVING FOR THE RELATIONSHIP OF OEM & TIER1

Jaguar Land Rover, Dr. Yi Zhou, 04 Nov. 2019
Outline

- Automotive and Automated Driving Today
- Technical Challenges for Automated Driving
- Challenges for Automated Driving Projects and Potential Solutions
- New Partnership between OEM and Tier 1
- Summary
Who is Driving Automated Driving

Investors are seeking opportunities

If there are ADS devices for NCAP, why don’t do more

Dividend and Stock price must increase

Shareholder

OEM

When are you ready?

I’m ready, are you?

Engineers would like to take on the challenge. Good engineers would leave the traditional OEMs/Tier1s if there is no such opportunity/project.

Let car drive safer than human!
Automotive: From Mechanical to Software Industry

Defender 1990

- Compact Vehicle: 15%
- Premium Vehicle: 28%
- Hybrid Vehicle: 47%
- Electric Vehicle: 65%

Range Rover 2010

- Percentage of Whole vehicle cost on Software:
  - 2010: 10%
  - 2015: 15%
  - 2020: 20%
  - 2025: 25%
  - 2030: 30%
Automated Driving from L0 to L5

A Journey from supporting human to driving safer than human

Increasing safety and reliability requirements

- Higher Cost
- More Sensors
- More powerful ECUs
- More Complex Software
- More Software Update

Intel i7-5960X: 375 GFLOPS

More Safety
More Reliability
More Validation
More Exposure
Technical Challenges for Automated Driving

**Perception**
Detection & Fusion

- Technical:
  - Accuracy
  - Range
  - Integration
  - TP/FP
  - Robustness all Weather/Light

- Others:
  - Homologation for Active Sensor, e.g. Radar

**System**
Architecture & Algorithms

- Technical:
  - Redundancy
  - Corner Cases
  - Situation Analysis
  - Path Planning
  - Robustness

- Others:
  - Homologations in different countries
  - SOTIF/ FUSA

**Validation**

- Technical:
  - Mileage
  - Coverage
  - Data Collection
  - Reference
  - Re-Simulation
  - Data Storage

- Others:
  - Legal Requirements for public road test
Challenges for Automated Driving Projects

- Requirements will be more complex
- Integration will be more difficult
- Change Requests will come for anytime
- Validation will be more complex and expensive
- SOTA, a new challenge for Classic Project Cycle
Challenges with Requirements

- Automated Driving System must be reliable
- Automated Driving System must be safer than human driver
- Therefore feature must be safer
- Therefore perception must be more perfect
- Requirements become more and more complex
- "OEM is writing science fiction to push Tier ONE"
- "Tier One accepts everything since this is the rule of the game"

Whole Project will be destroyed by bad Requirements from beginning

- "The radar must report if target is wet or dry"
- "The Camera must always detect object in any weather/Light condition"
- "The false positive rate should be less than 1/10^12 km"
### Challenges with Integration

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<th>Camera</th>
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- More Sensors and ECUs will be integrated into limited space
- Strict integration guidelines for sensor performance conflict with design
- Required power consume increase continuously, challenging for electric vehicles
- Weight of Sensors and ECUs become sensitive for WLTP CO2 homologation
- More and better cleaning systems for system availability has been required but limited solution on the market
Challenges with Change Requests

- Perception and decision algorithms must be continuously updated in the project cycle.
- System limitation and corner cases will be continuously detected in the project cycle.
- Feature requirements and interface must be modified based on findings from the project validation.
- Change Requests during lifetime of deployment are inevitable.
- Conflicts between OEM and Tier One because of impact on time and resource planning.

- Quality reduction
- Project Delay
- Additional cost
- Safety Risk
Challenges with Validation

- Legal and Homologation Requirements are increasing when level of Automated driving is increasing
- Required Validation Mileage and Scenarios is increasing exponentially
- Required Validation Data Storage is increasing exponentially
- Required Re-simulation Processing Power is increasing exponentially
- Even with huge validation mileage, 100% Corner Cases coverage is still not possible
- Both OEM and TIER One will spend most of the financial benefit just for the validation
Challenges with SOTA: Project after Project

- Homologation update could force SOTA
- Performance Improvement require SOTA
- Bugfix require SOTA
- New SOTA SW requires the re-validation for OEM & Supplier after SOP
- Connectivity Infrastructure must be maintained
- Software updating process should not limit the vehicle availability
- Cyber security must be as high as possible
So many challenges, what should we do?

- Compare to classic automotive projects, Automated driving is extreme difficult with technologies and project operation, for OEM and Tier 1

- OEM needs TIER 1's collaboration already in roadmap and architecture definition phase

- For the technical challenges, except OEM and Tier 1, Tier 2 and Research must be also be involved in very early development phase

- The challenges from project operation could only be reduced, when OEM and Tier 1 could have a open, fair and trusting partnership

- Except the ADS teams, collaboration between OEM & TIER must also involve Simulation, Network, Body, Design, Quality and Business departments,

  Let OEM and TIER 1 work like “Two Brothers!”
Vehicle road validation is necessary but works like lottery

- Missing corner cases could be reduced only by huge amount of validation kilometres and hours

- Closed Loop HIL is the best tool to find system weakness and corner cases

- Quality of sensor model is the key to provide reliable and cost valuable validation solution

- Too less full solution suppliers on the market,

→ Driving Mio Kilometres without driving it! We are asking for more suppliers for this!
One more thing, how about Deep Learning?

- Everyone is talking about deep learning, everyone is using it to package the product as selling points.

- Is deep learning really controllable?

- How about if the classifier has been cheated?
  - Should we disable online training?
  - Should we still use classic decision tree to fuse the result?
  - And, for any time, for high level automated driving, we should have at least two additional redundancy sensor techniques to check the result!

Image detection results from the Keras.js web-based demo.
Summary

- Automated driving has and is disrupting the whole Automotive industry
- Perception, decision making under uncertainty, SOTIF and redundancy are the technical challenges
- Relationship between OEM and TIERs is not buyer and seller anymore: it is partnering!
- Validation becomes more important and challenging than ever
- OEM should be more careful to introduce high level automated driving
- Main goal of automated driving should make driving safer than human
- Respect to science and ethics
THANK YOU

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