

Opportunities to Increase ADAS Usage of Driving Simulators

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ADAS = Advanced
Driver Assistance
Systems
(SAE Levels 0-3)

Six Trends in ADAS Market that Will Likely Lead to Higher Simulator Leverage

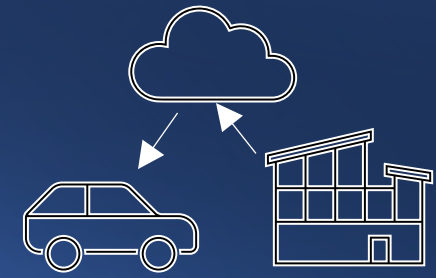
1. If customers are paying for subscriptions on SW-defined vehicles, then they will demand feature freshness, which will drive a very agile cadence of feature updates, which will magnify development workload.
2. SW-defined vehicles will have to lock down their HW platforms early and resist change, so it is critical to make sure that the platform has enough bandwidth to allow for sales of SW upgrades over a vehicle's 10-year useful life.
3. Probabilistic AI algorithms are replacing deterministic C++ algorithms at a rapidly-increasing rate in ADAS, and this will drive more verification testing.
4. Level 3 automated driving is the peak of human factors work and of hazard severity. Some of this critical work is too dangerous to run with real customers on real roads.
5. ADAS is a very large user of prototypes for development, so they also will be a large target for any cost reduction efforts.
6. Most of ADAS evaluation is subjective, and simulators allow subjective evaluations of CAE models.



The Auto Industry is Pivoting to SW-Defined Vehicles

- Tesla has proven the value of this new SW-defined business model.
- The auto industry is moving towards the SmartPhone business model where customers will buy new features as Apps from an OEM AppStore and pay to keep them updated through subscription plans.
- But the key challenge for ADAS Apps is that they are often safety critical.
- The hazards when ADAS Apps fail are typically more severe than when smartphone apps fail.
- This will drive a significant amount of validation effort into a process that needs to be agile to meet the freshness needs of subscription plans.
- This creates a significant opportunity for driving simulators.

Trend 1: Increased Demands for Feature Freshness



If customers are paying for subscriptions on SW-defined vehicles, then they will demand feature freshness. Simulators can help with here:

- a) Rapid SW version changes will dramatically increase development & verification (DV) complexity and time.
 - Simulators already save Vehicle Dynamics DV time by eliminating the wait between part changes.
 - In ADAS, there are not as many HW part changes but here are a lot of scenario changes. So, simulators could eliminate the travel time for scenario changes.
- b) More frequent SW changes place a premium on intuitive designs and Human-Machine Interfaces (HMI) in order to mitigate the potential for increased customer confusion.
 - In ADAS, customer confusion is already a problem, and it will get worse as more features get released.
 - Simulators allow immersive customer clinics to surface issues and find intuitive solutions.

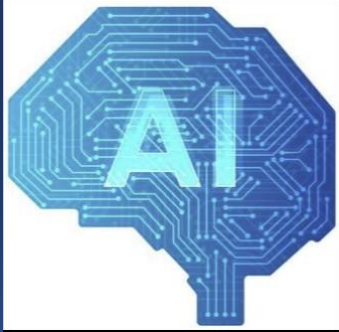
Trend 2: Pressure to Maximize Hardware Platform Longevity



- In the new world of SW-defined vehicles, the vehicle HW platforms get locked down early and then don't change for years, so it is important to specify HW requirements early in order to make sure that the platform has enough bandwidth to allow for sales of SW upgrades over a vehicle's 10-year useful life.
 - So, engineers need to imagine all the hardware content that is required and get it included in the HW design so that it is available when they make the features in SW later.
 - So, engineers are required to consider all the types of features that they might build and think through the enablers as well as the hazards & countermeasures.
 - This requires alignment meetings to consense on feature value as well as hazard severities and controllabilities.
 - Simulators can be useful for this, especially at the <start> and <ending> gateways of the HW platform design phase in order to gain alignment on content costs and benefits before prototypes are available.

Trend 3:

Adoption of AI Algorithms Will Increase Testing Requirements



- Probabilistic AI algorithms are replacing deterministic C++ algorithms at a rapidly-increasing rate in ADAS, and this will drive more DV testing.
 - Probabilistic AI algorithms are consistently out-performing traditional, deterministic, human-coded algos.
 - AI algos often surprise us by demonstrating new emergent capabilities that are better than we would have expected.
 - But, when AI algos fail, they often do so in ways that are surprising to us, which makes them feel unpredictable.
- The lack of determinism in AI will limit the amount of “engineering judgment” sign-off based on code knowledge, since AI algorithms are not human-readable.
- This may drive more simulator testing of variants that were not built as hardware prototypes (eg- testing SWB if only LWB protos were built) to subjectively evaluate that there are no unforeseen sensitivities.

Trend 4: Level 3 Features Will Require Significant Human Factors Work

- Within Automated Driving, Level 3 (L3) is the peak of human factors work and of hazard severity. L2 Urban can also be risky due to complexity and mode confusion.
 - For example:
 - Driver is watching a movie while using the L3 feature.
 - An object falls out of a truck ahead the L3 vehicle.
 - System starts doing an evasive lane change.
 - System asks the driver to re-engage immediately. How should this be done?
 - Where does the driver look (gaze tracking)? What does the driver do? Is their reaction helpful or harmful? How does the system design need to change based on this?
- This is critical design work that can only be done safely and realistically in a dynamic driving simulator



Trend 5: Cost Reduction Pressures Will Reduce ADAS Test Fleet Size



ADAS is a very large user of prototypes for development, so they also will be a very large target for any cost reduction efforts.

- Prototype Builds and extensive Real-World test drives are very expensive budget items.
- ADAS prototype reductions will be required to form a positive business case for new simulator purchases.
- Potential opportunity: use simulators as a low-risk way to allow non-engineer customers to do “real world” drives
 - For instance, non-engineer employees can be more effective at finding issues since they lack a “mental model” of the feature and are therefore less biased

Trend 6: ADAS Evaluation is Still Very Subjective



- Most of ADAS evaluation is subjective, and simulators allow subjective evaluations of CAE models
 - ADAS management is good at subjective evaluations, and not as good at understanding (or believing) objective metrics
 - This is especially true when the message from the objective metrics is unclear (eg- a parameter change makes some metrics better and others worse)
 - Simulators allow ADAS CAE engineers to evaluate their models to make sure that they “feel” right, and to find and fix issues if they don’t.
 - Simulators can foster alignment between CAE and Development engineers on targets, status, and future plans.

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