Simulation Interoperability Standards Organization

"Simulation Interoperability & Reuse through Standards"

Real-time Self-driving Car Experience: M&S and Self-driving Standards Synergy

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Theses

While it is uncertain if Advanced Driving Assistance Systems(ADAS's) will have the impact anticipated, it does seem that they are highly likely to be a significant part of civil life in the Western World and across the rest of the globe. This usage will impact large segments of society, so will have, accordingly, impacts on military operations. In a parallel environment, the military is becoming more and more invested in autonomous combat vehicles.

- **One thesis of this paper is that the on-going developments in civil and defense communities may hold useful insights for both.**
- **Another is that the M&S community and the Standards professionals in it, may find a useful series of developments in ADAS communities from which M&S would profit, should they keep channels of information open between the two.**
- **The final thesis is that the ADAS community is already amassing data on human/computer interfaces and other impacts of the user of ADAS's and which may already be of interest to both simulating civil populations and combat within them.**

Basic Disclaimers

- **Terminology**
  - In the underlying paper, we used the common term Self-Driving Automobiles or SDA's, as this is one of the more popular terms for them
  - Another, perhaps more descriptive and professional term is Advanced Driver-Assistance System or ADAS, which will be used in this presentation (a new standard?).
  - Only time will tell which term will be part of the vernacular, but the choice here was more for brevity than professional precision; the terms are used interchangeably
- **R&D Participation or Financial Interest**
  - None of the authors is actively engaged in any formal study or research effort in this matter, but all have backgrounds in computer simulation or education
  - None of the authors has any direct financial interest in the matters being discussed, save for being a citizen

When will we get self-driving?

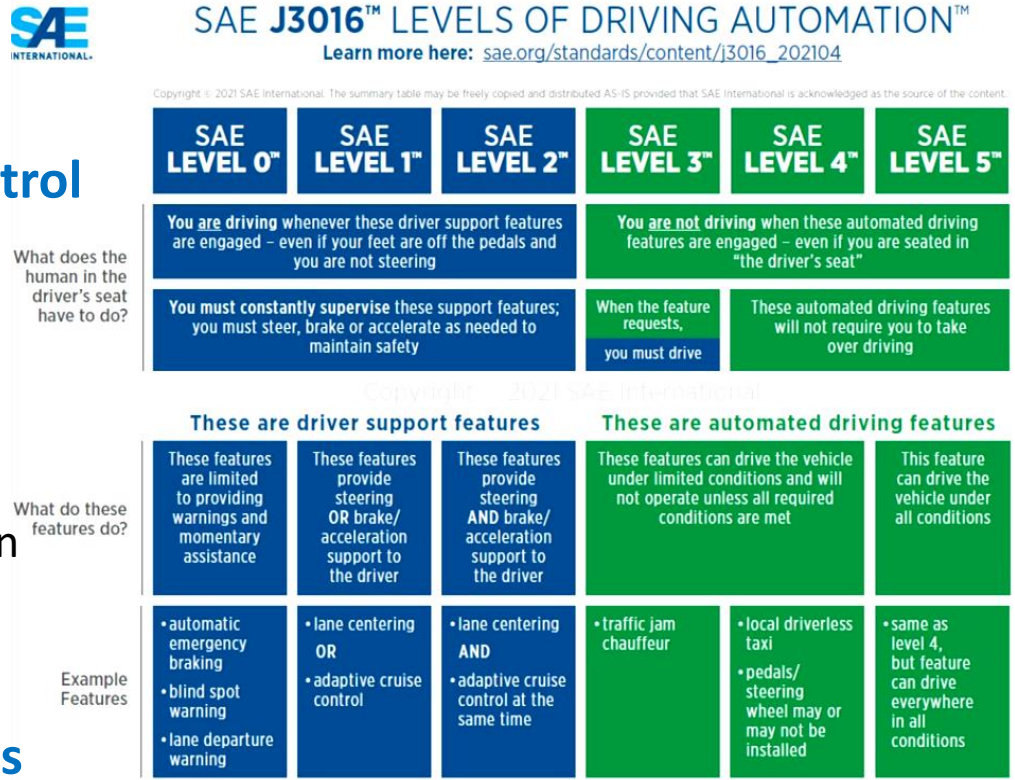
- **Self-Driving IS HERE already!**
- **State or art: lane-minding, speed control and following distance**
- **Total autonomy testing in restricted areas**
- **More complete solutions in beta tests**
  - The system used by our co-author would turn over to human control if it sensed lack of attention (sensed by wheel pressure and direction of gaze)

ADAS Basic Functions and Goals

- **Basic requirements of an ADAS:**
  - Route identification, optimization and modification
  - Speed control and power consumption monitoring
  - Collision avoidance and safety enhancement
  - Lane selection and turn execution
- **Additionally, the above requirements must be executed with an appropriate balance of at least these criteria:**
  - Safety
  - Optimal time to arrival
  - Comfort vis-à-vis maneuver actions

Advance Driver-Assist Systems Technology

- **In Automobiles, the Society of Automotive Engineers (SAE) reins**
- **SAE has defined levels of ADAS control**
- **These are expanded in SAE J3016:**
  - Level 0: No Driving Automation
  - Level 1: Driver Assistance
  - Level 2: Partial Driving Automation
  - Level 3: Conditional Driving Automation
  - Level 4: High Driving Automation
  - Level 5: Full Driving Automation
- **Image to right shows some analyses**



Lessons Learned from ADAS Beta Testing

- **Current technology is like teaching a teenager to drive**
- **Human tendency is that you know you can do it better**
  - Watching another entity operate includes reaction time lag
  - Everyone has a different strategy
- **Gaining trust takes time**
  - Operator must understand ADAS methodology (algorithm/policy)
  - Experience and exercise improves trust
- **Takeaways:**
  1. User interface must enhance trust (Why did it do that?)
  2. Training will be at least as important as with traditional technologies

Automated Combat Vehicles (ACV's)

- **ACV's show a much wider range in types, environs and uses**
- **As well as surface, nations now have sub-surface vessels and aircraft**
- **All three environments have vehicles with varying levels of control**
- **They face many of the issues of civil ADAS, but have some more:**
  - Weapon control
  - Resistance to take-over by foes
  - Need to maintain technical ascendancy
- **One of original *raisons d'être* for M&S was the ability to simulate:**
  - Drones,
  - Autonomous Ground Vehicles
  - Robotic Naval Vessels

Lots of Strategies Attempting to Guide Progress

- Battlespace will be “full” of autonomous vehicles
- Dynamically developing strategy in various levels of DoD
- M&S Community could be useful in factoring in changes
- More than just combat vehicles
- Positing the advent of autonomous supply and logistics

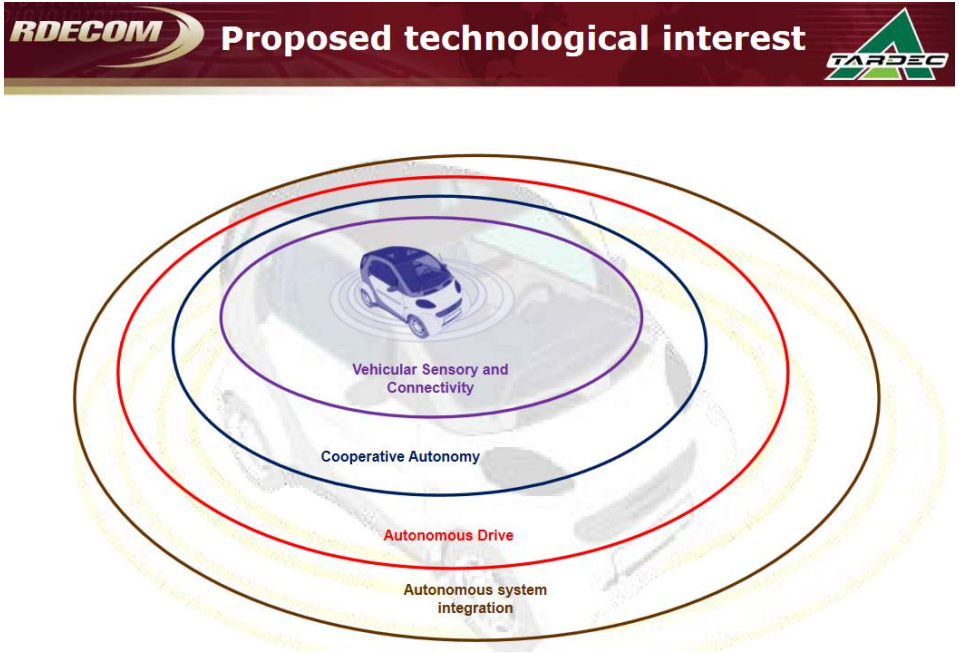
Autonomous Logistics

What Might the DoD Contribute to Civilian ADAS's

- As the DoD rushes ahead to prevent losing the technology advantage, the civilian effort is funding more vehicles in actual conditions
- The design of ADAS's was directed to the use in which they are now increasingly operational
- This use has brought to the fore the major emotional and sensitivity issues that can "make or break" new technologies
- There are examples of poor technical decisions have been made by the public because of emotional reactions to factual issues
- The standards community may want to consider if they have a professional obligation to encourage more *logos* and less *pathos*

Will the Future Need Standards?

- **The DoD strategy for technology adoption:**
- **Create an expanding list of priorities of what needs to be considered first and best.**
- **The DoD hierarchy:**
  - Safety
  - Mutual interaction
  - Full autonomy
  - Integration of critical systems

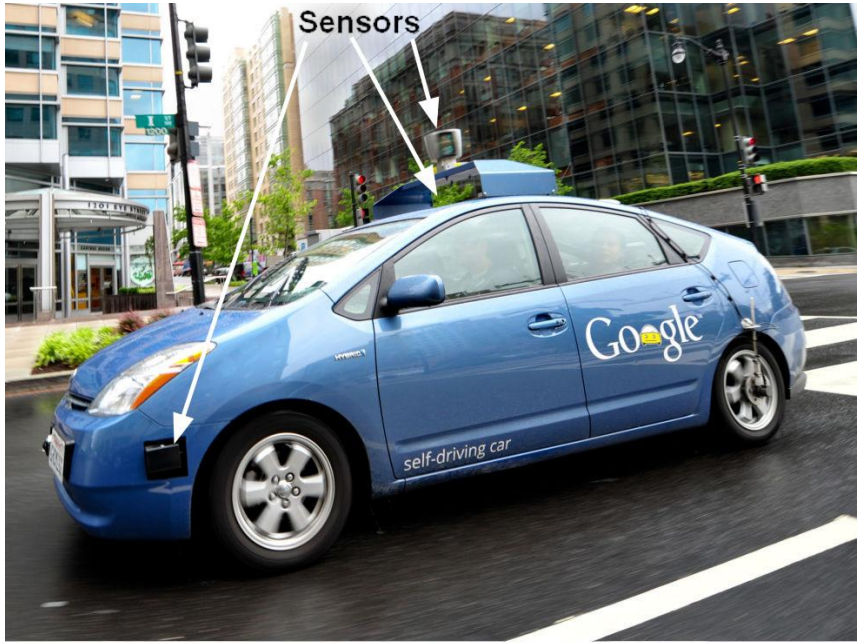


The Human Reaction

- The public may be more sensitive and adverse to products designed with little attention to impacts on the users than service personnel
- Already there are reports about the impact of autonomous driving upon the stress level of the users
- As with any emerging technology, there may be some major disruptions in the way people lead their lives
- People note that the desire to rely on ADAS's is, to some degree, countered with the increased stress from lack of control
- Humans see this even without a machine intrusion; the person in the driver's seat is often more at peace than the rider in the right seat

External Sensors Have Many Negatives

- **Sensors can be burdensome**
  - Appended
  - Wind noise
  - Aerodynamics costs
- **Tesla going a different way**
- **They are following a more austere suite, mainly cameras**
- **Future will decide**
- **Standards would facilitate a more valid discussion**



Enlarge: A Google self-driving car, built on a modified Toyota Prius, combines information gathered from Google Street View with artificial intelligence software that gathers input from video cameras inside the car, a LIDAR sensor on top of the vehicle, radar sensors on the front of the vehicle and a position sensor attached to one of the rear wheels that helps locate the car's position on the map.

Autonomy Considerations

- To meet some of these challenges, new technologies may make the ADAS technologies more comfortable and acceptable
- Having a Virtual Conversational “coach” to work with the user or seek user input may reduce the fretting caused by fresh ideas
- In order to establish realistic and valuable parameters for change/improvement, Neural Net Training would be useful
- Going outside the ADAS and user, Deep Learning could probe emotions
- Emotional state of riders could be monitored by better sensors to recognize stress and anxiety, then adjust the ADAS’s driving style
- Using data from above, then correlated with vast stores of other data, Natural Language Processing might help to parse out connections

Technology and Issues

Problem	Potential counters
Trauma and stress reduction	Virtual conversational counseling
Establishing parameter criteria	Neural Net Training
Better understanding of emotional issues	Deep Learning
Monitoring personnel emotional states	Emerging sensor capabilities
Identifying emotional correlations	Natural Language Processing

Conclusions

- Self-Driving Automobiles are here already
- Much data is being amassed on impact on humans
- Autonomous Combat Vehicles are a similarly burgeoning phenomenon
- With around a million ADAS's on the road, a lot of data is being created
- Both in simulations and operations, all the communities have things to offer the other, so as to preclude having to learn painful lessons twice
- The standards community has both significant skills in, and value to be gained by, being part of this evolution
- At the very least, they need to be aware of capabilities, trends, and controversies to support better defense simulations in urban areas

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Q&A / Discussion