

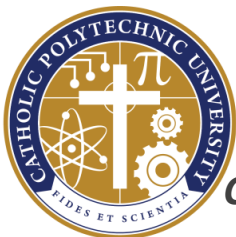


**Simulation Interoperability
Standards Organization**

"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 Self-Driving Automobiles (SDA'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 SDA communities from which M&S would profit, should they keep channels of information open between the two.**
- The final thesis is that the SDA community is already amassing data on human/computer interfaces and other impacts of the user of SDA's and which may already be of interest to both simulating civil populations and combat within them.**



Basic Disclaimers

- **Terminology**

- In this paper, we use 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.
- 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 are 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!**
- **Most all of us have driven cars that have lane-minding, speed control and vehicle separation preservation**
- **One of the authors has started a car, gave it the address and took no interventions, arriving safely, as was directed by him**
- **That is not quite yet the level depicted in the image which is shown above in a way which does clearly show a very casual driver and inattention**
- **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)**





SDA Basic Functions and Goals

- **Basic requirements of an SDA:**
 - 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



- In Automobiles, the Society of Automotive Engineers (SAE) reins
- SAE has defined levels of SDA 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



What does the human in the driver's seat have to do?

What do these features do?

Example Features

SAE J3016™ LEVELS OF DRIVING AUTOMATION™

Learn more here: [sae.org/standards/content/j3016_202104](https://www.sae.org/standards/content/j3016_202104)

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SAE LEVEL 0™	SAE LEVEL 1™	SAE LEVEL 2™	SAE LEVEL 3™	SAE LEVEL 4™	SAE LEVEL 5™
You are driving whenever these driver support features are engaged – even if your feet are off the pedals and you are not steering			You are not driving when these automated driving features are engaged – even if you are seated in “the driver’s seat”		
You must constantly supervise these support features; you must steer, brake or accelerate as needed to maintain safety			When the feature requests, you must drive	These automated driving features will not require you to take over driving	

These are driver support features

These features are limited to providing warnings and momentary assistance	These features provide steering OR brake/acceleration support to the driver	These features provide steering AND brake/acceleration support to the driver	These features can drive the vehicle under limited conditions and will not operate unless all required conditions are met	This feature can drive the vehicle under all conditions
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<ul style="list-style-type: none"> • automatic emergency braking • blind spot warning • lane departure warning 	<ul style="list-style-type: none"> • lane centering OR • adaptive cruise control 	<ul style="list-style-type: none"> • lane centering AND • adaptive cruise control at the same time 	<ul style="list-style-type: none"> • traffic jam chauffeur 	<ul style="list-style-type: none"> • local driverless taxi • pedals/steering wheel may or may not be installed 	<ul style="list-style-type: none"> • same as level 4, but feature can drive everywhere in all conditions
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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 SDA, but have some more:
 - Weapon control
 - Resistance to take-over by foes
 - Need to maintain technical ascendancy
- One of original *raison d'être* for M&S was the ability to simulate:
- Drones

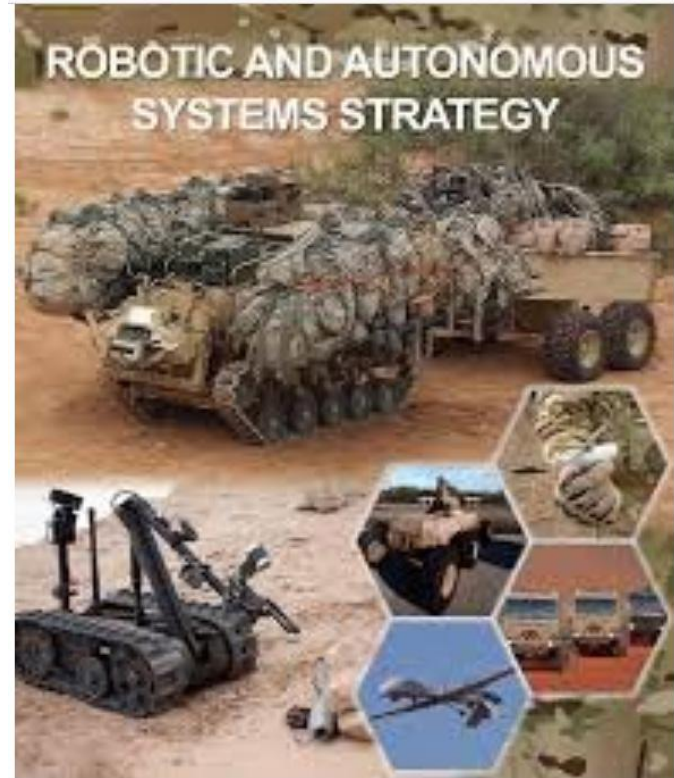


- Battlespace will be “full” of autonomous vehicles





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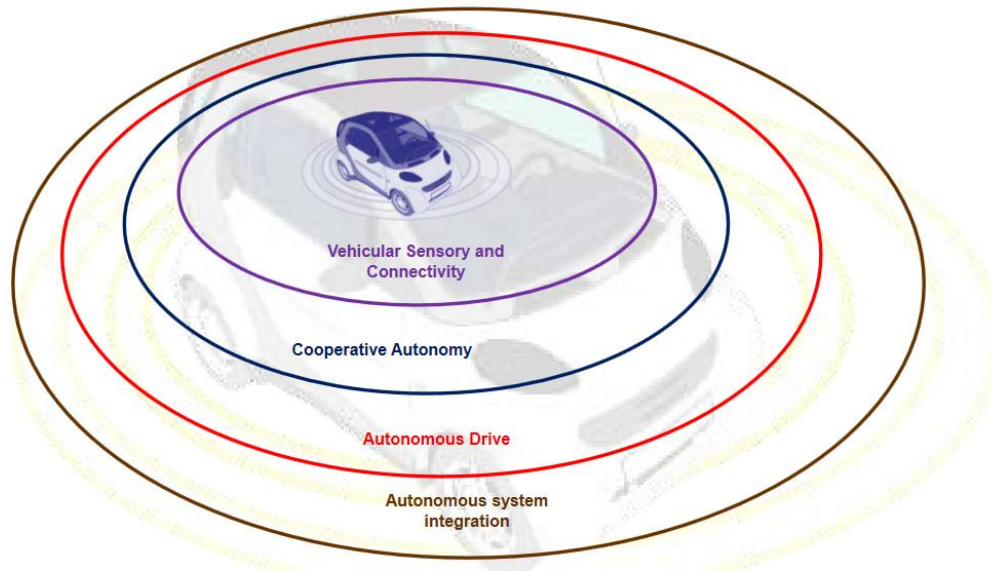




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Will the Future Need Standards?

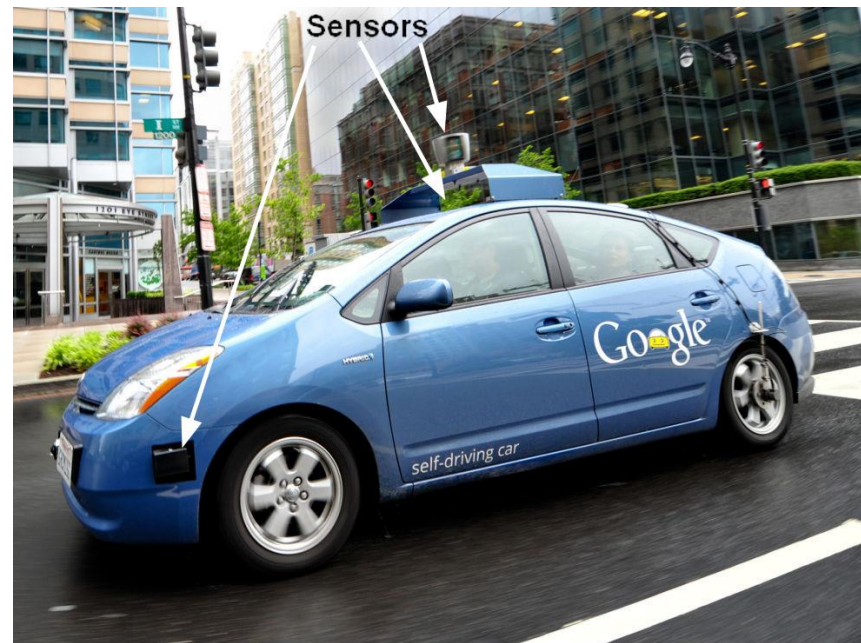




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- **Sensors can be burdensom**
 - Appended
 - Wind noise
 - Aerodynamics costs
- **Tesla going a different way**
- **Future will decide**
- **Standards would facilitate a more valid discussion**



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.



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



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Q&A / Discussion