Ansys

ENVIRONMENTAL SUSTAINABILITY IN FOCUS

SIMULATION PRODUCT HANDPRINT: AUTONOMOUS VEHICLES

Ansys is the global leader in engineering simulation software and services widely used by engineers, designers, researchers and students across a broad spectrum of industries and academia, including aerospace and defense, automotive, electronics, semiconductors, energy, materials and chemical processing, turbomachinery, consumer products, healthcare and sports.

Engineering simulation is the application of physics-based software solutions across the product lifecycle from ideation to design, manufacturing and operation, enabling engineers to virtually test operational performance and predict how product designs will behave in real-world environments. Applying engineering simulation solutions significantly reduces cost, shortens time to market and reduces risk of failure by improving product quality.

Ansys is committed to the conservation and sustainability of the planet's resources by operating our business in ways that reduce our environmental impact and carbon footprint. We also encourage and support our stakeholders, including our vendors and customers, to do the same. As part of Ansys' environmental sustainability efforts, we made our first **CDP submission** in 2020 and are committed to taking steps to measure and mitigate the carbon footprint of our operations.

As the global leader in simulation software, Ansys is well positioned to also provide technology solutions that support and enable the sustainability goals of our customers across diverse industries. ***Our solutions have a positive impact on the environment by helping our customers*** to reduce their use of resources while increasing their efficiency and productivity. Discovering and implementing efficient means of innovative product design and operation — with minimal use of physical resources — is at the very heart of our vision of pervasive simulation.

While measuring and reducing our own environmental impact is essential, the benefits from this process are finite. By contrast, our ***product handprint*** — the use of simulation by customers to reduce their own carbon footprint and the footprint of their products — is nearly infinite. Here we present one in a series of use cases illustrating how Ansys simulation creates these handprint benefits.

PRODUCT HANDPRINT INITIATIVE

USE CASE / AUTONOMOUS VEHICLES

Improving Safety, Quality of Life and Reducing Congestion and Emissions

The automotive industry is on the cusp of a transportation and mobility revolution. Many automakers around the world are committing to an all-electric future. Powered by 5G, future vehicles will offer a connected experience like never before. And with increasingly powerful software algorithms, the journey to fully autonomous vehicles (AVs) will continue.

Autonomous vehicles promise a number of societal and environmental benefits. These include:

Safety: It is estimated that over 90% of the 30,000+ road fatalities in the US in 2019 were caused by human error. By some projections, a 10% market penetration of AVs could cut this number in half.[1]

Quality of Life: Because they do not require a driver, AVs offer the potential to democratize mobility for people below the driving age, the elderly and disabled, and underserved communities in urban and rural areas to help enable them to live more connected, healthier and productive lives.

Reduced Congestion and Emissions: : People in the US spend on average 54 hours per year in traffic jams. AVs promise a 35% improvement in traffic flow by 2050.[2] From the platooning of trucks on the highway to the automatic location of parking spaces, autonomous electric vehicles could provide emission savings of ~21% per passenger vehicle and ~15% per commercial vehicle per year by 2050 compared with non-autonomous electric vehicles.[3]

The Grand Challenge to Widespread AV Adoption

The biggest obstacle to the widespread deployment and adoption of AVs is demonstrating that they are safe. Physically driving the number of miles needed to assure this safety is impracticable. The answer to this engineering problem is simulation. Using simulation, engineers can set up and test the vehicle's response in all cases, including edge or corner cases, whch would be extremely difficult to realize through physical testing; thus greatly increasing the overall safety factor of the vehicle. Only with simulation can AVs become a practical reality.

Simulation Is the Solution for Fast, Cost Effective and Safe AV Development

With simulation, engineers can create virtual models of AVs in real-world scenarios and speed up design and testing by orders of magnitude. Simulation is mission critical for the development of autonomous vehicles and is used at massive scales by automakers, suppliers and autonomous mobility companies. For example, OEMs and tech companies are able to drive millions of virtual miles per day.

This contrasts with the nearly two million miles of physical testing conducted by companies on California's roads in 2020.[4]

Ansys Simulation Solutions Applied to Four Critical AV Technologies

Ansys' solutions help autonomous vehicle OEMs, suppliers and mobility companies in four critical technology areas:

Autonomous System

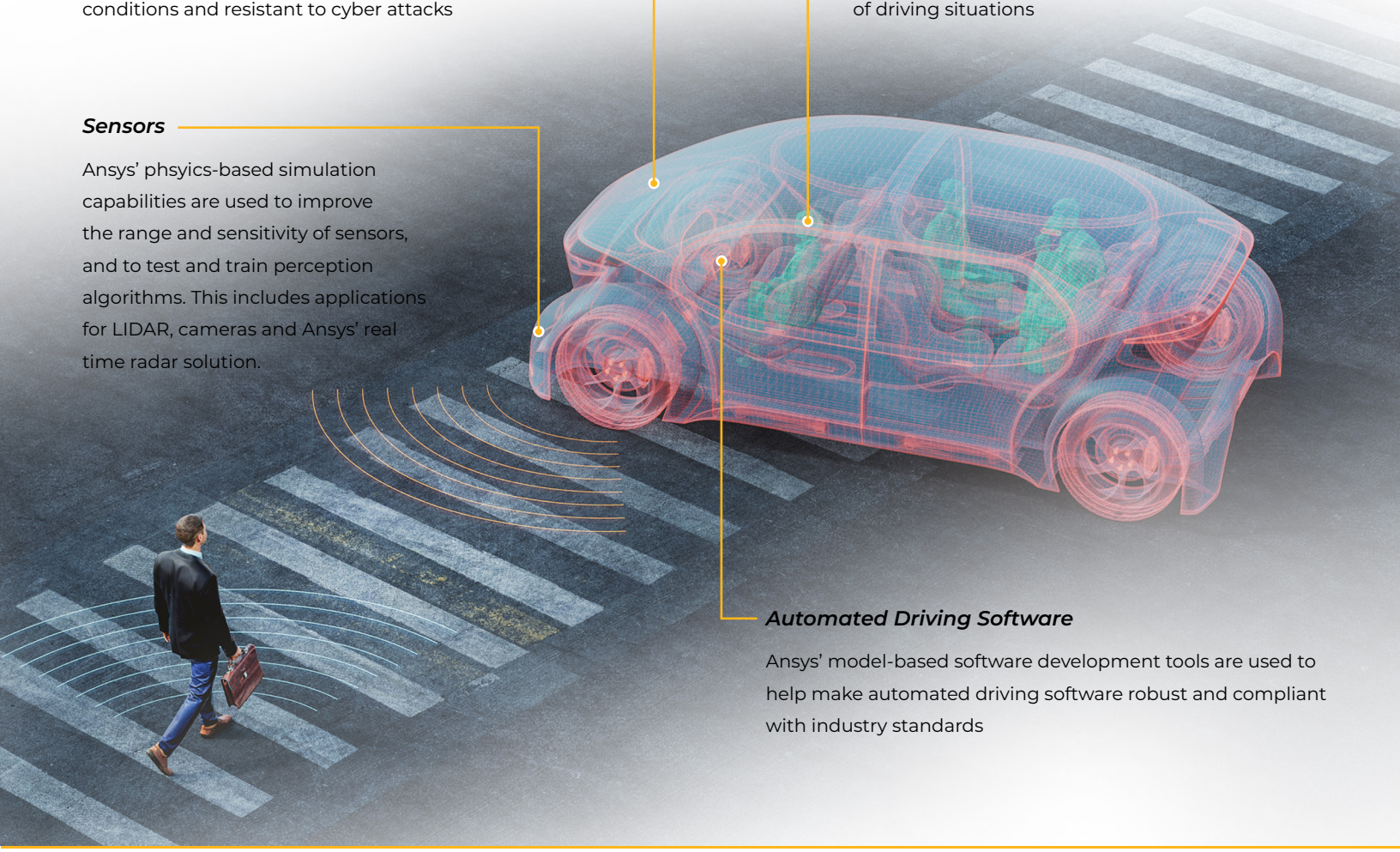
Ansys' functional safety and cybersecurity tools are used to help make autonomous vehicle systems fault-tolerant, better able to handle unforeseen conditions and resistant to cyber attacks

Virtual Test Drivers

Ansys' simulations are used to perform vast amounts of test drives virtually to validate the safety of autonomous systems over a broad range of driving situations

Sensors

Ansys' phsyics-based simulation capabilities are used to improve the range and sensitivity of sensors, and to test and train perception algorithms. This includes applications for LIDAR, cameras and Ansys' real time radar solution.



Automated Driving Software

Ansys' model-based software development tools are used to help make automated driving software robust and compliant with industry standards

Customer Examples

FLIR: Thermal Cameras for Safer Cars

With safety of paramount concern, the addition of thermal cameras can improve how autonomous vehicles detect objects and pedestrians in adverse weather and lighting conditions, as well as improve performance in everyday daylight scenarios. FLIR has conducted preliminary tests to demonstrate how thermal cameras improve automatic emergency braking, especially in low-light and dark conditions. FLIR is taking steps to improve upon this work by fusing visible, thermal and radar sensors to achieve superior braking performance. In collaboration with Ansys, thermal sensors are being developed in the virtual thermal world to enable rapid, physically accurate simulation validation of edge cases.

AEye: Accelerating Autonomous Driving Safety

The next generation of autonomous vehicles will mimic how human eyes focus on and evaluate road conditions by leveraging AEye and Ansys technologies. AEye is incorporating Ansys' industry-leading simulation solutions into the design of its Intelligent Detection and Ranging (iDAR™) platform — enabling customers to reduce physical prototyping and improve the safety and reliability of autonomous systems. Safeguarding autonomous driving requires next-generation sensors to quickly and correctly interpret certain hazardous road scenarios that cannot be reliably detected by conventional perception platforms. To validate the sensors' effectiveness, exhaustive road testing must be successfully completed — demanding significant development time and expenses. With Ansys, AEye empowers automotive manufacturers to potentially simulate driving situations across millions of miles in just days, minimizing physical prototyping.

Indy Autonomous Challenge: Autonomy Meets High-Speed Racing

The Indianapolis Motor Speedway (IMS), home of the Indy 500, hosted a new form of racing in 2021 with the Indy Autonomous Challenge. This initiative, led by Energy Systems Network, sought to advance state-of-the-art autonomous vehicle technology by challenging university teams to program a fully autonomous race car to compete head-to-head at the IMS for $1.5 million in prizes. Early innovation in the autonomous industry revolved around a testing-first, prototype development approach. But in the Indy Autonomous Challenge, race teams adopted a simulation-first approach, safely developing and testing their control algorithms using Ansys solutions prior to receiving a race car or having access to track facilities. As the exclusive simulation collaborator for this event, Ansys hosted a series of development challenges culminating in a final simulation race featuring a virtual model of the track with synchronized orchestration between race vehicles. Ansys awarded winner PoliMOVE from Politecnico di Milano (POLIMI), Milan, Lombardy, Italy $100,000 and runner-up TUM Autonomous Motorsport from Technische Universität München (TUM), Munich, Bavaria, Germany $50,000 in cash prizes.

Sources:

[1] Researchgate - https://www.researchgate.net/publication/277025982_Preparing_a_nation_for_autonomous_vehicles_Opportunities_barriers_and_policy_recommendations

[2] Science - https://www.sciencedaily.com/releases/2019/05/190519191641.htm#:~:text=A%20fleet%20of%20driverless%20cars,35%20percent%2C%20researchers%20have%20shown

[3] Jooyong - https://www.ce.utexas.edu/prof/kockelman/public_html/TRB19EnergyAndEmissions.pdf

[4] AV Perm - https://www.dmv.ca.gov/portal/news-and-media/av-permit-holders-report-close-to-2-million-test-miles-in-california/

Additional Resources:

- https://www.ansys.com/about-ansys/news-center/06-10-19-ansys-bmw-grouppartner-jointlycreate-simulation-tool-chain-autonomous-driving
- https://www.ansys.com/about-ansys/news-center/01-07-20-flir-systems-ansys-collaborate-toenhance-autonomous-vehicles-safety
- Transportation Research - https://cecas.clemson.edu/~avahidi/wp-content/uploads/2018/09/ReviewPaper_Vahidi_Sciarretta.pdf
- National Renewable Energy Laboratory - https://www.nrel.gov/docs/fy17osti/67216.pdf
- Mccarthy, John Francis. "Sustainability of Self-Driving Mobility: An Analysis of Carbon Emissions Between Autonomous Vehicles and Conventional Modes of Transportation" - https://dash.harvard.edu/handle/1/33813411
- "Analysis of the Potential of Autonomous Vehicles in Reducing the Emissions of GreenhouseGases in Road Transport" https://www.sciencedirect.com/science/article/pii/S1877705817326073

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