Michigan Connected and Automated Vehicle Working Group

March 14, 2019

Meeting Packet

1. Agenda
2. Meeting Notes
3. Attendance List
4. Handouts
5. Presentations

Michigan Connected and Automated Vehicle Working Group

March 14, 2019

Washtenaw Community College
Morris Lawrence Building, Room 101
4800 E. Huron River Dr.
Ann Arbor, MI 48105

Meeting Agenda

12:30 PM **Registration and Networking**

1:00 PM

Introduction and Update

Richard Wallace, Vice President, Transportation Systems Analysis, CAR

Washtenaw Community College Welcome Remarks

Kimberly Hurns, Vice President for Indtruction, Washtenaw Community College

Scalable Cloud-based Simulation: The Key Enabling Technology Making AV's Possible

Jeff Blackburn, Head of Business Development, Metamoto

Importance of High-fidelity Vehicle Dynamics for AV/ADAS Development

Robert McGinnis, Senior Account Manager, Mechanical Simulation Corporation

Linking the World to Sensor Models for Realistic Simulation

Tony Gioutsos, Director Portfolio Developer for Autonomous Americas, Siemens

2:20 PM **Networking Break**

2:40 PM

Hot Topics Discussion

Scott Shogan, VP, Connected/Automated Vehicle Market Leader, WSP

Frank Perry, Principal Consultant, CAV Program Manager, WSP

Update on MDOT CAV Activities

Joseph Gorman, Connected Vehicle Engineer, Michigan Department of Transportation

Car Hackers: The Auto Industry's Latest Safety Feature

Jennifer Tisdale, Director Connected Mobility & Critical Infrastructure Security, GRIMM

Automotive Cybersecurity

Cyndi Millns, Professional Faculty – Cybersecurity, Washtenaw Community College

4:00 PM **Meeting Adjourned**

Michigan Connected and Automated Vehicle Working Group
March 14, 2019

Meeting Notes

The Winter 2019 meeting of the Michigan Connected and Automated Vehicle Working Group was held on **March 14, 2019** and hosted by **Washtenaw Community College;** the meeting was held at the Morris Lawrence Building, 4800 E. Huron River Dr. Ann Arbor, MI 48105.

Richard Wallace, Vice President, Transportation Systems Analysis, CAR welcomed the Michigan CAV Working Group attendees, reviewed the meeting agenda and mentioned noteworthy CAV (and related) news. Richard also invited **Barb Land, COO of Square One Education Network** to provide a brief introduction to the 2019 Innovative Vehicle Design Challenge which will be held on May 11, 2019, at the Kettering University GM Mobility Research Center, Flint, MI. An invitation to the Innovative Vehicle Design Challenge can be found in the last section of this meeting packet.

Dr. Kimberly Hurns, Vice President of Instruction at Washtenaw Community College (WCC), also welcomed all attendees to WCC. Dr. Hurns highlighted WCC's initiatives related to CAV, ITS, advanced manufacturing, cybersecurity, and mobility education. The goal is to make students ready for the upcoming industry transformation and labor force development. WCC faculty members are pioneers in developing new curriculum and offering new courses in these areas. Sixteen such courses are being offered at WCC now that have helped many students to successfully transfer to four-year colleges.

Jeff Blackburn, Head of Business Development, Metamoto, introduced the start-up simulation company Metamoto. Jeff highlighted that it is statistically impossible to accrue enough real-world testing miles for automated driving systems to validate them as a human-equivalent level of safety. Creating the right testing scenarios that reflect the behavioral competencies (such as freeway high-speed merging) and incorporating them into scalable simulations is the key enabling technology for making AV's possible. Metamoto offers a cloud-based simulation service allowing ADS developers to run hundreds of simulated scenarios overnight.

Robert McGinnis, Senior Account Manager, Mechanical Simulation Corporation, presented the "Importance of High-fidelity Vehicle Dynamics for AV/ADAS Development". Mechanical Simulation Corp offers a simulation platform that emphasizes the physics of complex dynamic mechanical systems. The tool allows for easy manipulation of virtual vehicles to simulate dynamic performance with high-fidelity. An example use-case is predicting the dynamic performance of a vehicle with a variety of load-types, such as pulling a trailer or carrying a roof-rack. Such work is critical for all vehicles regardless of the level of automation. Distinct tools are available for general vehicle type, including CarSim, BikeSim, and TruckSim.

Tony Gioutsos, Director Portfolio Developer for Autonomous Americas, Siemens, presented "Linking the World to Sensor Models for Realistic Simulation". Tony started with discussing the necessity of linking detailed world models with sensor models and available modeling framework. Then he introduced the Siemens Prescan Simulation tool. Prescan is an open-architecture simulation tool able to support multiple uses and levels of fidelity. A current focus of the Prescan development team is to develop accurate user-configurable simulations for a variety of sensors. Tony presented approaches for simulating raw camera, radar, and lidar sensor inputs, as well as V2X wireless communication.

After the networking break, **Scott Shogan, VP, Connected/Automated Vehicle Market Leader, and Frank Perry, Principal Consultant, CAV Program Manager, WSP**, continued the meeting with the Hot Topics Discussions. Scott Shogan briefly recalled high-level discussions from the 2019 Consumer Electronics Show (CES) in Las Vegas, implying that the futuristic hype of previous years has been tempered by the difficult work of real-world deployment. Then, Frank provided a view from his ongoing work with the OmniAir Consortium—a group set-up to certify DSRC V2X devices. Work is ongoing to deploy a U.S. national V2X-based ITS system but has been complicated and delayed by various factors.

Joseph Gorman, Connected Vehicle Engineer, Michigan Department of Transportation, provided an update on MDOT CAV activities, including infrastructure deployment plan (especially in SE Michigan region), CV design and maintenance guidelines, connected signals policy, and current CAV and ITS projects. Michigan continues to deploy a statewide DSRC-based connected vehicle system. An RSU has recently been installed in Houghton. MDOT is soon planning to contract a vendor to set-up a statewide Security Credentials Management System (SCMS) for the various deployments around the state.

Jennifer Tisdale, Director Connected Mobility & Critical Infrastructure Security, GRIMM, presented "Car Hackers: The Auto Industry's Latest Safety Feature." Jennifer highlighted automotive- and defense industry focused on cybersecurity issues and challenges. For example, the risks are associated with EVs and charging stations, shared mobility, connectivity, and increased SW applications. Training and skill development are also essential to the industry.

Cyndi Millns, Professional Faculty – Cybersecurity, Washtenaw Community College, spoke about automotive Cybersecurity. WCC is offering an associate degree in Applied Science Cybersecurity (APSCY). The program features flexible learning environments, industry best practices and certifications, and soft skills development. The cybersecurity degree also works closely with other WCC programs, such as advanced transportation center, mobile hacking workbench integration, and development of certificate in automotive cybersecurity. Industry partnerships are also key to the success of the program.

The meeting adjourned at 4:15.

MDOT maintains a webpage dedicated to its work related to CAV technologies (http://www.michigan.gov/mdot/0,1607,7-151-9621_11041_38217---,00.html). The page includes documents, presentations, and other materials that may be of interest to CAV stakeholders. Meeting packets containing materials (agenda, meeting notes, attendance, and presentation slides) from past Michigan Connected and Automated Vehicle Working Group meetings are also available on this page.

Michigan Connected and Automated Vehicle Working Group

March 14, 2019

Attendance List

First	Last	Organization	Position
Alex	**Sergay**	Washtenaw Community College	Senior Instructional Designer
Anthony	**Magnan**	Verizon Wireless	5G Solutions Engineer
Barb	**Land**	Square One Education Network	COO
Barbara	**Hauswirth**	Washtenaw Community College	Experiential Learning Coordinator
Bert	**Baker**	Great Wall Motors R&D	Program Manager - Autonomous Vehicle Systems
Bill	**Shreck**	MDOT	Interdepartmentl Liaison
Bob	**Feldamier**	Macomb Community College	Dean - Engineering & Advanced Tech
Brandon	**Barry**	Block Harbor Cybersecurity	CEO
Brandon	**Tucker**	Washtenaw Community College	Dean of Advanced Technologies and Public Service Careers
Chase	**Chen**	AECOM	Traffic Engineer
Cheryl	**Harvey**	Washtenaw Community College	Assistant Director of CS
Christyn	**Lucas**	Detroit Regional Chamber	Manager, Business Research
Corey	**Reiter**	Morpace, Inc.	Business Development Manager
Cyndi	**Millns**	WCC	Professional Faculty

First	Last	Organization	Position
David	**Walmroth**	Ann Arbor Autonomous Vehicle Group	Co-Organizer
Elizabeth	**Nofs**	Washtenaw Community College	Curriculum Designer
Eric Paul	**Dennis**	CAR	Senior Transportation Systems Analyst
Erin	**Milligan**	P3Mobility	CEO
Frank	**Perry**	WSP	CAV Program Manager
Gary	**Streelman**	Magneti Marelli	Dir Adv Eng & New Concepts
Glen	**Konopaskie**	P3Mobility	Southeast Michigan
Ian	**Hubert**	MSC Software	Technical Manager
Jacob	**Perrin**	dSPACE Inc	Applications Engineer
James	**Schirmer**	Square One Educational Network	Project Specialist
Jeffery	**Blackburn**	Metamoto	Head of Business Development
Jennifer	**Hoerz**	Bosch	Marketing manager
Jennifer	**Tisdale**	GRIMM Cyber Research	Director
Jesse	**Halfon**	Dykema	Attorney
Joseph	**Gorman**	MDOT	Connected Vehicel Engineer
John	**Michalczuk**	P3M/Carnrite	Consultant
Joseph	**Bartus**	Macomb County Department of Roads	Traffic and ITS Project Engineer
Katharina	**McLaughlin**	WSP	
Ken	**Zurawski**	Ricardo	Business Development
Kim	**Hill**	HWA Analytics	President
Komal	**Doshi**	Ann Arbor SPARK	Director of Mobility Programs

First	Last	Organization	Position
Kristin	**Welch**	Bedestrian	Strategy
Kyle	**Williams**	Molex	Director
Kyle	**Vano**	P3Mobility	Consultant
Mark	**Peters**	OnBoard Security	Director Transportation Business Development
Mark	**Davids**	CAV Education Network	Board of Directors
Massimo	**Baldini**	Tome, Inc.	President
Matthew	**Gibb**	The Next Education	Chairman
Michelle	**Mueller**	WCC	VP ECCD
Mike	**Blicher**	Autotalks	Business Development
Nathan	**Voght**	Washtenaw County	Economic Development Specialist
Neil	**Gudsen**	Washtenaw Community College	Program Development Manager
Niles	**Annelin**	MDOT	Manager
Nelson	**Kelly**	Macomb Community College	Assistant Director
Qiang	**Hong**	CAR	Senior Research Scientist
Raymond	**Hess**	City of Ann Arbor	Transportation Manager
Richard	**Murphy**	Michigan Municipal League	Program Coordinator, Civic Innovation Labs
Richard	**Wallace**	CAR	VP TSA
Rini	**Sherony**	Toyota Motor North America	Sr. Principal Engineer
Robert	**McGinnis**	Mechanical Simulation Corporation	Senior Account Manager
Scott	**Shogan**	WSP	VP, Connected/Automated Vehicle Market Leader
Shugang	**Jiang**	SF Motors	Sr. Manager
Sia	**Lyimo**	WESTERN MICHIGAN UNIVERSITY	STUDENT

First	Last	Organization	Position
Stephen	**Selander**	Selander Law Office, PLLC	Attorney
Susan	**Proctor**	Michigan Economic Development Corporation	Strategic Initiatives Director
Ted	**Sadler**	Integral Blue	Connected Vehicle Specialist
Tim	**Palmer**	MSC Software	Manager
Tom	**Richer**	MDOT	ITS Project Engineer
Tony	**Gioutsos**	Siemens	Director Portfolio Developer for Autonomous Americas
Valerian	**Kwigizile**	Western Michigan University	Associate Professor
Valerie	**Sathe Brugeman**	CAR	Senior Project Manager
Wayne	**Snyder**	NextEnergy	Director Technology Development
Zahra	**Bahrani Fard**	CAR	Transportation Systems Analyst

Michigan Connected and Automated Vehicle Working Group

Handouts

2019 Innovative Vehicle Design Challenge Competition

Date: Saturday, May 11, 2019
Time: Challenge Competitions 10am to 4pm
Gates open at 8am
Location: Kettering University GM Mobility Research Center
Kettering University 1700 University Ave. Flint MI 48504

Join us for an amazing day of student led engineering and innovation at the Square One Education Network's 12th Innovative Vehicle Design (IVD) Challenge Competition!

Volunteer here:
https://www.surveymonkey.com/r/IVDVolunteer19

Developing talent for tomorrow's mobility industry workforce is crucial to economic success. Square One links excellent teaching and learning practices to real world engineering challenges to grow skilled, creative and energetic talent. The Square One Innovative Vehicle Design programs showcase the creative engineering strengths of today's students at a regional competition focused on innovative solutions leading to superior vehicle performance.

Teams compete in one of the following challenges: student-built, go-kart sized electric vehicles, autonomous vehicles built on Power Wheels Jeep platforms, and a 1/10th scale radio-controlled re-engineering challenge. Each has a unique connected (V2X) component to the mission challenge.

These three vehicular engineering projects are exciting, complex and relevant learning opportunities to inspire youth toward science, technology, engineering, or math (STEM) oriented career pathways. Join us to meet the 50 competing teams from around the state and see their engineering solutions in action!

Admission is free.

Square One is a Michigan-based 501c3 STEM educational organization serving K-12 students and teachers. Our mission is to empower teachers with a complete set of resources for students to engage, using hands-on learning tools and modern learning fundamentals, with the intent of developing skills needed for the next generation technical workforce. Our vision is to prepare students with the essential skillset for higher learning institutions and the rapidly evolving needs of STEM related jobs.

Proud Partners in

SQUARE ONE NATION INNOVATIVE VEHICLE DESIGN™

The Square One Education Network Innovative Vehicle Design Challenge Competition is Made Possible With the Support of...

P3 Group

Washtenaw Community College

Nissan

MIAT College of Technology

Michigan Dept. of Talent and Economic Development (TED)

Michigan Economic Development Corporation – Planet M

MIS Cares ~ AM General ~ NDIA

Eisbrenner Public Relations ~ WSP

Good Sense Media ~ RC Fun House

Special thanks to our hosts at Kettering University

INNOVATIVE VEHICLE DESIGN™

www.squareonenetwork.org ~ 248.736.7537 ~ 26100 American Drive Suite 607 Southfield MI 48034

Attention University & College Students planning careers in Autonomous & Intelligent Vehicles

Intelligent Ground Vehicle Competition

The 27th Annual IGVC 7-10 June 2019 at Oakland University Rochester Michigan

Self Drive Challenge

IGVC Student Challenges

1. **Autonomous Navigation**
2. **Design, Documentation & Presentation**
3. **Computer Architectures**
4. **Self Drive**
5. **Cyber Security** **"new for 2019"**

AutoNav Challenge

Competition Objectives

- Full spectrum systems engineering experience for engineering and computer science student teams
- World Class Career building University/College education project experience for Mechanical, Electrical & Computer Engineers and Computer Science Majors
- Direct application to Autonomous & Intelligent manned & unmanned vehicles for the Automotive and Defense Markets
- Provide Industry & Government Managers, Sponsors and Engineers, a multi-day interaction with students, teams and faculty

Student Team Benefits

- First full project experience for your resume
- Intelligent & Autonomous proficiency
- Great recruiting by sponsors
- Published technical papers
- Multiple awards; Cash & certificates
- Networking with other US and International students & faculty
- Tailored to support 4-8 credits per year, one or two semesters
- Under-Graduate or Graduate eligible

Student Teams & Robots

For Rules and more IGVC Info go to: WWW.IGVC.org

2019 IGVC College & University Teams
AN - Autonomous Navigation & SD - Self Drive

Bluefield State	AN
Bob Jones University	SD
Boise State University	AN
British Columbia Institute of Technology	AN
Case Western Reserve University	AN
Delhi Technological University	AN
Delhi Technological University	AN
Embry-Riddle	SD
Florida Tech	AN
Florida Tech	SD
Gannon University	AN
Georgia Tech	AN
Hosei University	AN
Indian Institute of Technology Kanpur	AN
Indian Institute of Technology Kharagpur	AN
Lawrence Technological University	AN
Lawrence Technological University	SD
Manipal Institute of Technology Manipal	AN
Michigan Technological University	AN
Millersville University	AN
New York University	SD
North Dakota State University	AN
Oakland University	AN
Oakland University	SD
Ohio University	AN
Old Dominion University	AN
Rochester Institute of Technology	AN
Roger Williams University	AN
SRM Institute of Science and Technology	AN
The Citadel	AN
Trinity College	AN
United States Military Academy	AN
United States Military Academy	SD
Univ. of Detroit Mercy-	AN
Univ. of Detroit Mercy -	SD
University at Buffalo	AN
University of Central Florida	AN
University of Cincinnati	AN
University of Michigan	AN
University of Michigan Dearborn	AN
University of Toronto	AN
Wayne State University Engineering	AN
Western Illinois University	AN
Worcester Polytechnic Institute	AN

Michigan Connected and Automated Vehicle Working Group

Presentations

Michigan Connected and Automated Vehicle Working Group

Richard Wallace, V.P., Transportation Systems Analysis, CAR

March 14, 2019

Washtenaw Community College

Ann Arbor, MI

Meeting Agenda

1:00 PM **Introductions and Update**
Richard Wallace, V.P., Transportation Systems Analysis
Center for Automotive Research

Washtenaw Community College Welcome Remarks
Kimberly Hurn, VP of Instruction, Washtenaw Community College

Scalable Cloud-based Simulation: The Key Enabling Technology Making AV's Possible
Jeff Blackburn, Head of Business Development, Metamoto

Importance of High-fidelity Vehicle Dynamics for AV/ADAS Development
Robert McGinnis, Senior Account Manager
Mechanical Simulation Corporation

Linking the World to Sensor Models for Realistic Simulation
Tony Gioutsos, Director Portfolio Developer for Autonomous Americas, Siemens

2:20 PM **Networking Break**

2:40 AM **Hot Topics Discussion**
Scott Shogan, V.P., Connected/Automated Vehicle Market Leader, WSP

Update on MDOT CAV Activities
Joseph Gorman, ITS Program Manager, Michigan Department of Transportation

Car Hackers: The Auto Industry's Latest Safety Feature
Jennifer Tisdale, Director, Connected Mobility & Critical Infrastructure Security, GRIMM

Automotive Cybersecurity
Cyndi Millns, Professional Faculty – Cybersecurity, Washtenaw Community College

4:00 PM **Meeting Adjourned**

Working Group Mission

Cooperatively pursue projects and other activities that are best accomplished through partnerships between multiple agencies, companies, universities, and other organizations and that ultimately advance Michigan's leadership position in connected and automated vehicle research, deployment, and operations.

Goals

- Benefit our state and our industry (automotive and more)
- Enhance safety and mobility in Michigan and beyond

Upcoming CAV Events

- **ADAS Sensors**
  March 20-21, 2019 | The Henry Hotel, Dearborn, MI
- **Michigan Defense Expo (MDEX)**
  April 3-4, 2019 | Macomb Community College (MCC) Expo Center, Warren, MI
- **SAE Government and Industry**
  April 3-5, 2019 | Walter E. Washington Convention Center, Washington, D.C.
- **2019 Washington D.C. Auto Show**
  April 5-14, 2019 | Walter E. Washington Convention Center, Washington, D.C.
- **SAE WCX**
  April 9-11, 2019 | Cobo Center, Detroit, MI
- **2019 Innovative Vehicle Design Challenge**
  May 11, 2019 | Kettering University GM Mobility Research Center, Flint, MI
- **Next Gen Mobility Summit**
  May 23-24, 2019 | Somewhere in Silicon Valley, CA
- **TU-Automotive Detroit 2019**
  June 4-6, 2019 | Suburban Showcase, Novi, MI

Noteworthy CAV (and Related) News

- The Partnership for Autonomous Vehicle Education (PAVE) was announced in January. Its goal is to educate the public and policymakers about AVs.
- GM is closing factories in the region
  - But Waymo and FCA are adding them
- Meanwhile, Ford and Volkswagen have announced a partnership to make pickup trucks and commercial vans, but they also are exploring collaborations on EVs, AVs, and mobility services.
- Similarly, Daimler and BMW have extended their mobility partnership, which includes five joint ventures:
  - REACH NOW for multimodal services
  - CHARGE NOW for charging
  - FREE NOW for taxi ride-hailing
  - PARK NOW for parking
  - SHARE NOW for car-sharing
- Both Uber and Lyft have announced plans for IPOs sometime this year

Thank you to our hosts!

Washtenaw Community College

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Scalable Cloud-based Simulation:
The Key Enabling Technology Making AV's Possible

About Me

Jeff Blackburn
Head of Business Development
Metamoto, Inc.

6+ years experience with Legacy Simulation tools (Siemens Tass PreScan)

10+ years experience in AV development (IVBSS - embedded code development with National Instruments)

Developed and Teach the SAE classes

“Introduction to the Highly Automated Vehicle”
“Autonomous Vehicle Regulations and Liability”
“Autonomous Vehicle Simulation Hands-on Workshop”

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The Empirical Problem - Scale

~5 to 9 billion miles required*

95% CI with 5% to 20% degree of precision

100 AV’s with 100% uptime → 12.5 to 400 years to completion

	Benchmark Failure Rate		
How many miles (years) would autonomous vehicles have to be driven…	(A) 1.09 fatalities per 100 million miles?	(B) 77 reported injuries per 100 million miles?	(C) 190 reported crashes per 100 million miles?
(1) without failure to demonstrate with 95% confidence that their failure rate is at most…	275 million miles (12.5 years)	3.9 million miles (2 months)	1.6 million miles (1 month)
(2) to demonstrate with 95% confidence their failure rate to within 20% of the true rate of…	8.8 billion miles (400 years)	125 million miles (5.7 years)	51 million miles (2.3 years)

* “Driving to Safety: How Many Miles of Driving Would it Take to Demonstrate Autonomous Vehicle Reliability?”, Nidhi Kalra, Susan M. Paddock, RAND Corporation, 2016

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The Tactical Problem - Testing Coverage

The relevant real-world cases (accidents) shouldn't be reproduced in the real world

Shadow Driving/Partial AV is neither adequate or safe

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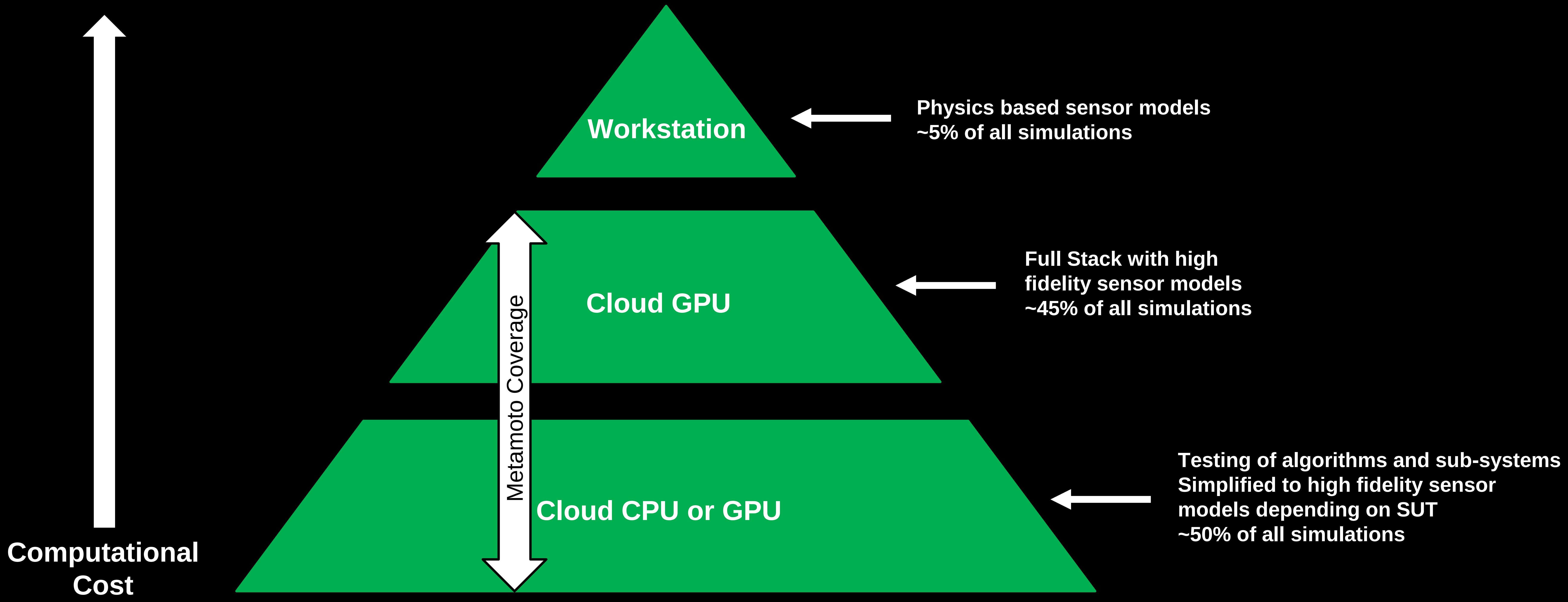
Using Simulation Efficiently



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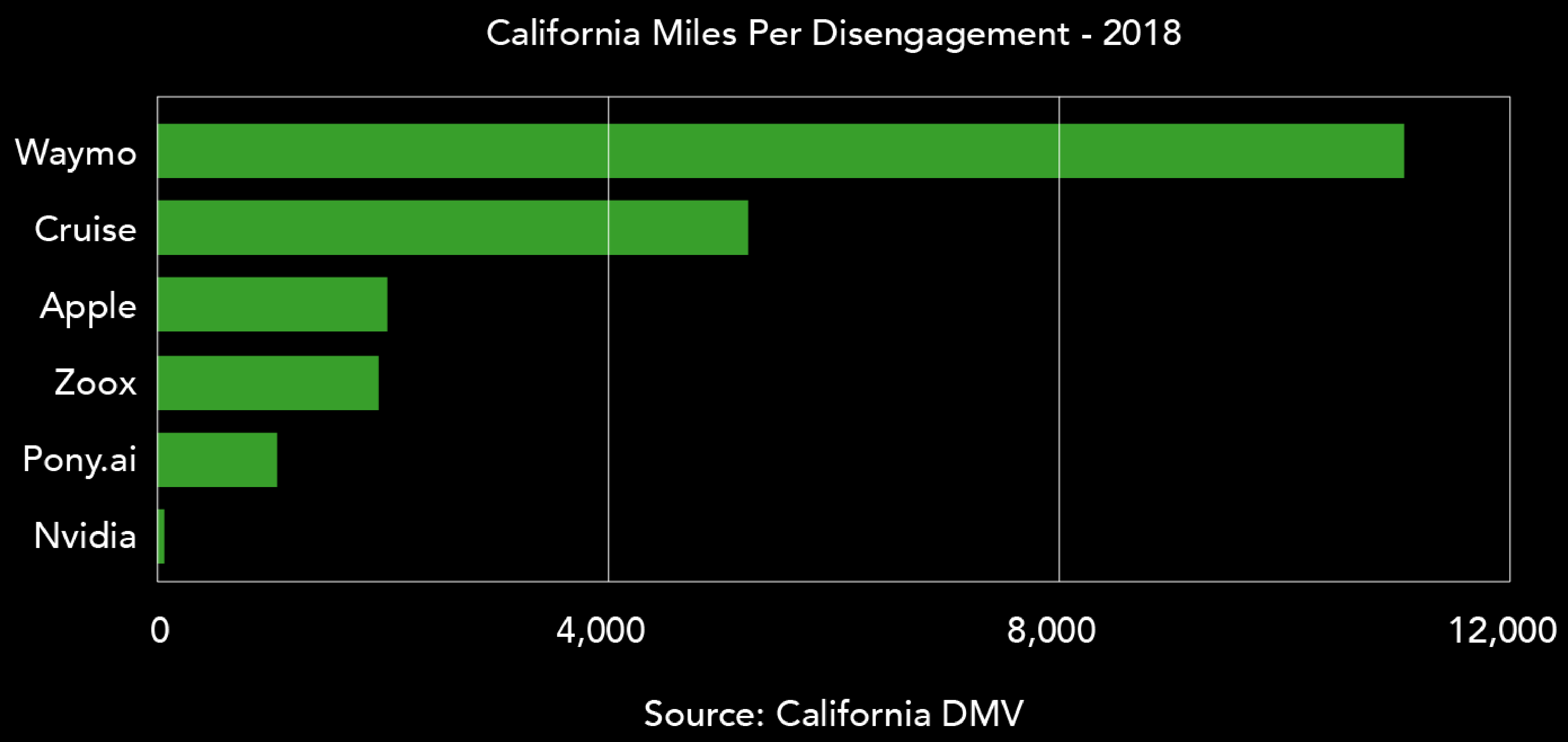
Scalable Simulation Drives AV Performance



Waymo and Simulation

Waymo is performing millions of simulations per night

"In raw miles, Waymo is by far the leader," said Grayson Brulte, a Beverly Hills-based driverless industry consultant. "They're like Jesse Owens or Carl Lewis – running a 100-meter dash around everybody."

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Scalable Simulation Drives AV Performance

Behavioral Competencies - An Overview

Edge cases should be classified and categorized into behavioral competencies

Don't test useless miles

NHTSA	28 behavioral competencies
Waymo	19 behavioral competencies
Total	47 behavioral competencies

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Behavioral Competencies - Example

Scenario	Perform High-Speed Merge (e.g., Freeway)
Parameterization	8 variables with 5 possible values per variable 5^8 = ~400,000 test cases (without intelligent parameterization)
Assume	10 scenarios are required per behavioral competency Each behavioral competency has a possible 4,000,000 test cases

~200,000,000 test cases are required to prove out all 47 behavioral competencies

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The Legacy Scale Problem - Serial Test Execution

~200,000,000 test cases are required to prove out all 47 behavioral competencies

Legacy Simulation – Serial Test Execution

5 minutes per simulation → ~25,000 simulations per year
200,000,000 / 25,000 → ~8,000 years (or Workstations)
~$45k per workstation → $1.80 per simulation

Cloud Based Simulation – Parallel Test Execution

10,000 parallel instances → ~250 million simulations per year
200,000,000 / 250,000,000 → ~10 months
$3 per hour → $ 0.42 per simulation

Assumes running 8/5/260 (Typical use case)

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The Legacy Scale Problem - Serial Test Execution

~200,000,000 test cases are required to prove out all 47 behavioral competencies

Legacy Simulation – Serial Test Execution

5 minutes per simulation → ~105,120 simulations per year

200,000,000 / 105,120 → ~1,903 years (or Workstations)

~$45k per workstation → $.43 per simulation

Cloud Based Simulation – Parallel Test Execution

10,000 parallel instances → ~1 billion simulations per year

200,000,000 / 1,000,000,000 → ~2 months

$3 per hour → $ 0.00003 per simulation

Assumes running 24/7/365 (Max Thru-Put Use Case)

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Product Offering

Designer

Scenario Creation

Script AV Exercises

Expose Parameters

Director

Cloud Simulation

Scalable, On Demand

Usage Based Pricing

Analyzer

Simulation Replay

Analyze Results

AV Debugging

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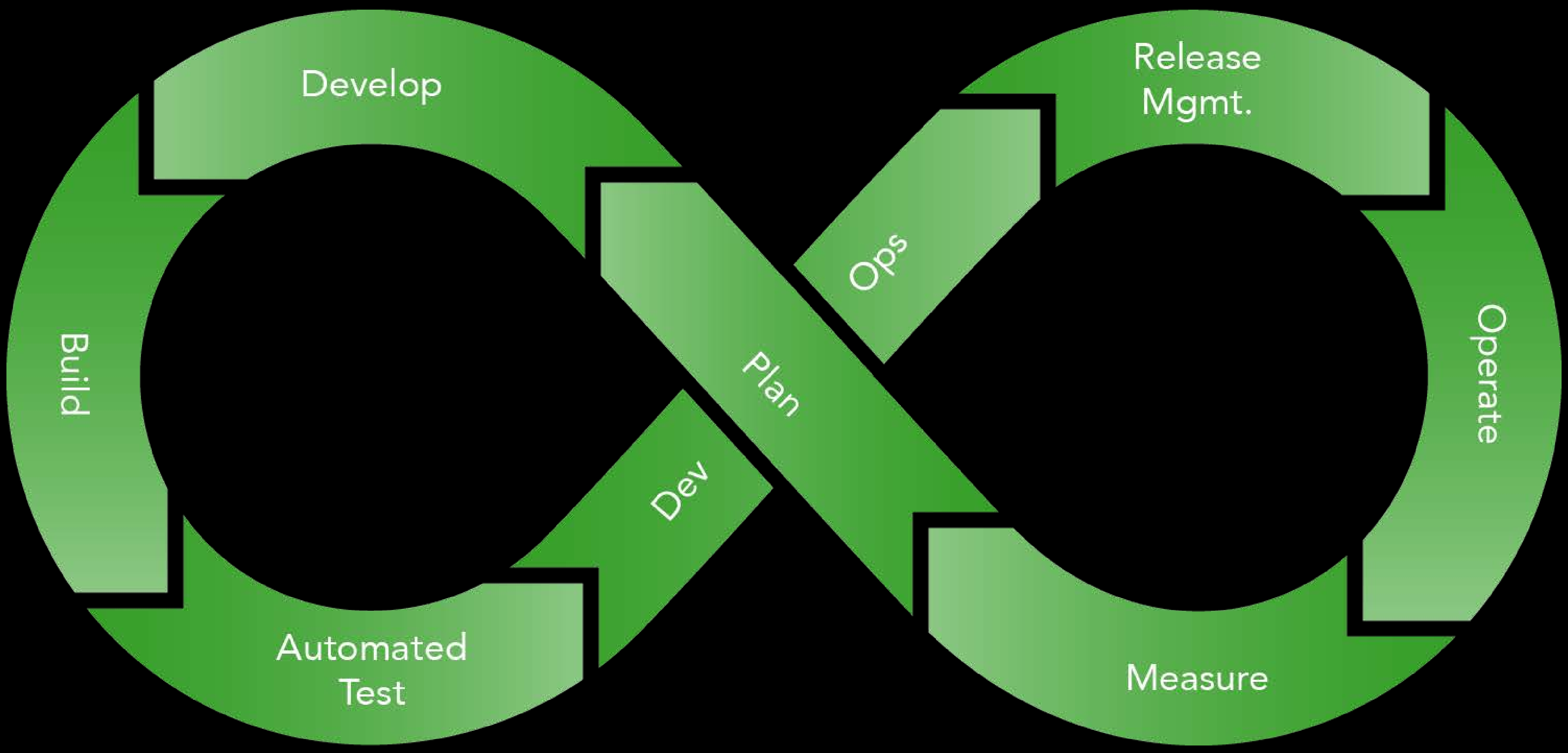
Integration



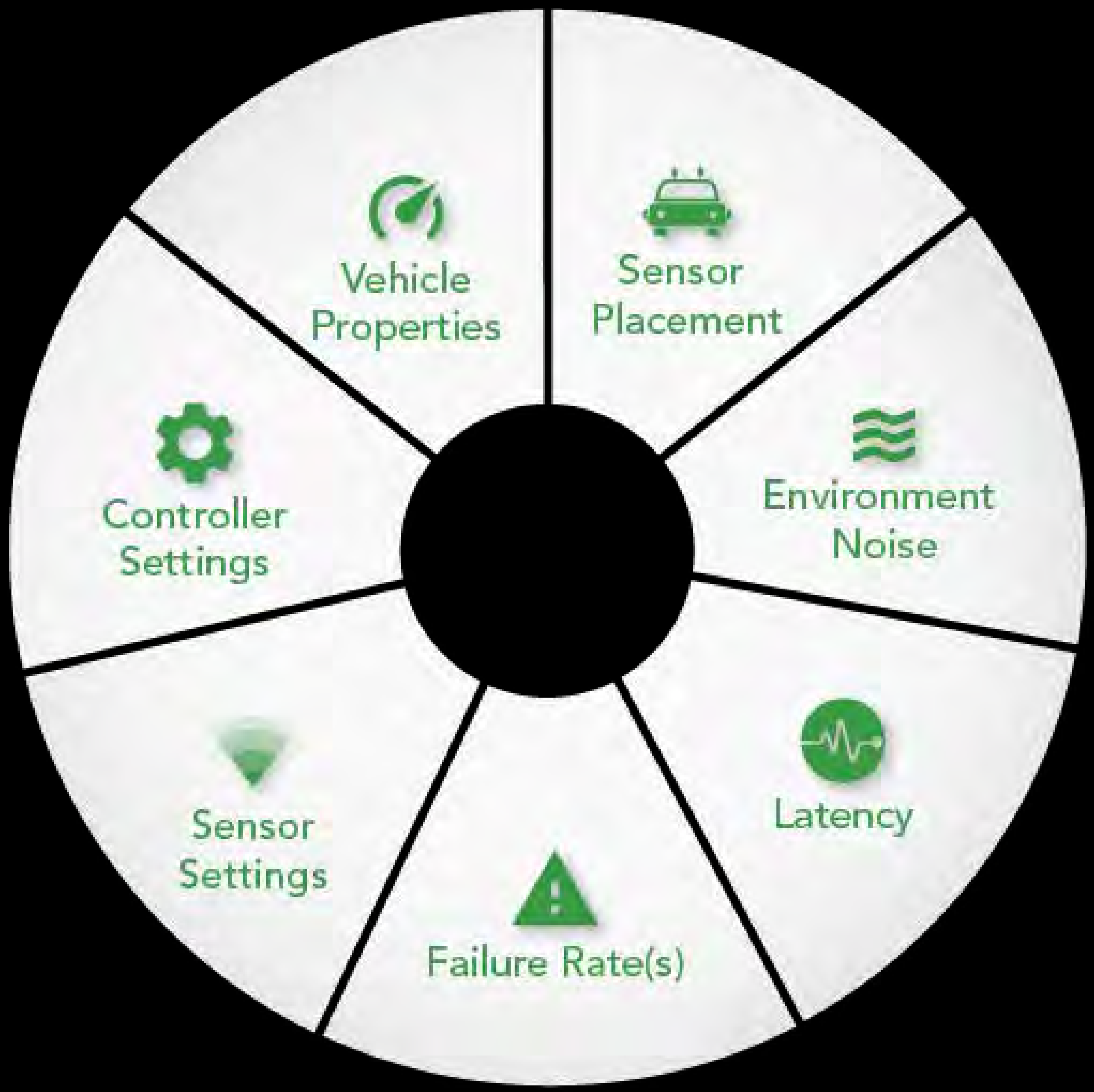
Tools

Bamboo
Jenkins
Jira
Jama
GitHub
Bitbucket

Modern DevOps Processes

Parameter Exploration

Environmental Factors



Hardware Factors


SERVICES
GO VIRTUAL
Main St

Sensor Simulation

Camera / IR Camera

Spectral Density
Lens Distortion
Dirty Lens
Foggy / Wet Lens
Vignetting & Bloom

Lidar

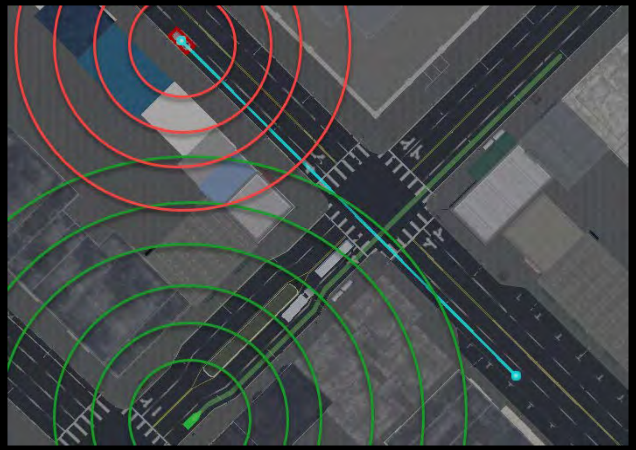
Beam Widening
Multiple Returns
Material Reflectivity
Atmospheric Attenuation

Radar

Custom Scan patterns
MIMO
Multipathing
Clutter
Material Properties
Micro-Doppler
Custom Waveforms

GPS / IMU

Positional Noise
Gyro Noise / Bias
Accelerometer Noise / Bias
Abbe Error



V2X

BSM 1 & 2
Multipathing
Dropped packets
Signal Fade With Distance

Sensor Simulation

Visible Light Configurable Camera Settings

- Image output type
- Encoding of the image data published to the data bus
- Frame width in pixels
- Frame height in pixels
- Frame rate
- Vertical field of view
- Pixel size in micrometers
- Focal length in millimeters
- Lens radial distortion coefficient k1
- Lens radial distortion coefficient k2
- Lens radial distortion coefficient k3
- Lens tangential distortion coefficient t1
- Lens tangential distortion coefficient t2
- Principal point x offset
- Principal point y offset
- Enables or disables HDR
- Dirt texture to use
- Level of dirt on the lens
- Blooming
- Vignetting
- Fogged lens
- Wet lens
- Stuck pixels
- Low light noise
- Labeled image output by their ground-truth object type
- Origin corner of the image data
- Cropping
- Object list output
- Remove outlier pixels
- Object types to report
- Minimum width (in pixels) for detection
- Minimum height (in pixels) for detection

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Sensor Simulation

Low distortion regular lens

frameWidth: 1280
frameHeight: 720
pixelSize: 4.08
focalLength: 3.8
distortionK1: -0.06
distortionK2: 0.0005
distortionK3: 0
principalCxOffset: 0
principalCyOffset: 0

Full frame distorted wide-angle lens

frameWidth: 1280
frameHeight: 720
pixelSize: 7.32
focalLength: 3.01
distortionK1: -0.12
distortionK2: 0.01
distortionK3: 0
principalCxOffset: 0
principalCyOffset: 0
fullFrame: true

Uncropped 120° fisheye lens

frameWidth: 1280
frameHeight: 1280
pixelSize: 4.36
focalLength: 1.61
distortionK1: -0.06
distortionK2: -0.1
distortionK3: -0.43
principalCxOffset: 0
principalCyOffset: 0
fullFrame: false

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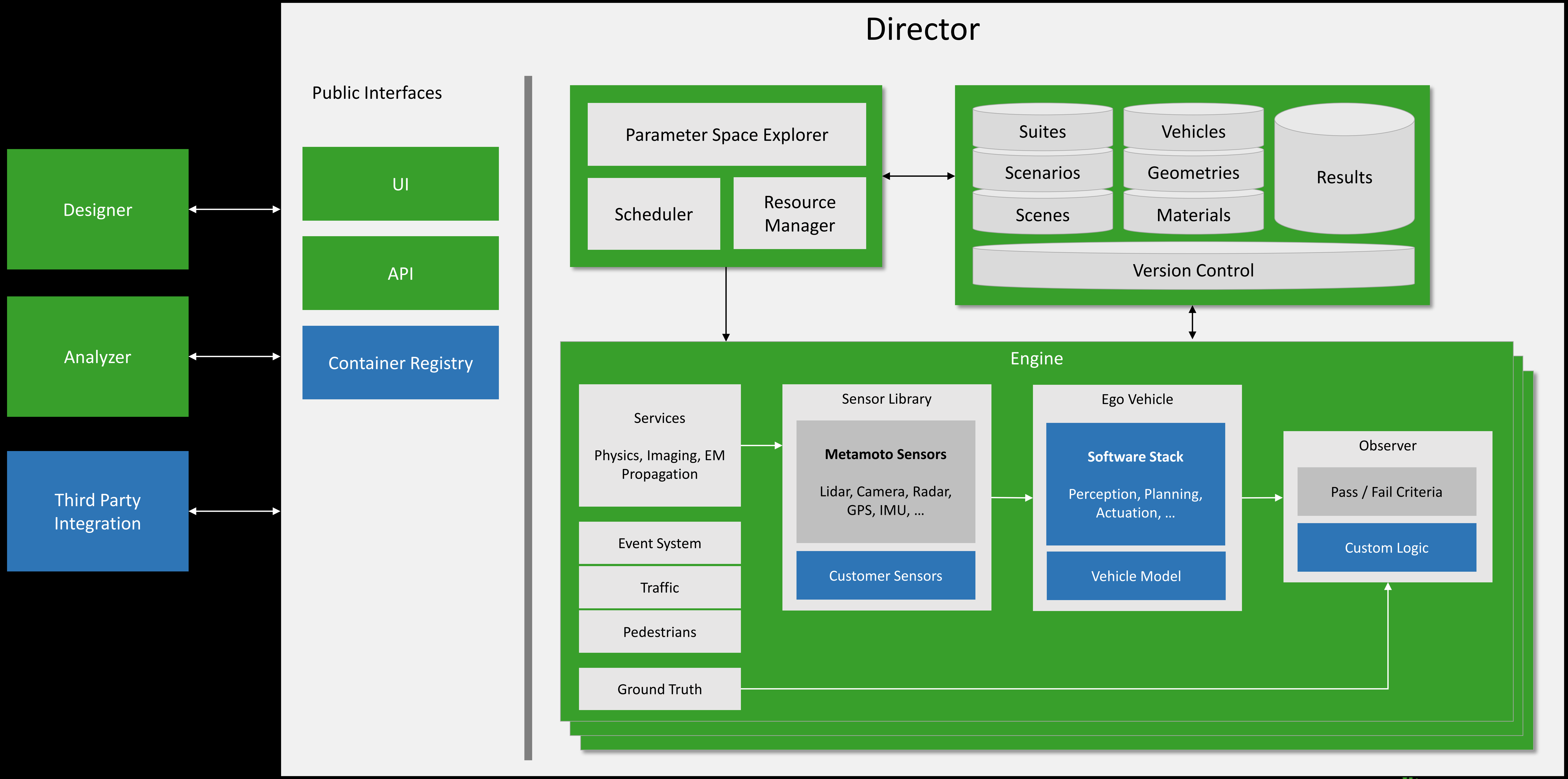
System Architecture

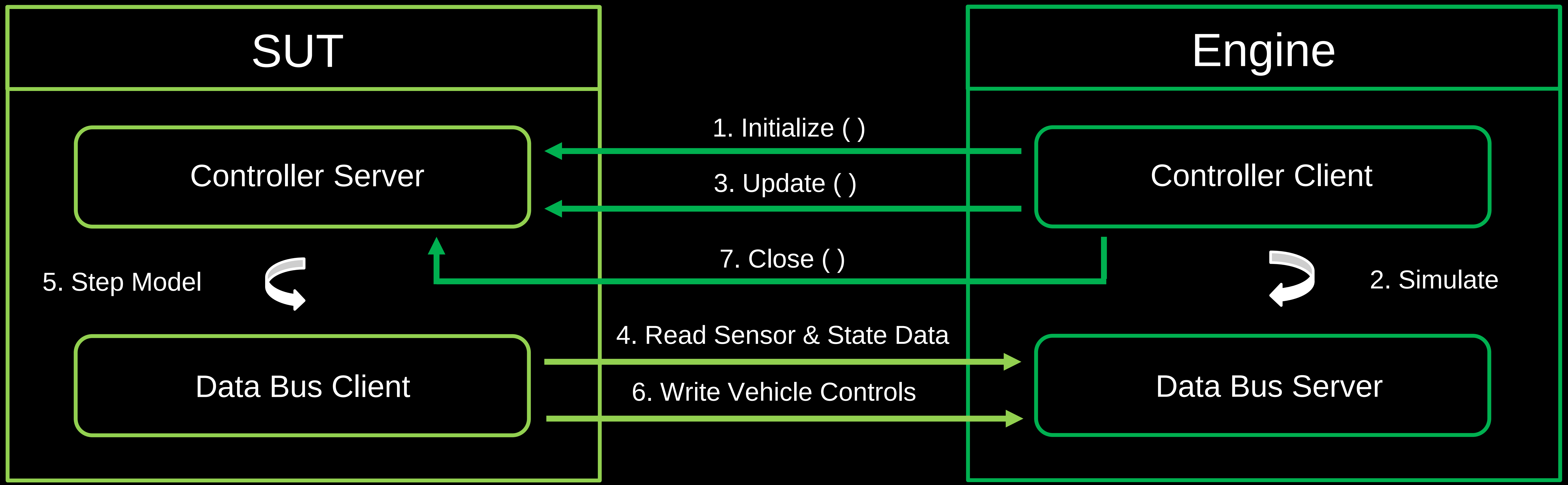
Overview



System Under Test (SUT) Integration

- Containerized External Code
  - Sensors
  - Controllers – driving data, processing, etc.
  - Vehicle Dynamics

- gRPC and Protobuf API
- Publish – Subscribe Data Bus
- SUT Connector for Local Testing



BAIDU APOLLO INTEGRATION

Feeding raw sensor data from Metamoto simulation into Apollo and visualizing its perception stack output

The Solution

Scalable, cloud based simulation, integrated into an continuous build and test software development workflow, is the key enabling technology making AV's possible


GO VIRT
7CHENKD

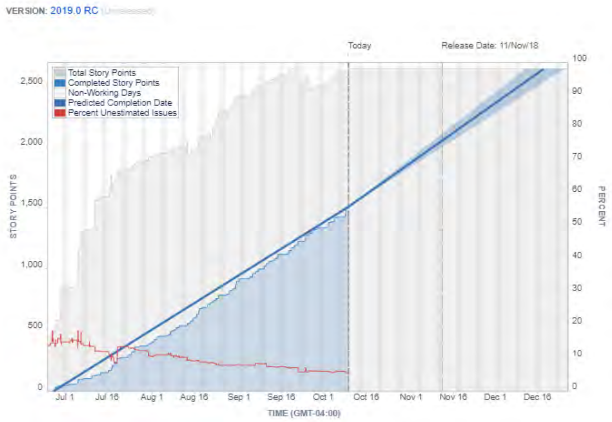
Questions?

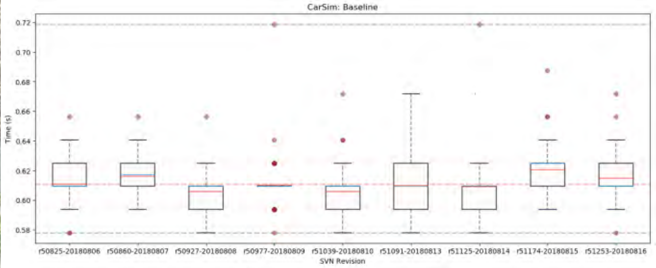
jeff.blackburn@metamoto.com
650-313-3649

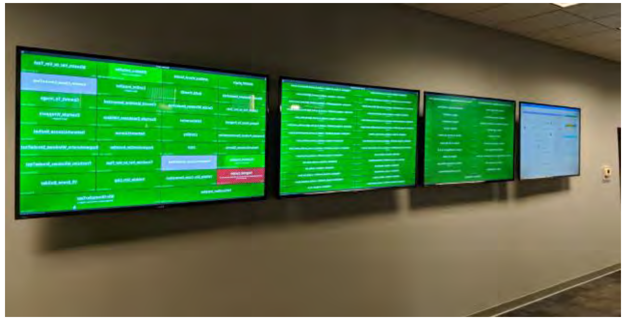

Ax 0.282
Ay -0.757
Roll -0.722
Pitch -1.164
Yaw 168.3
100 75 50 25 0
100 75 50 25 0
CARSIM
RPM X 1000
0 20 40 60 80 100 120 140 160 180 200

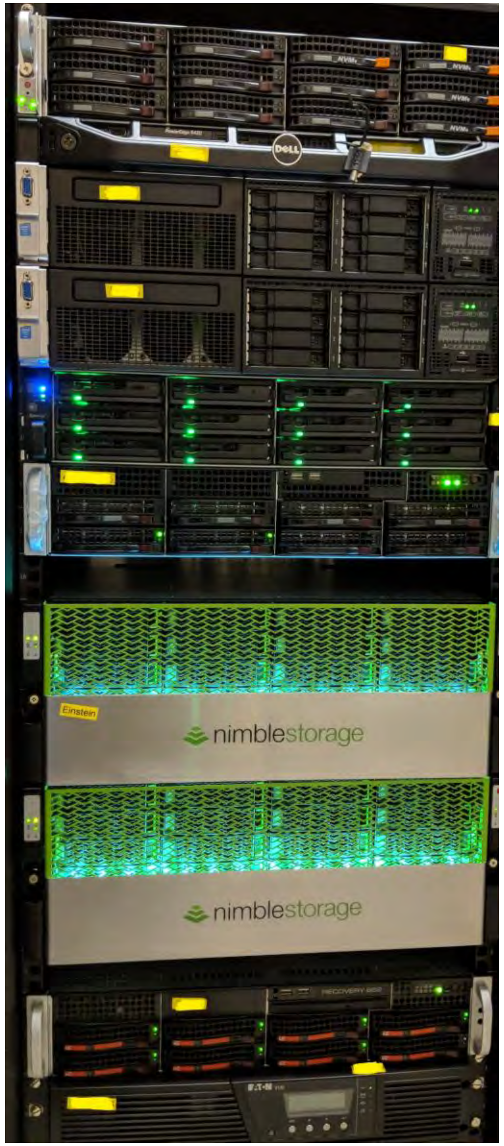
Mechanical Simulation Snapshot

- University of Michigan / UMTRI origins
- Founded 1996
- 50 Empolyees
- 7 Global Agents
- Customers in 60+ countries









carSIM truckSIM bikeSIM

100+ OEMs and Tier 1 Suppliers
250+ Universities
4700+ Active Licensed Seats

40+ Worldwide Car and Truck OEMs

GM TOYOTA Ford CHRYSLER

GEELY MITSUBISHI MOTORS FIAT mazda

NISSAN SUBARU HONDA HYUNDAI

ISUZU DAEWOO LAND ROVER

Technology Partners

rFpro
UNREAL ENGINE
atlatec
AVSIMULATION
tass international
A Siemens Business
unity

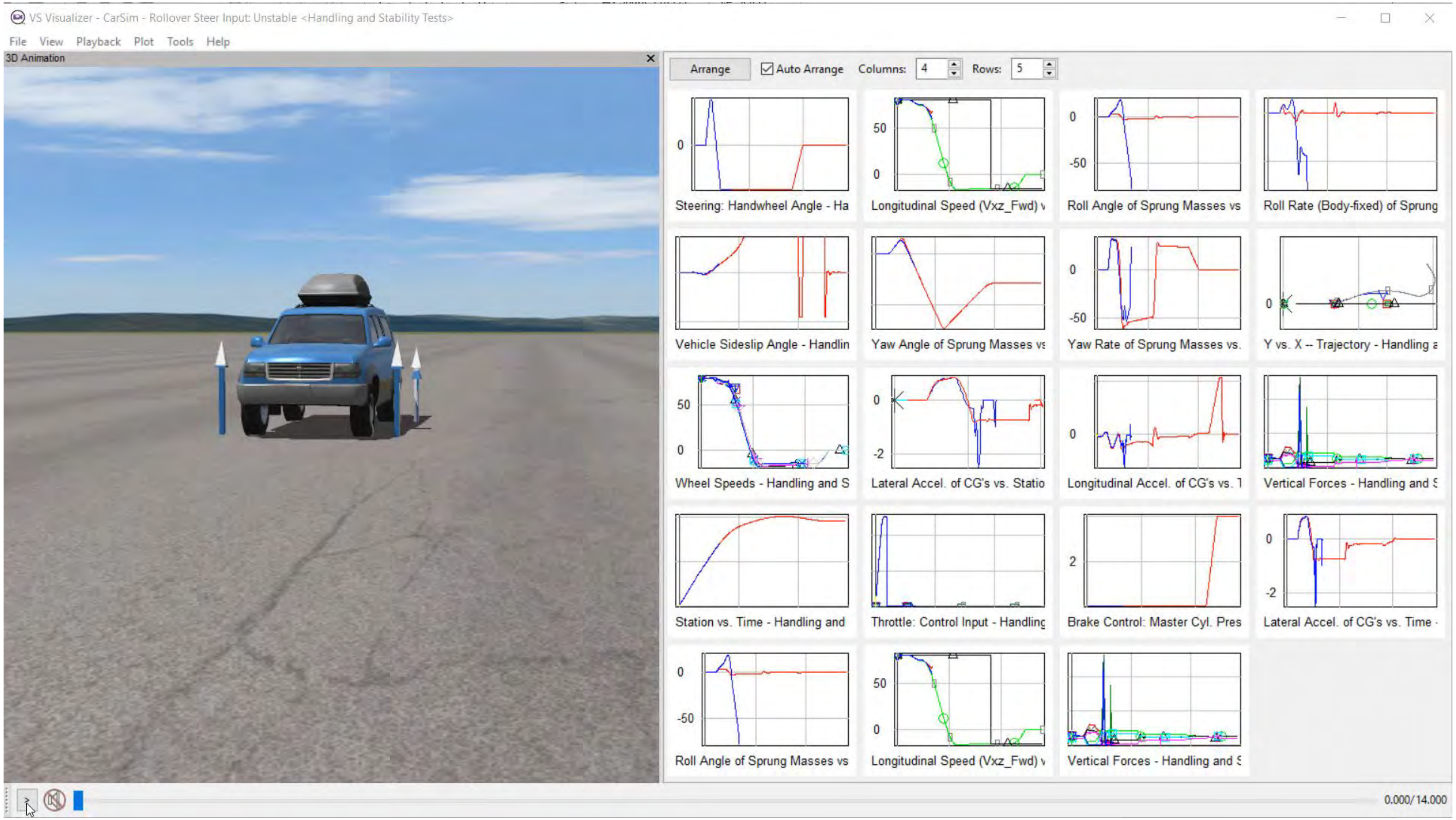
here
Maps for Life
MATLAB SIMULINK
GT Gamma Technologies
TNO
BASELABS
ANSYS

NVIDIA.
spirent
Promise. Assured
tracetronic
GUIDING YOUR VISION
AHLMAN
ENGINEERING

M city
UNIVERSITY OF MICHIGAN
VT
VIRGINIA TECH
TRANSPORTATION INSTITUTE

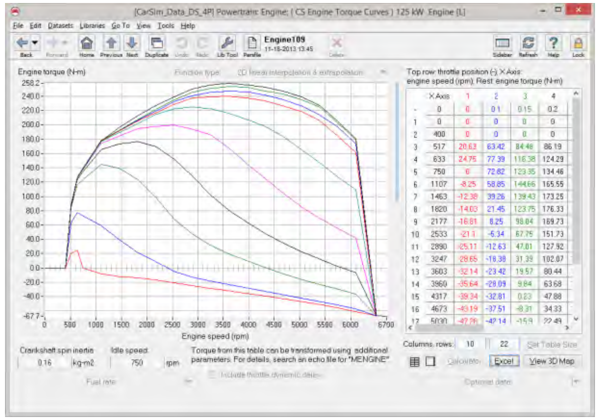
dSPACE
RT-LAB
A&D
A&D Technology, Inc.
NATIONAL INSTRUMENTS
ETAS
concurrent
REAL-TIME

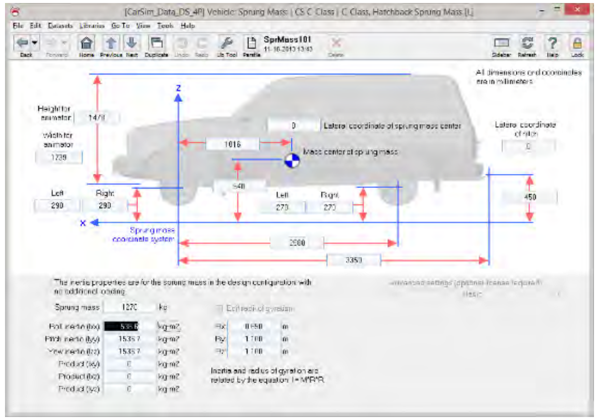
Accurate High-Fidelity Vehicle Dynamics

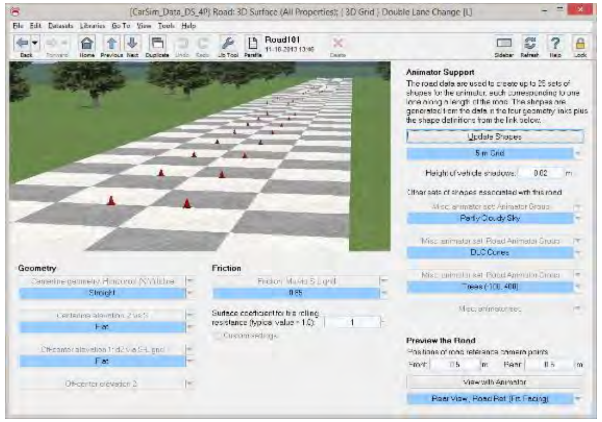


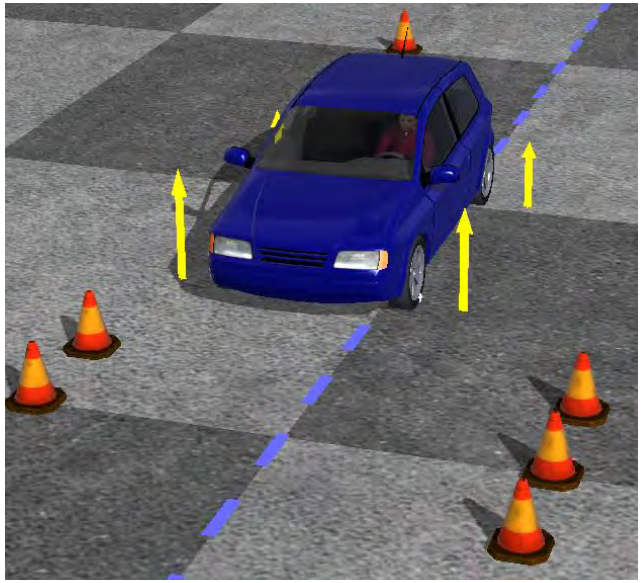
Car/Truck/BikeSim

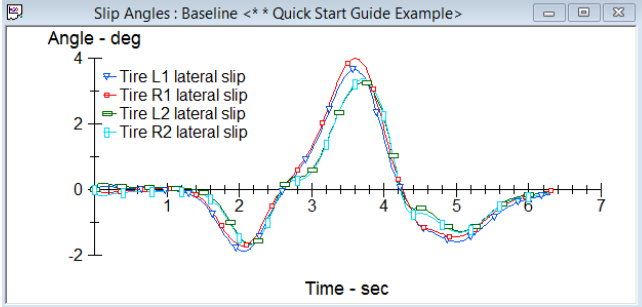
Braking
Steering
Powertrain
Suspension kinematics
Suspension compliance
Tire models
Driver models
Autonomous driving
Weight distribution
Fuel economy
3D roads
Road roughness
Traffic vehicles
Pedestrians
ADAS Range sensors
Camera sensors
VS/Python scripting

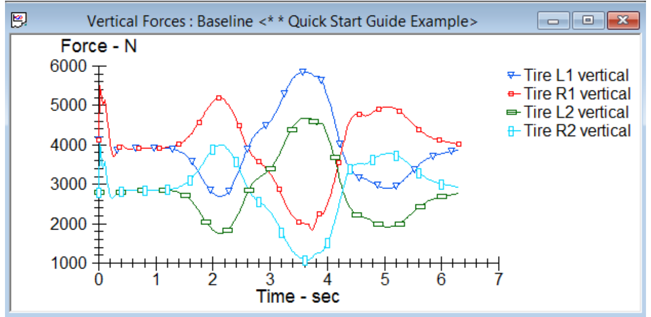












Vehicle Simulation and Testing Platform

Tire Models

Steering Models

Driver Models

Active Suspension Models

Testing Complex Driving Sequences

ESC/ABS/Traction Controllers

ICE and Hybrid Powertrain Controllers

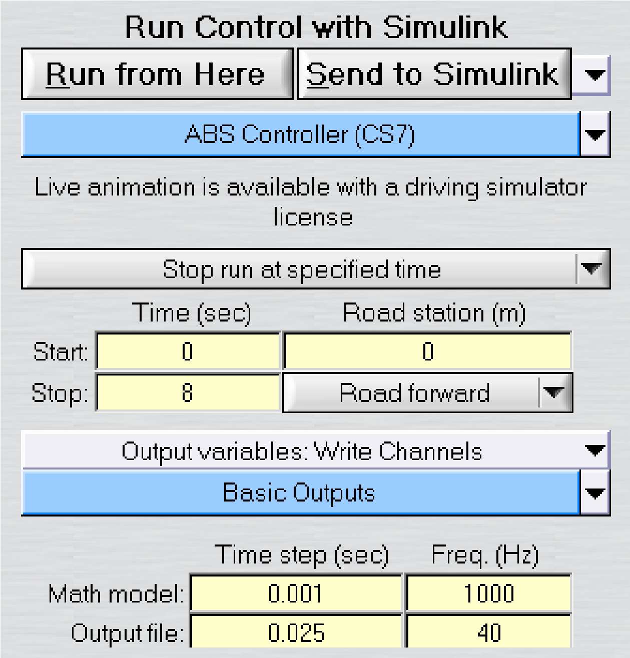
Autonomous and ADAS Systems:

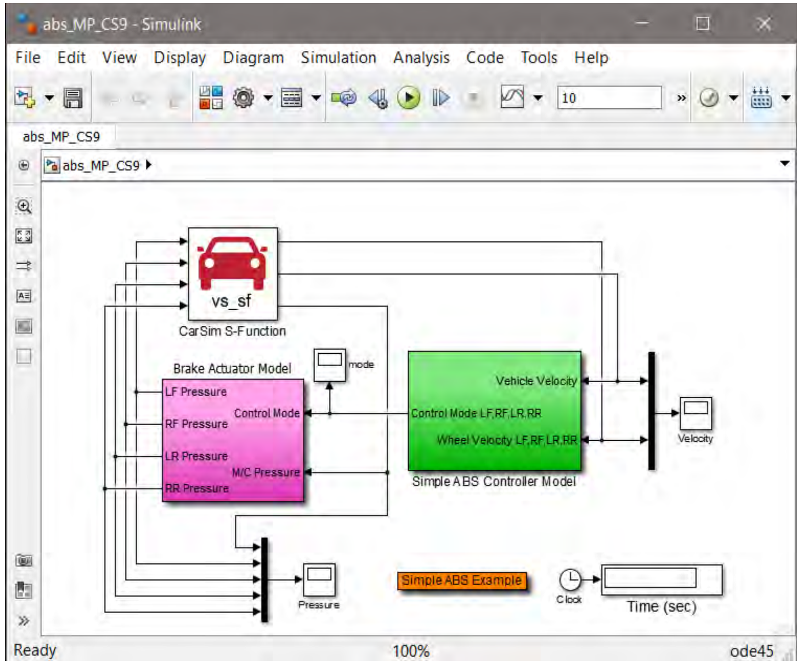
- Lane Keeping / departure
- Cooperative Active Cruise Control
- Forward Collision
- Level 4/5 Handoff
- Sensor Models

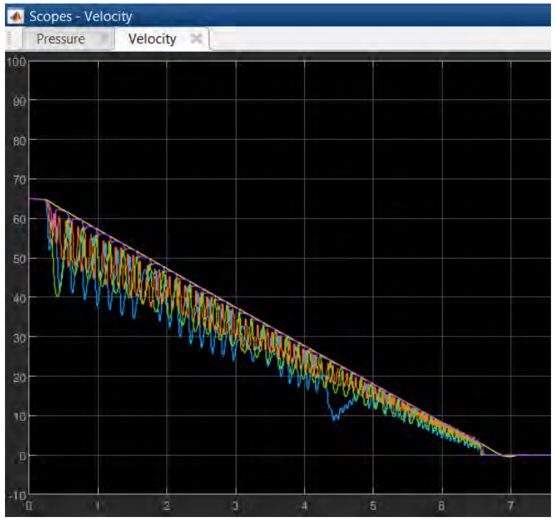
VS Commands scripting
Python
Matlab/Simulink, LabView, ASCET
API - C/C++
HPC and Cloud Computing

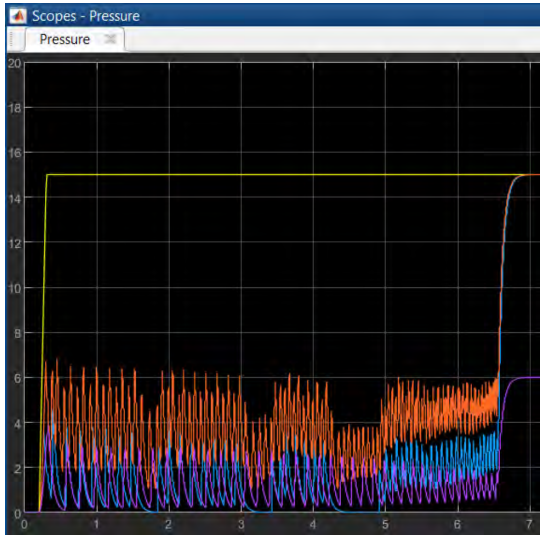
VS Connect
FMI and FMU
Hardware in the Loop
V2V, V2I, GPS Communication
Driving Simulators

MATLAB/Simulink Interface (when necessary)





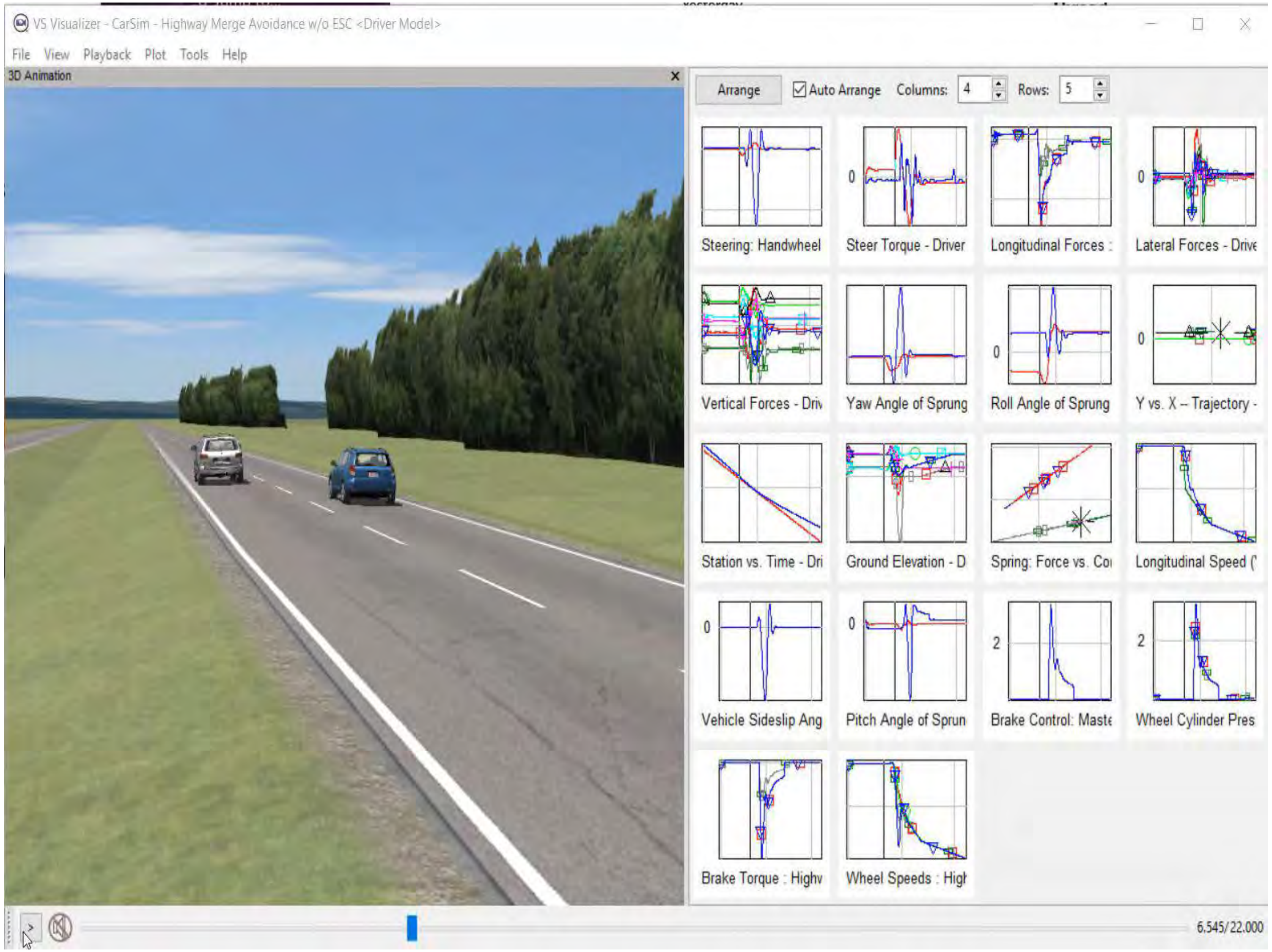




- S-Function loads the CarSim Solver
- Use Simulink from CarSim
- Use CarSim from Simulink

- Multiple S-Functions support running multiple vehicles in the same simulation (CACC for example)

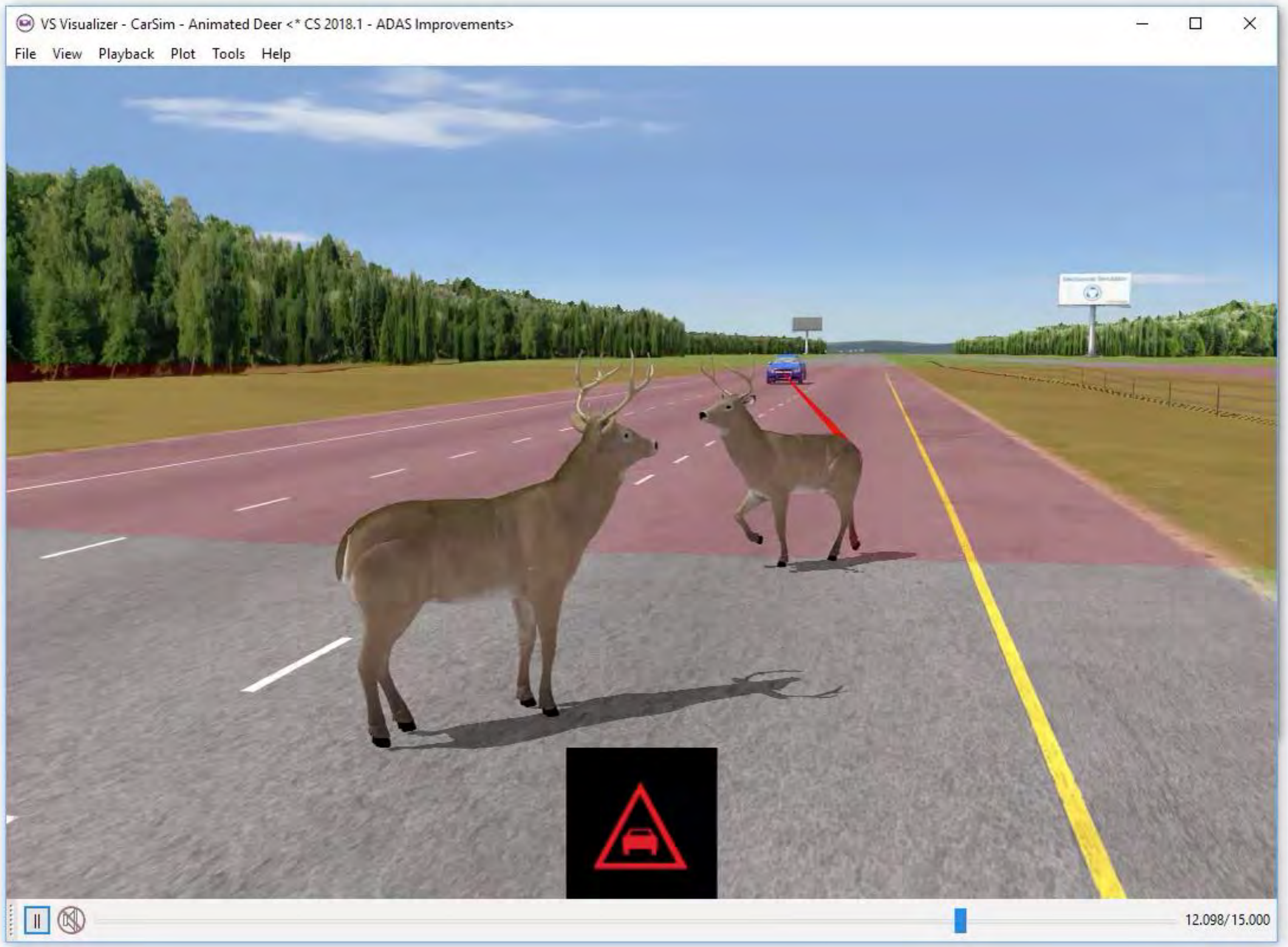
Multiple Car Interactions



Autonomous Vehicles from Recent Futurists

- Never crash
- Never exceed .3g acceleration
- Straight to Level 5
- Mass deployment in 2021 models

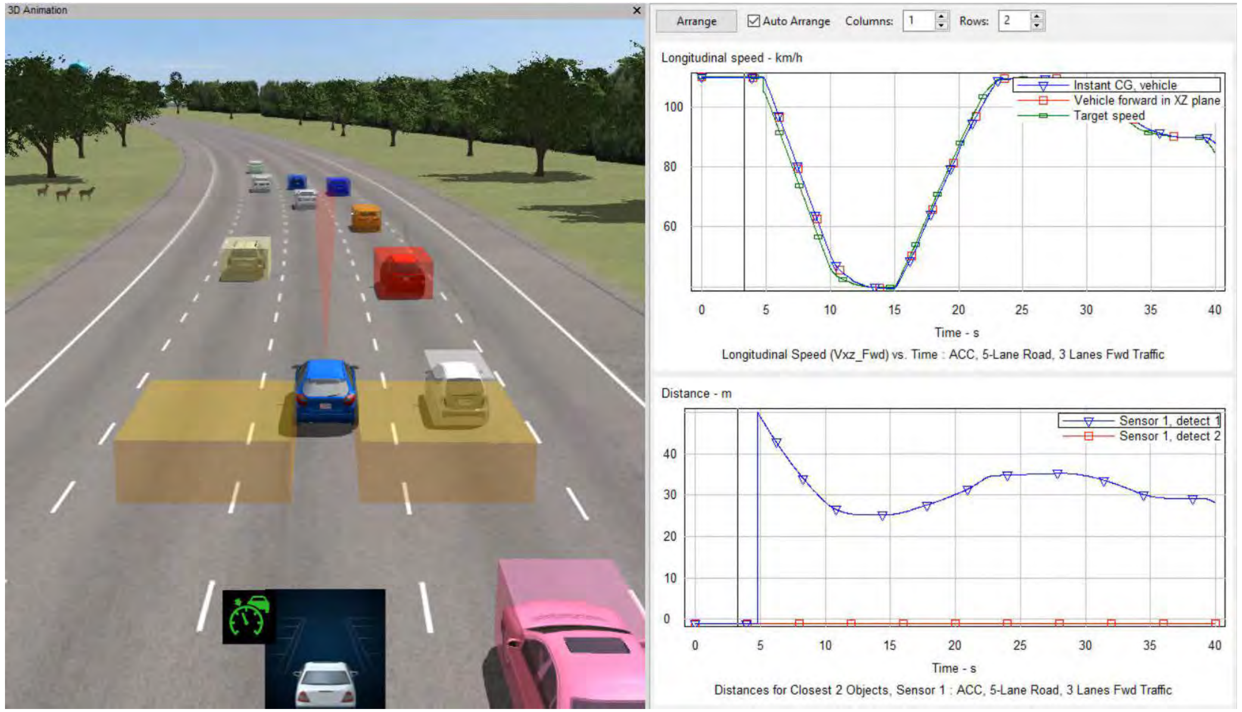
- Passenger sickness
- Pedestrian bullying



OEMs have Invested Millions in Simulation

- Software tools
- HIL benches
- Test equipment
- Data storage
- Engineering
- Validation and Certification

- Wide range of maneuvers
- Road surfaces
- Weather conditions
- Vehicle payloads
- Controller settings



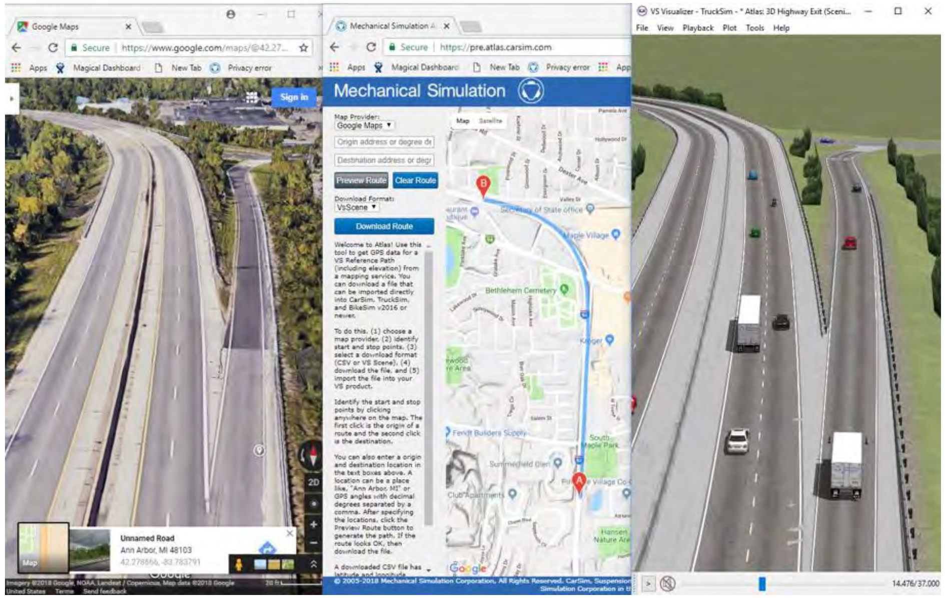
Value

- Trusted technologies
- Reduce time to market
- Improves domain knowledge
- Continual validation

All AV Companies Understand Simulation is Essential

- 8,000,000,000,000,000 miles are required
- Tests must be run every night/day
- Pass/Fail must be analyzed automatically
- How is pass/fail determined?
  - Variance from path – lane keeping
  - Avoidance of collision – how much distance is ideal
  - Reduction of energy in collision
  - Network benefit – if we all stop…we won't get anywhere

- Trusted Simulation is the only answer.



Bicycle Model / Game Engine Model

First model taught at university

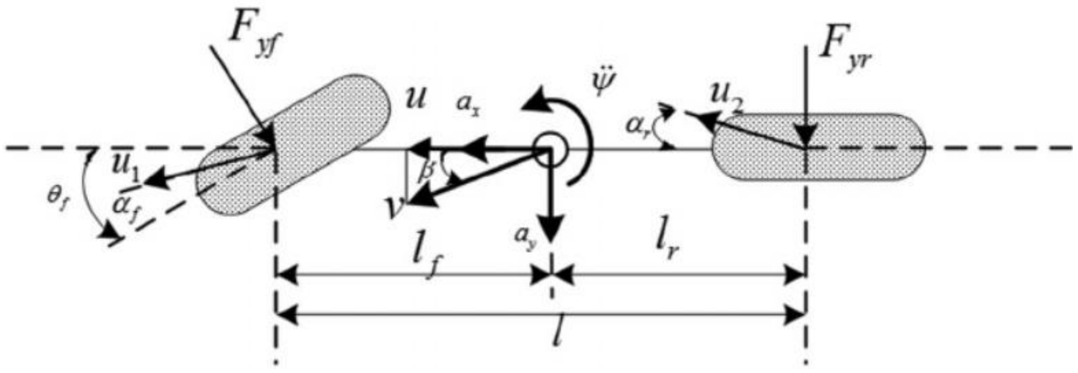
Bicycle model – very limited

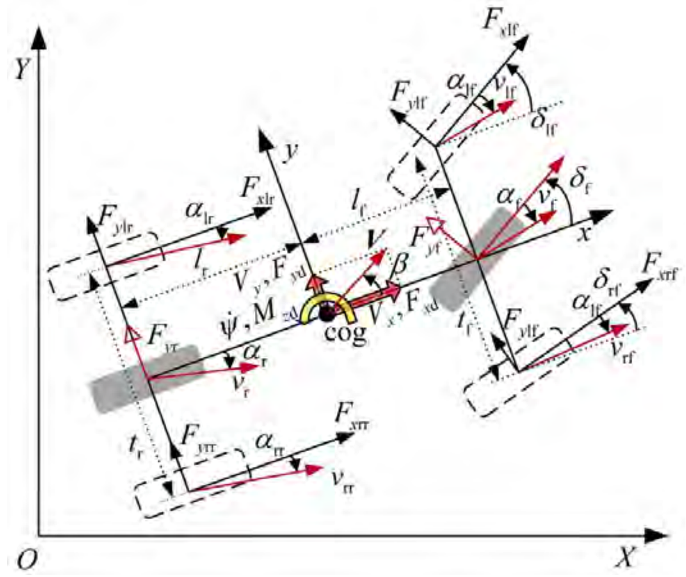
Game Physics – more sophisticated, not intended for engineering

Minimal Degrees of Freedom

Cannot handle wide range of vehicles: motorcycle, tractor-trailer, etc.

Nobody has time to second guess unproven/unvalidated physics





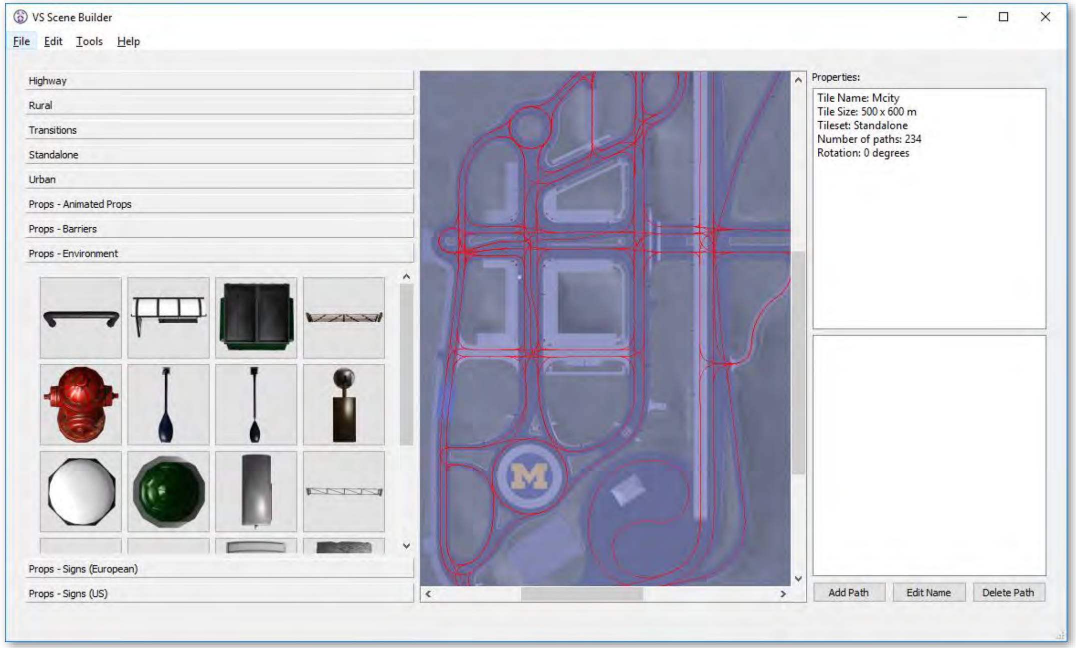
High-Fidelity Models Provide

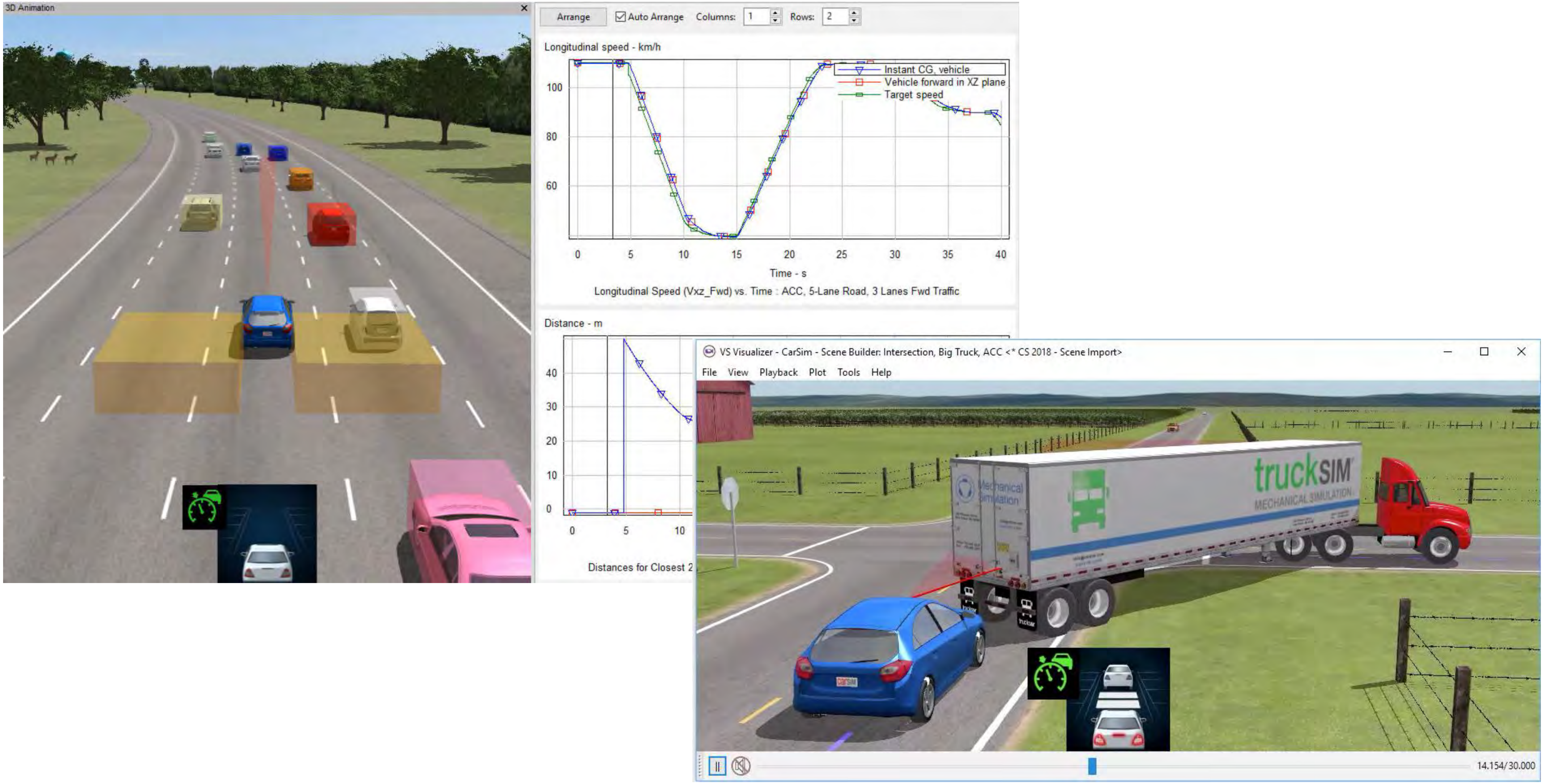
- ABS/ESC/TC controls
- Active dampers, torque vectoring, new steering strategies
- Hybrid technologies – regen braking
- Loaded vehicles behave differently – passengers, roof racks
- Road conditions (crowns, drop off, gravel, pot holes, roughness, ice patches, etc.)
- Understeer/oversteer
- Ackerman steering
- Comprehensive tire models
- Sensor motion (roll, pitch, yaw)
- Ride motion is important

Connectivity Required for Complete Solution

- Developing driver controls
- Handoff Strategies
- Regression tests
- Hardware-in-the-loop
- Machine learning/optimization
- Mapping
- Scenarios
- Sensor simulation
  - Best of class
  - Prescan

- Matlab/Simulink, C/C++, Python
- Windows, Linux, HIL, Embedded
- AWS, Azure, HPC
- Tools for DOE/optimization
- Tools for Cloud/HPC




3D Animation
Arrange
Auto Arrange
Columns: 1
Rows: 2
Longitudinal speed - km/h
Instant CG, vehicle
Vehicle forward in XZ plane
Target speed
100
80
60
0 5 10 15 20 25 30 35 40
Time - s
Longitudinal Speed (Vxz_Fwd) vs. Time : ACC, 5-Lane Road, 3 Lanes Fwd Traffic
Distance - m
40
30
20
10
0
0 5 10
Distances for Closest 2
VS Visualizer - CarSim - Scene Builder: Intersection, Big Truck, ACC <* CS 2018 - Scene Import>
File View Playback Plot Tools Help
truckSIM
MECHANICAL SIMULATION
14.154/30.000

Thank you

- Robert McGinnis
- Mechanical Simulation
- rmcginnis@carsim.com

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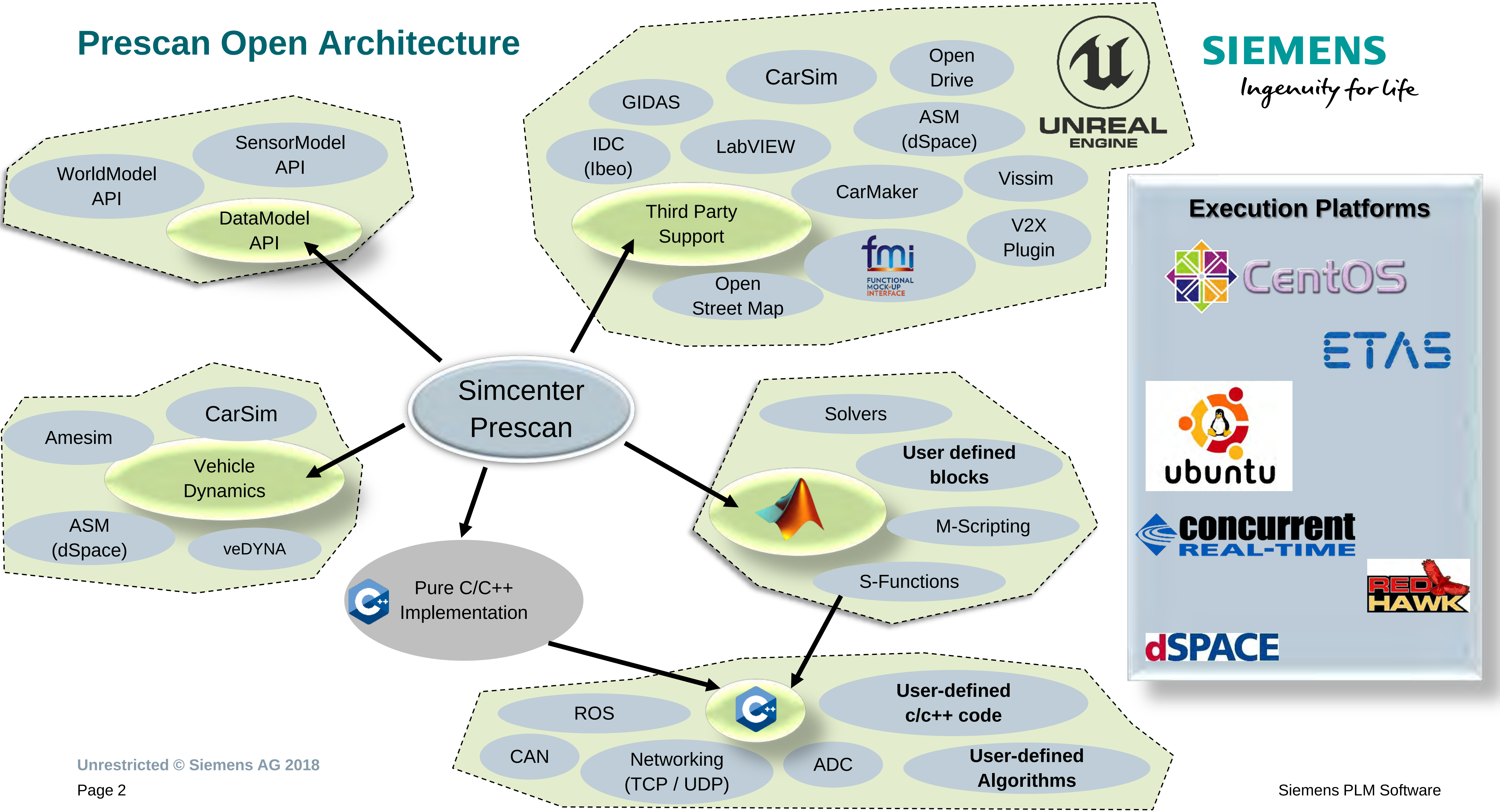
Ingenuity for life

Linking the World to Sensor Models for Realistic Simulation

Tony Gioutsos – Portfolio Developer TASS - Siemens

Prescan Open Architecture



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World & Sensor Modeling

The necessity of linking detailed World models with detailed Sensor models

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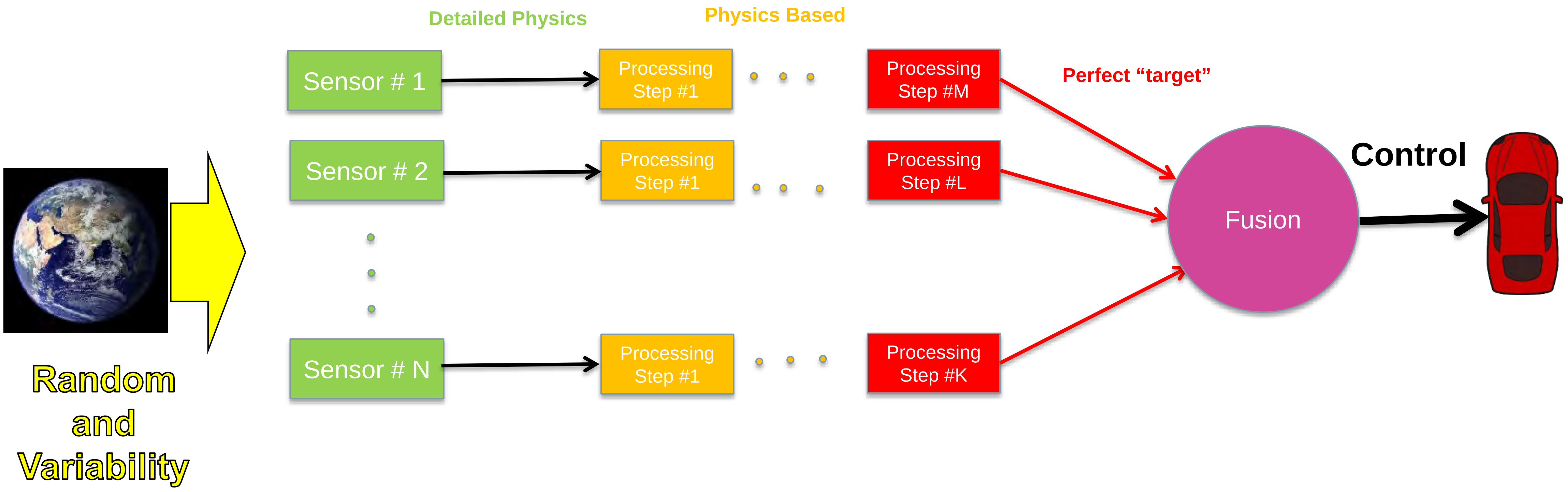
- Simcenter Prescan is constructed from the ground up to perform realistic ADAS/AV V&V
- ADAS/AV Integration environment commercially available since 2006
- Far ahead of the competition

Available Data in the Sensor Processing Chain



Simcenter Prescan

The most realistic and comprehensive solution for Digital Twin of the World

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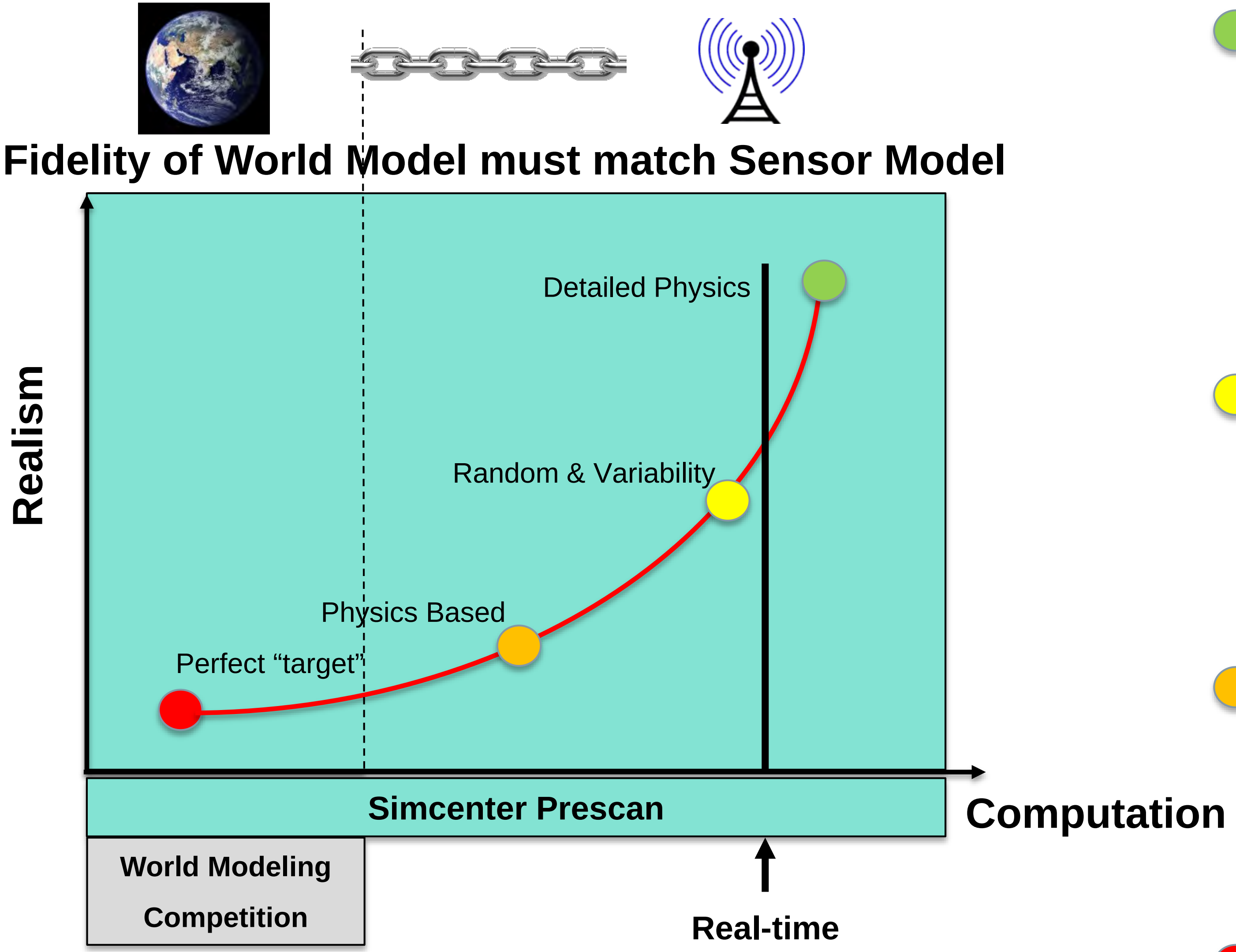
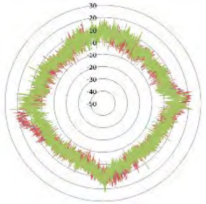
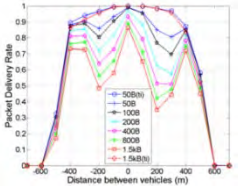


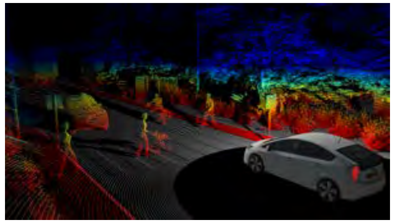
Detailed Physics – Physics Based Camera, Physics Based Radar, Detailed V2X models, Ray Tracing Lidar/Camera



Random & Variability of Word & Sensors



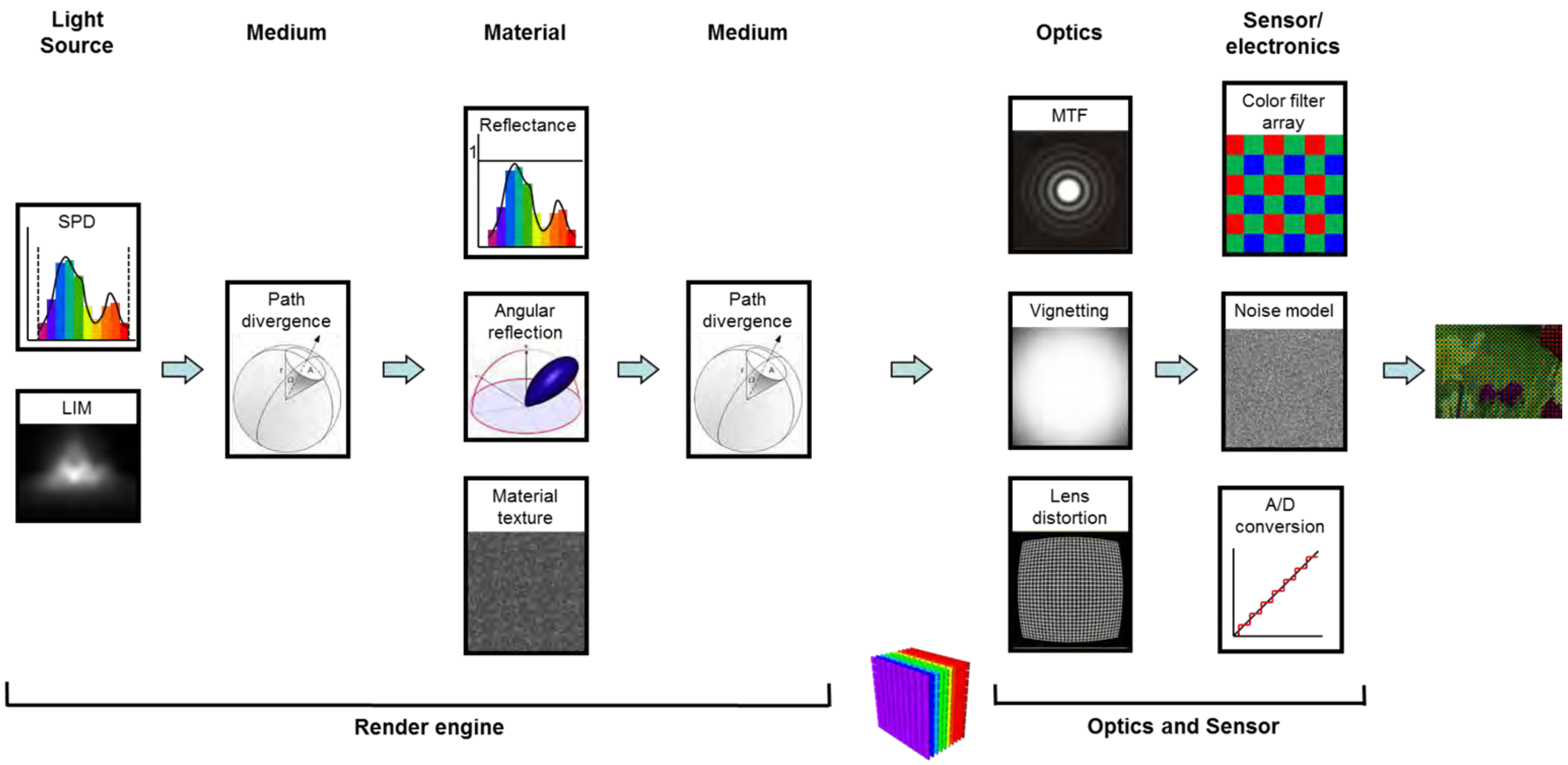
Physics Based



Perfect “target” – No sensor info

Camera Sensor Models

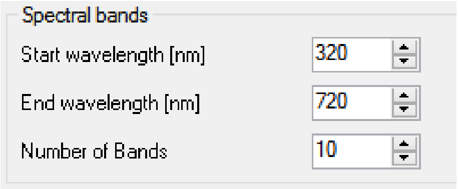
Physics Based Camera (PBC) Pipeline Overview

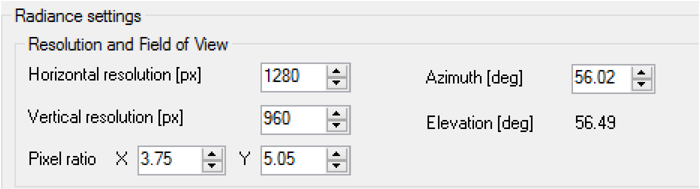


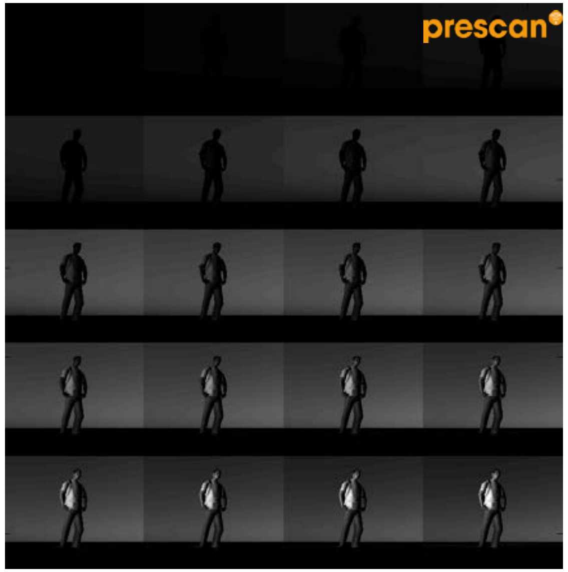
8

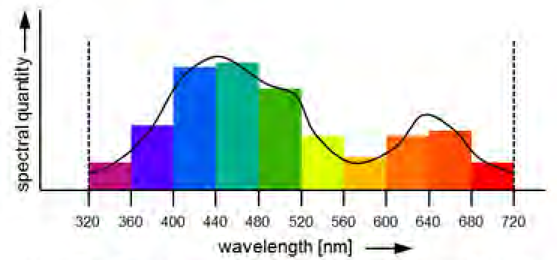
Camera Spectral Density

- The spectrum of light that reaches the lens is calculated
- The user can specify the number of bands to be used.
  - For example 10 bands for visible light (320-720 nm)
- Materials
- Puddles with reflections
- Retro reflections for physics based materials
- Assignment of materials to regions/objects
- Environment
- Configuration of sky SPD and intensity
- Ability to control ambient lighting

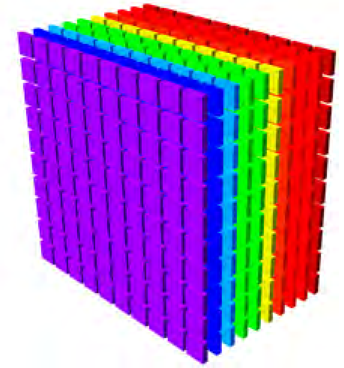








A spectral quantity and how it is spectrally discretized into a number of wavelength bands.



The radiance map, or spectral cube, is a stack of frames. One frame for each wavelength band.

9

Camera Inputs

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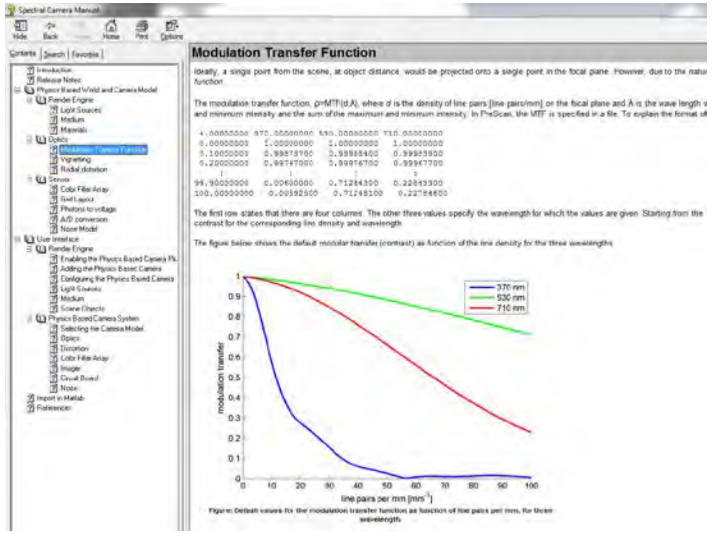
Lens modelling
- according to Zmax standard
- Focal length
- Aperture
- Vignetting
- Modulation Transfer Function
- Barrel and Pincushion distortion

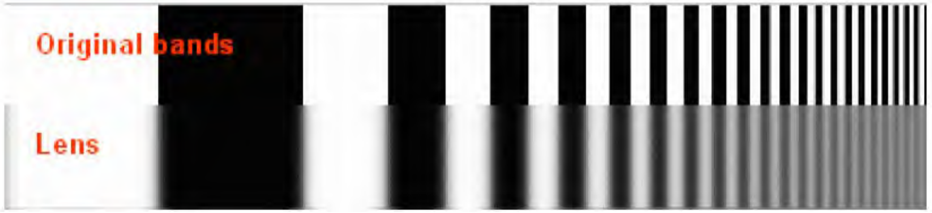
Color Filter Array
- RCCC or BGGR filters
- edit the transmittance

Image sensor
- Imager layout
- Imager electrons

Circuit board
- Digital precision
- Off-chip gain

Noise model
- Read noise
- Dark noise
- Photon dependent noise, array uniformity





Detailed information is available in the manual.

Example Usage for Adapting Camera Exposure

PBC Imagery Injected into NVIDIA Drive PX2 (DIL simulator at Ford September 5th)

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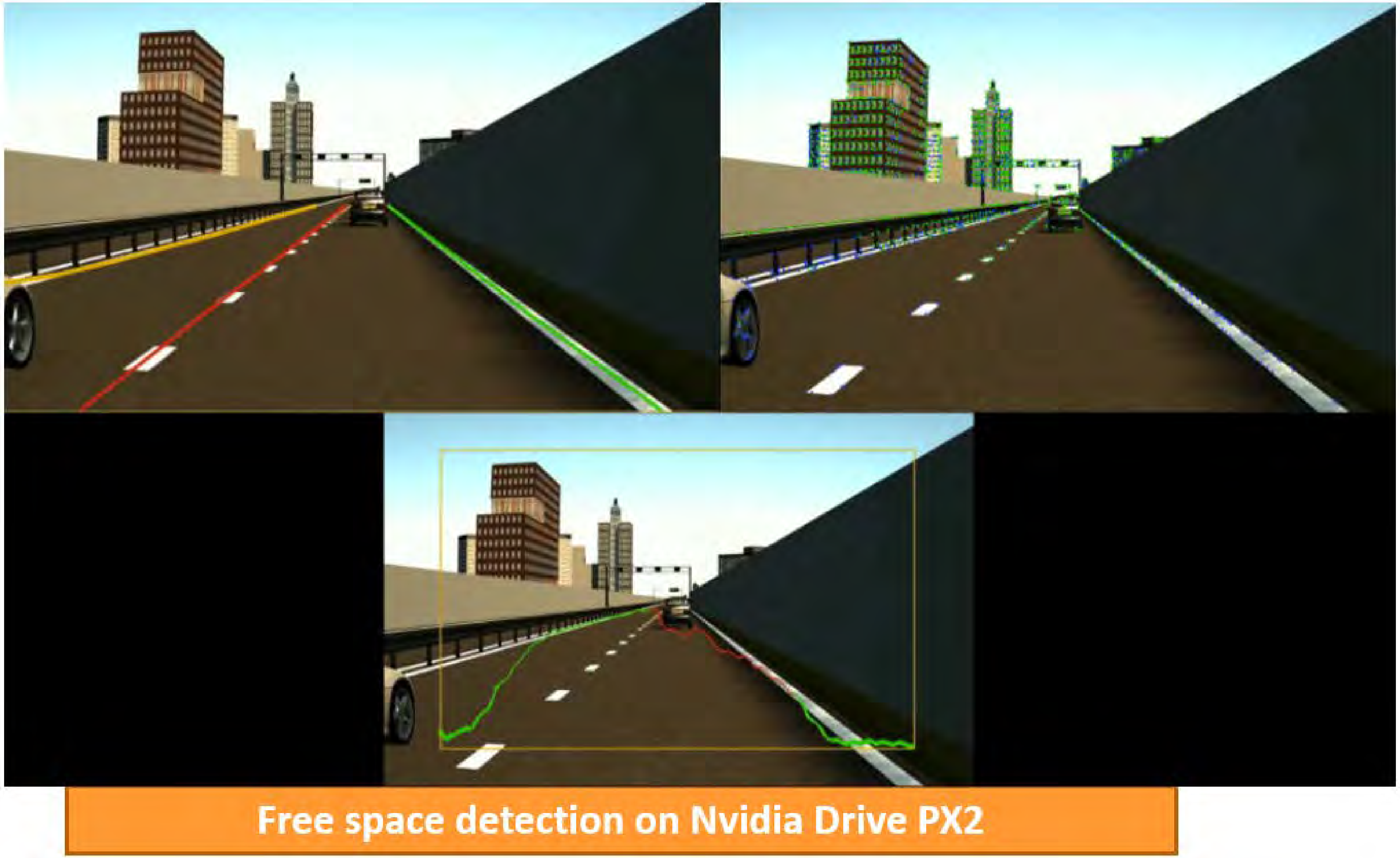
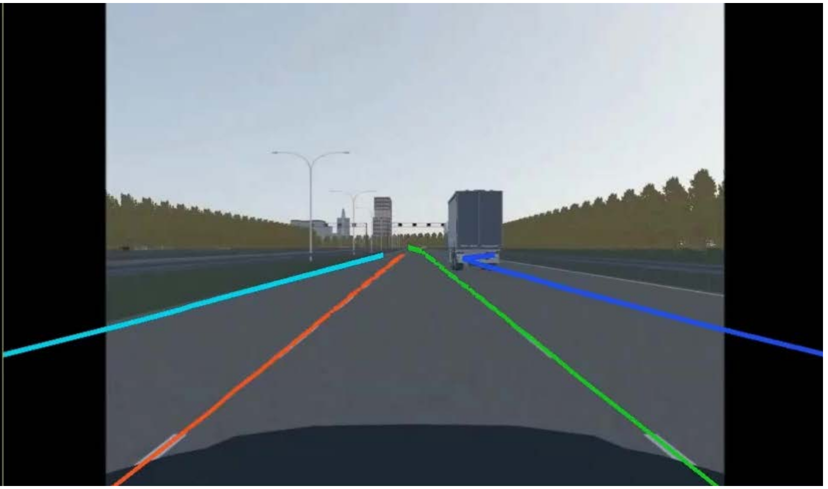


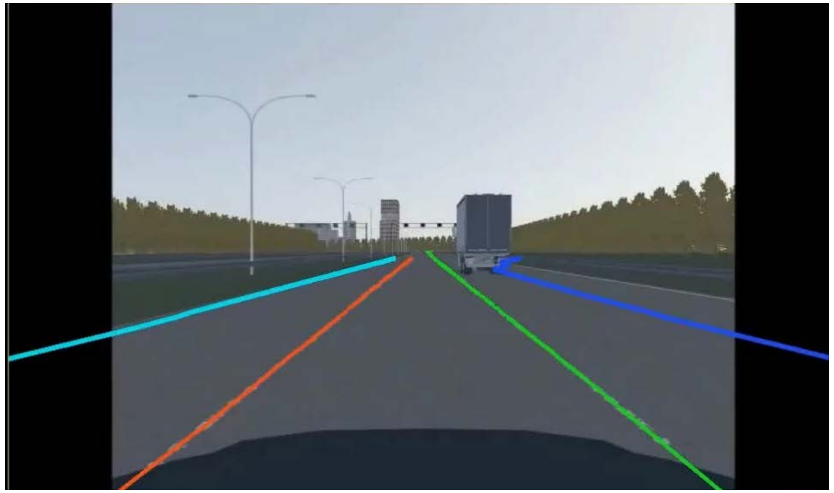
NVIDIA

Effect of Lane Line Corrosion

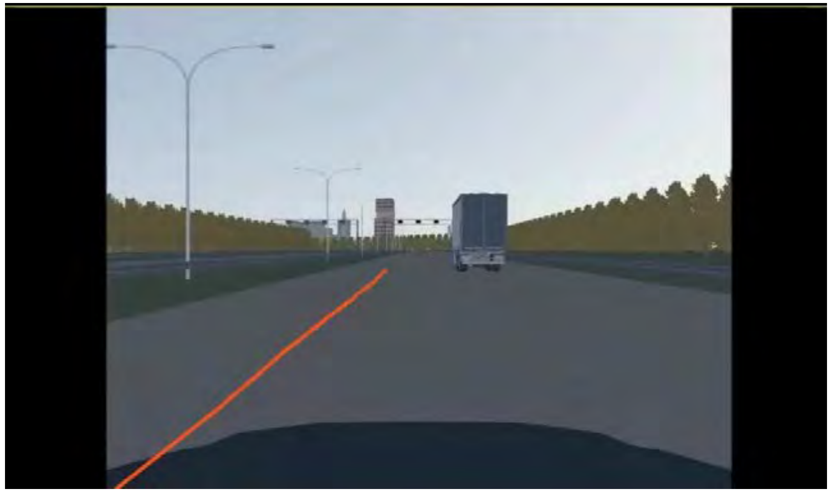
Lane Corrosion 0%



Lane Corrosion 50%



Lane Corrosion 80%



Effect of Lane Line Corrosion

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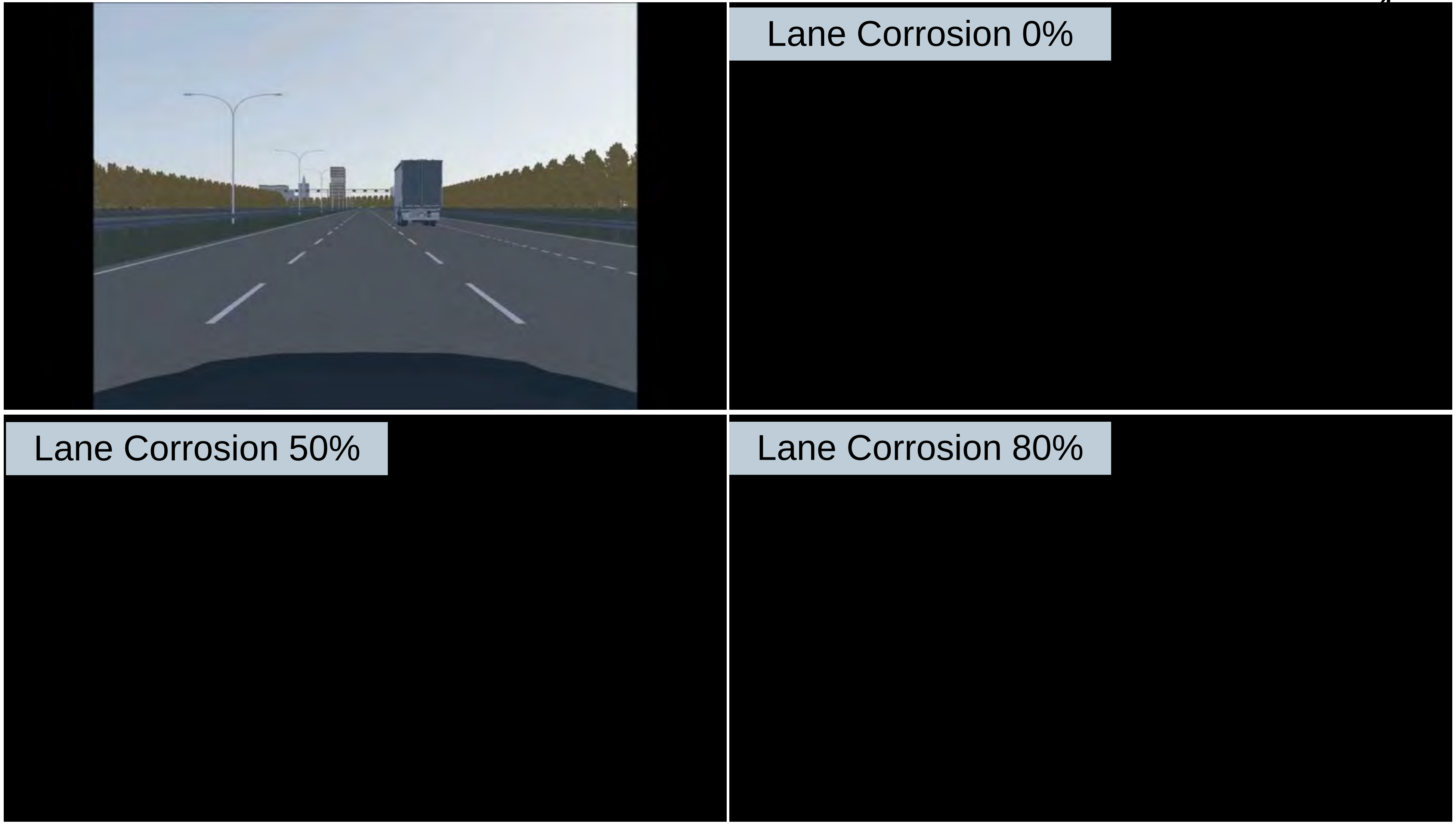
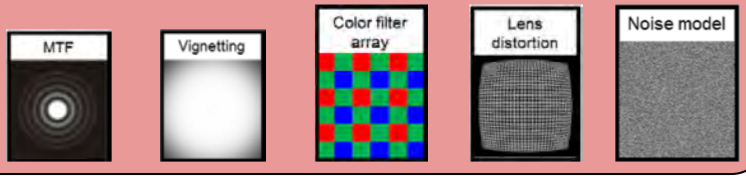


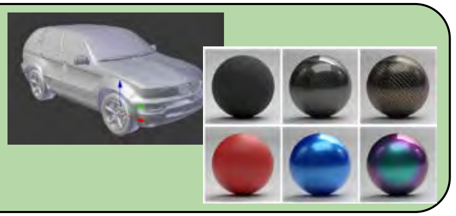
Advanced Camera Model

Sensor Parameters



World Definition

PreScan
Simulation of ADAS & active safety



Simulate Light in the Scene

- Multi-bounce
- Spectral Effects
- Weather
- Physics Based
- Dirt/Dust
- Refraction/Reflection
- Temporal Effects

$$L_o(\mathbf{x},\mathbf{w}) = L_e(\mathbf{x},\mathbf{w}) + \int_\Omega f_r(\mathbf{x},\mathbf{w}',\mathbf{w}) L_i(\mathbf{x},\mathbf{w}')(-\mathbf{w}'\cdot\mathbf{n})d\mathbf{w}'$$

Radar Sensor Models

Object Level Radar/Lidar

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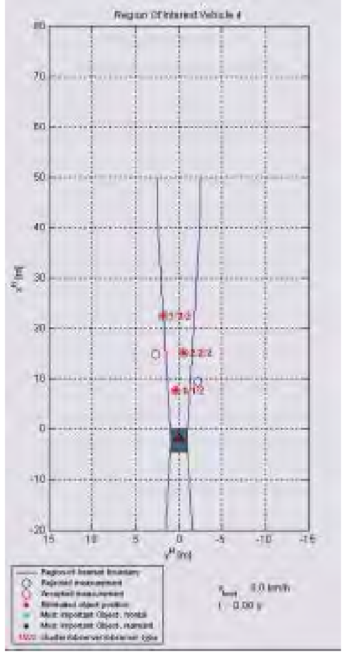
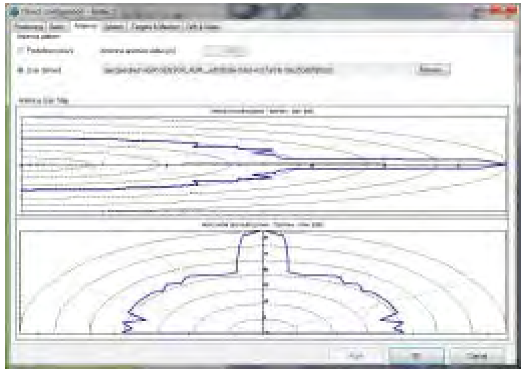
AIR sensor

- Idealized radar model
- Bounding box detection
- Occluded targets are visible
- No distortions
- Output on target level



Radar/TIS sensor

- Single-path reflection radar model
- Detection of actual target geometry
- Occluded objects will not be detected
- Distortions like noise, drift and misalignment
- Output on detection level
- Different scan patterns
- Targets have radar cross section (RCS) definition
- Calculation of dB loss (attenuation)
- Use of antenna gain maps



Radar and Lidar sensor settings

- Position & orientation
- Frequency
- Scan pattern (fixed or user controlled)
- Resolution cell size (range & angle)
- Max. detected objects
- Antenna parameters / gain map
- Noise, drift and misalignment

Output signals for each target

- Distance to target (Range)
- Velocity (x,y,z) relative to target (Rangedot)
- Detection angles in azimuth (θ) and elevation (φ)
- Local incidence angles in azimuth and elevation
- Energy loss (dB loss)
- Target ID and Target Type

Example of Real-time Physics Based Sensor Data- Radar Energy Loss

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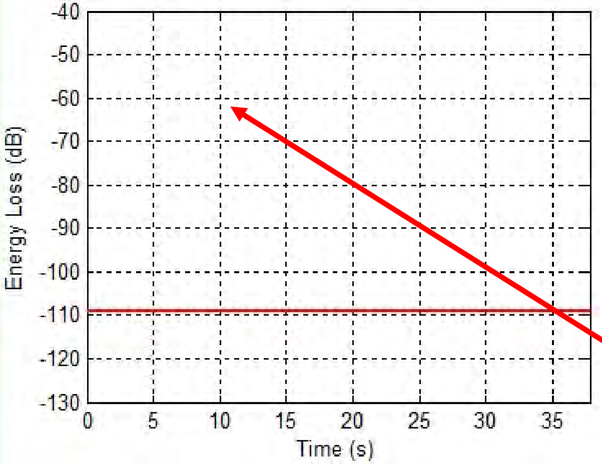
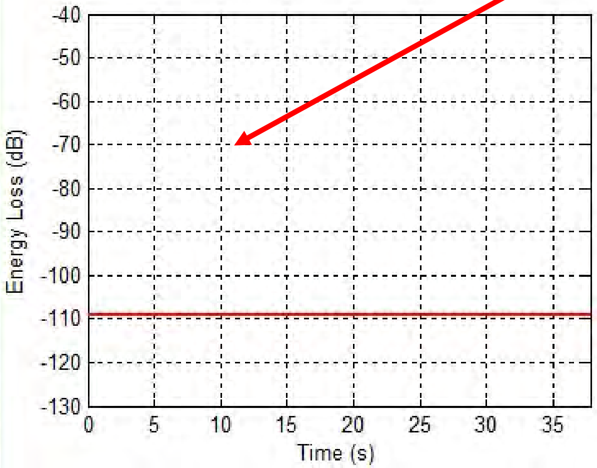


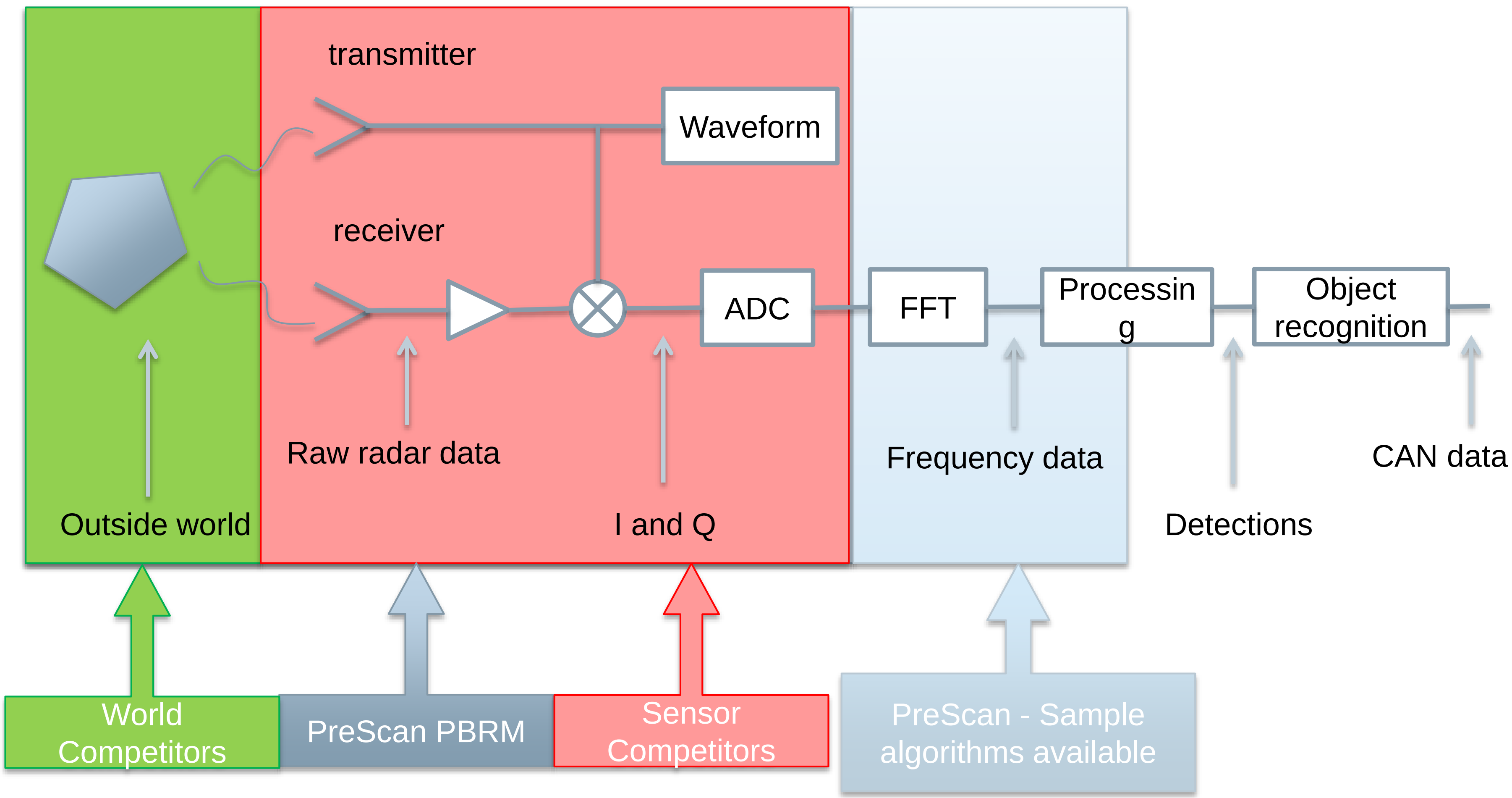
Energy Loss affected by Angle of Object

Note Attenuation difference

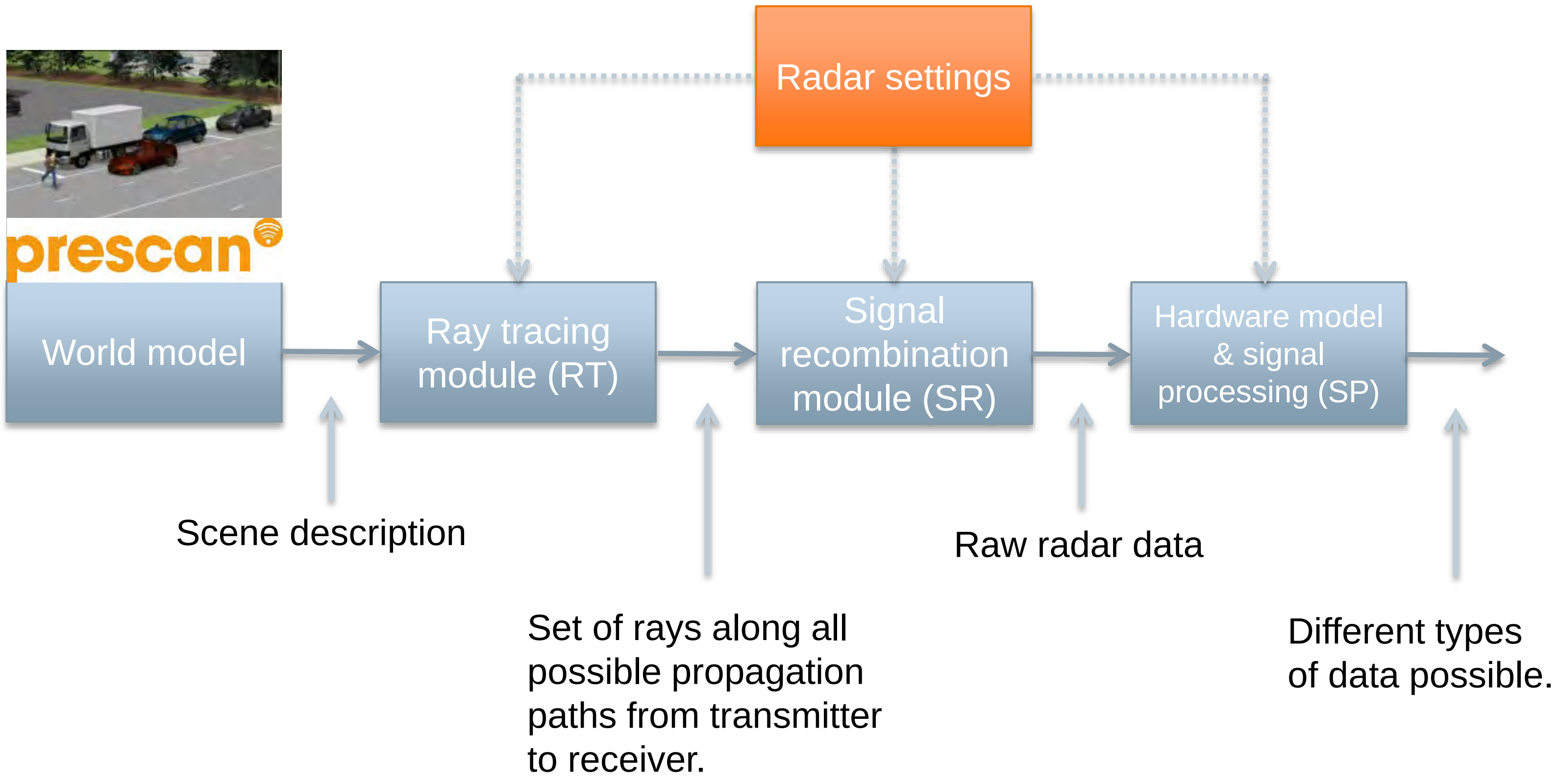


Energy Loss affected by Angle & **Weather (Small Attenuation)**

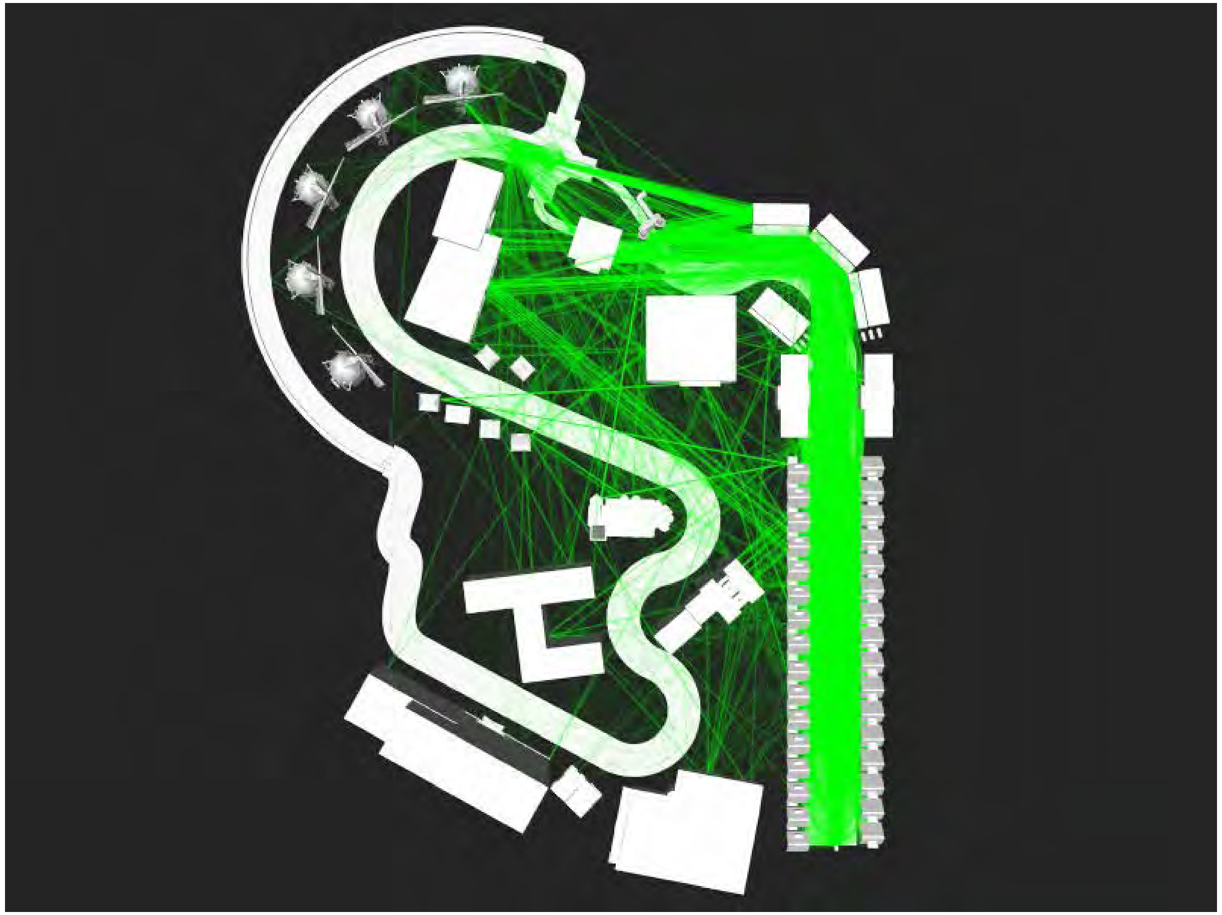
Detailed Physics Based Radar Module (PBRM)

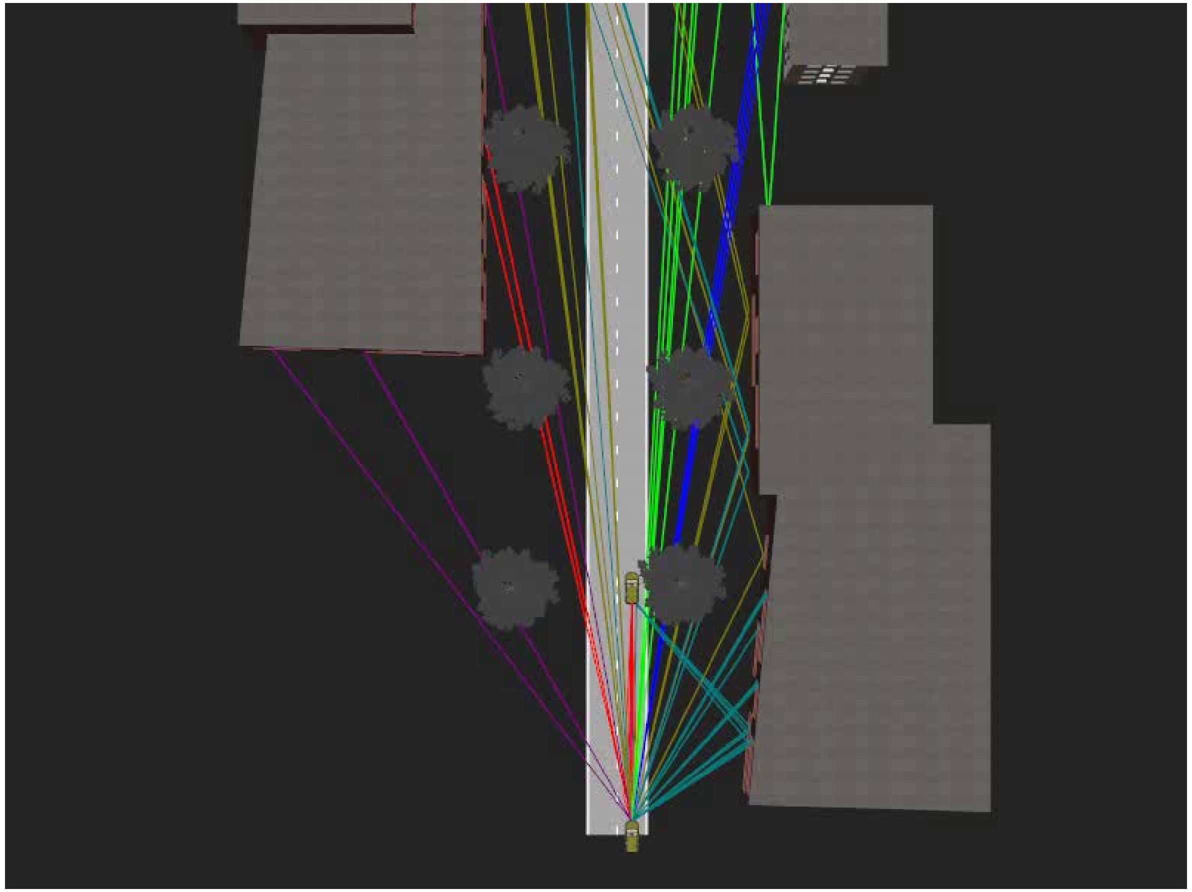


Simulation Overview



Multipath Simulation and Perfect Ground Truth

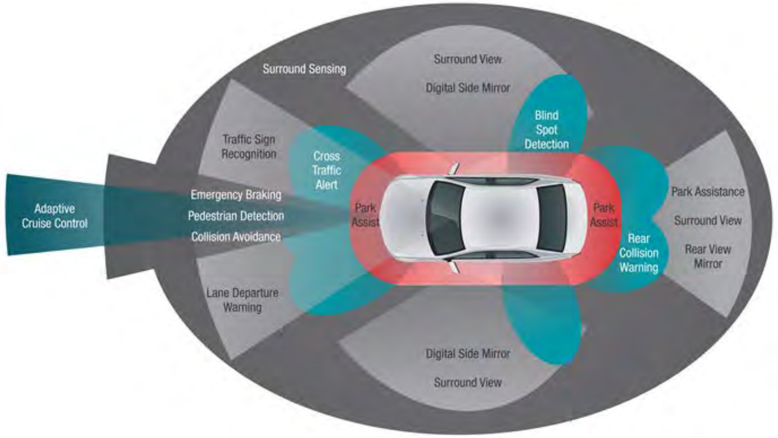




Capabilities

SIEMENS
Ingenuity for life

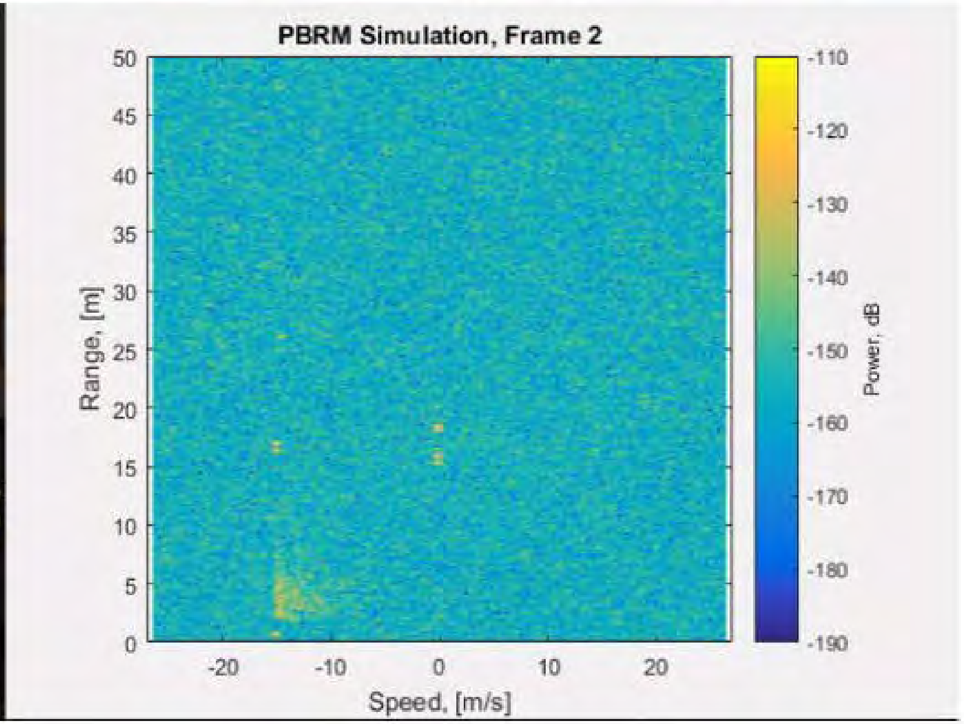
Multipath simulation up to any number of bounces.
Configurable tradeoff between fidelity and performance.
Multistatic antenna configurations (MIMO).
Fully customizable waveforms (FMCW, Fast Chirp Modulation, etc).
Physical material properties, including polarization effects.
Clutter simulation.
Micro-doppler effects.
Interference between different radar sets..
Non-perfect component behaviour.



City Example

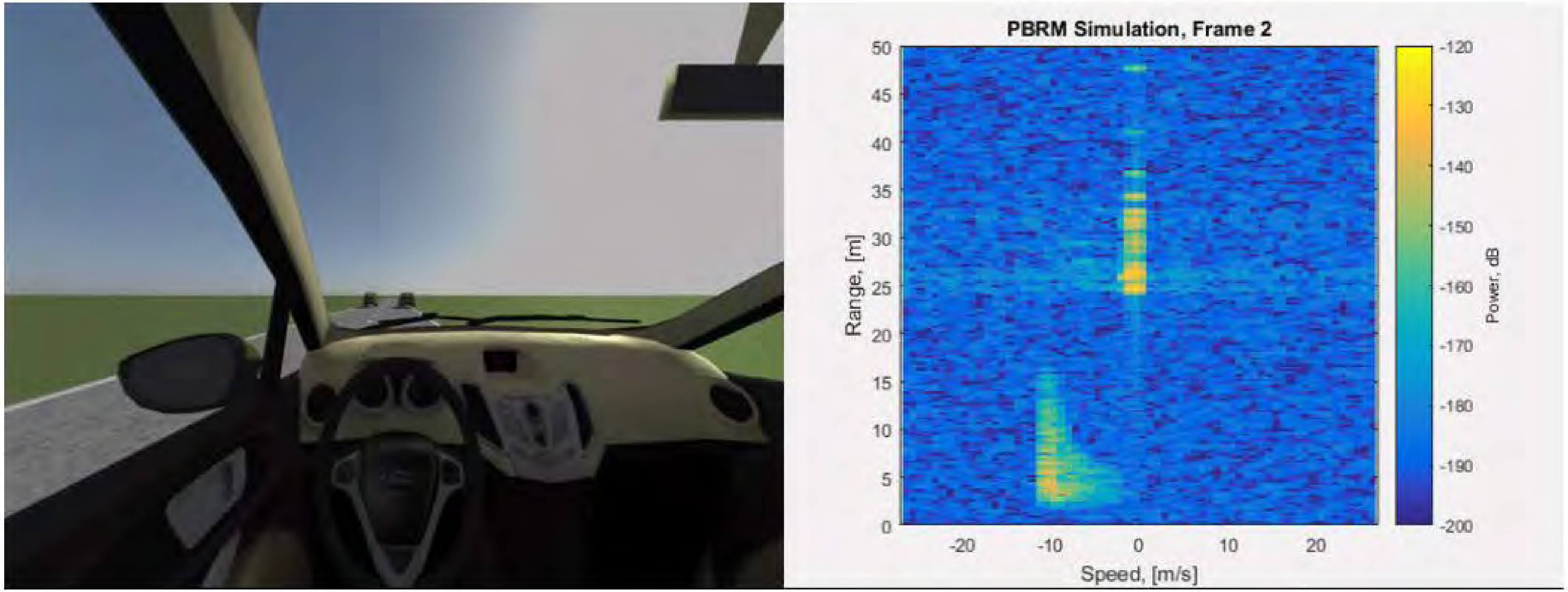
Camera image from point of view of radar.

Simulated radar data, processed to Range-Doppler



Highway Example

Example without thermal and receiver noise
Sweep bandwith 600 Mhz



Verification of RCS - Corner reflector 15dBm2

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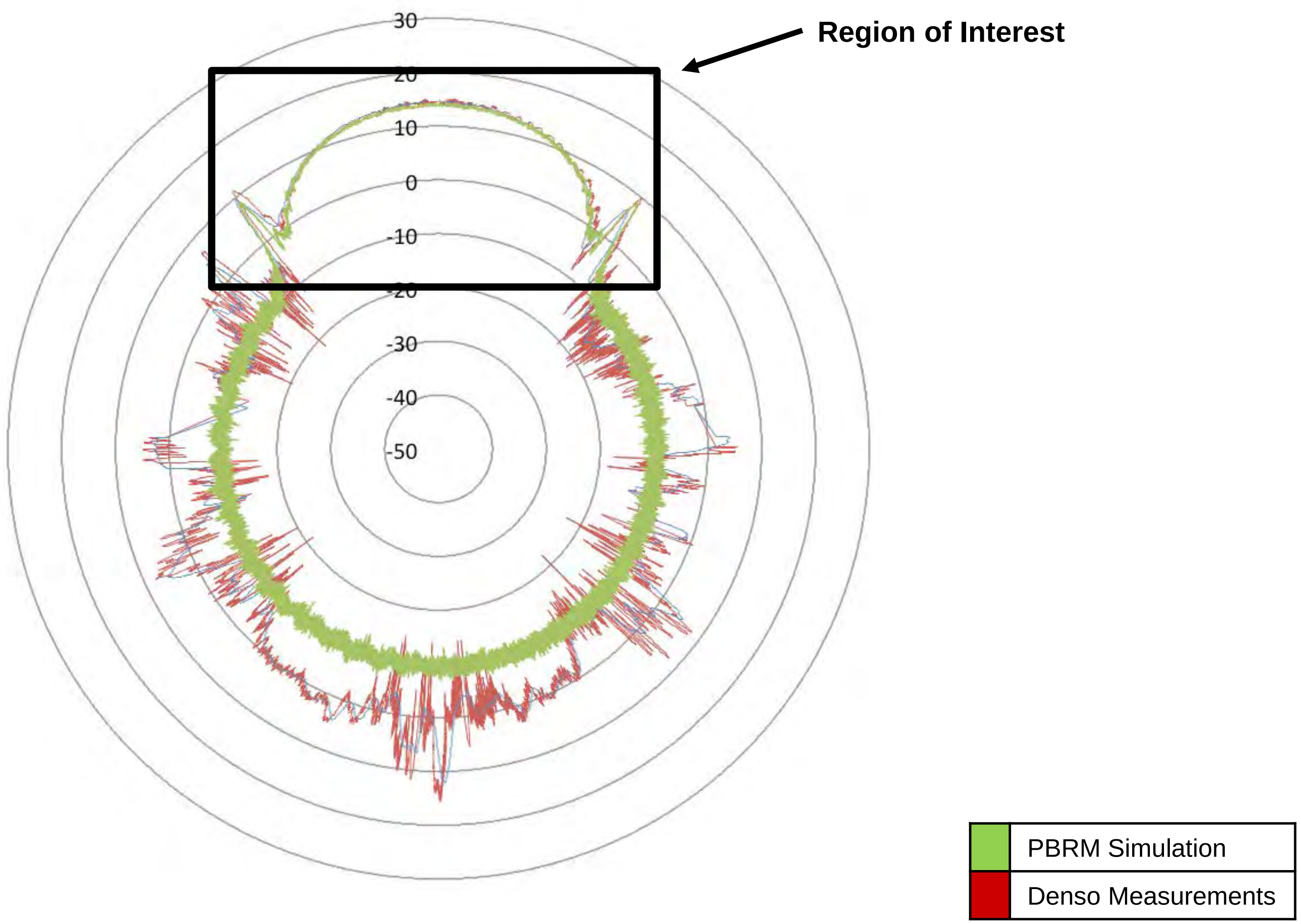
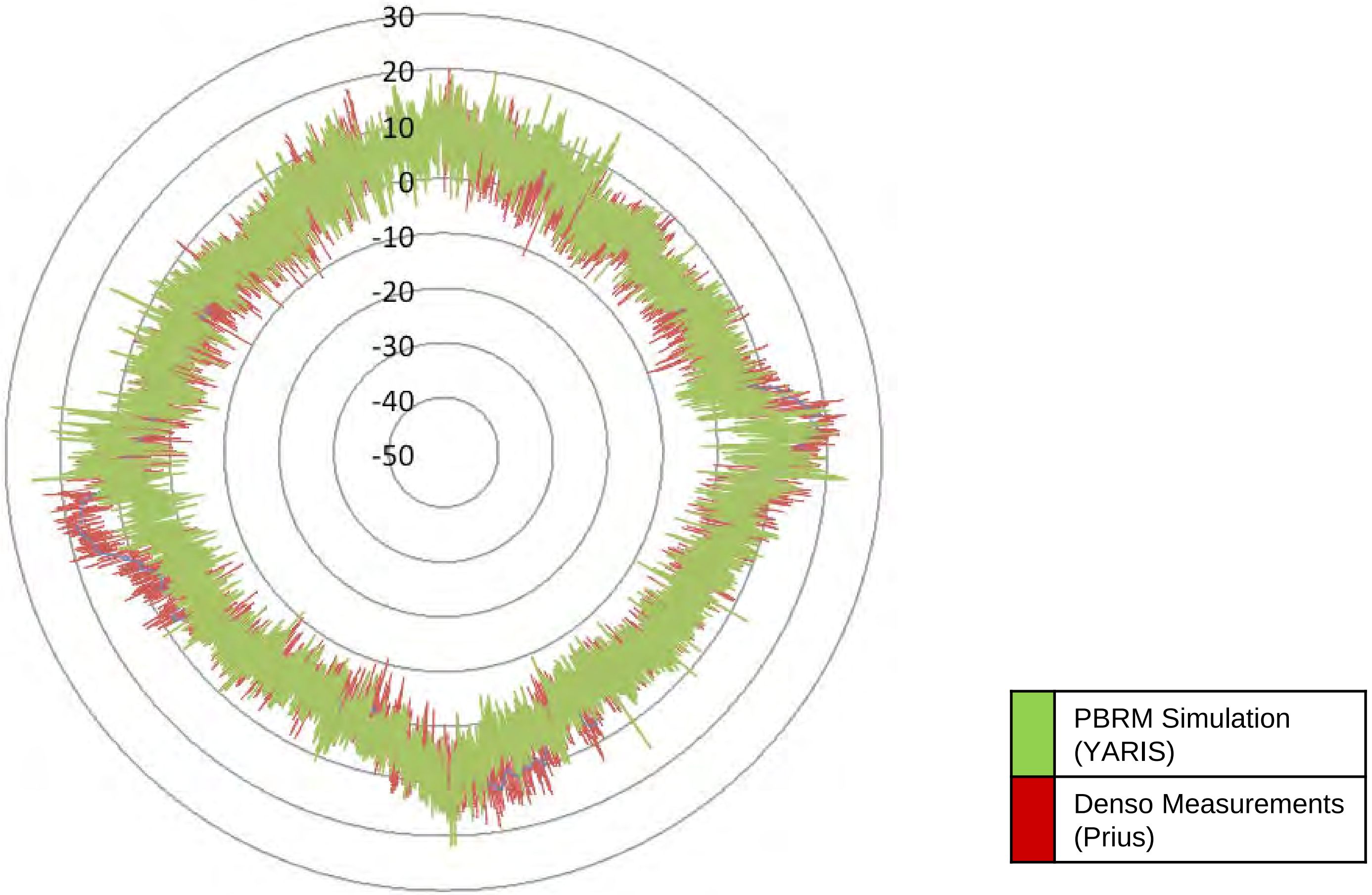


Verification of RCS - Vehicle



Lidar Sensor Models

Point Cloud Sensor

Made for real-time applications

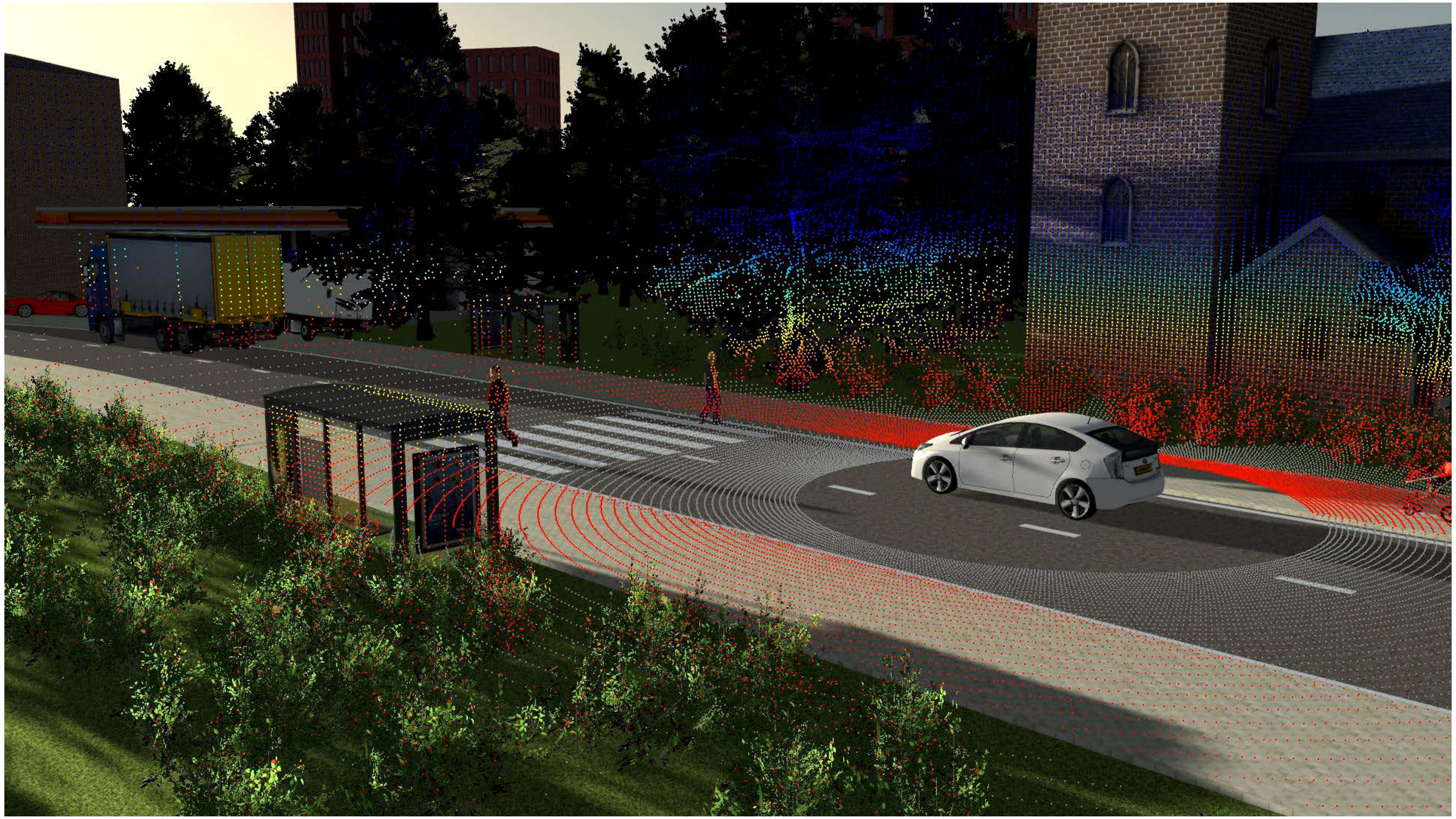
Able to generate 240,000 points and run in real-time for a highway scenario that contains up to 7 target vehicles

Outputs:

Point cloud measurements in x,y,z coordinates

Range and angle

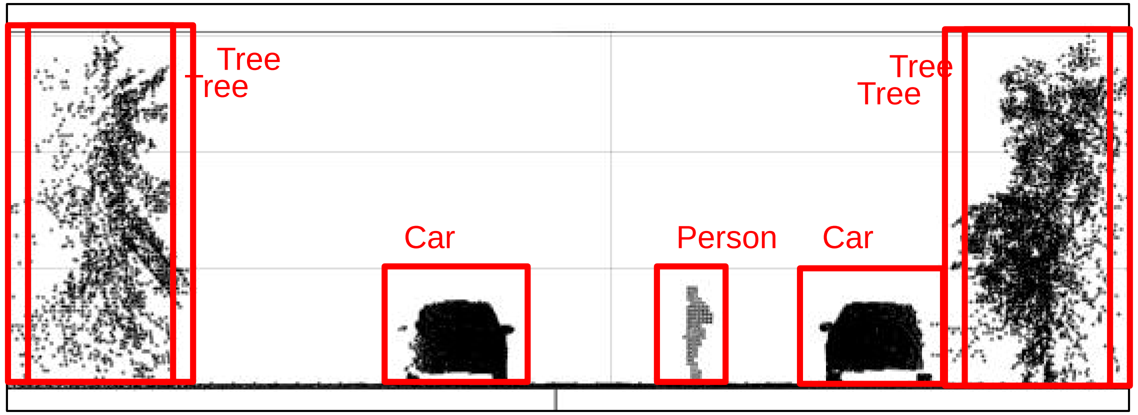
Intensity values used for object differentiation



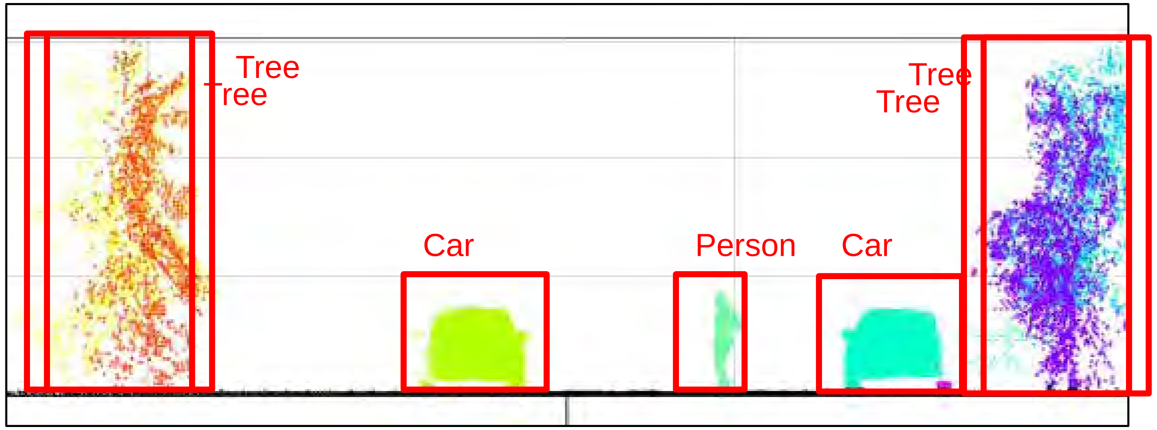
PCS Ground Truth

SIEMENS
Ingenuity for life

De-clustered Point Cloud Data



Clustered Point Cloud Data



Point Cloud Sensor Settings

Resolution
Horizontal #Samples : 320
Vertical #Samples : 160

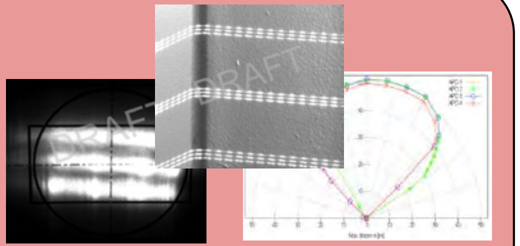
Field of View
FoV Azimuth [deg] : 60
FoV Elevation [deg] : 30

Detailed physics LIDAR sensor model – in development

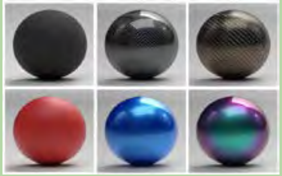
SIEMENS
Ingenuity for life

Input

Sensor Parameters
- Beam shape
- Beam divergence
- Wavelength
- Scan pattern (direction and time)
- Directional sensitivity
- Pixel sensitivity



World Definition



Simulation

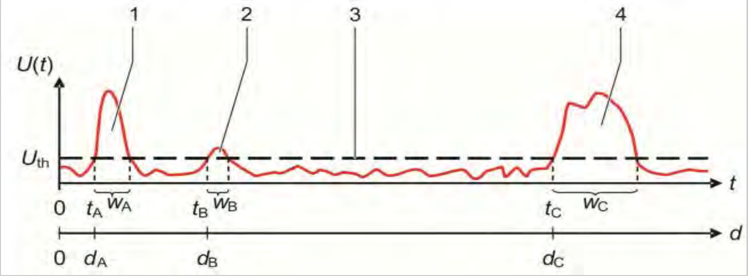
Tx — Tx Optics → Simulate Light in the Scene

Rx — Rx Optics ← Simulate Light in the Scene

Simulate Light in the Scene
- Multi-bounce
- Time Effects
- Weather
- Dirt/Dust
- Spectral Effects
- Refraction / Reflection

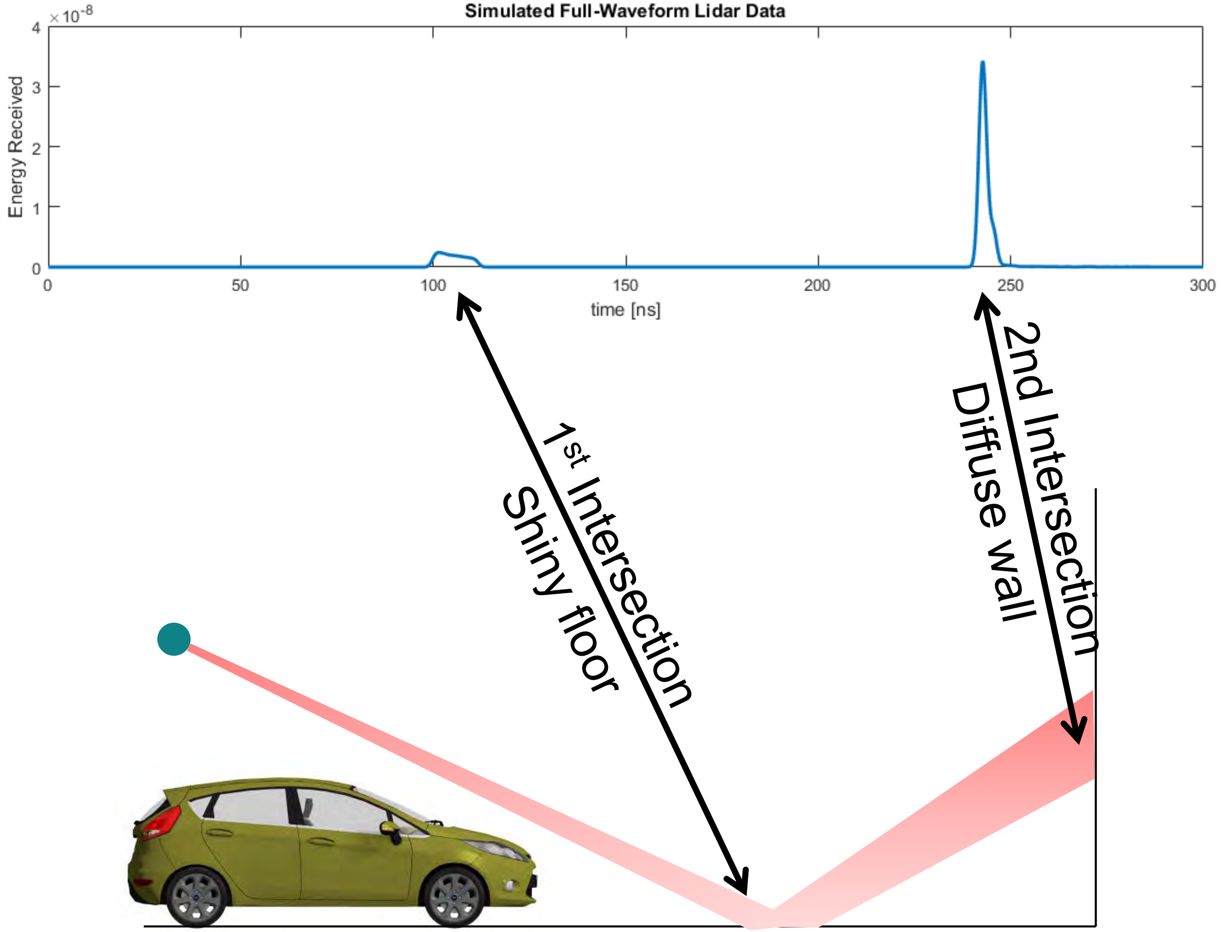
Output

Raw Data



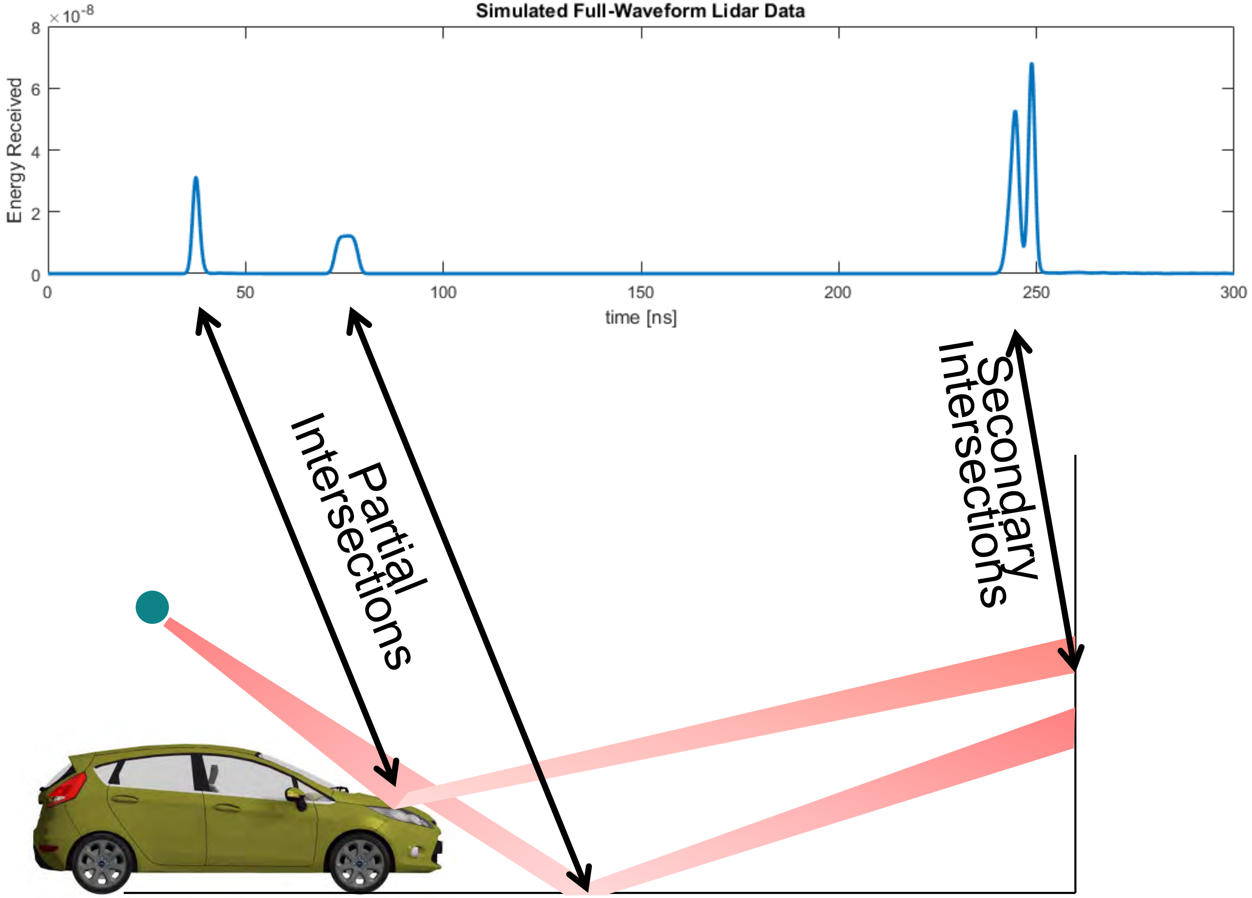
Signal Processing →

Detailed Physics Based Lidar Simulation



Detailed Physics Based Lidar Simulation

SIEMENS
Ingenuity for life



Weather Effects

SIEMENS
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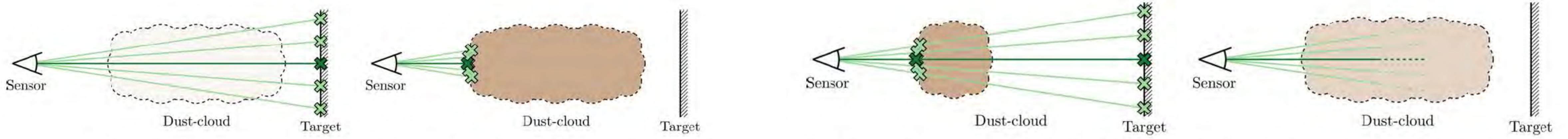
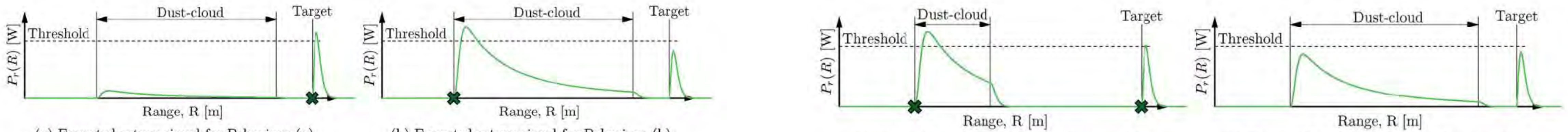
LIDAR sensors are affected by weather (e.g. rain, snow, fog) and dust. Therefore it is important to simulate how light from a LIDAR beam scatters in an environment. This can impact both the waveform and the final point cloud generated by the LIDAR



(a) Returns from the target.
(b) Returns from a dust-cloud between the sensor and target.
(c) Returns from both the dust-cloud and target.
(d) No returns from either the dust-cloud or the target.



(a) Expected return signal for Behaviour (a).
(b) Expected return signal for Behaviour (b).
(c) Expected return signal for Behaviour (c).
(d) Expected return signal for Behaviour (d).

V2X Sensor Models

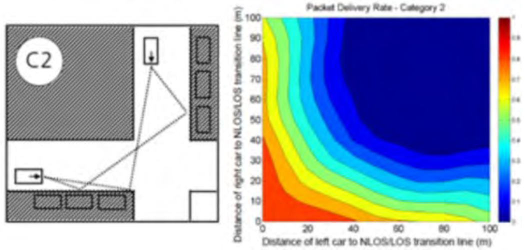
Sensor Modeling
V2X

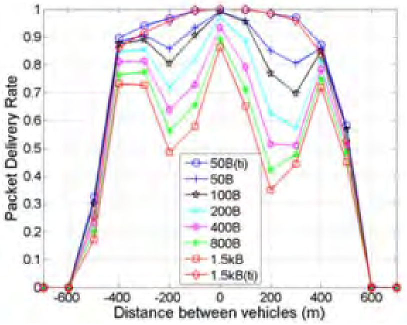
SIEMENS
Ingenuity for life

Application layer: Building your control algorithms

Facilities layer: Select your message set using standard message sets in PreScan GUI

	Distance based / ideal sensor No license needed	Fraunhofer statistical sensor Separate license required	Physics based sensor Separate license required
Network layer: How is the message distributed?	N/A	N/A	Framework ready *Hopping, geo-addressing to be added by TASS or partner in future versions*
Access layer: Message scheduling & queuing	N/A	Effects are lumped in one statistical model for <u>specific</u> scenarios	802.11p (ITS-G5,DSRC)
Radio channel layer: 	N/A		Dedicated radio models





Conclusions

SIEMENS
Ingenuity for life

- It is important to link the world with your sensor models
- Your sensor models should be a tradeoff between computation and realism
- Detailed Physics Based Sensor models were depicted for camera, Radar, Lidar and V2X

THANK YOU!!!!

MICHIGAN DEPARTMENT OF TRANSPORTATION

Statewide CAV Program Update

CAR CAV WG 2019 | March 14th, 2019

MDOT
Michigan Department of Transportation

MISSION

MDOT will work to ensure Michigan remains the national leader in the evolution of CAV technologies, to deliver enhanced transportation safety and reliability, providing economic benefit and improved quality of life.

PROGRAM GOALS

Goal 1: Serve as a national model to catalyze CAV deployment

Goal 2: Establish Foundational systems to support wide-scale CAV deployment

Goal 3: Make Michigan the go-to state for CAV research and development

Goal 4: Accelerate CAV benefits to users

Goal 5: Exploit mutual benefit opportunities between CAV tech and other department business processes/objectives

Goal 6: Use Michigan experience to lead dialogue on national standards and best practices

Infrastructure Deployment Plan

- Expansion underway to create one of the largest CV infrastructure deployments in the world

CV Design & Maintenance Guidelines

Statewide Guidelines Document

- Develop roles and responsibilities for the designer, MDOT, integrator, and general contractor
- Develop criteria for general deployment
- Standards development for different scenarios
  - Freeway vs Intersection
  - Installation on different structure types
  - Communication architectures to be applied
- Plan delivery requirements for different procurement methods

Updating Standards - Connected Signals Policy

- Coordinated effort with Signals Division to update traffic signal controller specification standards
- All new or upgraded traffic signals on the MDOT system will be CV-enabled going forward
- Developing process to configure and test RSUs at Signals Shop

Current CV Efforts

- Working to procure and implement SCMS
- Developing device/backoffice interoperability conformation process.
- Test and deploy ITIS phrase support for TIM.
- Houghton CV Deployment

Upcoming CV Efforts

- Statewide ITS Architecture update to include CV
- US-23 FlexRoute RSU deployment
- Houghton CV deployment integration


Communications
Talent
Research
Infrastructure
Applications
Data
Vehicles
MDOT
Michigan Department of Transportation
Michigan is Open for Business for CV Partnership Opportunities

GRIMM

HACKERS:

THE AUTO INDUSTRY'S LATEST SAFETY FEATURE

March 14, 2019
Connected & Automated Vehicle Working Group
Center for Automotive Research (CAR)

- Executive Director, **MI Homeland Security Consortium**

- Cyber-Mobility Program Manager, **Michigan Economic Development Corporation**

- Cybersecurity Manager, R&D, **Mazda North America**

- Director, Strategic Partnerships & Transportation Security Programs, **GRIMM Cyber Research**

- Cybersecurity Director, **NDIA MI**
  - Cybersecurity: Defense Sector Summit
  - Cyber Military Vehicle Industry Collaboration

What this presentation is *NOT*...

NO SCARE TACTICS

What This Talk *IS* About...

GRIMM

- Overview of Automotive Industry Trends
- Focus on Cybersecurity Implications
- What Is Working?
- Where Do We Need Improvement?
- Building a Framework
- Embracing Hackers in the Industry
- The Business of Hacking
- Talent of Tomorrow, Today

Automotive Industry Trends & Cybersecurity Considerations

EVs and Charging Stations

The Promise

- Energy Security
- Environmental Benefits
- Cost Savings
- Noise Reduction
- Tax Incentives

The Risk

- Shorter Range
- Long Charging Times
- Bi-Lateral Data Exchange
- Data Ownership

Shared, Smart Mobility

The Promise

- Cost-Efficient
- Solve Urban Density Issues
- Environmental Benefits
- On-Demand Transportation
- Social Experience

The Risk

- The Car is the Center of the IoT discussion
  - Data
  - Data
  - Data

Increasing R&D for Connected, Automated & Autonomous Systems

The Promise

- Fewer Fatalities
- Increased Safety
- Economic Empowerment; Commercially
- Traffic Management; Ant Farm Theory

The Risk

- Biometrc Data; Heart, Glucose, Vital Signs
- Increasing Software Applications; POEs
- Shift of Fatality Responsibility; Driver to Programmer
- Secure Vehicle in an Insecure Environment
- Lack of Regulation and Legal Guidance

Positive Cyber Automotive Trends

2017 Car Hacking Village, DEFCON, Las Vegas, Mazda CX-5

R&D Security by Design

Auto ISAC

Meet Ups Industry Professionals

Bug Bounties

Increased Hacker Embrace

Cyber AutoMobility Goals

Building a Framework to Validate Security Products

Legacy System Security Practices

Standardization of Compliance

Investment into Security Similar to Safety

Improved Cyberscurity Organizational Strategy; including IR Plans

Knowledgeable Cyber Automotive Workforce

The Business of Hacking: Planes, Trains & Automobiles
(Embedded Systems & Critical Infrastructure)

Creating a business model where a business model did not exist

Changing the narrative around "Hackers"

Bringing Calm to Chaos

Use Moral Compass

The GRIMM Business Model

A SDVOSB Cybersecurity Firm with a Holistic Approach*

CONSULTATION	RESEARCH	TRAINING

• Technical Consultation
  ○ System Review
• Non-Technical Consultation
  ○ C-Level
  ○ IR Planning
  ○ Standards & Practices
• Government Testimony, Consulting & Research
• Hacker Motivation & Mindset
• Classified Cyber Ranges
	• Advanced Penetration Testing
	• Reverse Engineering
	• Application of Adversarial Methodologies
	• Embedded Talent
		• Defensive Automotive Security Engineering
		• Telematics Security
		• Executive Leadership
		• Applications Security
		• Aerospace/UAV
		• Custom Built

*GRIMM offers SME's with Secret and Top Secret Clearance

The Talent of Tomorrow, Today: Things to Consider When Hiring a Hacker

Skills

Can they recommend practical and effective counter-measures to their findings?

Education requirements preferred: CS vs Mechanical / Electrical / Systems Engineering

Qualify / Quantify their experience

Beyond Skills

Expensive; Market Competition

Confidential Information is at stake

Do they understand your business needs and technical needs?

Hobbyist vs Professional; Scope-creep

GRIMM

The Common Bond: Cyber Talent Shortage

SQUARE ONE
EDUCATION NETWORK
the future starts with us

CYBERTRUCK CHALLENGE

SAE INTERNATIONAL

CYBERPATRIOT
INTEGRITY SERVICE EXCELLENCE
NATIONAL YOUTH CYBER EDUCATION PROGRAM

Washtenaw Community College

GRIMM

Let's stay in touch!

TWITTER: @GRIMMCYBER

LINKEDIN: Jennifer E. Tisdale

https://www.linkedin.com/in/jennifertisdale1

WEBSITE: WWW.GRIMM-CO.COM

EMAIL: Jennifer@grimm-co.com

Automotive Cybersecurity

Cyndi Millns, Professional Faculty

Washtenaw Community College

Evolution of Cybersecurity

Computers

People

Things

Associate in Applied Science Cybersecurity (APSCY)

- Linux
- Introduction to Programming
- Networking (Cisco – CCENT/ICND1)
- System Administration (Client OS and Servers)
- Scripting (PowerShell and Python)
- Introduction to Network Security – Security+
- Essentials of Network Penetration Testing (Ethical Hacking)
- Introduction to Cryptography or Cybersecurity Operations
- Network Perimeter Protection – CCNA Security

Program Features

- Transferability
- Flexible learning environments
- Industry best practices and certifications
- Soft skills development
- Critical thinking through reverse engineering and analysis

Why Automotive Cybersecurity?

Image courtesy of the U.S. Department of Transportation

http://www.informationisbeautiful.net

Lines of Code

It should not be thought from above that Soviet party line is necessarily disingenuous and insincere on part of all those who put it forward many of them are too ignorant of outside world and mentally too dependent to question (*) self-hypnotism, and who have no difficulty making themselves believe what they find it comforting and convenient to believe. Finally we have the unsolved mystery as to who, if anyone, in this great land actually receives accurate and unbiased information about outside world. In atmosphere of oriental secretiveness and conspiracy which pervades this government, possibilities for distorting or poisoning sources and currents of information are infinite. The very disrespect of Russians for objective truth---indeed, their disbelief in its existence---leads them to view all stated facts as instruments for furtherance of one ulterior purpose or another. There is good reason to suspect that this government is

field of international law. This publication has been written with the expectation that the military attorneys making use of it will be provided with a basic understanding of the legal system governing the international community. International law is an area of jurisprudence which challenges. It quite often fails to provide concise "textbook answers" to problems which reach a degree of complexity far greater than that found in any other legal system. Entrusted with the task of regulating the conduct of international sovereign entities, it is a legal framework which develops on a daily basis. Its successes go largely unnoticed, while its failures gain almost instantaneous notoriety and condemnation. It is a jurisprudential system particularly unsuited for complacent personalities and regimented minds. Hopefully, military attorneys will not view the often evident imprecision of international law as a fatal weakness but as an opportunity afforded its practitioner to develop an efficient and viable legal system. Constructive criticism and the ability to apply concepts and rules to practical international legal problems must be based on a working knowledge of the subject matter. The achievement of this end underlies the purpose of this publication.

1 Million

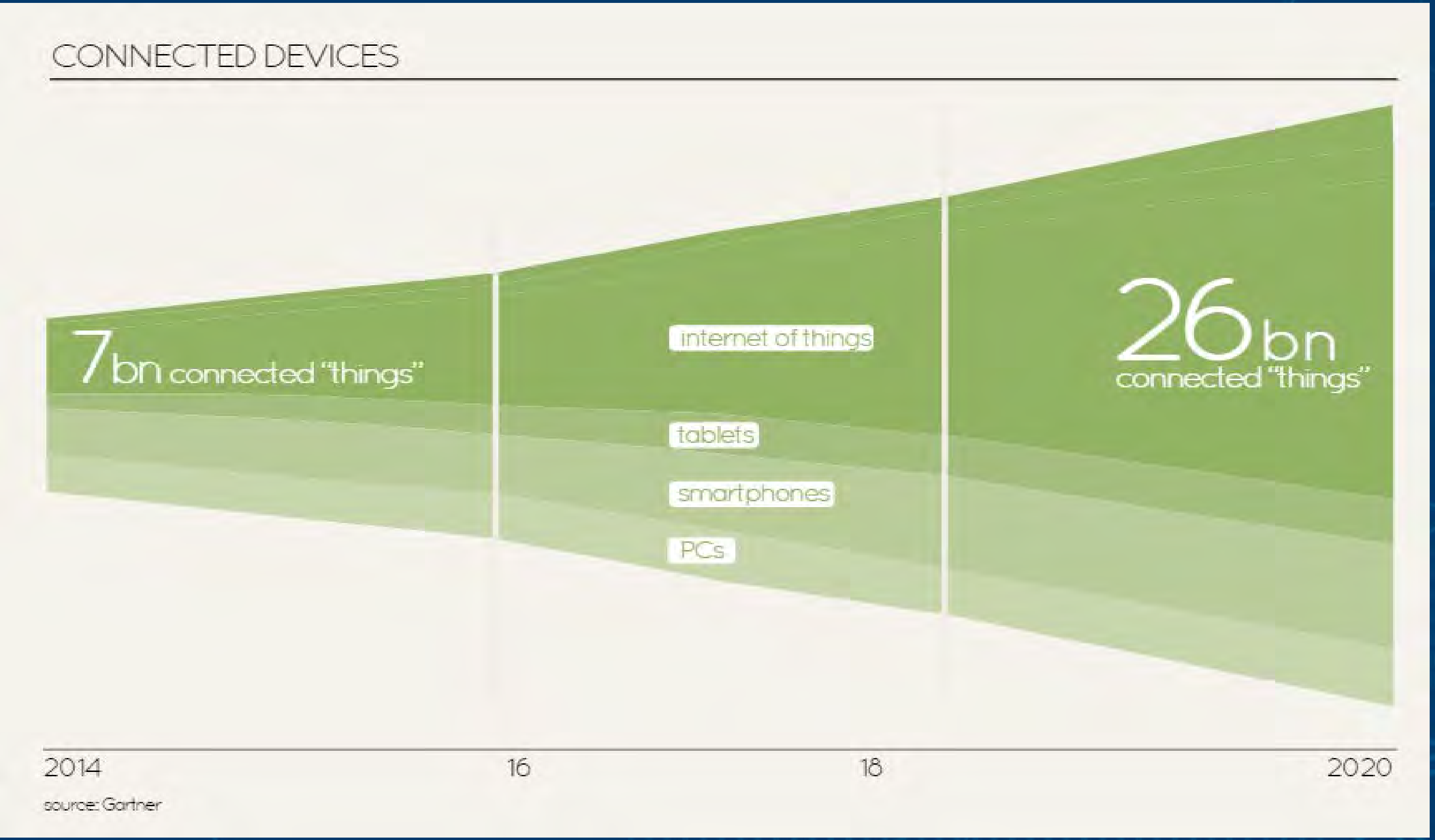
100 Million

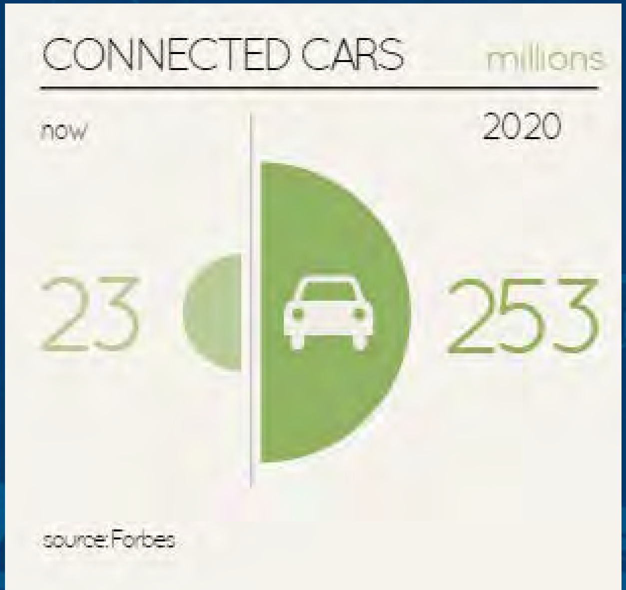
14 Million

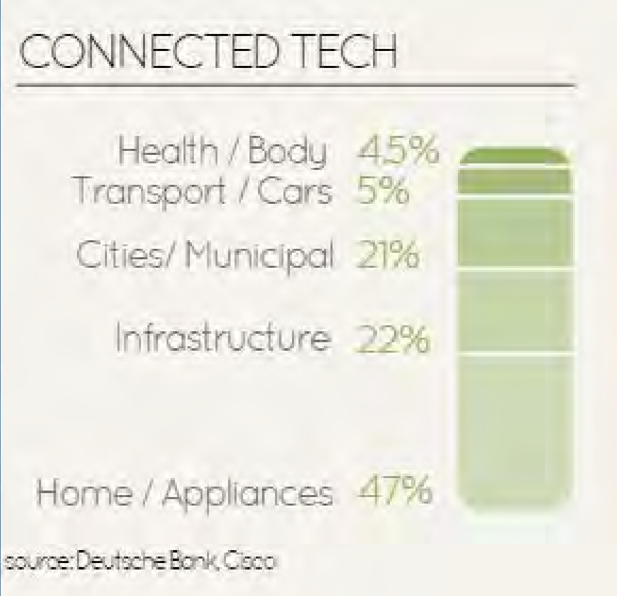
Ann Arbor, MI

Washtenaw Community College

http://www.informationisbeautiful.net







Ann Arbor, MI

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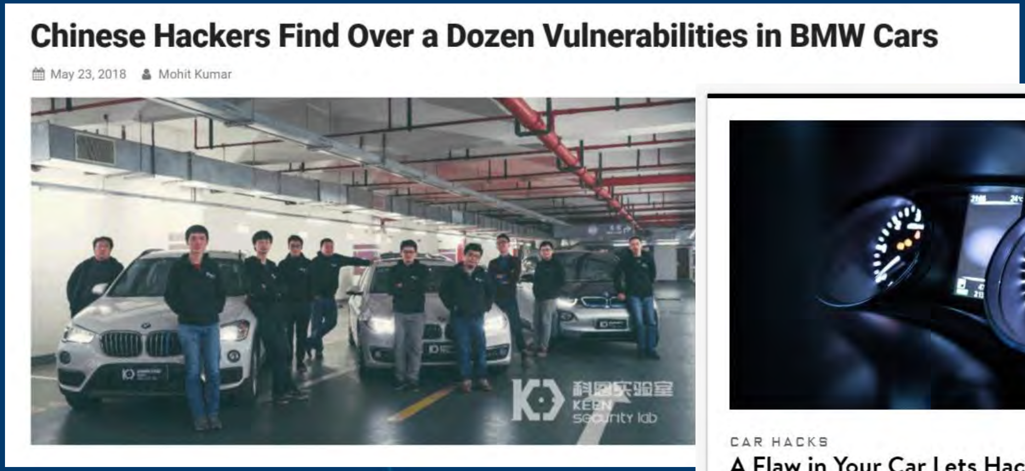
What could go wrong?


Chinese Hackers Find Over a Dozen Vulnerabilities in BMW Cars

May 23, 2018 Mohit Kumar


CAR HACKS

A Flaw in Your Car Lets Hackers Shut Down Safety Features

ANDY GREENBERG


SECURITY

A New Wireless Hack Can Unlock 100 Million Volkswagens

ANDY GREENBERG


SECURITY

Hackers Fool Tesla S's Autopilot to Hide and Spoof Obstacles

ANDY GREENBERG

- Safety
- Theft
- Terrorism
- Revenge
- Mischief
- Extortion-Ransomware
- Insurance fraud
- Espionage
- Stalking
- Feature de(activation)
- Identity theft
- Counterfeiting

Entry Points for Hackers

- External
  - Bluetooth
  - Internet
  - Wi-Fi
  - Key fob
  - LIDAR
    Digital broadcasts
  - Tire Pressure Monitors
  - Tail light
  - DSRC
- Internal
  - Diagnostic Port
  - CD/DVD
  - USB/SD card
  - Aux input
  - CAN Bus
  - Other networks
  - Mobile phone

Automotive Cybersecurity at WCC

- Cybersecurity Associates Degree
- Advanced Transportation Center
- Mobile Hacking Workbench integration
- Development of Certificate in Automotive Cybersecurity

Washtenaw Community College

Cybersecurity

Automotive	Manufacturing	Health Sciences
HVAC/Construction	Business/Finance	Retail/Hospitality

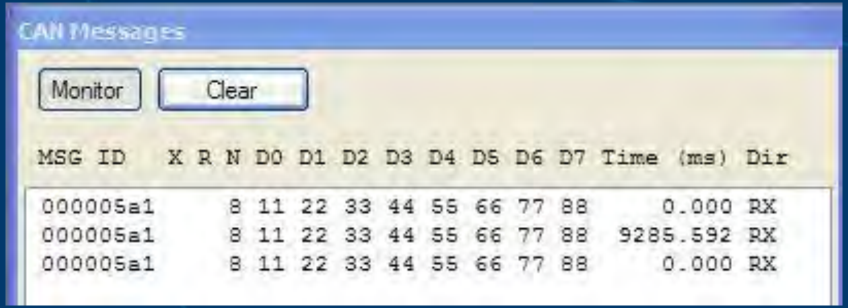
Cybersecurity	Cybersecurity	Cybersecurity
Automotive	Manufacturing	Health Sciences
Cybersecurity	Cybersecurity	Cybersecurity
HVAC/Construction	Criminal Justice	Culinary/Hospitality

Mobile Hacking Workbench - ACE

Ann Arbor, MI

Washtenaw Community College

Analyze
Isolate
Replay



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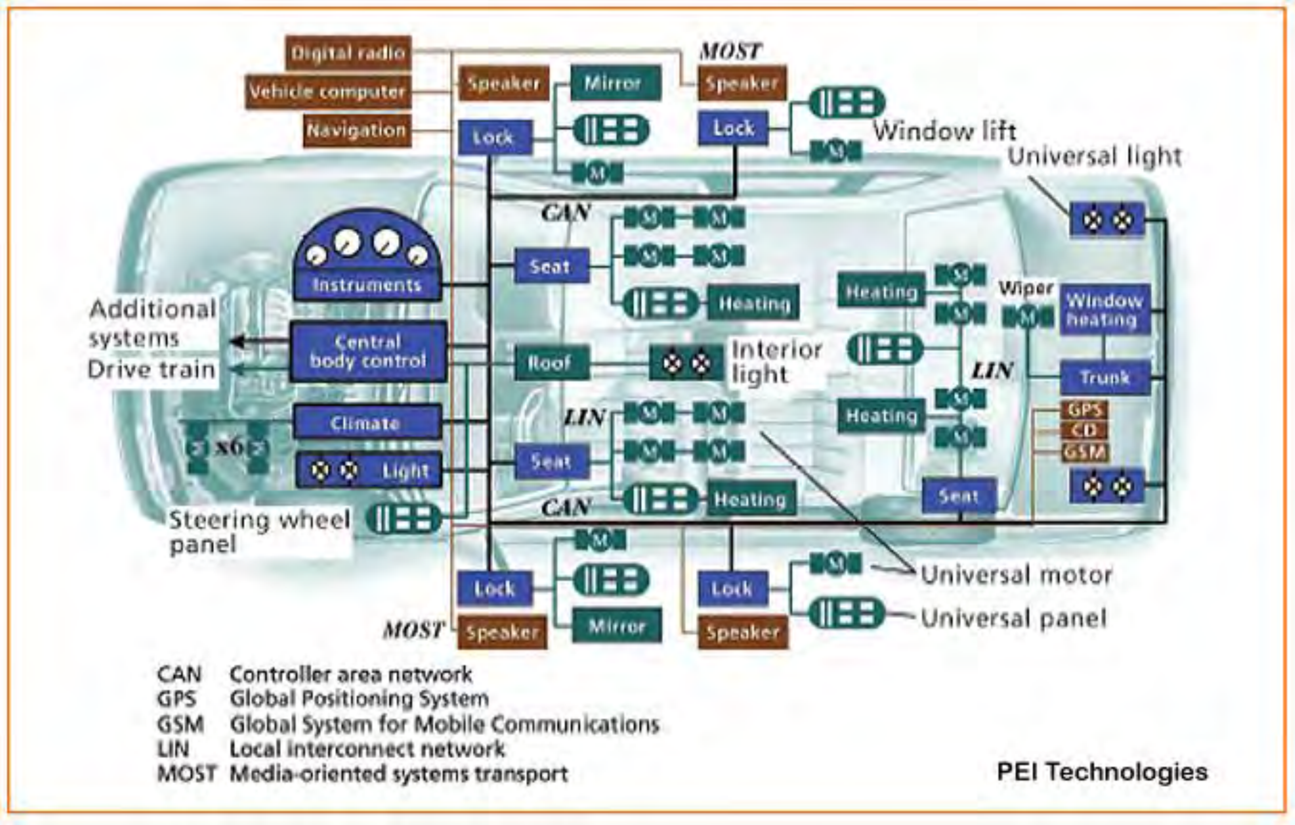
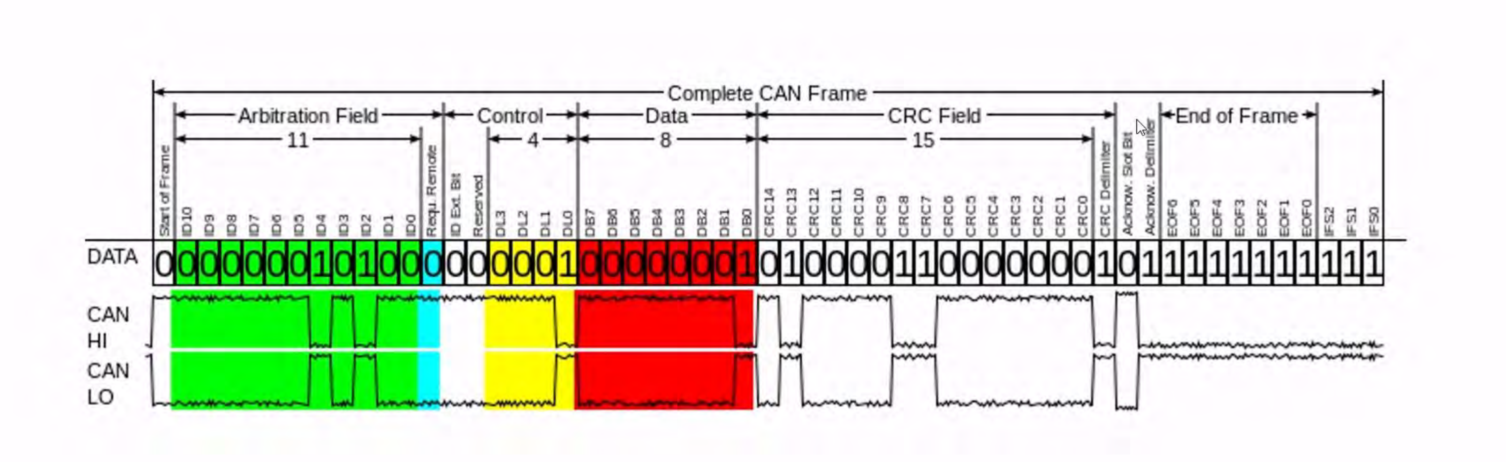
000005a1			8	11	22	33	44	55	66	77	88	9285.592	RX
000005a1			8	11	22	33	44	55	66	77	88	0.000	RX





Proposed Certificate in Automotive Cybersecurity

Pre-requisite: Linux

- CST185 Essentials of Local and Mobile Networks
- CSS200 Introduction to Network Security
- CPS171 Intro to Programming with C++ or CPS141 Introduction to Programming using Python
- CSS205 Essentials of Penetration Testing (Ethical hacking)
- CSSxxx Pentesting Automotive Platforms
- Automotive Technology Course (to be determined)

Faculty Preparation

- **Professional faculty in Automotive Technologies, Information Technology & Cybersecurity and Mechatronics**
- **Grimm's Defensive Automotive Engineering Training**
- **Non Credit Course Offerings in Intelligent Transportation**
  - **Intelligent Transportation Systems Basics**
  - **Automated Vehicle Localization Techniques**
- **Industry Partnerships**

Next Steps

- Automotive Cybersecurity Certificate launch
- Program integrations
- K-12 pipeline
- Industry events and partnerships

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