Xilinx Adapt Automotive

DMS is here, and OMS is coming…are you ready?

14 January 2021

Mike Lenne, PhD – Senior VP, Fleet & Human Factors
Kevin Tanaka – Senior Director, Automotive Marketing

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TECHNOLOGY TO DRIVE A SAFER WORLD

Industry leading **operator state monitoring technology** that enhances transport related safety and operational performance in real time in the real world.

Global and local **partnerships and collaborations** that underpin industry acceptance and the efficacy of our technology.

Applied Human Factors approach to our current and future technology development and validation.

- Global company, based in Canberra with over 200 full-time employees, listed on London Stock Exchange (AIM: SEE).
- Offices and people in UK, Europe, USA, Asia.

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TRANSPORTATION MARKET FOCUS

WHAT WE DO - *Monitoring of Humans for Transport Safety*

OEM Business

FOVIO driver monitoring technology platform

Leadership position in Driver Monitoring Systems (DMS), globally

DMS debuted in GM Cadillac CT6 Super Cruise 2018

Engaged by 6 global automotive OEMs to deliver DMS across 9 programs

Extensive work with leading aircraft OEMs, carriers, simulator co. and ATC (air traffic control)

Data driven pilot training and in-cabin pilot attention/drowsiness/ incapacitation monitor

Aftermarket Business

Guardian: Pioneering real time driver fatigue/distraction detection and intervention technology

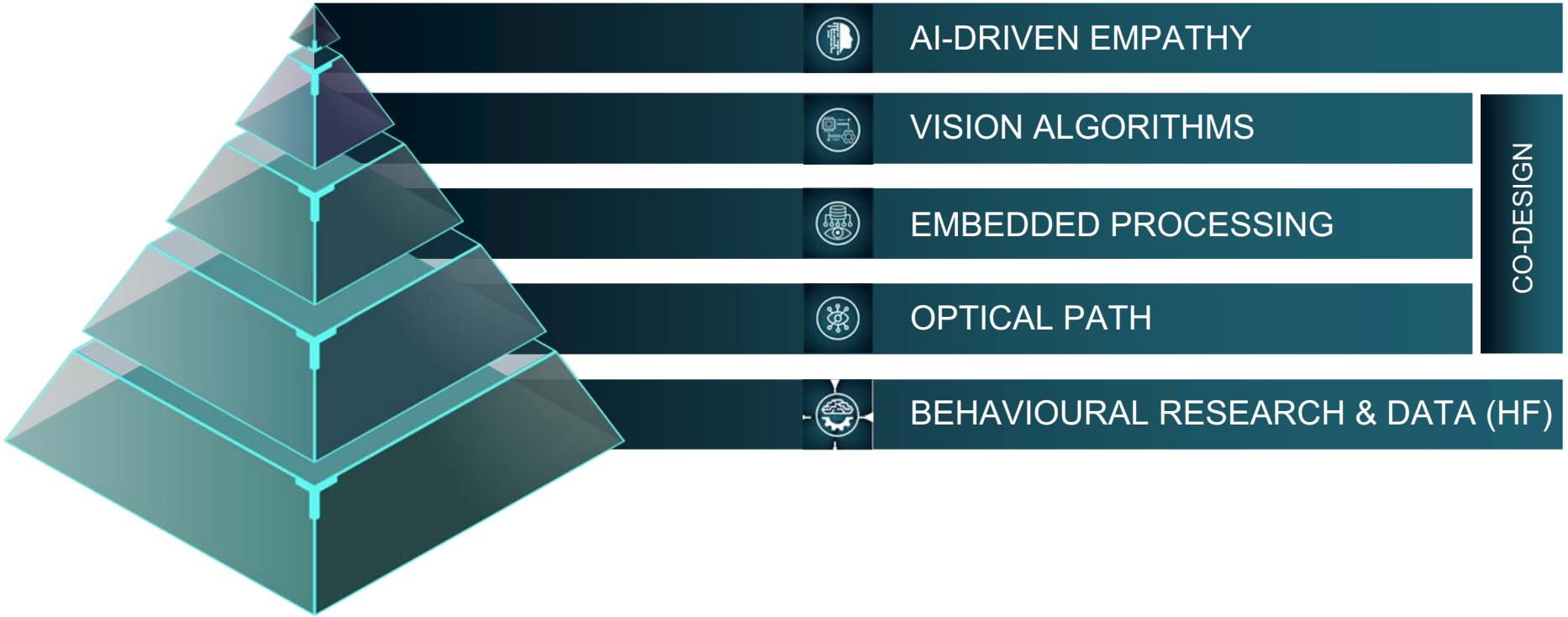
Commercial transport and logistics focus globally

Expanding global footprint with >20,000 connections in more than 26 countries

Exclusive global mining partner – Caterpillar Inc.

CAT

SEEING MACHINES EXPERTISE



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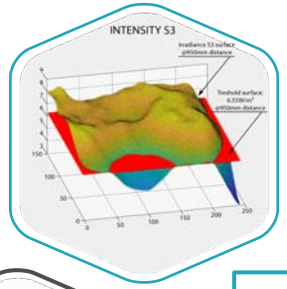
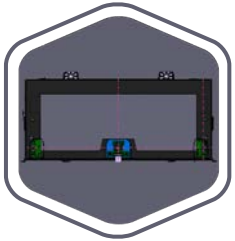
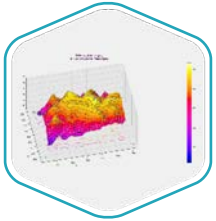
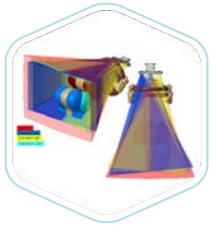
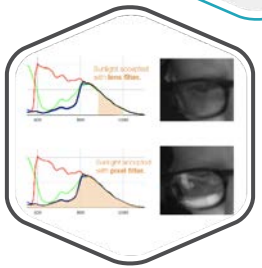
SEEING MACHINES OPTICAL PATH KNOWLEDGE











- Image quality and illumination metrics to achieve eye-tracking performance targets are shared with OEMs.
- Metrics input into requirements.
- We then work closely with Tier Ones to ensure requirements are achieved in any design.

Outcome = DMS that works

Seeing Machines Research & Development and co-design with customers for key optical properties:

- Camera and IR light count and position
- MTF – Image sensor choice and lens design
- SNR – IR light design and imaging filter design

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IN-VEHICLE DMS INTEGRATION POINTS (Camera & Processing)

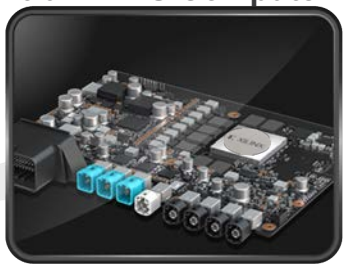
Instrument Clusters

Mirror/Headliners

Infotainment

Standalone ECUs

Central ADAS Compute ECU



Embedded products strategy allows for Best-in-Class Driver Monitoring in multiple in-vehicle locations through *flexible* systems integration

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EMBEDDED PRODUCT OFFERINGS OVERVIEW

Gives customers flexibility to decide optimal delivery platform independent of the features/functions required

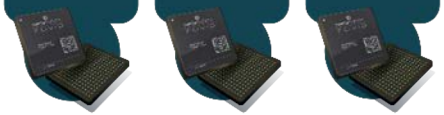
FOVIO-Chip Family

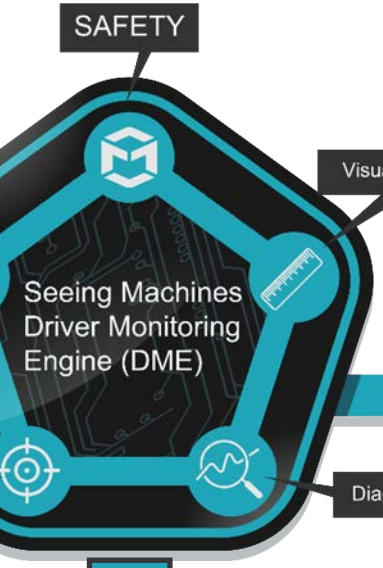
Maximum Efficiency / Standalone ECU

Seeing Machines FOVIO Driver Monitoring Product Chip Family

- Full featured DMS in a Chip
- Pre-validated
- Powered by SM's Occula™ NPU Accelerator
- NCAP Ready

FDM Base	FDM Premium	FDM Aftermarket
NCAP Low Mono Cam	NCAP High Multi-Cam	DMS Smart Cam





NEW

ASIC Encrypted Occula NPU RTL + FOVIO-Engine (e-DME) Software

FOVIO-Engine SW

Maximum Flexibility / Integrated ECU

Seeing Machines FOVIO Driver Monitoring Engine Software

- Embedded DME (e-DME) Libraries
- Highly optimized for ARM platforms
- Ported Acceleration

e-DME Qualcomm	e-DME Renesas	e-DME Xilinx
Snapdragon	R-Car	Ultrascale+
Qualcomm	RENESAS	XILINX

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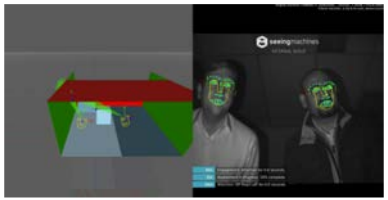
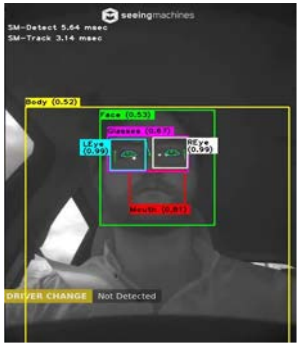
FOVIO CHIP FAMILY with Occula™ NPU

	FDM1CCM1E (XA7Z020-based in CLG400)	FDM1CBM1E (XA7Z010-based in CLG400)	FDM1CAM1E (XA7Z010-based in CLG225)
Recommended For	Development and Very High-End Solutions	Best in World / Feature-rich DMS solutions	Best in Class solution for NCAP/NCAP + at lowest cost system

Family of devices and software stack that scales from highest performance and lowest-cost EURO NCAP base solution to full-featured high-end driver monitoring system variants

In collaboration with XILINX





Introduction of SM's new proprietary Occula™ Neural Processing Unit (NPU)

- Single-shot real-time multi-object detection and tracking
- Optimized tracking algorithm that is 1/3 the network size of the previous generation and 1/2 the latency
- Efficient support for multiple occupants and accommodates significantly occluded view of faces/eyes
- Algorithm can be adapted to locate any object type (mobile phones, infant car seats, etc.)
- Tracker specialized for head tracking with face masks (sickness masks)

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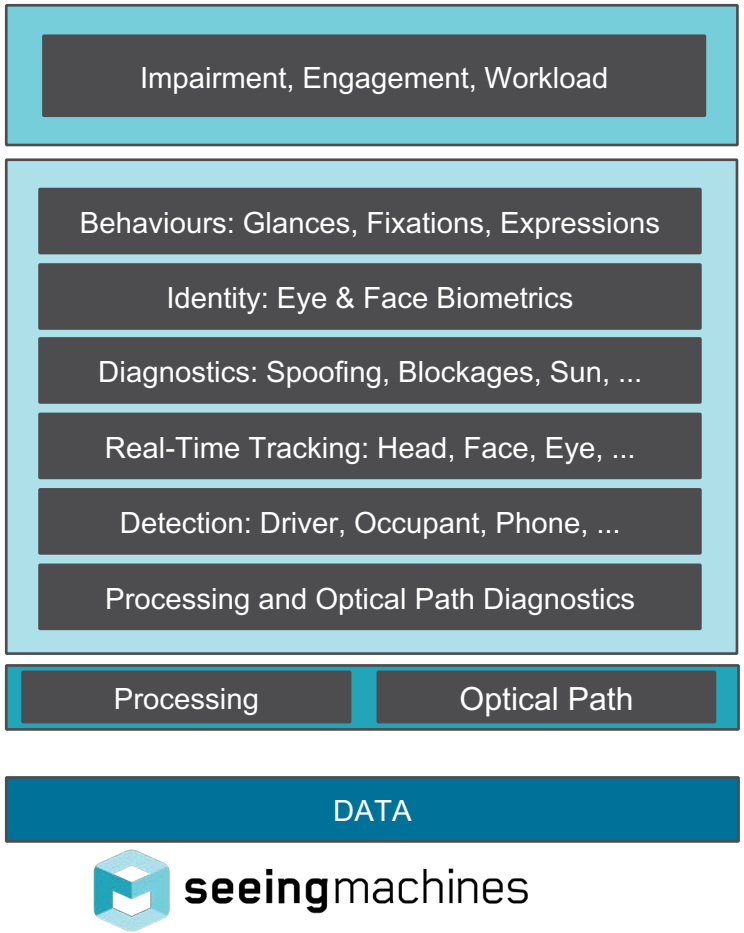
“FULL STACK” DRIVER MONITORING TECHNOLOGY APPROACH



High-Level Inference Algorithms
Classification of Key Driver Mental States
Expertise in human factors science and machine learning.

Low-Level Measurement Algorithms – Core detection and tracking along with diagnostics
Image and signal processing to extract measurements from video and audio of driver.
Expertise in algorithm techniques and embedded software.

Platform Hardware Technology
Optimized embedded processing and optical solutions.
Expertise in electronics, processing and optics technologies.

Multi-Source Databases
Scientific quality (HF), Crowd-sourced quantity (Guardian)

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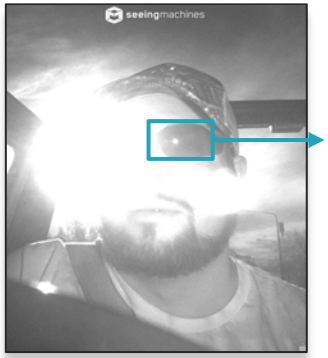
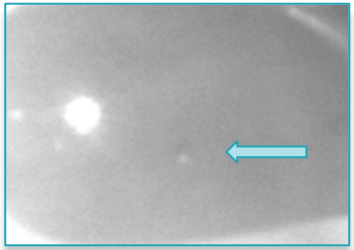
ROBUST CORE TRACKING = Higher Confidence Driver State

TRUSTED CORE TRACKING and HIGH AVAILABILITY IN REAL WORLD CONDITIONS

Typical driving situation
Driver wearing sunglasses in full sun
1.3MP NIR sensor.



Algorithms control contrast in eye image region by selecting optimal intensity and energy of NIR pulse matched to imager control settings.



Zoom of image in eye region.
Very low contrast eye features.
Just enough information to still track the driver.

*High performance core tracking and high availability of signal are <u>absolute requirements</u> for understanding **Driver State** (Distraction/Impairment). Expertise in and co-design of tracking algorithms and optical path control is the way to achieve this.* ***GARBAGE IN = GARBAGE OUT***

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SEEING MACHINES EXPANSION INTO OMS

As we extend our product lines to support occupant monitoring, we address these challenges in three areas of strategic focus:

Ensure that **driver state performance** is NOT compromised.

- Maintain a **5-Star Euro NCAP** capability.
- Ensure safety for **all users** in **all conditions**.

Create algorithms that use the **highly-optimised acceleration** capabilities of OCCULA™.

- Market-leading computational performance on **FDM Chip** and **CPU**.

Focus on providing **quality features** for the **front seat occupants**.

- Minimise the tracking volume.
- Maximises the image quality.
- Minimise the optical path cost.

NFOV Camera

WFOV Camera

Initial Demonstrator uses

Powered By OCCULA NPU

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+ all SM software EMBEDDED on FDM-CHIP (Z-7010 in CLG225)

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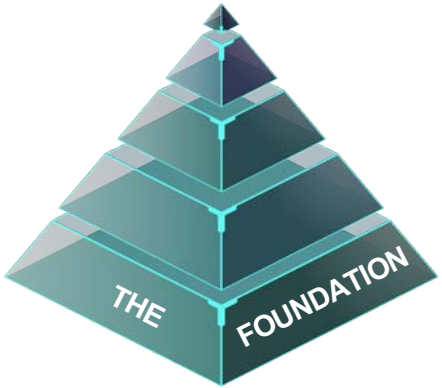

Behavioral Research and Data (Human Factors)

TECHNOLOGY DESIGN TO SUPPORT PEOPLE

SAE LEVEL 0 | SAE LEVEL 1 | SAE LEVEL 2 | SAE LEVEL 3 | SAE LEVEL 4 | SAE LEVEL 5

Right Now | Today and Tomorrow | Tomorrow

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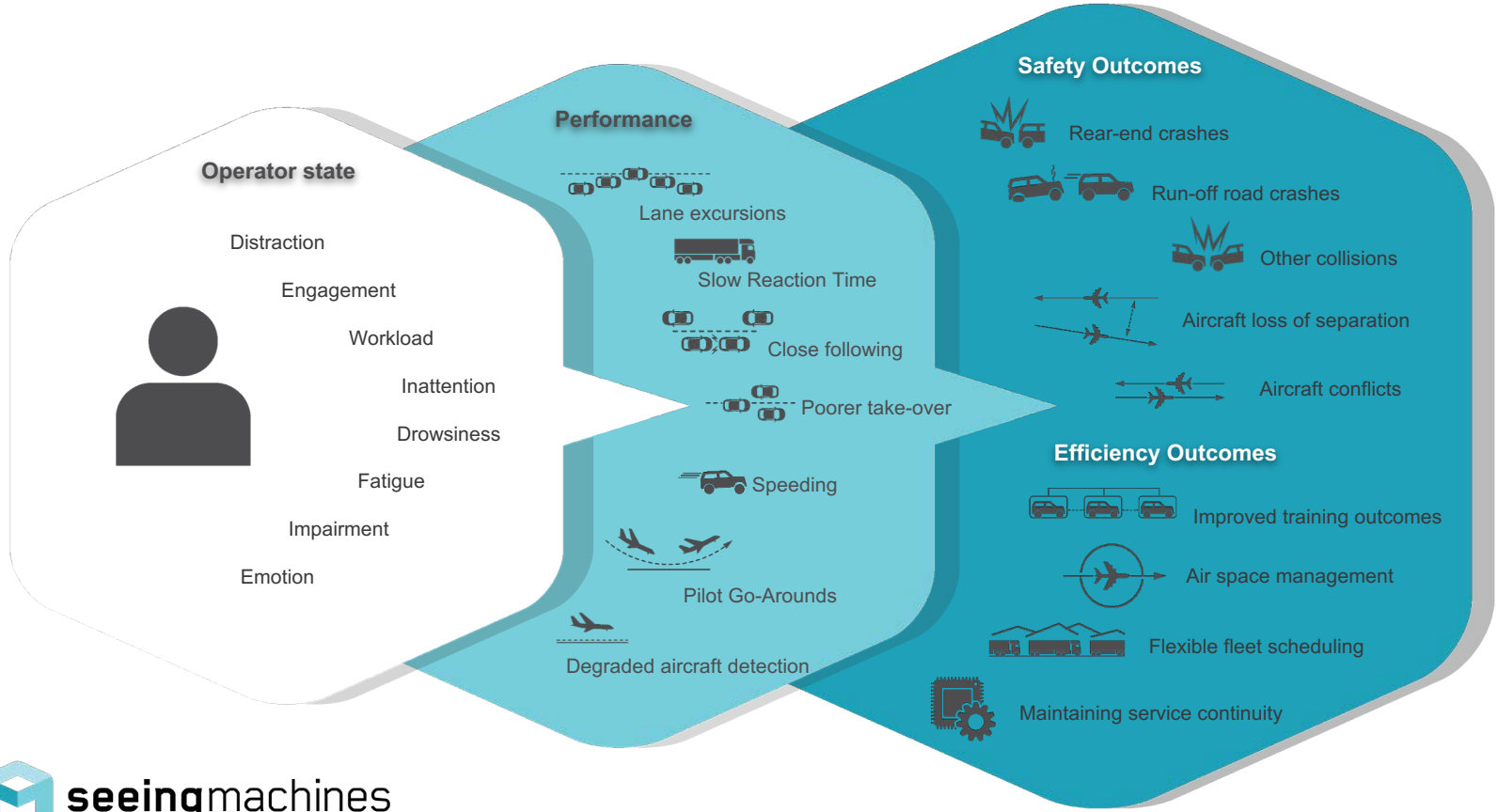
HUMAN FACTORS

HUMAN FACTORS DRIVEN OUTCOMES

Foundation of Seeing Machines Thinking and Development



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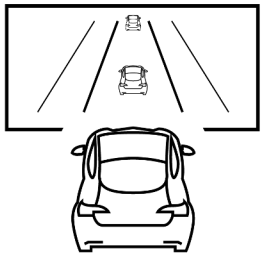
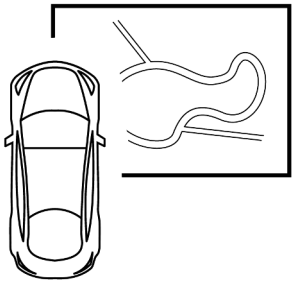
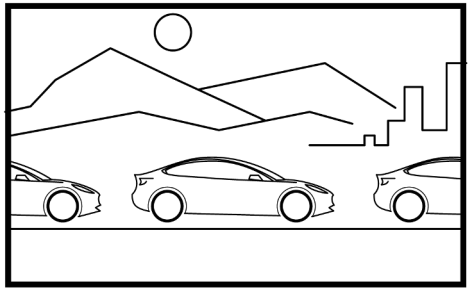
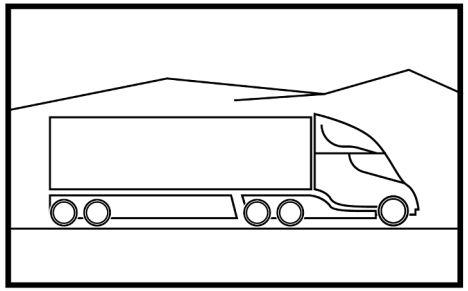
HUMAN FACTORS LEADERSHIP

BEHAVIORAL RESEARCH & DATA-DRIVEN DEVELOPMENT









Simulation	Test Track	On-Road test drives	Guardian (Fleet)

Deep understanding of operator state (truth development, algorithm development)

Deep understanding of real-world safety and efficiency (links to risk, algorithm validation)

DATA-DRIVEN INSIGHTS THAT DELIVER A KEY COMPETITIVE ADVANTAGE

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SEEING MACHINES PARTNERSHIPS AND COLLABORATION

Define concepts, identify data requirements → Develop relationships and programs to collect data → Generate cutting-edge insights from ground-truthing in real world → Input data and insights into algorithm development → Evidence based validation and dissemination

Australian Government
Department of Industry, Innovation and Science
Business Cooperative Research Centres Program
ACT Government
CANBERRA
MONASH University
Accident Research Centre
UNIVERSITY OF LEEDS
NATS
TOLL
RonFinemore TRANSPORT
VOLVO
L3 Commercial Training Solutions
Emirates
airservices

Collaborating with many partners in government, leading universities, and transportation customers to research and understand driver/operator performance and state to improve transport safety

CONTINUOUS INNOVATION – ADVANCED SAFE TRUCK CONCEPT

WHO: Seeing Machines, Monash University Accident Research Centre, Ron Finemore Transport & Volvo Trucks Australia

KEY FINDINGS:

1. Personalised approach to managing fatigue
2. Informing Australian National Heavy Vehicle Law reform
3. Improved algorithms

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DRIVER BEHAVIOUR DURING ASSISTED DRIVING

https://www.kron4.com/news/watch-video-shows-tesla-driver-apparently-asleep-behind-the-wheel/

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AUTOMATED VEHICLE TRIAL

CANdrive

PROVIDES

First on-road data of drivers in L2 scenarios completing a range of visual distraction and disengagement tasks

SCENE

About 30 drivers from ACT driving a Tesla Model S with Autopilot function on the test track (phase 1) and public road (phase 2)

IN VEHICLE MEASURES

- Seeing Machines DMS
- ECG
- Mobileye vehicle performance measures:
  Lane departure | Steering angle | Hard braking | Steering jerks
- Time of flight camera
- Forward-looking infrared camera
- Forward-facing camera
- Webcam

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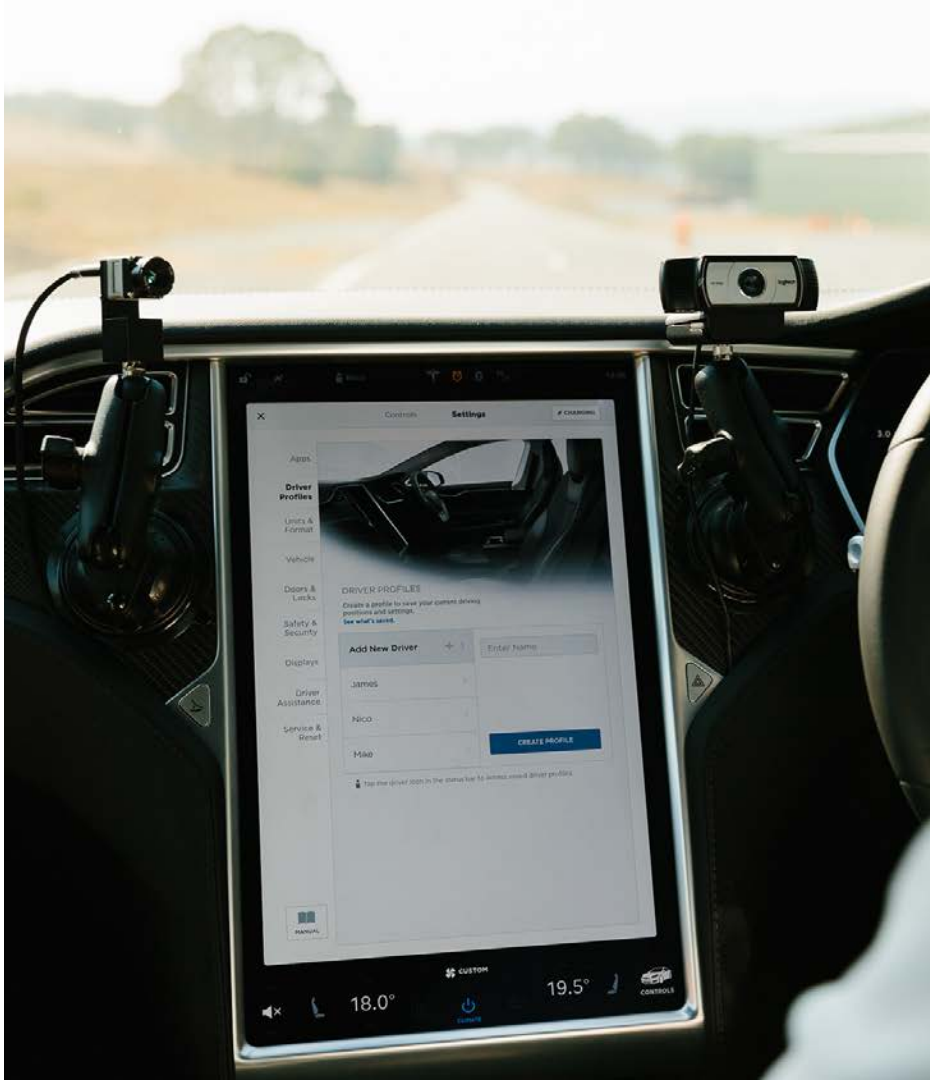
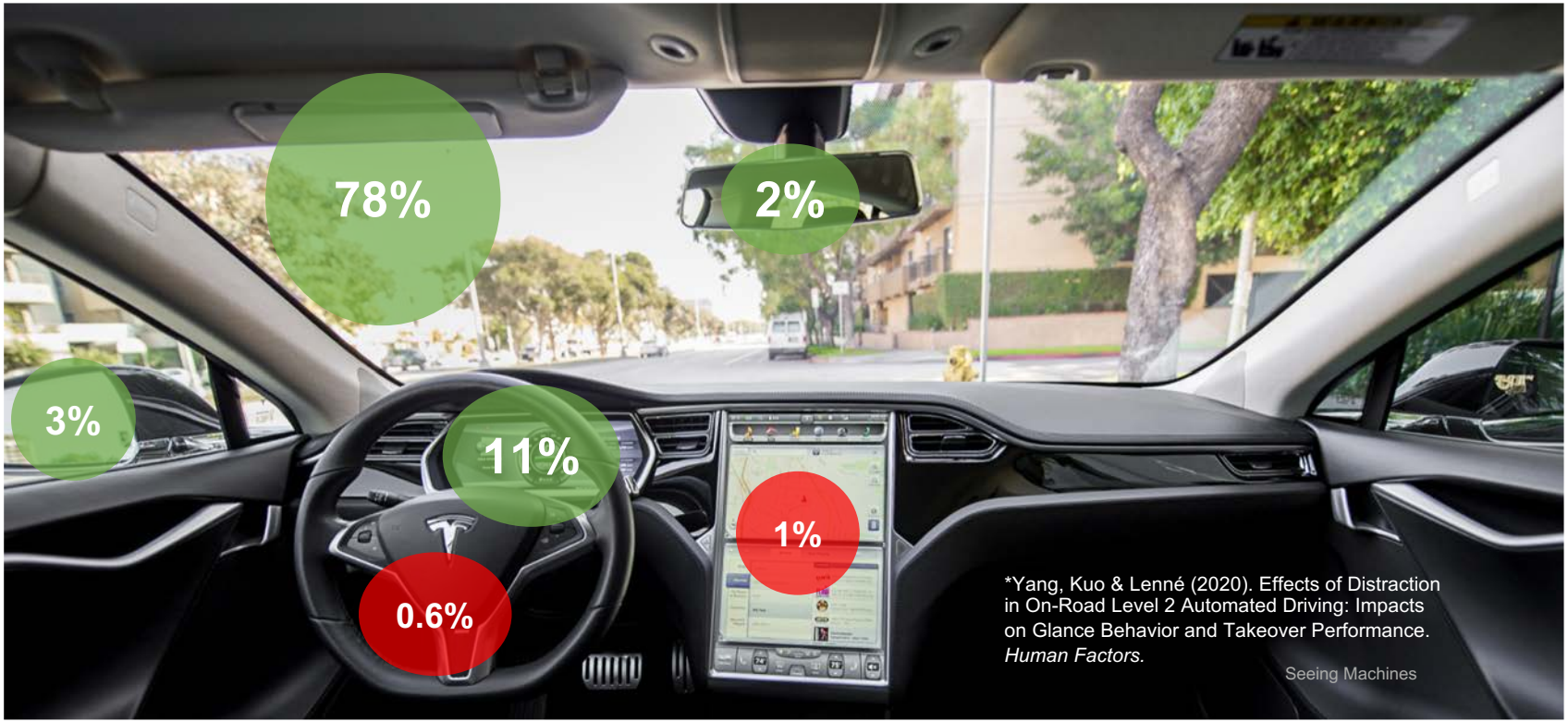


WHERE YOU LOOK DURING TYPICAL DRIVING



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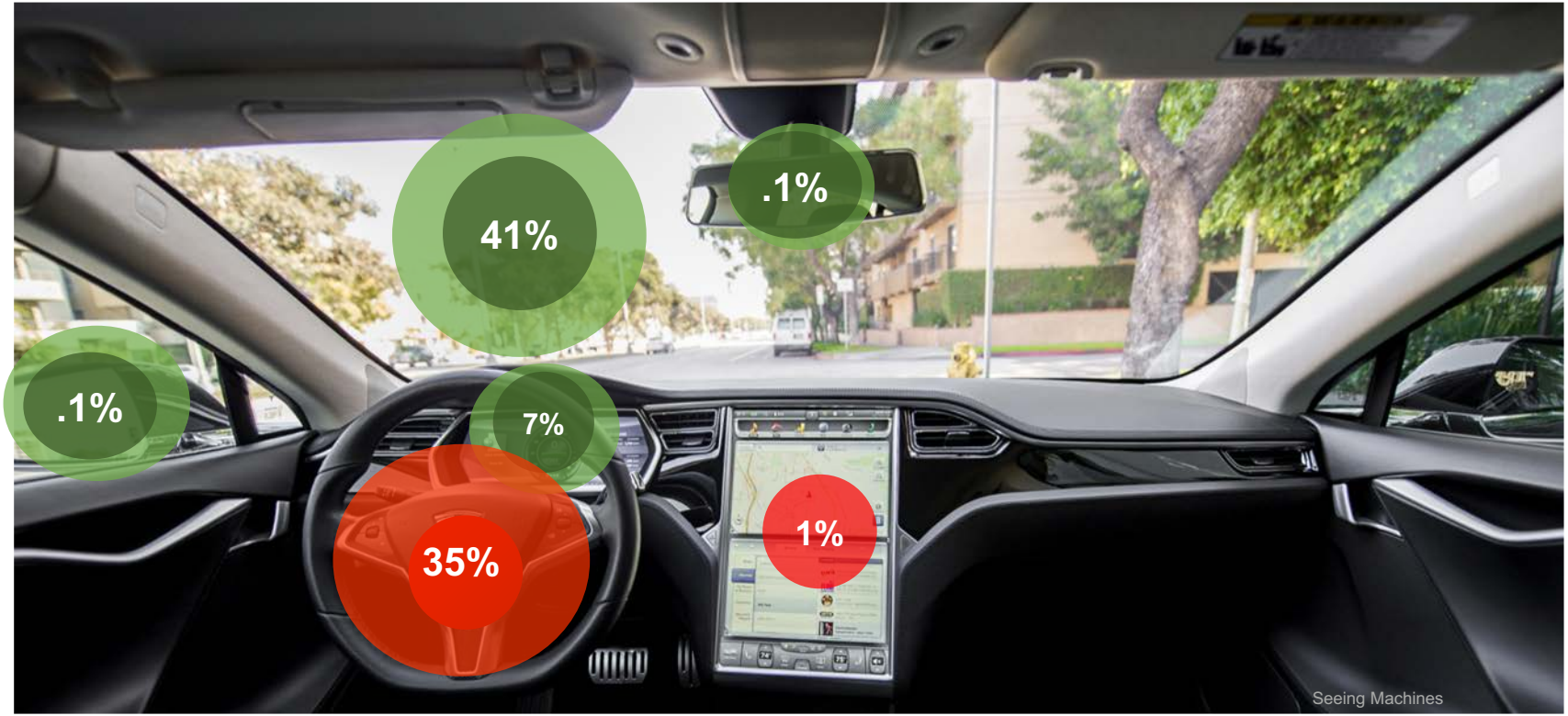
WHERE DRIVERS LOOK, TEXTING, WHEN AUTOPILOT IS ON



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HUMAN FACTORS LEADERSHIP
STAYING ONE STEP AHEAD

Prototyping and de-risking next generation concepts before they become production requirements

Human Factors: The Journal of the Human Factors and Ergonomics Society

Evaluating Driver Features for Cognitive Distraction Detection and Validation in Manual and Level 2 Automated Driving

Shiyan Yang, Kyle M. Wilson, Trey Roady, more... Show all authors

First Published October 15, 2020 | Research Article | Check for updates

https://doi.org/10.1177/0018720820964149

Altmetric 0

Article Information

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[1] Seeing Machines, Canberra, ACT, Australia

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SEEING MACHINES AUTOMOTIVE SAFETY LEADERSHIP

Represent Tier 2 technology suppliers as active participant in the Occupant Status Monitoring Working Group (OSMWG) introducing aspects for testing and validation of DMS sensing performance.

Advising on development of requirements and test procedures for General Safety Regulation 2 (GSR2) for DMS in SAE Level 3 and 4 AD systems.

Presented information on cutting-edge driver monitoring technologies and capabilities.

Due to Seeing Machines' Human Factors data driven research and development, we are viewed as a global expert in the field of Driver Monitoring safety.

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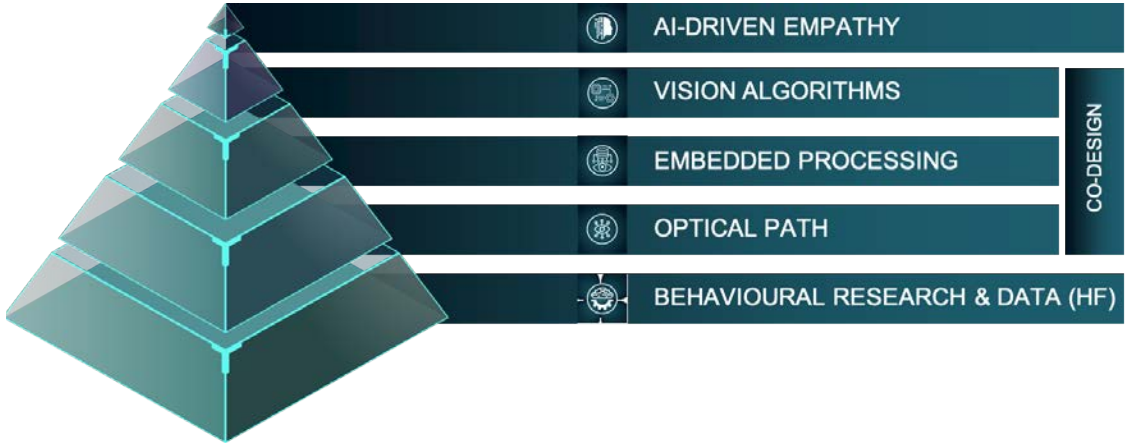
SUMMARY

- Continued legacy of industry leading DMS technology
- Extending leadership legacy from DMS to OMS



- Human Factors science approach (human state is hard and there is no substitute for scientific data-driven proof of efficacy)
- Recognized as a world leader by government and safety bodies and advising them in the field of Driver Monitoring Systems and safety (test protocols)

THANK YOU!

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