

seeingmachines

Computer Vision Technologies for Driver Safety Applications

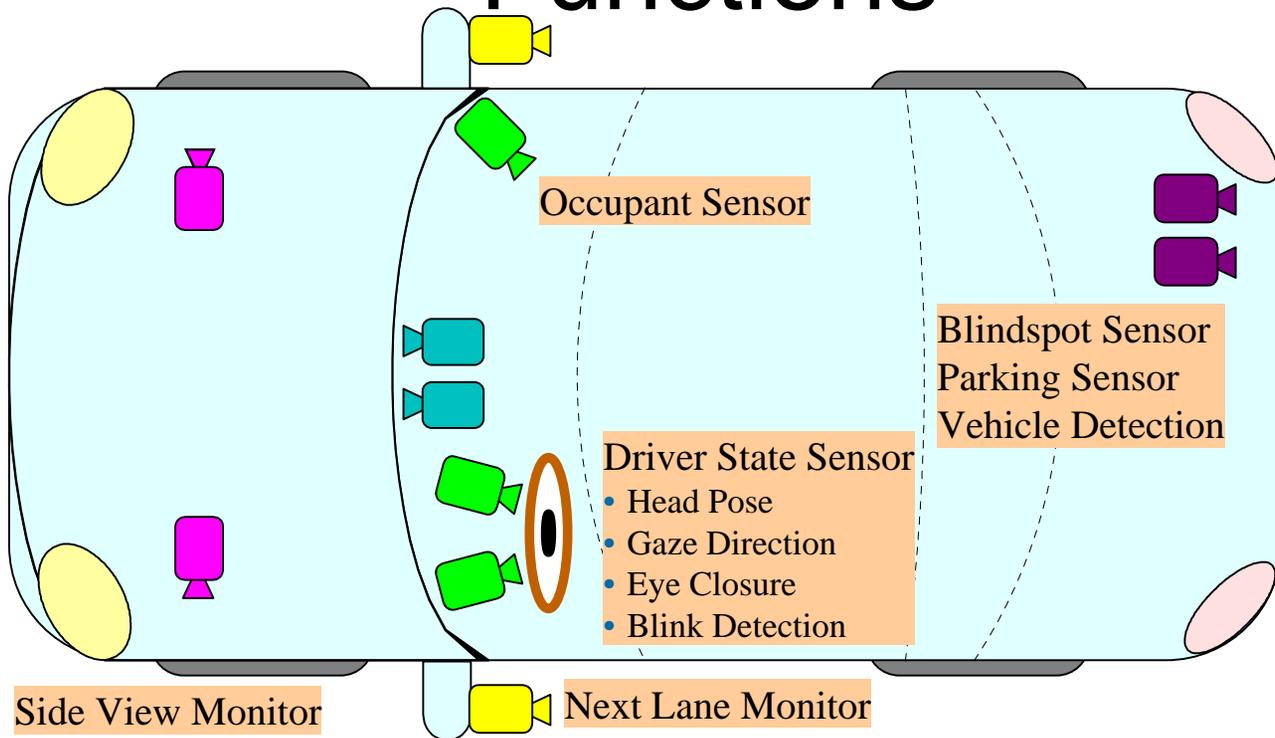
Alex Zelinsky
Chief Executive Officer
Seeing Machines



Smart Car Functions

Car Navigation
 Traffic Information
 Parking Information
 Internet Brokering
 Mobile Office
 Entertainment

Lane Departure
 Road Sign Recognition
 Road Hazard Detection
 Pedestrian Detection
 Obstacle Detection
 Vehicle Detection



Active Safety Systems

- Smart Airbags
- Collision Avoidance (Front, Side, Rear)
- Pedestrian Collision
- Lane Keeping
- Lane Changing
- Intelligent ACC

Advanced Driver Assistance Systems

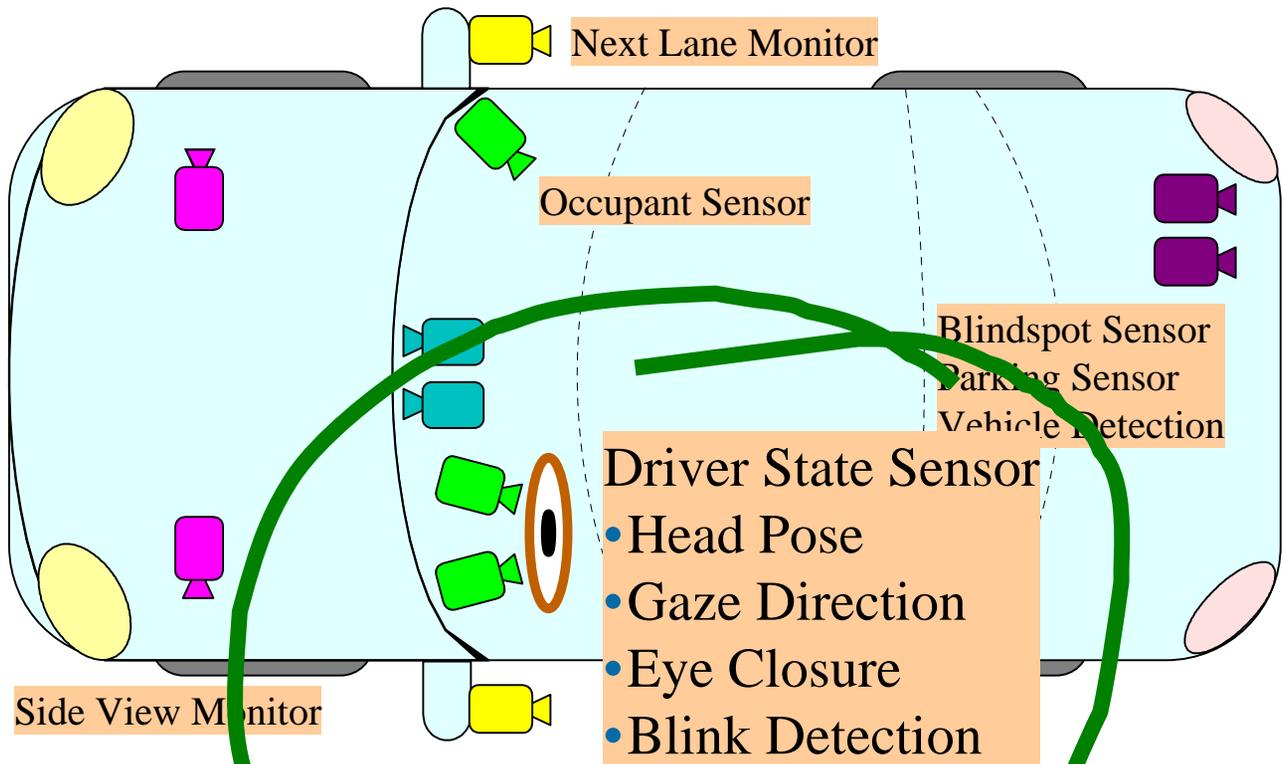
- Night Vision HUD
- Distraction / Inattention Mitigation
- Fatigue Detection
- Workload Management
- Driver Identification
- Comfort
- Parking Assistance





Our Niche....

- Lane Departure
- Road Sign Recognition
- Road Hazard Detection
- Pedestrian Detection
- Obstacle Detection
- Vehicle Detection



- Driver State Sensor**
- Head Pose
 - Gaze Direction
 - Eye Closure
 - Blink Detection

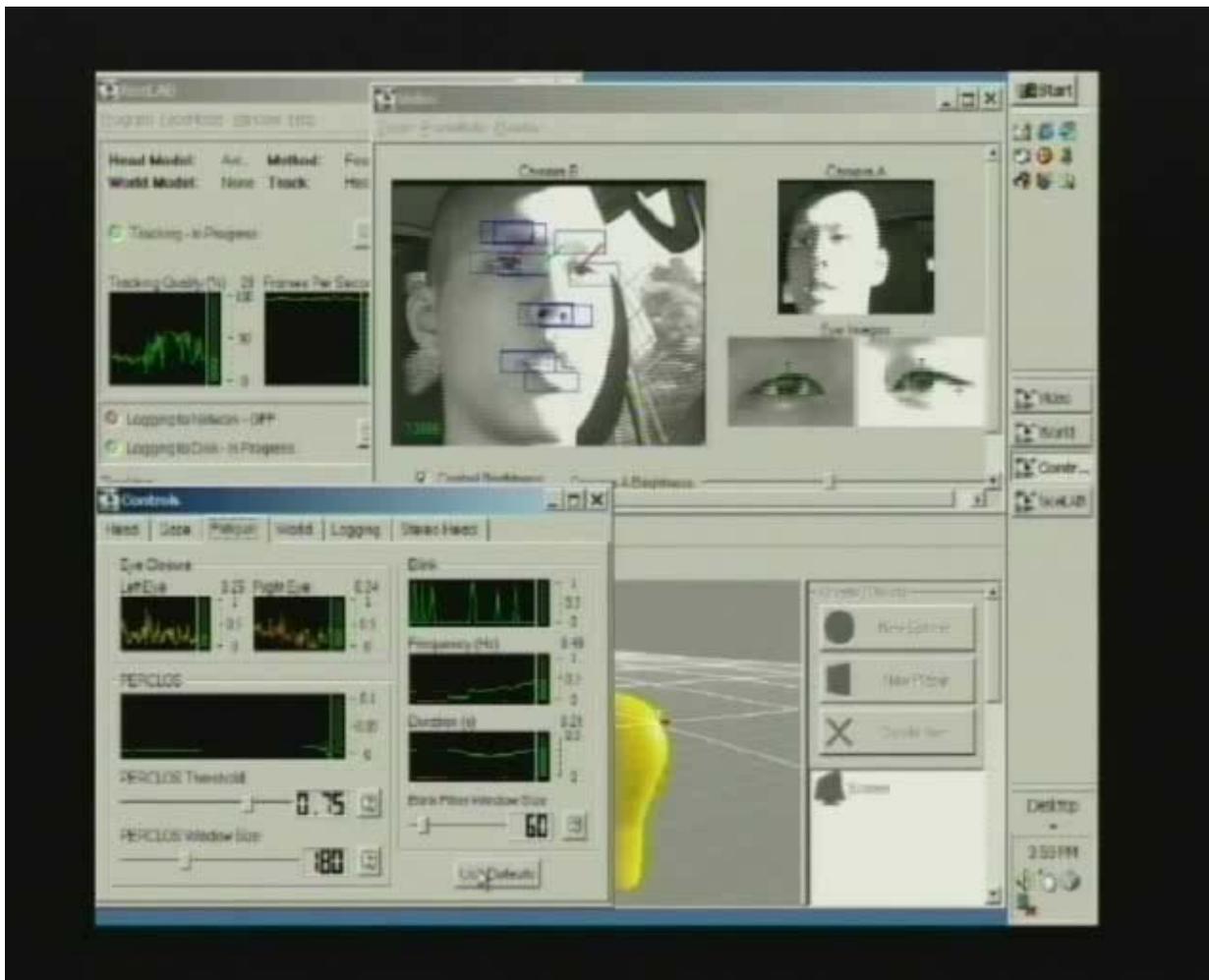
- Active Safety Systems**
- Smart Airbags
 - Collision Avoidance (Front, Side, Rear)
 - Pedestrian Collision
 - Lane Keeping
 - Lane Changing
 - Intelligent ACC

- Advanced Driver Assistance Systems**
- Night Vision HUD
 - Distraction / Inattention Mitigation
 - Fatigue Detection
 - Workload Management
 - Driver Identification
 - Comfort
 - Parking Assistance





Demonstration





Product Requirements

User acceptance will require::

- Autonomous
 - Real time operations with no intervention or training
- User independent
 - Age, race, facial hair, eye & sun glasses (> 95%)
- Robust
 - Failure Detection + Automatic Recovery (> 95%)
 - Lighting insensitivity
 - Wide range of head movement. (+/- 90%)
 - *Sensor redundancy with scalability (2nd generation)*
- Functional
 - Eye Tracking (movement, blink, eye opening, gaze)

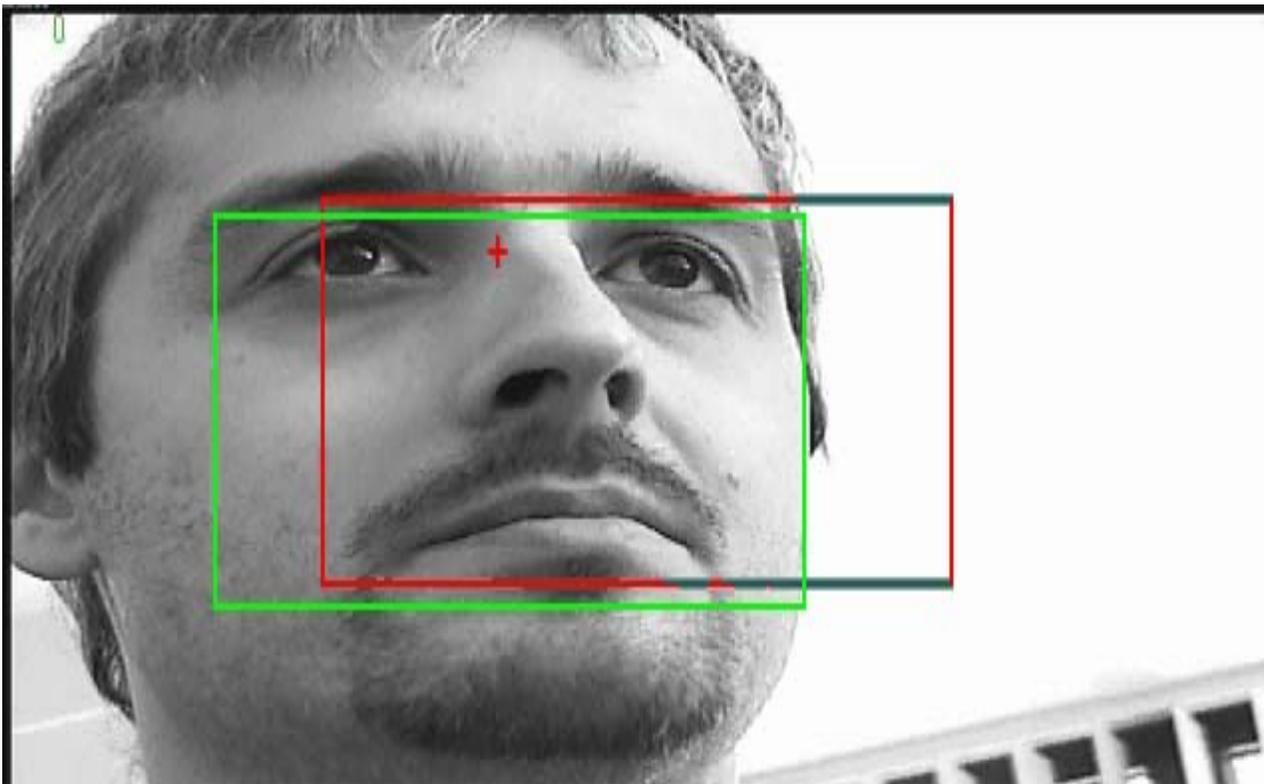


Automatic Initialisation



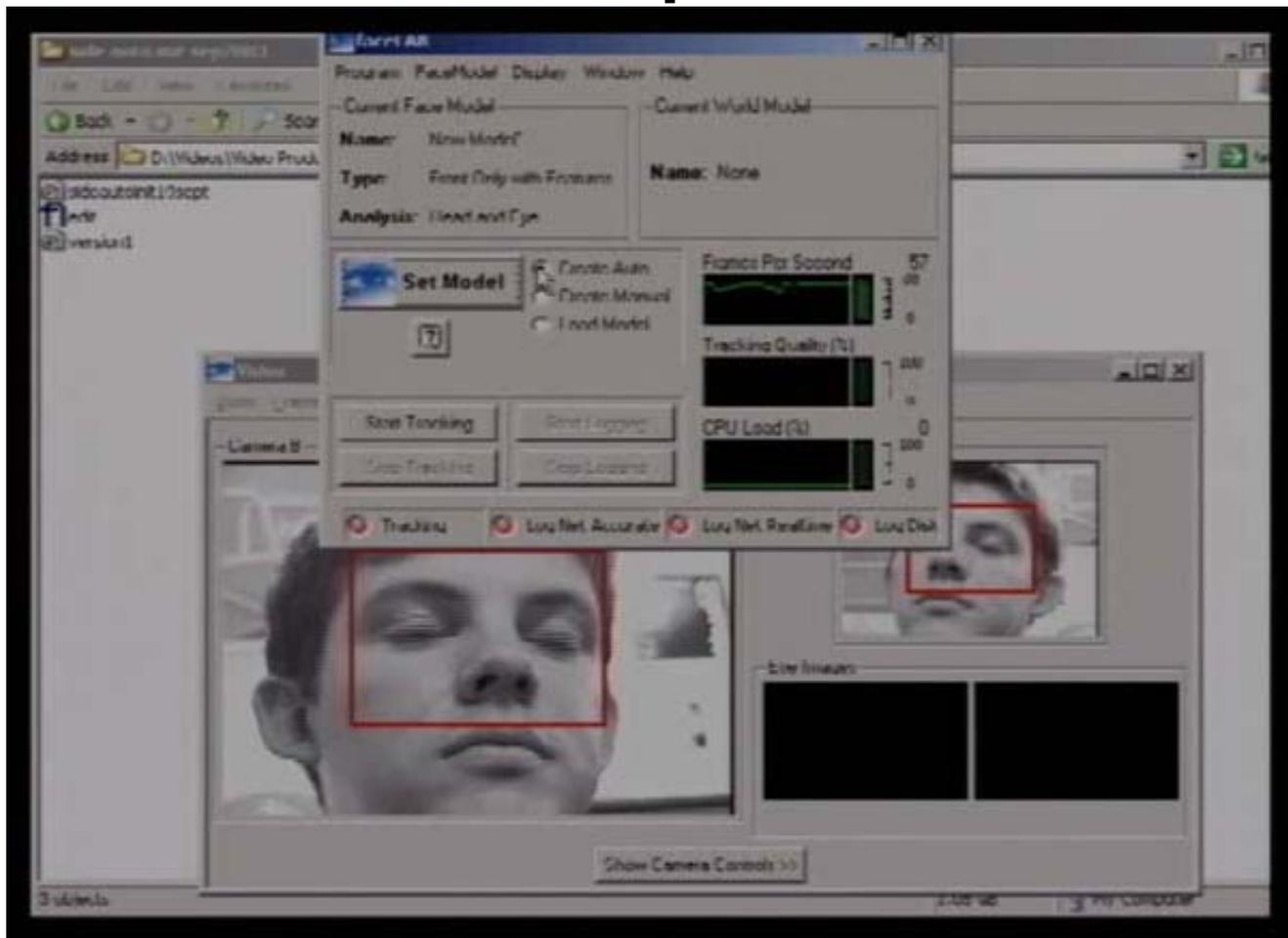


3D Tracking



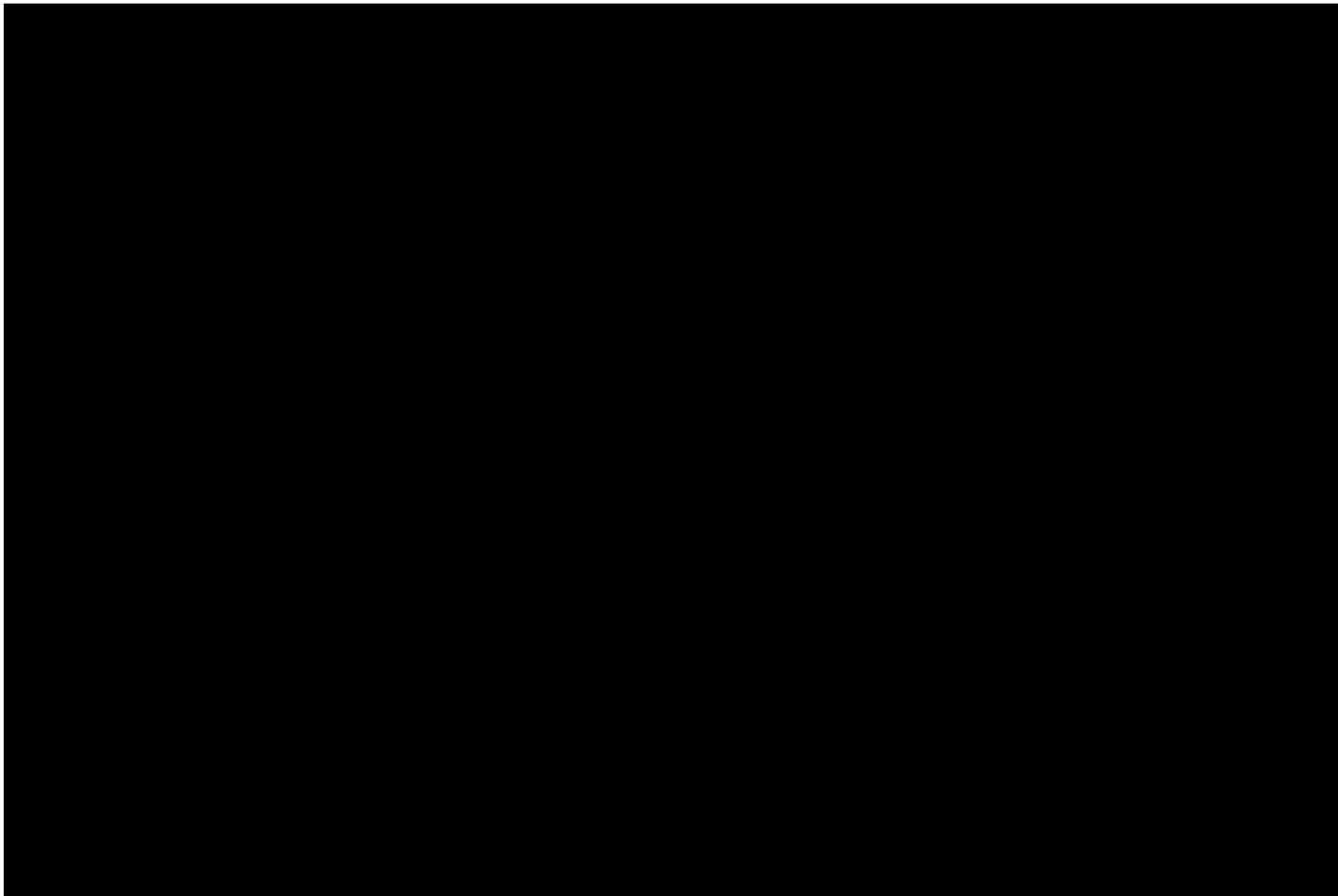


Improved Operations





Redundancy





High Dynamic Range

The screenshot displays the Seeing Machines software interface, which is used for eye tracking and facial analysis. The interface is divided into several windows:

- FacialLab:** This window shows the current face model and world model. It includes fields for Name (vch_n4_1), Type (Full Head with Features), and Analysis (Head, Eye and Gaze). There are buttons for "Set Model" (with sub-options: Create Auto, Create Manual, Load Model), "Start Tracking", "Start Logging", "Stop Tracking", and "Stop Logging". It also displays performance metrics: Frames Per Second (56), Tracking Quality (%) (77), and CPU Load (%) (63).
- Viewer:** This window shows two camera views (Camera A and Camera B) of a person's face. The face is overlaid with a 3D model and tracking lines. There are also "Eye Images" showing close-ups of the eyes.
- Controls:** This window provides detailed control and analysis options. It has tabs for Head, Eye, Gaze, World, Logging, and Stereo-Head. Under "Eye Closure", it shows graphs for Left Eye and Right Eye with values 0.00. Under "PERCLOS", it shows a graph and a threshold of 0.75. Under "Blink", it shows a graph with Frequency (Hz) at 0.20 and Duration (s) at 0.19. There are also sliders for "Blink Filter Window Size" (set to 60) and "PERCLOS Window Size" (set to 180).
- 3D View:** A 3D model of a yellow head is shown in a central window, with a red line indicating the gaze direction.
- Lightness Control:** Sliders for "Camera A Brightness" and "Camera B Brightness" are visible.
- Create / Delete:** A panel on the right side has buttons for "New Sphere", "New Plane", "Delete Item", and "Screen".

The Windows taskbar at the bottom shows the Start button, several open applications, and the system tray with the time 12:34 PM.



Eyes on Road

- Seeing Machines has developed an “Eyes on Road” demonstration for an OEM customer.
- Warnings provided through a HMI if the driver’s gaze is not directed on the road.
- The time allowed to look away from road is *adaptive*. The faster the car travels the less time to look away is permitted.
- The system works automatically for all drivers with no setup or manual intervention required.



The Setup





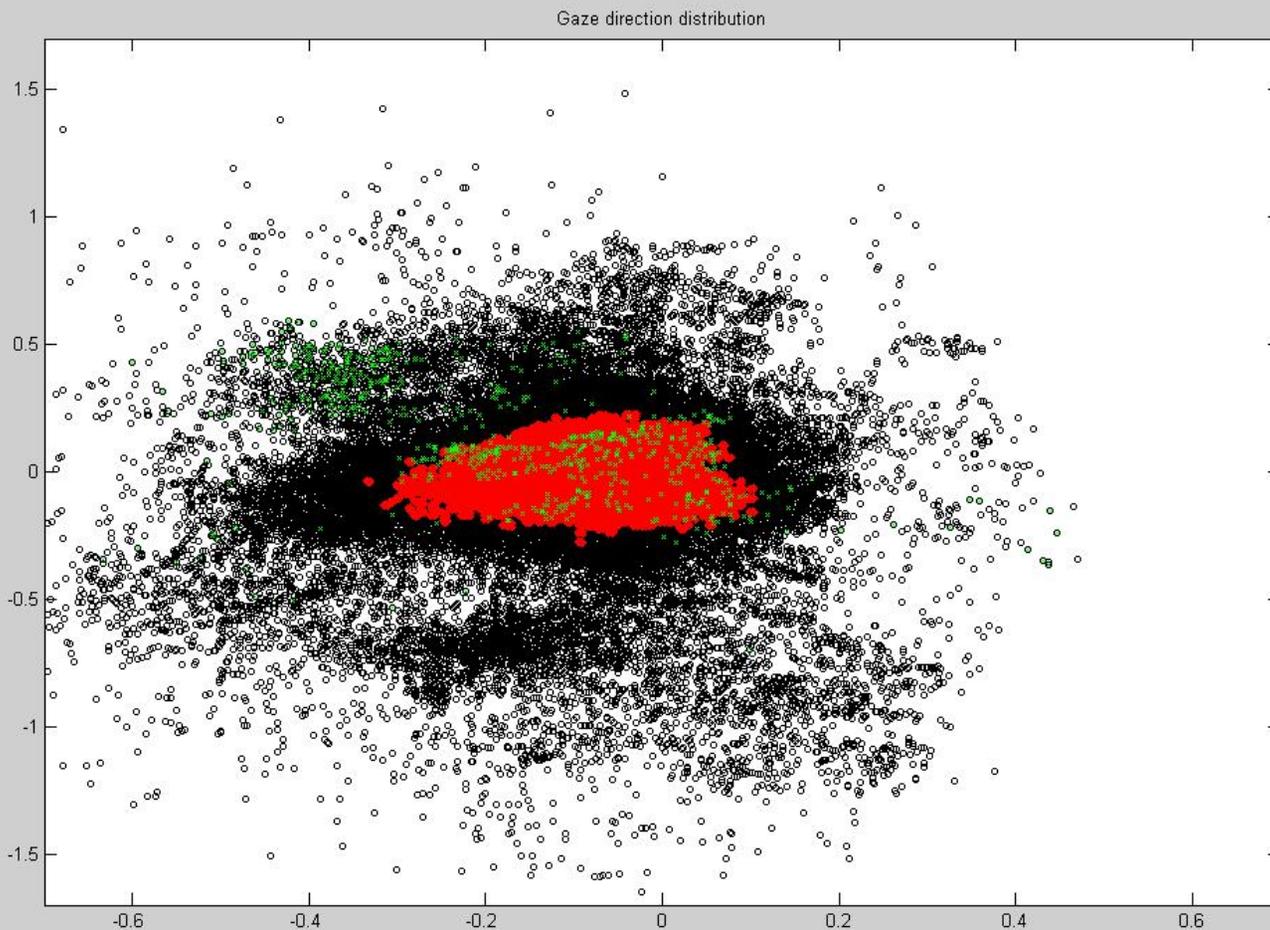
Hidden Markov Model

- A Hidden Markov Model with two states “on road” and “off road” is employed to classify driver attention online. The “on road” attention cluster is modeled as a Gaussian centered on the road ahead.
- Parameters of on road cluster are derived from the observations in the initial training period (2.5 min) as well as the state transition matrix. Training begins once car is traveling $> 50\text{km/hr}$
- The Hidden Markov Model is continually retrained as new data is acquired to accommodate to shifts in driver behavior and drifts in measurements.



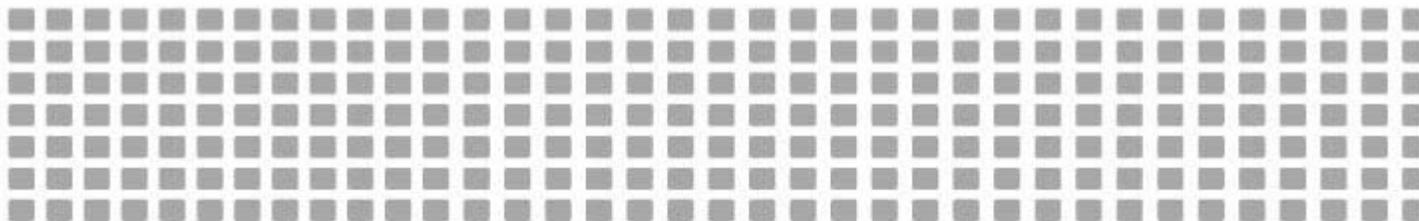


Head and Gaze Data





Eyes on Road



Seeing Machines DSS Demonstration





Lane Tracking



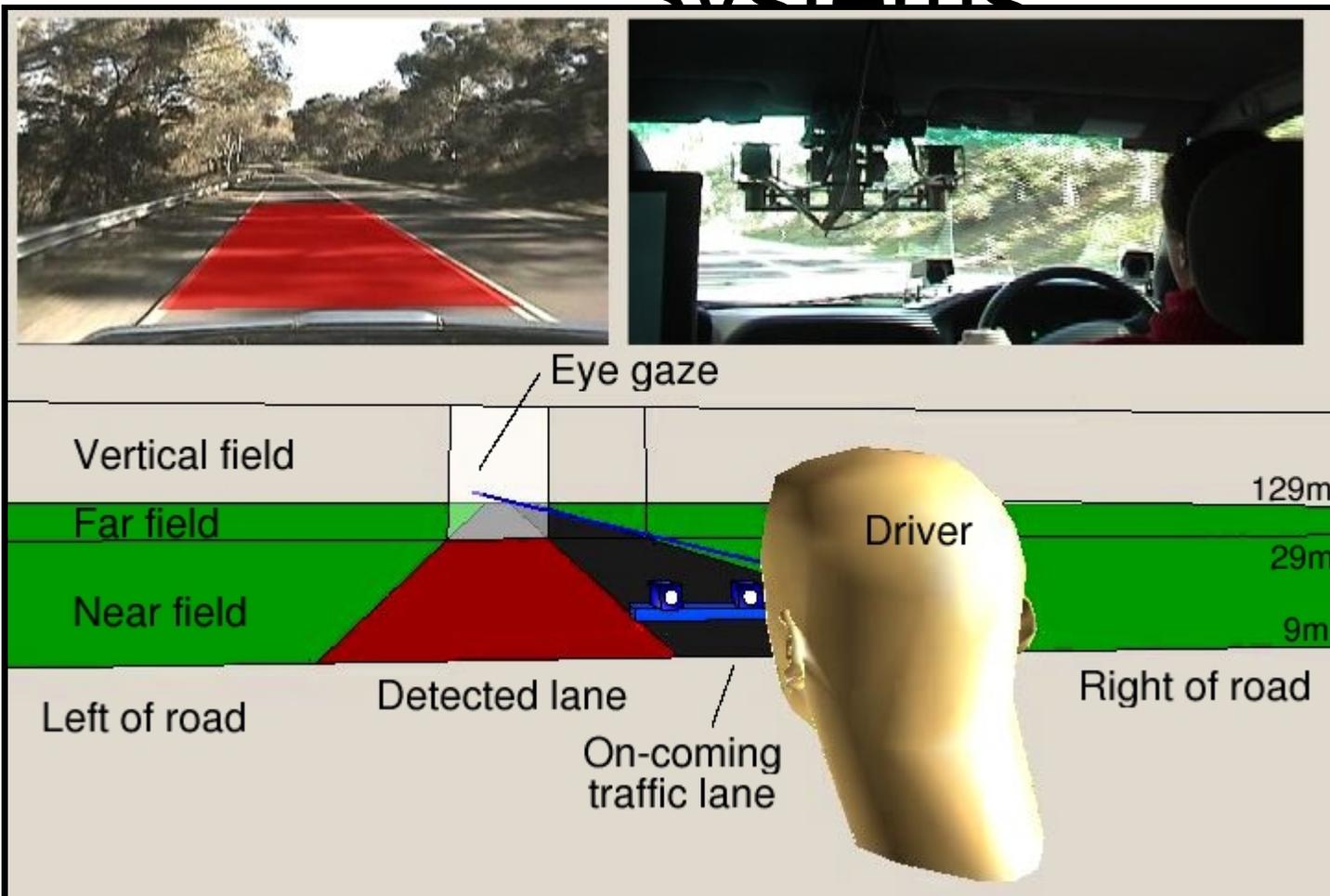


Multi Car Tracking





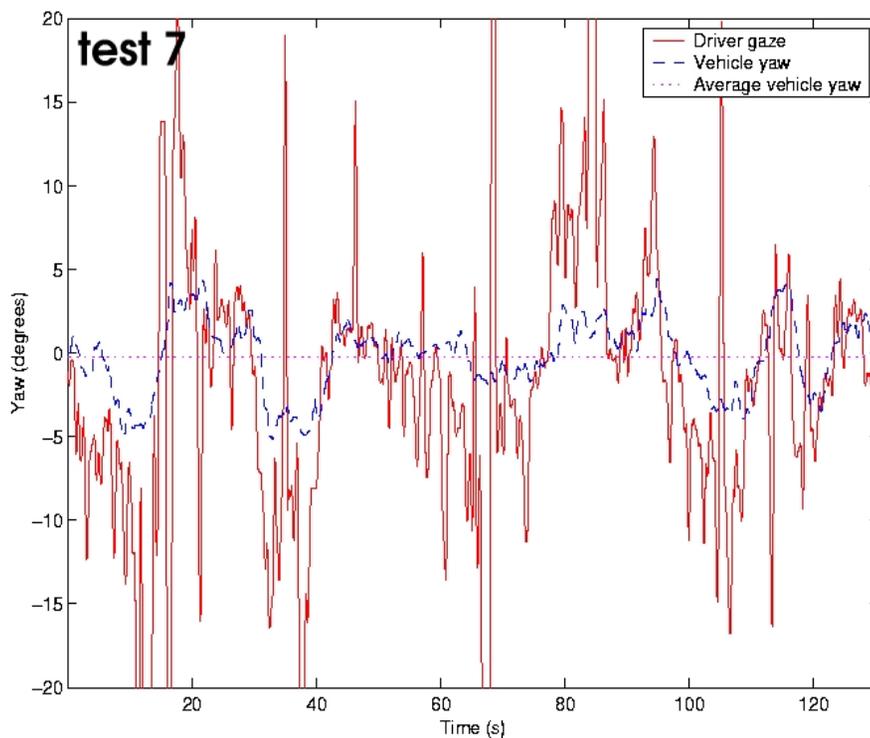
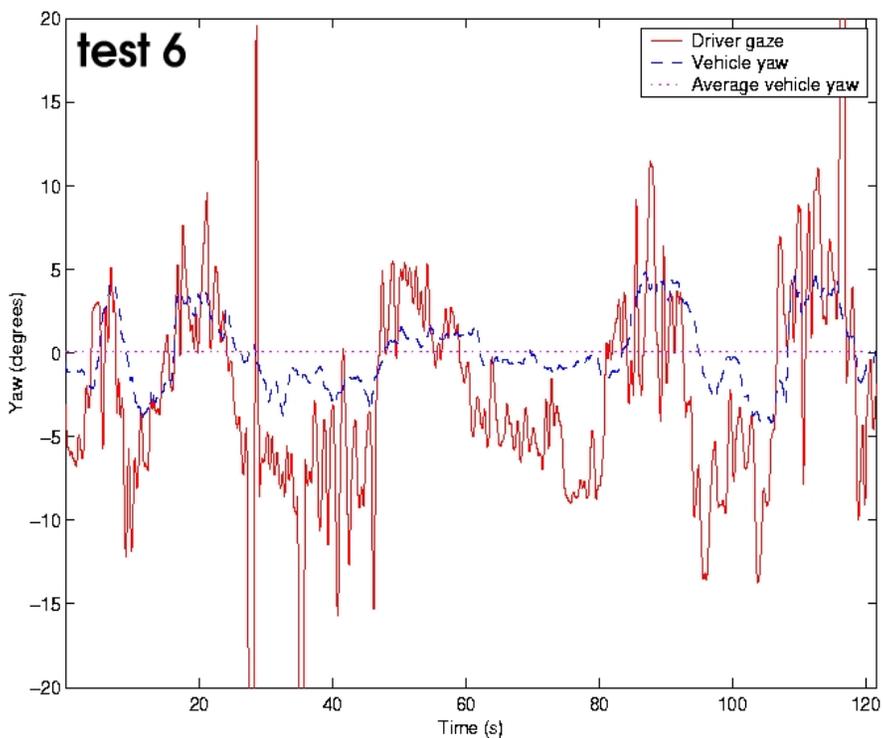
Integrated Systems





Driver Monitoring

Comparison between the driver's gaze and the yaw of the vehicle

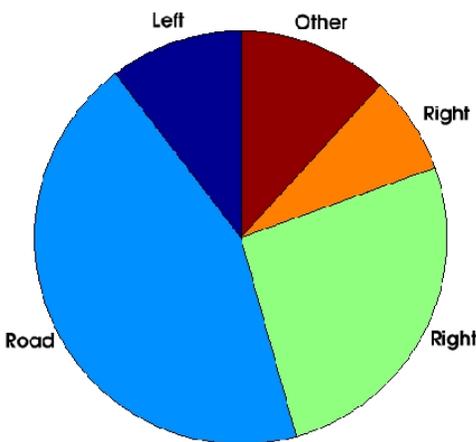




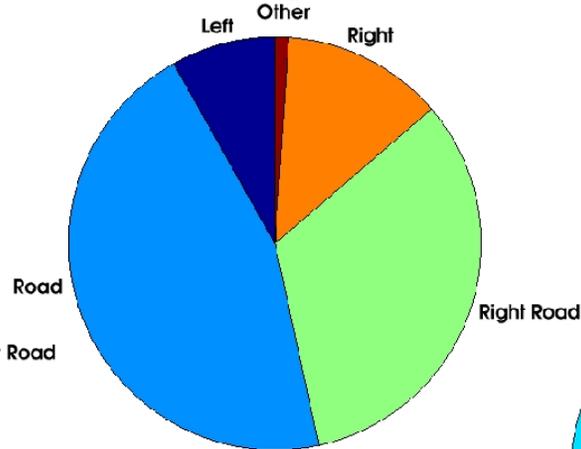
Driver Attention

High Curvature Road

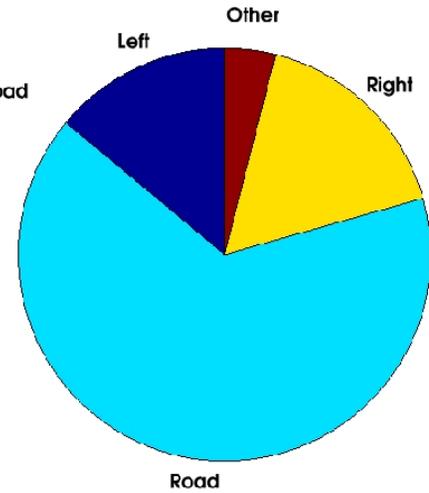
SW - Mainly Left Curvature



NE - Mainly Right Curvature



Highway



Test 1

Test 2

Test 3





Road Sign Reading

Speed Sign Recognition - 40 and 60 signs



Summary

- Do not confuse research tools with auto products.
 - High fidelity and accurate human factors R &D tools
 - Once the problem is understood simplify into a product.
- Automotive manufacturers are cost driven.
 - Seeking low-cost and simple to use systems.
 - New technology is introduced progressively.
 - Later generation models become more sophisticated.
- Seeing Machines is aiming for a \$250-\$300 product a limited number of simple functions



Contact Details

Seeing Machines
Innovations Building
Cnr Garran & Eggelston Roads
Canberra ACT 0200
Australia

www.seeingmachines.com
info@seeingmachines.com

tel +61 2 6125 6501
fax +61 2 6125 6504