



# faceLAB™ 4

***Real time. Real world. Real data.***



*Image courtesy Defence Science and Technology Organisation, Australia.*

Take Human Performance Measurement into the real world. More than just an eye-tracker, *faceLAB*'s flexible and mobile tracking solution enables analysis of completely naturalistic behavior—including head pose, eyelid movement and gaze direction in real-time, under real-world conditions.



- Real time eye & head tracking with comprehensive blink analysis
- High accuracy, high speed, completely vision-based tracking engine
- Automated & reusable calibration for fast enrolment of subjects
- Sunlight / darkness & glasses friendly—no helmets, attachments or wires
- Real-time automated acquisition & logging over network
- Suitable for outdoor or indoor use
- Comprehensive analysis tools & international support
- Turn-key desktop or laptop system
- Core technology available under license

## *user story:*

### *HumanFIRST driving simulator— University of Minnesota*

Universities and Research Centres around the world use *faceLAB*™ for driver behavior and analysis.

The ITS Institute of the University of Minnesota uses *faceLAB*™ to detect distraction and trigger events in their simulator.

*“faceLAB is integrated into the logic of our driving simulator. We give instructions to drivers to complete common in vehicle tasks such as operating the radio and CD player.*

*By defining a box around these regions, we can trigger events in the traffic such as a lead vehicle braking when the eye gaze is detected in the box.”*

*(continued over...)*

*faceLAB*™ produces accurate data on-time, in the toughest of tracking environments. From outdoor intelligent vehicle or aerospace studies through to usability and laboratory environments, *faceLAB*™ provides high accuracy and tolerance to a wide range of operational conditions. New in *faceLAB*™ v4 is a leading-edge active illumination technique, increasing the fidelity and accuracy of gaze assessment. Track each eye independently, and if the subject is close enough, even track pupil size and vergence. If conditions degrade, *faceLAB*™ continues to maintain the confidence of its classic, robust tracking system by default. Analyse and model fatigue and drowsiness in real-time with *faceLAB*™'s true blink analysis and PERCLOS fatigue assessment, including data on the minutia of eyelid behavior. Measurements are taken accurately on eyelid position rather than bright pupil or corneal occlusion.

Eliminate the hassle of interference, setup and correlation issues associated with traditional contact-based tracking methods—*faceLAB*™ does not use any RF, ultrasonic or electromagnetic systems. Our unique visual tracking system provides a single stream of data. No need to stitch or align multiple tracking devices to obtain a result.

No painstaking calibration of separate head tracking systems—*faceLAB™* itself caters to changes in pose or the movement of a subject. Specific techniques have been implemented in *faceLAB™* v4 to enable easier calibration of children and uncooperative subjects.

Minimise the time, cost and headache associated with experiments with *faceLAB™*'s unparalleled ease of use, quality of support and user-friendly interface. *faceLAB™*'s hallmark automatic initialisation feature has been improved, and now produces raw gaze output automatically, as well as head position and blink events over a wider field of view. Laboratory or simulator implementations are further enhanced—a wide variety of digital simulation platforms and third-party analysis tools are now natively supported—check our website for a full listing. Get direct representation of subject interaction inside your simulation environment, in real-time, and synchronised correctly to the experiment. Don't restrict your eye tracking experiments to screens—*faceLAB™* continues to offer a fully integrated 3D world model that encompasses physical objects as well as displays.

Maintain data and tracking integrity through a range of lighting and movement conditions. *faceLAB™* immediately recovers if a subject leaves the field of view, and the system is robust to occlusion or sudden movement. Work with all faces and all eye types, with or without contact lenses and with most eye-glasses. Work in bright sunlight or at night time, with subjects close to the camera or several metres away. Even if you can't see the eyes—if the subject is wearing



(...continued from page 1)

*"In this way, we can verify that drivers are completing these tasks, and also measure their dynamic ability to respond to critical traffic events that evolve while the driver is distracted."*

*faceLAB lets us study the effects of distraction in a more accurate and valid manner".*

Dr Nicholas J Ward  
Director, HumanFIRST Program  
ITS Institute, University of Minnesota  
[www.humanfirst.umn.edu](http://www.humanfirst.umn.edu)  
[www.its.umn.edu](http://www.its.umn.edu)

*"faceLAB™ lets us study the effects of distraction in a more accurate and valid manner"*

*faceLAB™*'s unique tracking system provides head pose, gaze direction and eyelid closure information in real-time without wires, magnets or a helmet.

Instead of using traditional corneal reflection techniques, input is obtained using a stereo camera pair and measurements are logged to disk or streamed over a network.

*faceLAB™* is the perfect tool for the analysis of driver behavior in simulators and test vehicles.

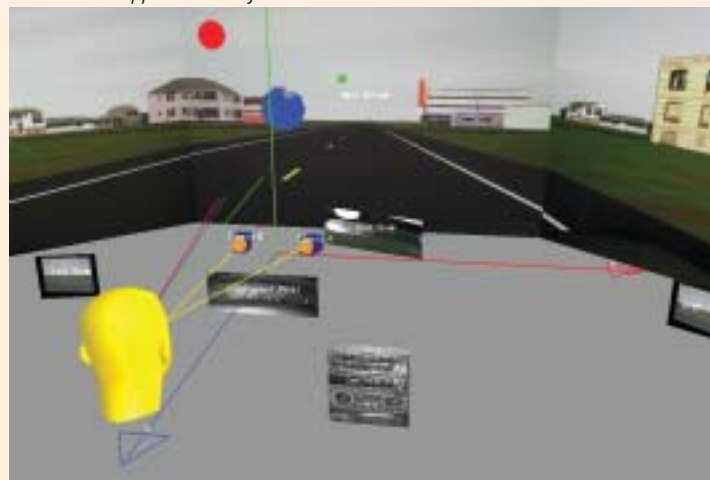
With a wide field of view, subjects are free to exhibit natural human actions, breaking out of the 'laboratory mode' of tracking behavior.

*faceLAB™* allows each subject to be calibrated once—automatically. The data can then be used day after day in subsequent experiments.

*faceLAB™* delivers data with the addition of a real-time PERCLOS fatigue assessment including raw data on the minutia of eyelid behavior.

*How faceLAB thinks in 3D.*

*faceLAB v4 supports real objects and screen intersections.*



*“The problem has been reliably measuring where aircrew look... faceLAB has revolutionised this process with data for entire trials collected and analysed in minutes, not hours.”*

Dr Simon Parker, Defence Science and Technology Organisation.

sunglasses for instance—*faceLAB™* still finds the head pose, eyes and mouth, and continues to produce accurate, robust and reliable data. Added flexibility is provided with the new ultra-wide field of view mode, allowing experiments with distant subjects or a variable experimental area. Reduce the amount of data stored or transmitted with variable width logging—capture only the data you need, and send it across a network where you need it.

Develop real-time applications using the *faceLAB™* freely available SDK, enabling other systems to localise salient facial features such as the eyes and mouth, in real-time, across standard network interfaces.

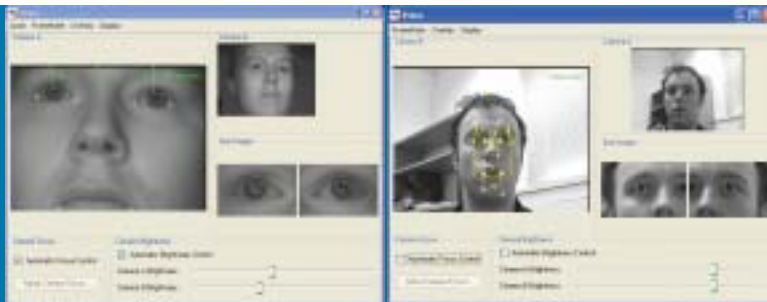
Seeing Machines has simplified the path to commercialising products based on *faceLAB™* technology with a licensable core now available.



Image courtesy Defence Science and Technology Organisation, Australia.



Real-time feedback inside faceLAB.



Real time display of key features inside faceLAB.

## Applications for *faceLAB™* include:

- adult or child psychology studies;
- general human factors research;
- driving and piloting studies in simulators or test vehicles;
- fatigue, distraction and inattention studies;
- human performance measurement in complex systems;
- vehicle safety and ergonomic assessment;
- human-machine interfaces;
- robot-human interaction;
- on-screen performance studies, web and interface usability;
- modelling human performance or cognitive workload;
- autostereoscopic displays;
- acquisition of reliable and pose-known features for biometrics;
- smart cockpit, situational awareness and agent advocate systems.

*\*Core technology available under license.*

### Feature Overview:

- Configurable for almost any tracking scenario: screen studies, simulators, CAVEs, automobiles, aircraft;
- Non intrusive operation (no wires, helmets or magnetic sensors);
- Automatic tracking, allowing instantaneous subject initialisation of head position, eye location and blink rate, with the click of a single button;
- Optional gaze calibration for improved accuracy, takes only a few seconds;
- Usable with many spectacles and all contact lenses;
- Able to track heads if the eyes are covered by sunglasses;
- Day and night-time operation;
- Usable in sunlight or variable contrast conditions;
- Graceful degradation of data in extreme conditions;
- Robust to partial occlusions, facial deformations, and natural movements;
- High speed tracking recovery <200ms to recover from occlusion or leaving viewing area;
- Computer controlled 18x optical zoom cameras for easy installation over a wide range of tracking scenarios;
- 60Hz data rate;
- Full 3D – 6 degrees of freedom (DOF) head tracking, 2 DOF gaze tracking;
- Pupil diameter (independent left/right eyes);
- Eye vergence distance (meters).

# specifications

---

The tracking volume of faceLAB 4 is flexible and can be adjusted to meet a wide variety of scenarios. The tracking field-of-view can be configured from 45 degrees down to less than 10 degrees.

Wider field-of-view (zoomed out) allows for large unconstrained head motions, whilst a narrow field-of-view (zoomed in) allows for either precision gaze, or long range tracking.

## Smallest Face

- Automatic tracking initialisation when face is only 20 percent of total image width;
- 6 DOF head tracking and recovery when face is only 10 percent of total image width.

## Largest Face

- Continues to track when face is so close, only half of it is visible.

## Head Rotations

- Tracking and recovery up to +/- 90° around neck axis (turn head from shoulder to shoulder);
- Tracking and recovery up to +/- 45° around nod axis (look up / look down);
- Tracking up to +/- 90° and recovery up to +/- 30° around tilt axis (lean left / right).

## Gaze Rotations

- Eye rotations of +/- 45°.

## Recovery Time

- Tracking failure recovery times approximately 200ms for both head and eye measurements.

## Obscuration

- Tracking when up to 50% of face is obscured;
- Recovery requires 80% of face to be visible.

## Wide Field-Of-View Configuration

In this configuration, head-position and rotation can be automatically tracked over large volumes, without calibration.

- Camera field of view out to 45°;
- Head tracking distance range from 0.5 to 1.4m;
- Head tracking horizontal range up to 1.5m.

## faceLAB "Classic" Configuration<sup>1</sup>

In this configuration, both head-pose and gaze tracking are possible. Gaze calibration is not required, but can be performed to remove any systematic bias. Resolution is not affected.

The specifications are similar to previous versions of faceLAB, with the exception that tracking recovery and robustness to large rotations is greatly improved.

- Camera field of view out to 30°;
- Gaze tracking distance range from 0.5 to 1.1m;
- Gaze tracking horizontal range up to 0.3m, vertical range up to 0.2m;
- Head tracking distance range from 0.5 to 1.75m;
- Head tracking horizontal range up to 1m;
- Typical static accuracy of head measurement within +/- 1mm of translational error and +/- 1° of rotational error;
- Typical static accuracy of gaze direction measurement within +/- 5° rotational error.

## Precision Gaze Configuration<sup>1</sup>

In this configuration, both head-pose and gaze tracking are possible. Gaze tracking is more precise; with the trade-off that head-pose is a little more constrained. This configuration is recommended for indoor screen or simulator experiments, where accuracy is at a premium.

- Camera field of view out to 30°;
- Precision gaze tracking distance range from 0.5 to 0.8m;
- Precision gaze horizontal range up to 0.25m, vertical range up to 0.15m;
- Conventional gaze tracking distance range from 0.8 to 1.1m;
- Head tracking distance range from 0.5 to 1.4m;
- Head tracking horizontal range up to 0.5m;
- Typical static accuracy of gaze direction measurement within 1° rotational error;
- Pupil diameter (independent left/right eyes);
- Eye vergence distance (meters);

## Eye Analysis Measurements

- PERCLOS fatigue assessment (day and night operation);
- Blink detection, including blink artefact correction for gaze direction, pupil diameter and vergence distance;
- Blink rate (Hz), and mean period (secs);
- Saccade detection.

## Analysis and Data Transmission

- Compatible with Eye Response Technologies GazeTracker™ analysis tool suite;
- Simultaneous real-time and filtered tracking data available as user-definable disk log, TCP/IP or serial transfer (using SDK);
- Real-time output to screen provides comprehensive feedback to the operator;
- 3D OpenGL World Model Editor/Viewer to assess interaction with environment;
- Time-stamped ASCII output also available for use with common applications such as Microsoft Excel™, Matlab™, SPSS™ etc;
- Experiment-time synchronisation across multiple systems available via NTP.

## Support

- Comprehensive colour illustrated manual;
- Online help, web-based user group support services, phone and email support;
- Portable software development kit (SDK) available for ease of data integration into custom applications/devices or simulators;
- On-site customer training is also provided.

## Vehicle and Simulator Versions

Customisable packs are available for easy incorporation into test-cars, aircraft/vehicle simulators and immersive display areas. Real-time and analysis integration available from simulation vendors such as Oktal, Drivesafety and 5DT.

## Video Overlay Display Kit (VOK)

Enables display and superimposition of gaze point and head intersection on screen. This function is useful for simulator environments, web usability studies, post and real-time video analysis.

<sup>1</sup> Example test results available at [www.seeingmachines.com](http://www.seeingmachines.com).