Light and Human vision benefits for driving simulators

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Günther Hasna | CTO

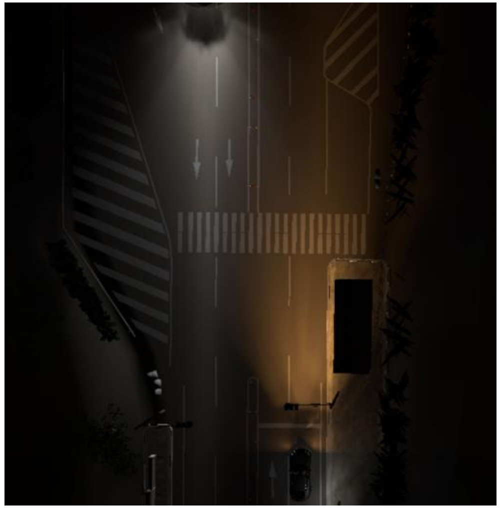
Content

Who is OPTIS ?

200 HIGHLY SKILLED EXPERTS	2400 CUSTOMERS	14 FAMOUS PARTNERS	50 COUNTRIES
500 LARGEST COMPANIES' SUPPLIER	3 RESEARCH & DEVELOPMENT CENTERS	8100 LICENSES OVER THE WORLD	

OPTIS,
the power of a large company with **the flexibility of a** small business.

VRXperience from OPTIS



- 5 years of physics-based simulation into VR
- Physics-based simulation needs **human eye** algorithms and to adapt to the **display** capacities

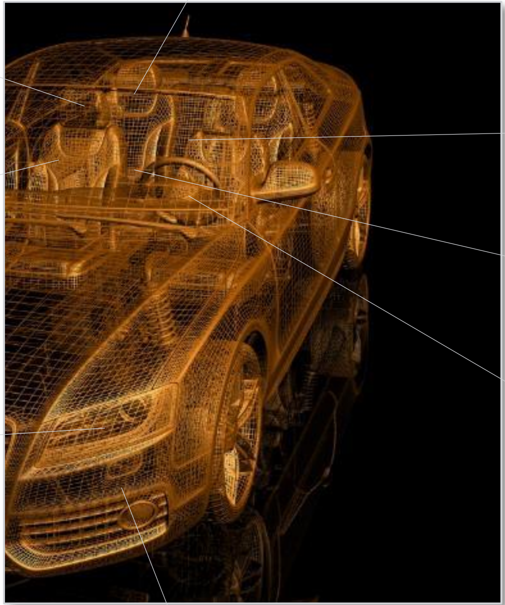
=> For engineering, it is important to get realistic results which allow to optimize the systems by simulation

The general aim is to reduce fatal accidents during night driving and adverse weather conditions (ADAS) and to replace complicated and sometimes dangerous real driving tests

The need for realism

Why do we need realism?

Realism allows to make the **right decision** to ensure **safety**



- **Vision for Rear Mirror Camera**
- **Mood Lighting**
- **Windscreen Coatings**
- **Head-Up Display**
- **GPS Displays**
- **Dashboard Control Pannel**
- **Headlamp & tail lamp**
- **Vision for ADAS**

Why do we need realism?

Thanks to **realism**, the **Virtual Experience** allows to:

- Test multiple cases and possibilities
- Recreate critical driving situations
- See what's happening when you don't see the danger
- Recreate the vision and feeling of the passengers

How to be realistic and predictive?

Let's take the example of a driving situation…

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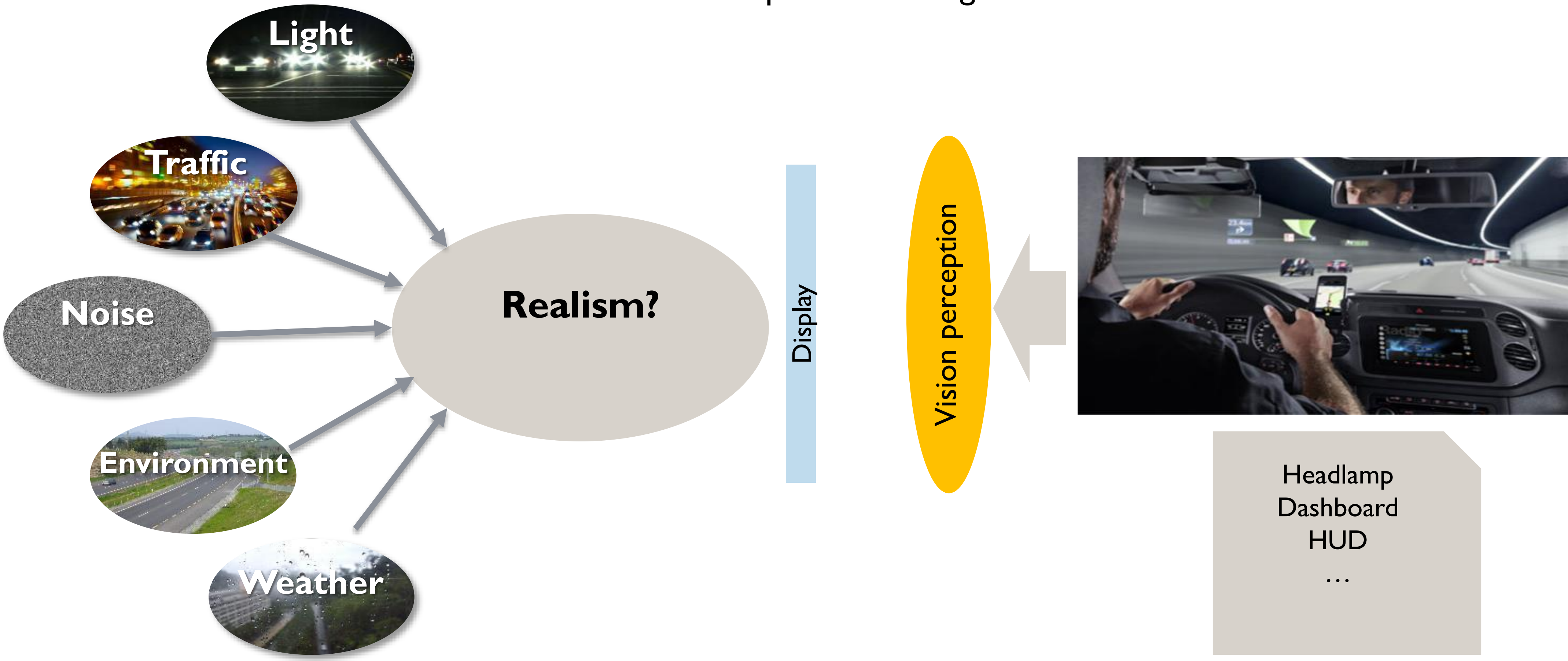


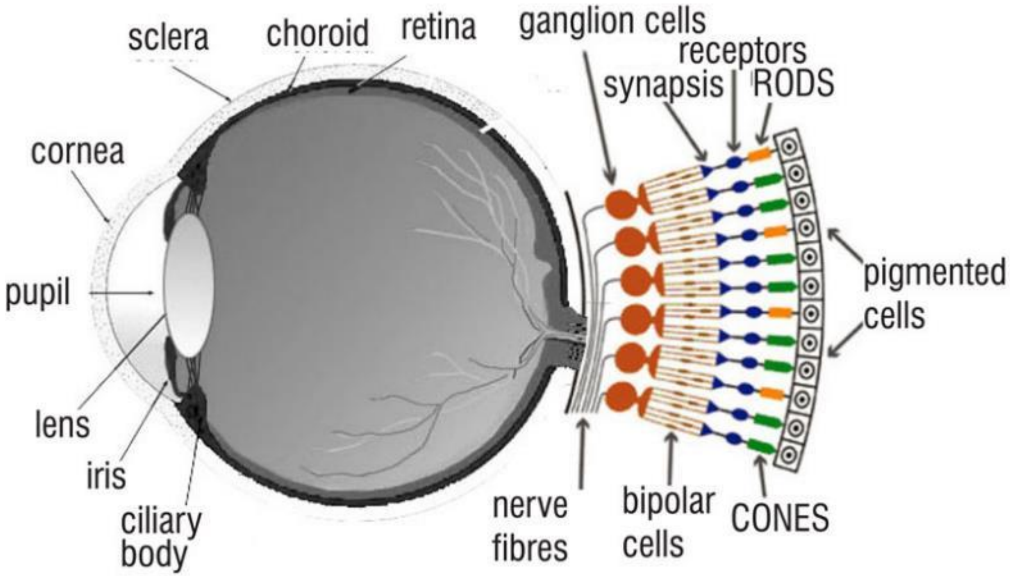
Visual perception and environment

What about virtual prototypes?

The **physical** prototype can be replaced with a **physical** virtual mockup

Human Vision Characteristics

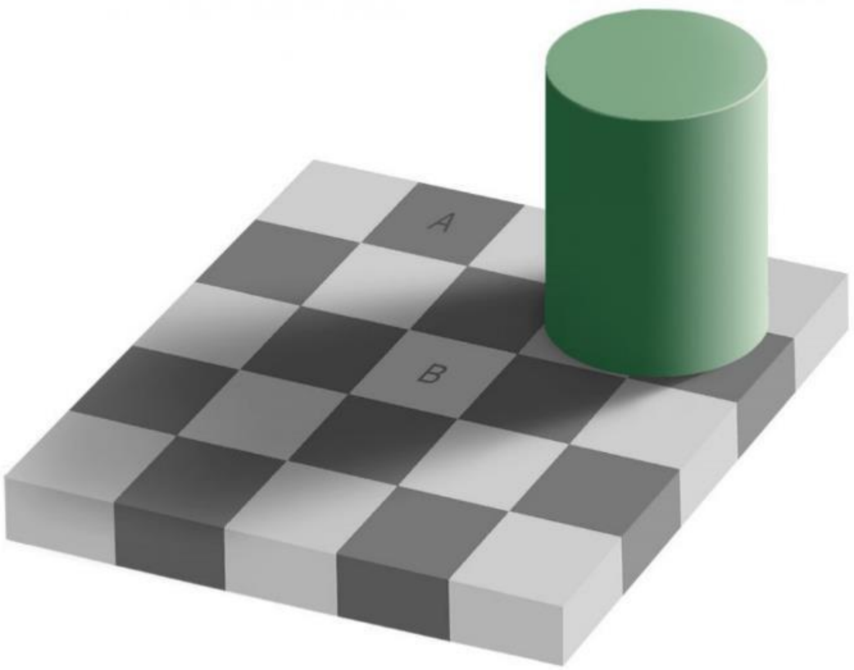
- Cones and rods
- Color perception
- High dynamic light perception
- Acuity (accuracy)
- 3D
- Accommodation
- Field of view
- Frequency

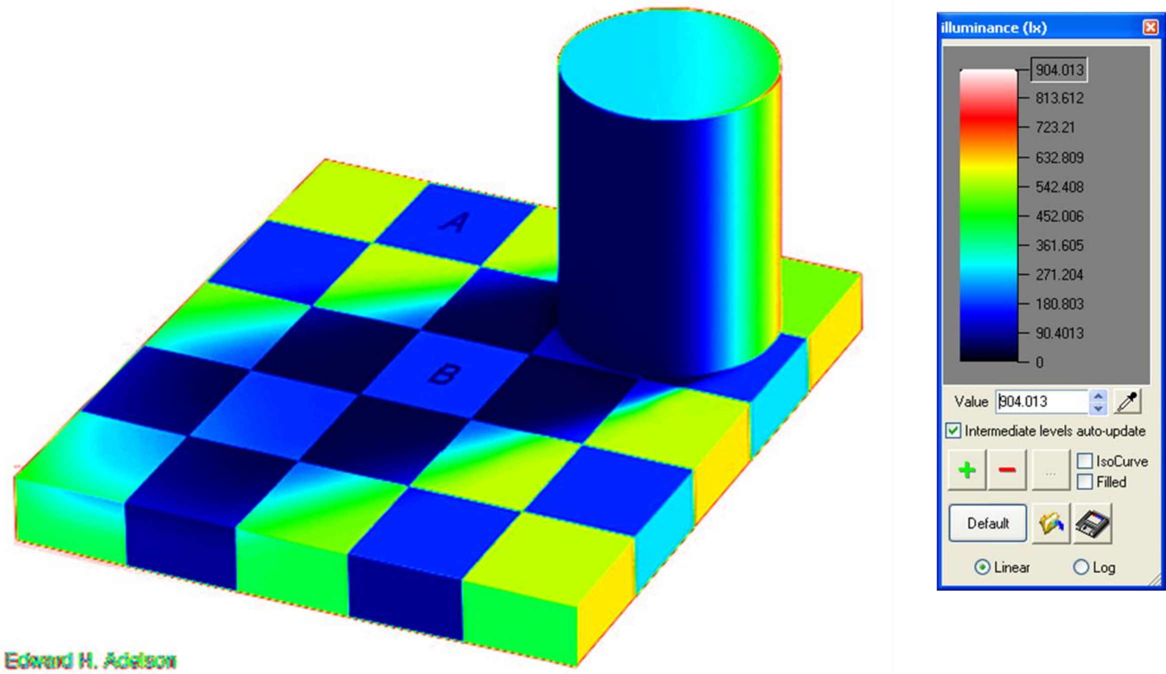


→ How to reproduce human vision and fill the gap between display and human eye?

Vision game: how your brain takes control of your vision

What can you say about field **A** and field **B** ?



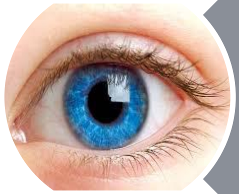


Light simulation provides the answer

Human eye vs Display

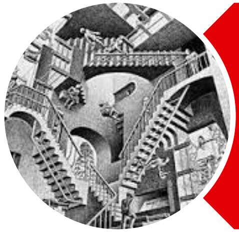
Human eye vs Display

Human eye vs Display



Sensor
- 120 MP Rods
- 8 MP in high illumination
- = 576 Megapixels

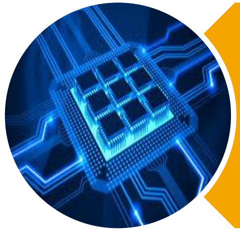
Processing
- 50 billions of neurons
- > Trillions of synapses



Result
- Colors
- Light
- 3D Images

Creating emotion and reaction

Display
- 4 K? 8K?
- Uniform distribution of Pixels

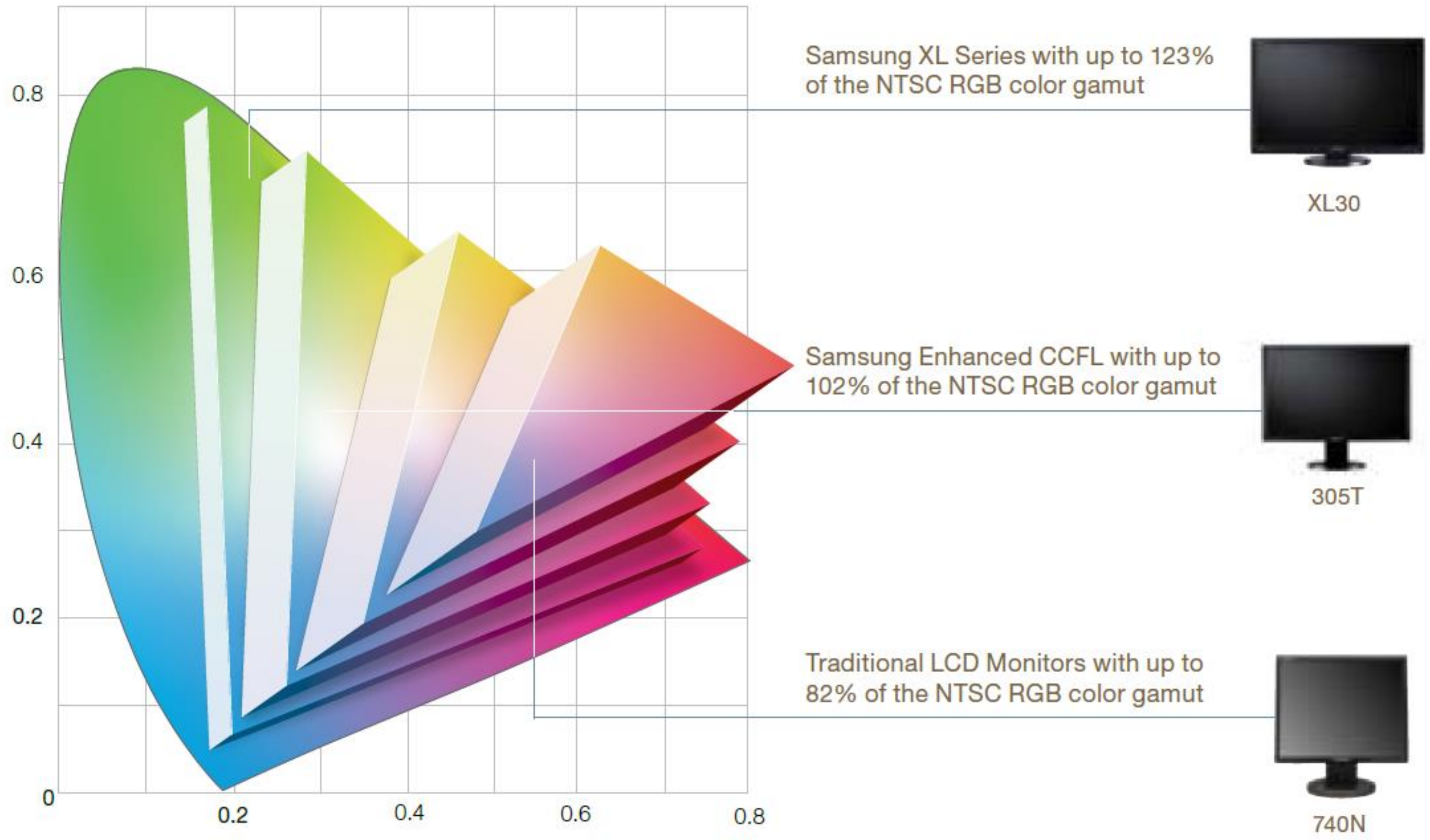


Processing
- 60 Hz – 100 Hz

Result
- RGB colors
- Light levels
- 3D images

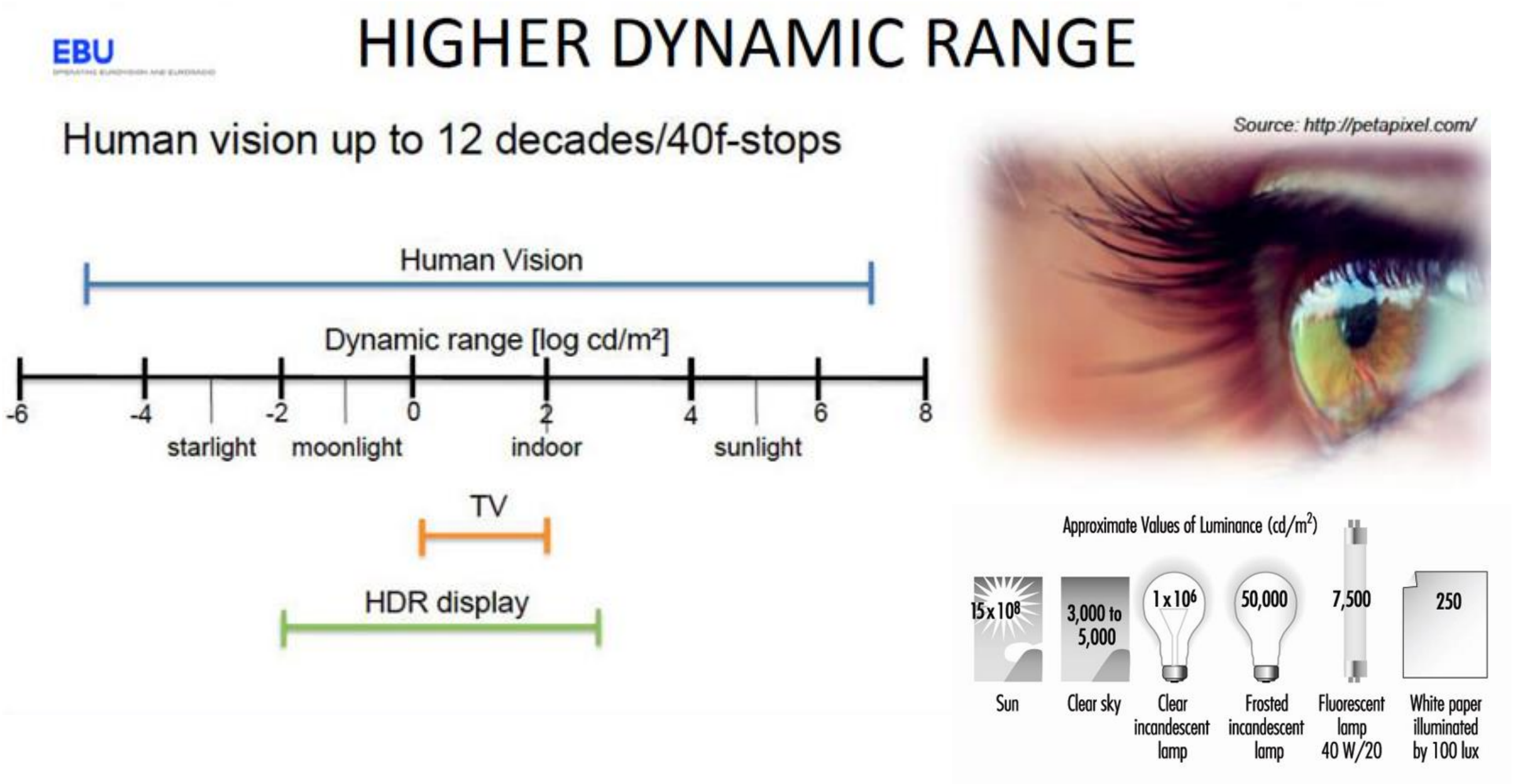
Human eye vs Display

Limitation of Displays – Color Gamut



Human eye vs Display

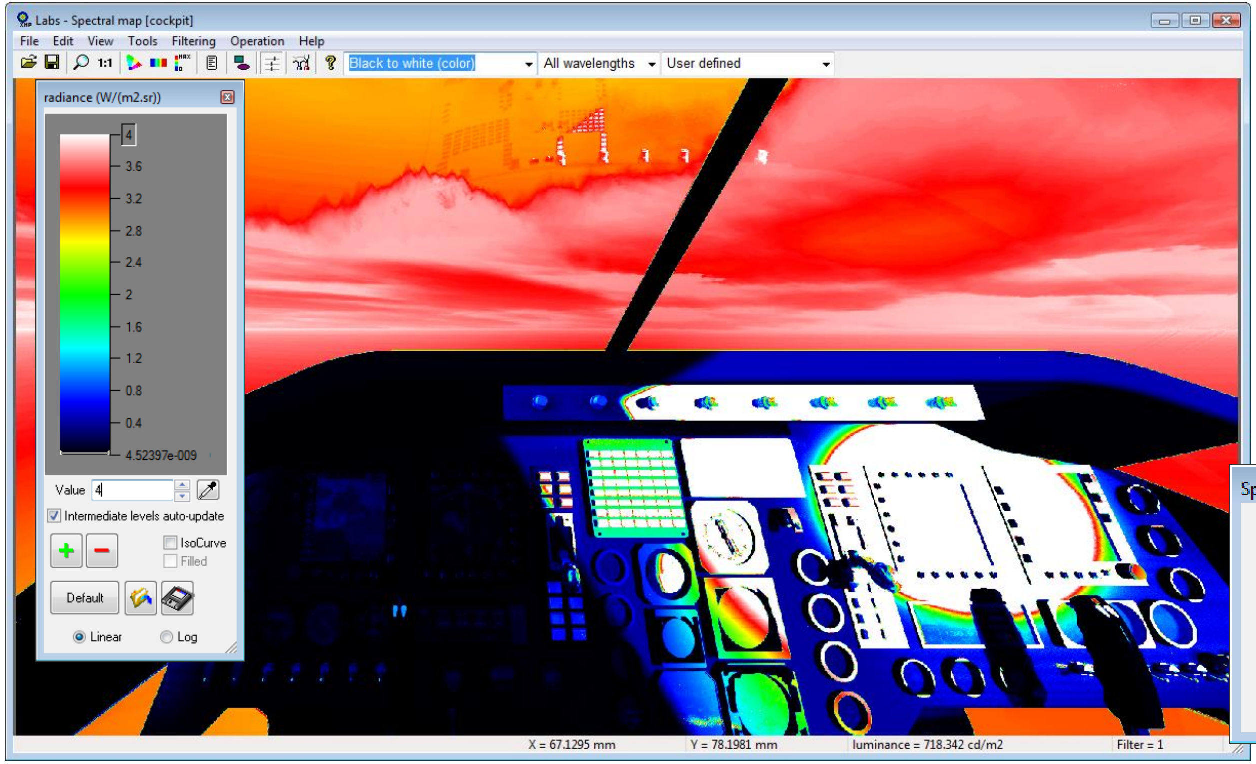
Limitation of Displays – Dynamic

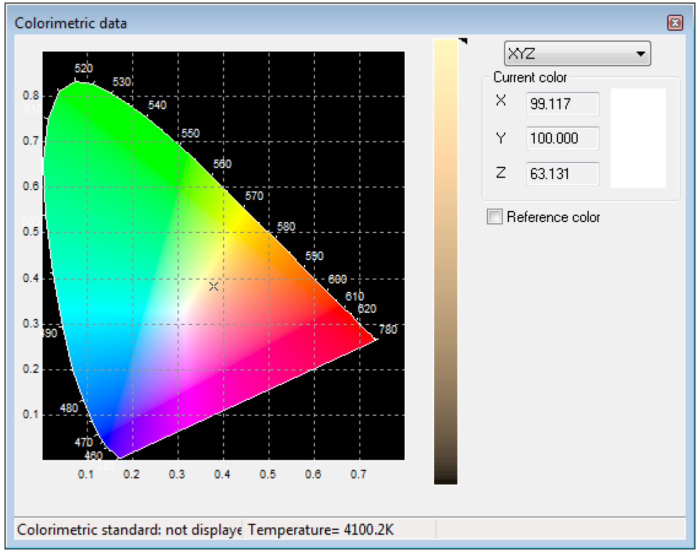


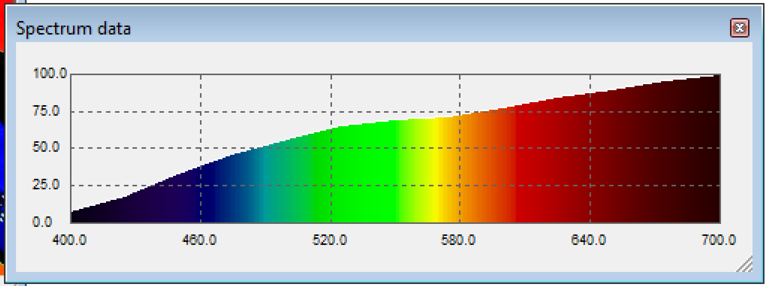
How to model human vision ?

How to model human vision?

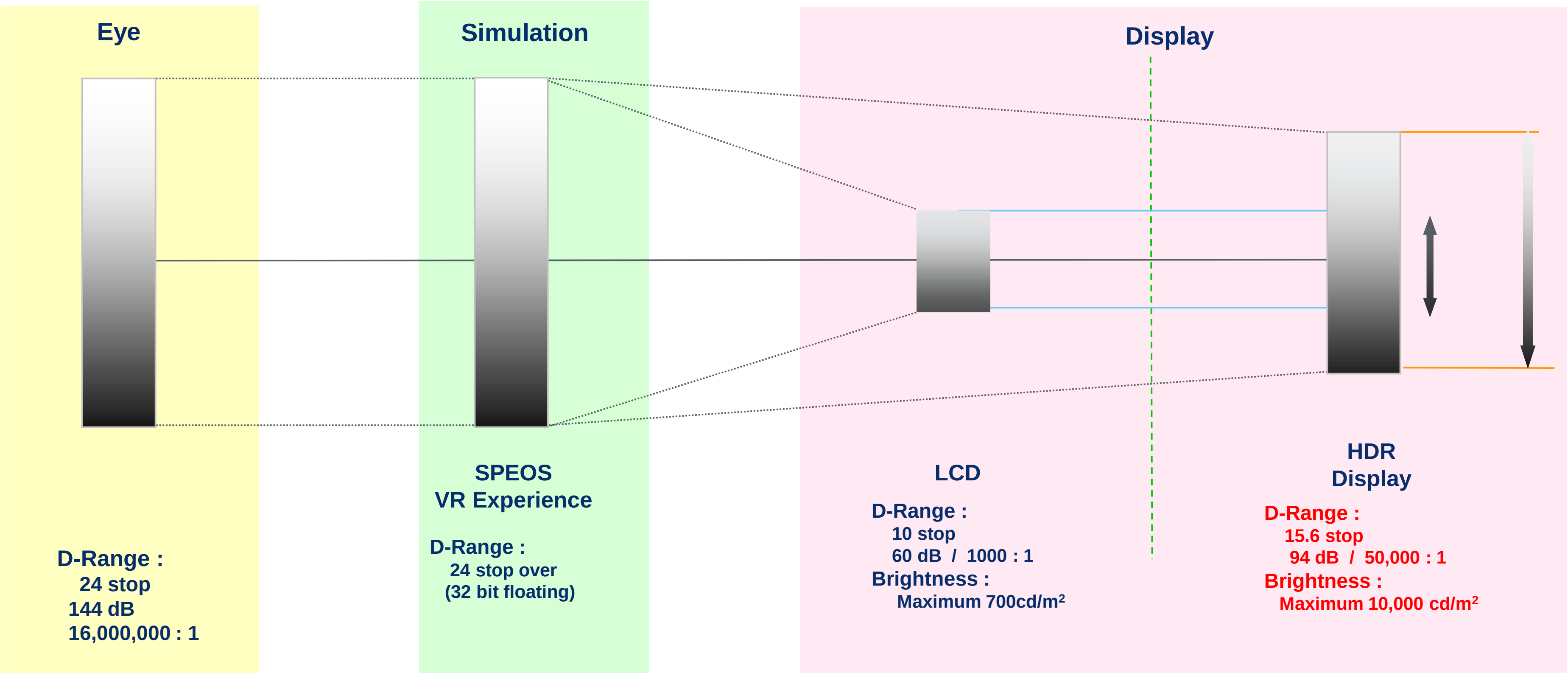
Simulate light thanks to physics





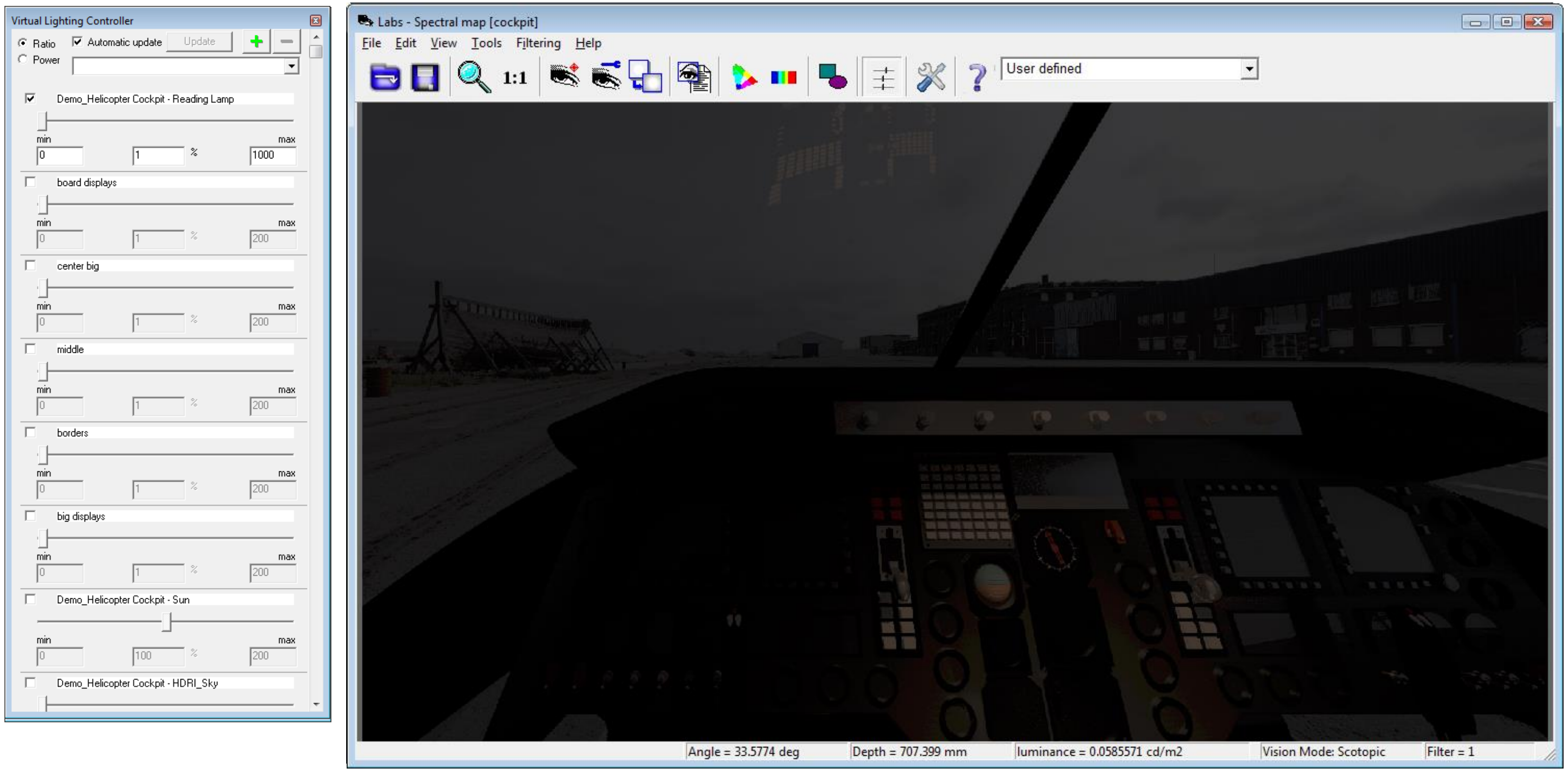


Simulate visual perception

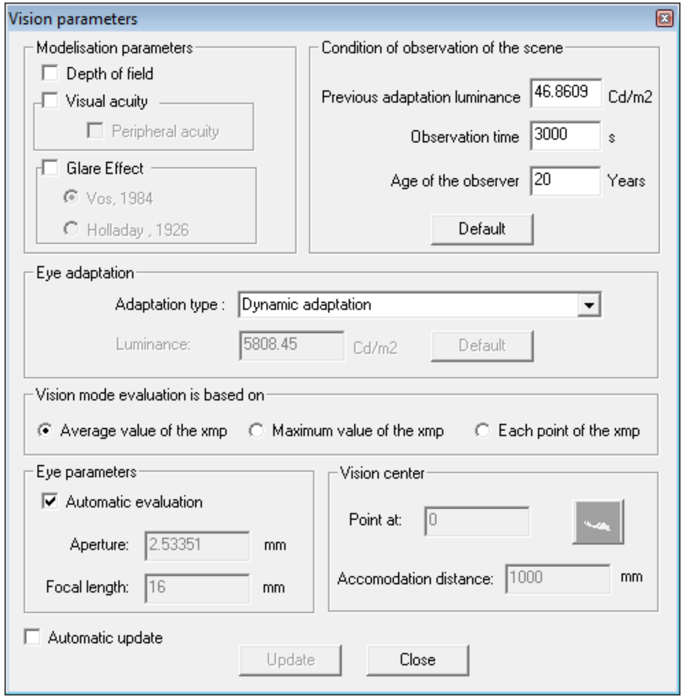


With the OPTIS Human Vision Algorithm it is possible to compress the Image Content to a realistic representation of the results!

Recreate light & color perception



Recreate 3D & accommodation

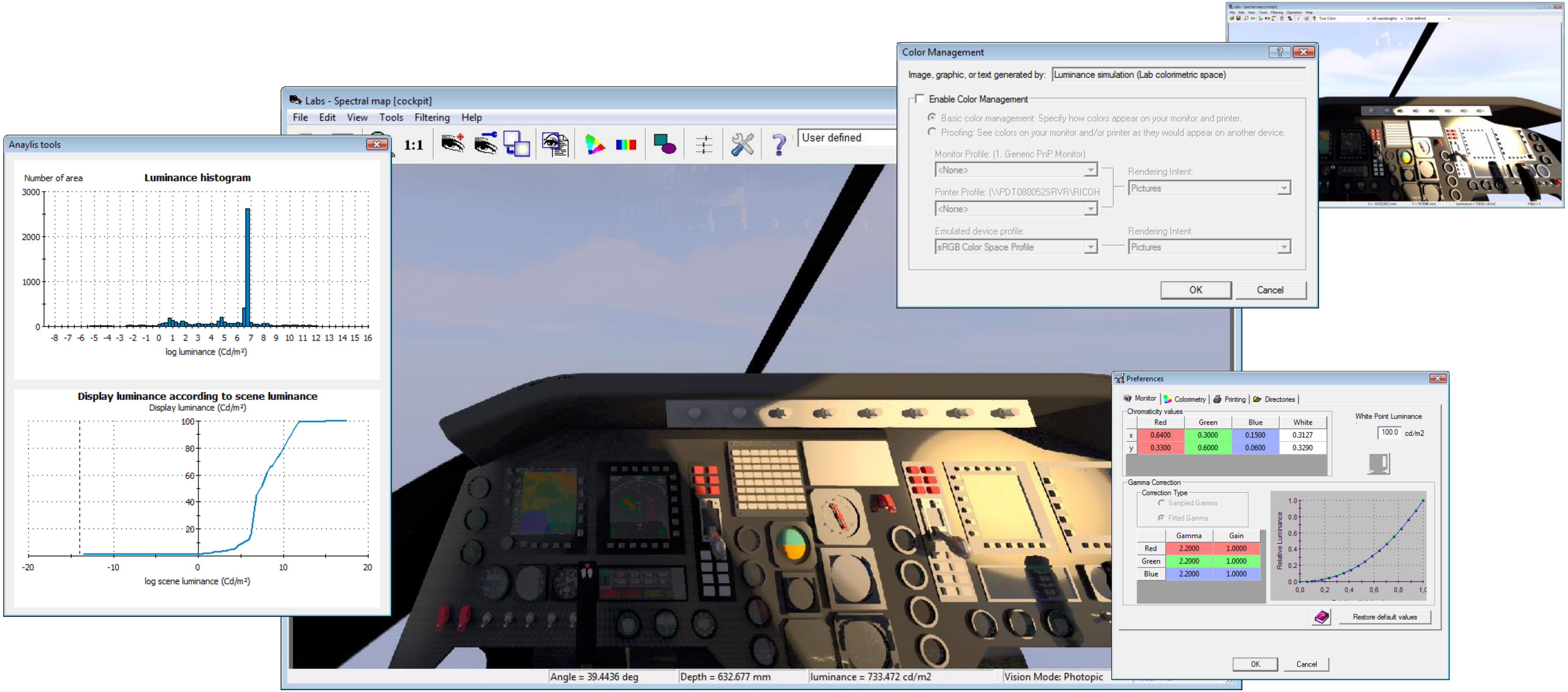


How to model human vision?

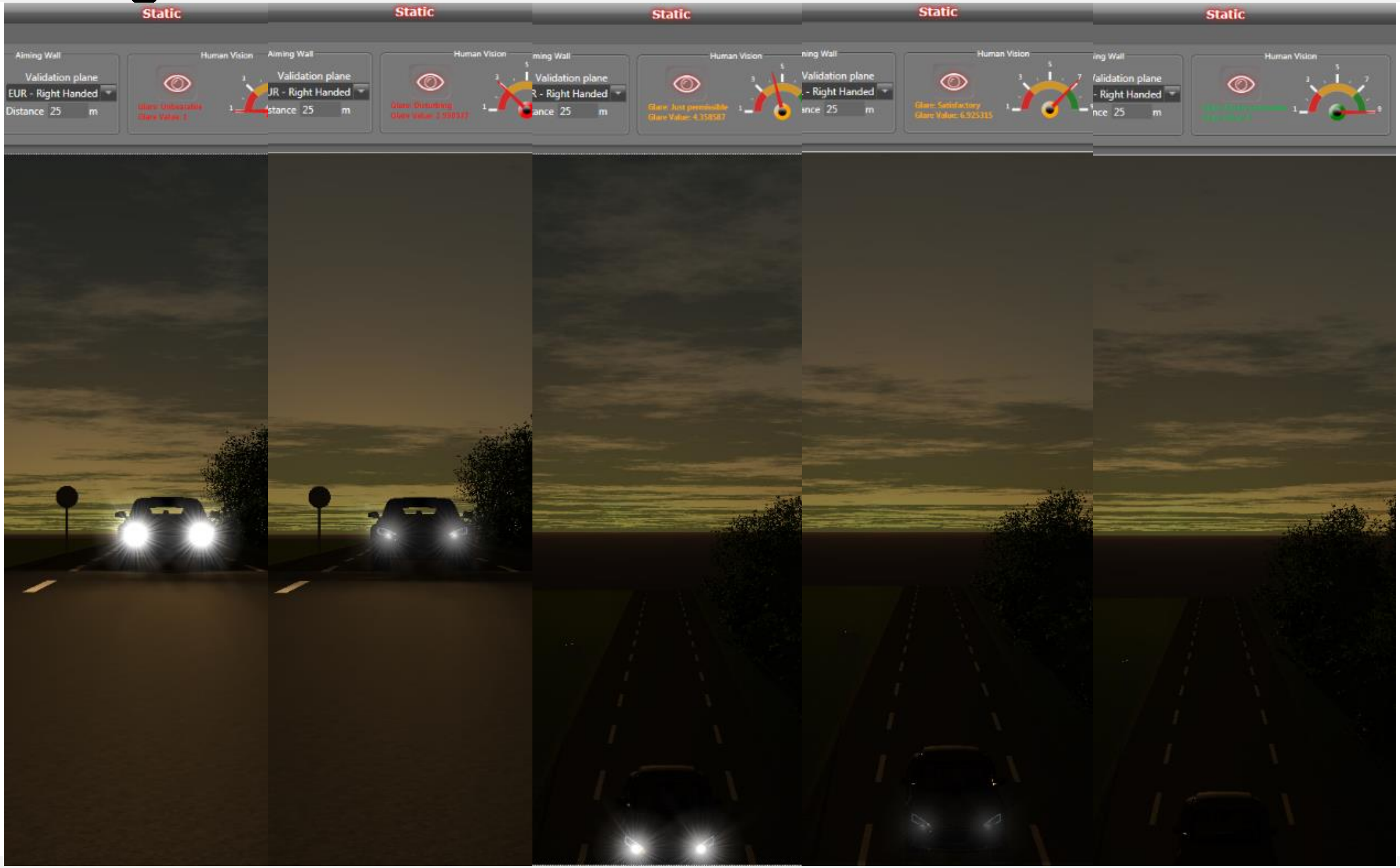
Simulate glare effects and visualization

How to model human vision

Simulate the representation on a display

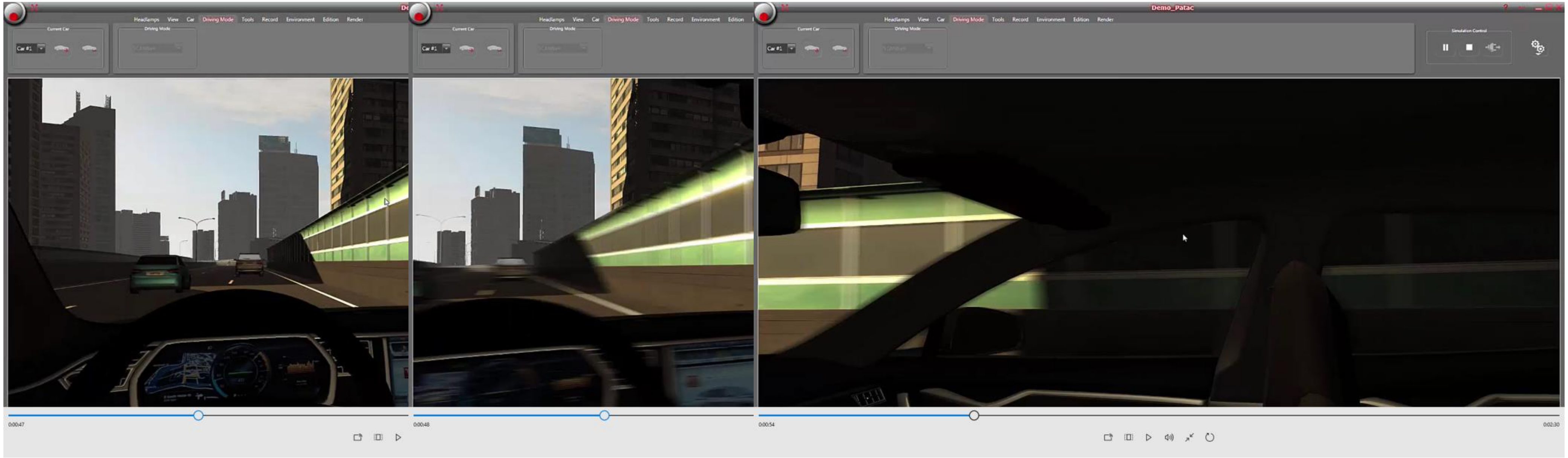


Discomfort glare in VRX



Improve the perception of speed

- At 120 km/h = 33 m/s
  - > When looking straight forward, objects don't move and appear clearly, as the building
- In 1/60s (60Hz display refresh rate), lateral objects move from 0.5 m from an image to the next one.



Implementation of non linear motion blur

Accuracy Validation

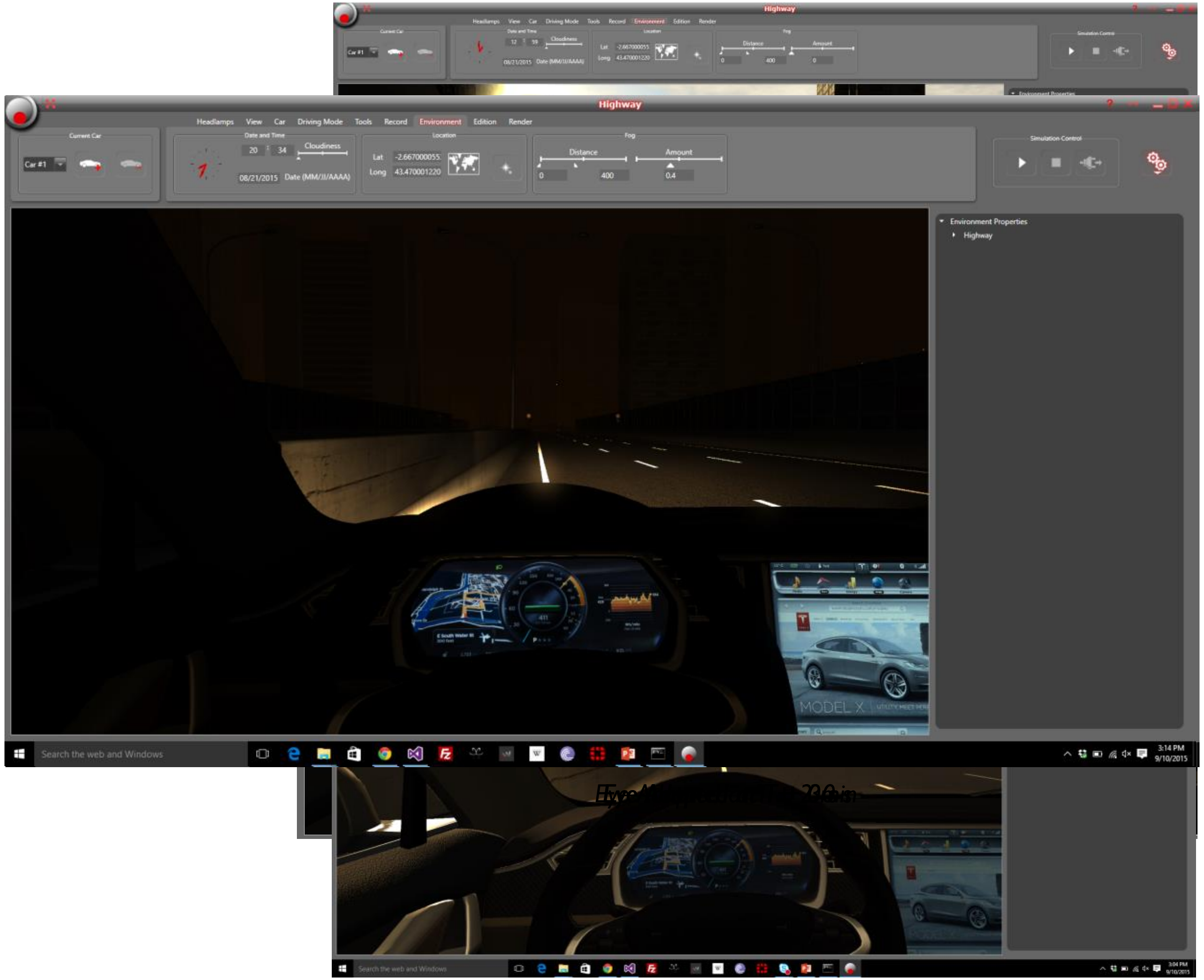
OPTIS compares simulated scenes to real measurements for the best accuracy.

The validity of OPTIS' simulation algorithms is certified by international standards as CIE 171:2006

Impact of the environment on human factors

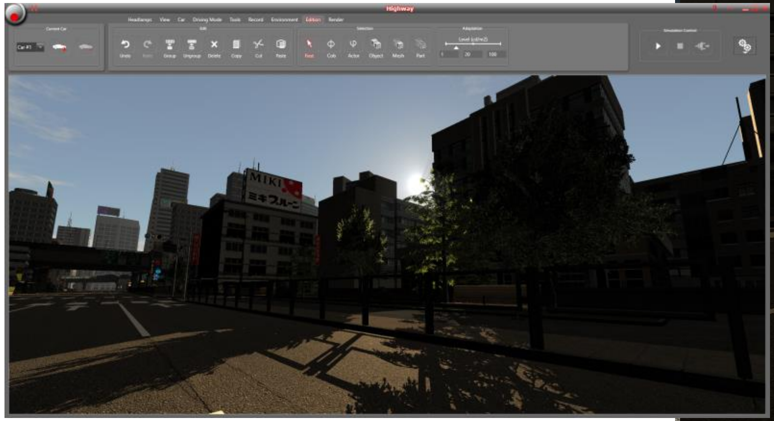
Experimenting the feeling of safety

- Glare effect on perception
- Fog effect on perception
- Dynamic eye adaptation to light



Reproducing any critical conditions

- Daytime
- Atmosphere Scattering



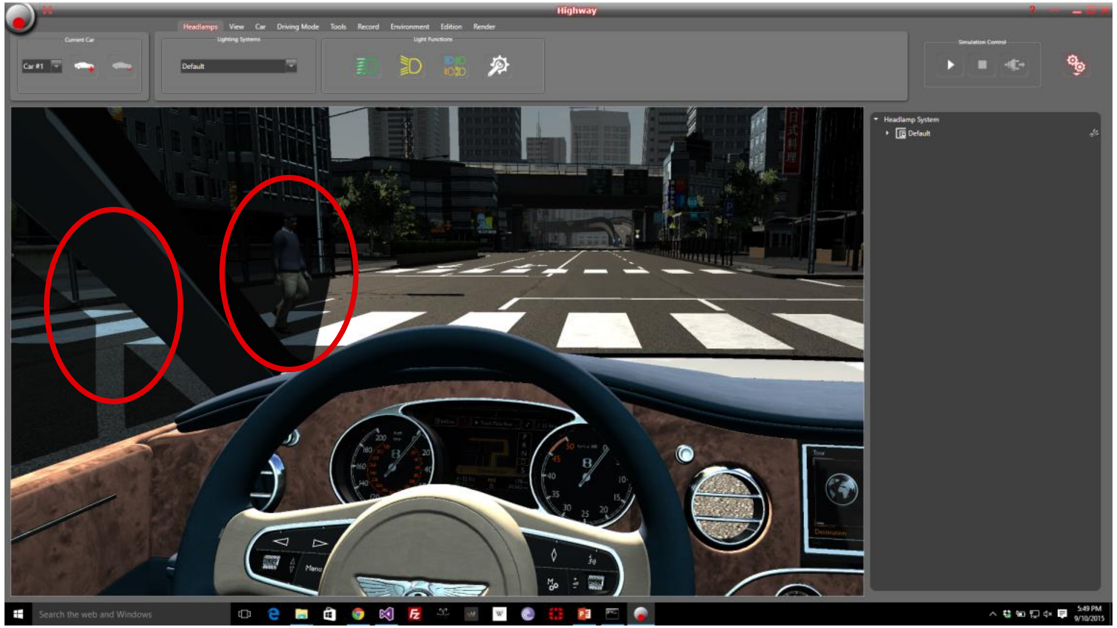
Without Atmosphere Scattering

With Atmosphere Scattering

Impact of the Environment on Human Factors

Feeling totally immersed

- Stereo vision for accurate representation
  - 1:1 scale for decision making
  - Allows occlusion analysis for A-pillar

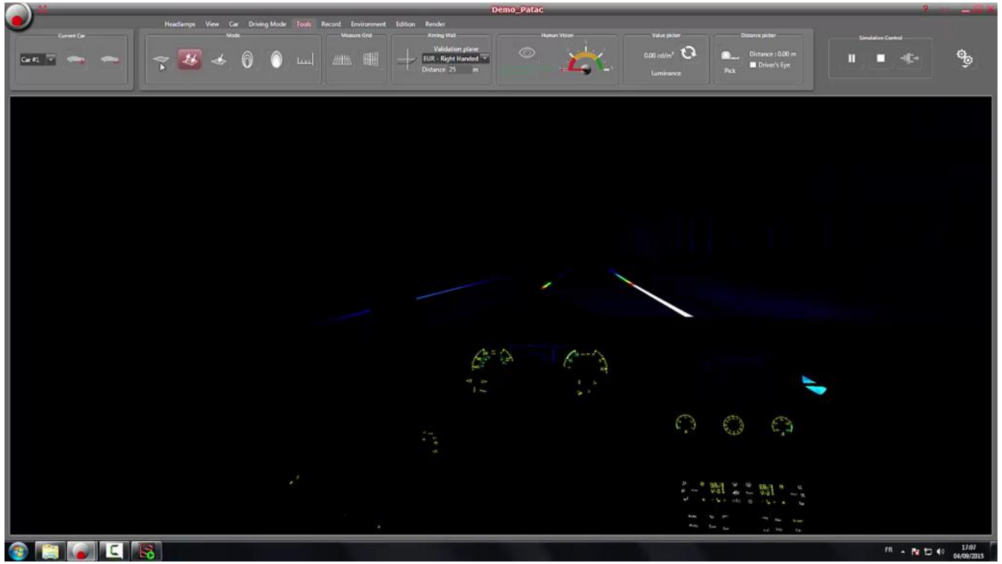


Pedestrian Previously hidden by the Pillar, visible only with full immersion
Road seems clear, but pedestrian is hidden behind the pillar

- Human tracking
  - Track and record gestures to analyze driver's experience
  - Simulate eyebox visibility

Seeing and being seen

- Next generation of headlamps
  - Validated with 2x500 sources at 60Hz
  - Connected to Mathlab/Simulink
  - Real photometry for advanced Engineering



Simulating life behaviour

- Pedestrians integration

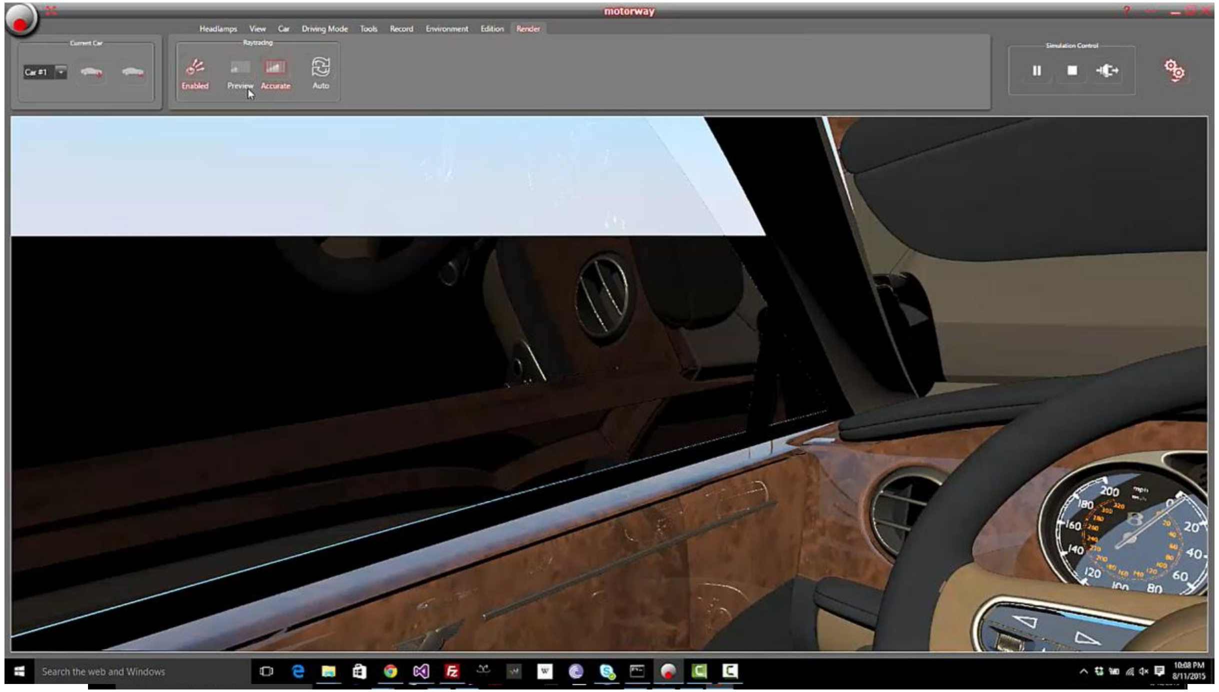
- Traffic animations

- Light Pollution

Performing ergonomics studies

- Windshield Reflection

- Car Model Switch



Bentley Mulsanne

Tesla Model S

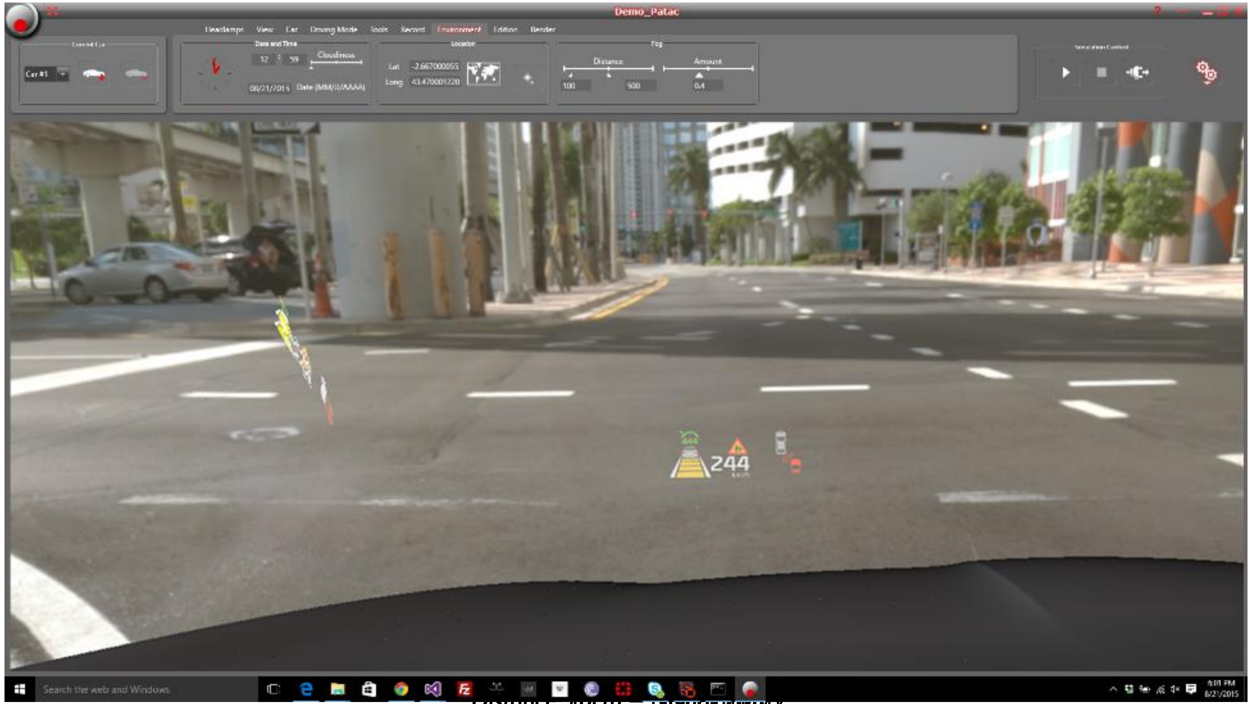
Designing advanced user interfaces

- HUD design and experience

  While driving

- Human vision reproduction

  Are you sure the driver will read display content ?



Realtime Stereo/Tracking Rendering of Optical HUD System

Applications

Night Drive Simulator

Headlamp assessment

- Real-time testing of headlamp performances
- Physically Correct Lighting (photometry & colorimetric)
- Regulation checks in real time
- Headlamps comparison during real-time driving
- Real-time testing of intelligent lighting systems (AFS, ACL, ADB…)

Immersive evaluation of ambient lighting

Dynamical assessment of interior lighting:

- Check perceive quality
- Design theme
- Place lights
- Observe light and materials interaction
- Observe spectrum change
- Measure lighting performance and behavior

Immersive perceived quality assessment

OPTIS

- **Evaluate perceive quality in driving conditions**
- **Identified use cases for perceived quality are**:
  - Functional and ambient daytime and night time lighting,
  - Visualization of limits of acceptable variations
  - Perceived spaciousness and depth perception
  - Ergonomics evaluation of car interior
  - Detection of reflections on windscreen and cluster
  - Materials and light in true color conditions

Conclusion

What does VRXperience bring ?

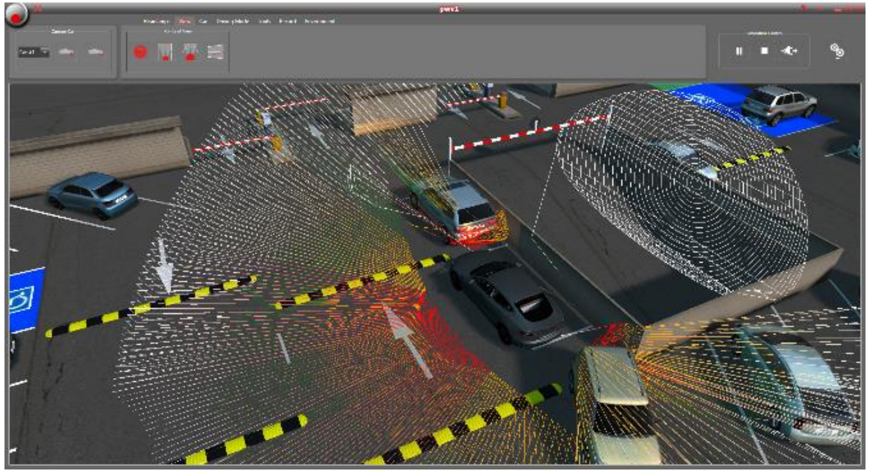
- Real light behavior for exterior and interior
- A display acts as a distorting glass and requires a human vision software interface
- Validated

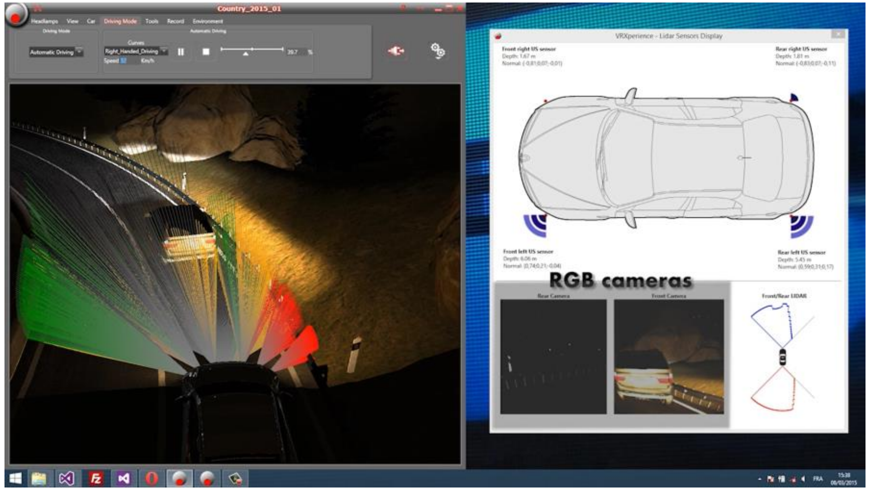
NEXT?

- Acoustics to improve realism
- ADAS / autonomous vehicles
    - Human behavior in autonomous vehicles
    - Passenger's experience of the journey

Imagining new ADAS/Automotive driving scenarios

- Lidar
  - 20M rays/s
  - Accurate sensors model (Velodyne…)
  - BRDF IR response up to 1000 nm
- US
  - Multiple sources to simulate multiple reflections
  - Manage surface granularity for diffusion
- Camera
  - Spectral rendering
  - Camera colorimetry
  - Optical deformation





Come to our booth

and live a VRXperience!!