Predicting the effects of light on in-vehicle displays

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1. Industry problem

Daylight falling on a display screen in your car can result in information becoming illegible due to washout or glare. This can cause distraction to the driver or mask safety critical information.

Automakers want to assess the impact of these effects for new vehicles without the need for costly prototypes, when it may be too late to make any changes.

Raytracing and physics-based rendering software allows the early identification of optical failure modes but how do you know you can trust the results?

This study verifies the use of the software SPEOS for the evaluation of in-vehicle display legibility through a comparison between measurements and simulations.

2. Measurements & simulations

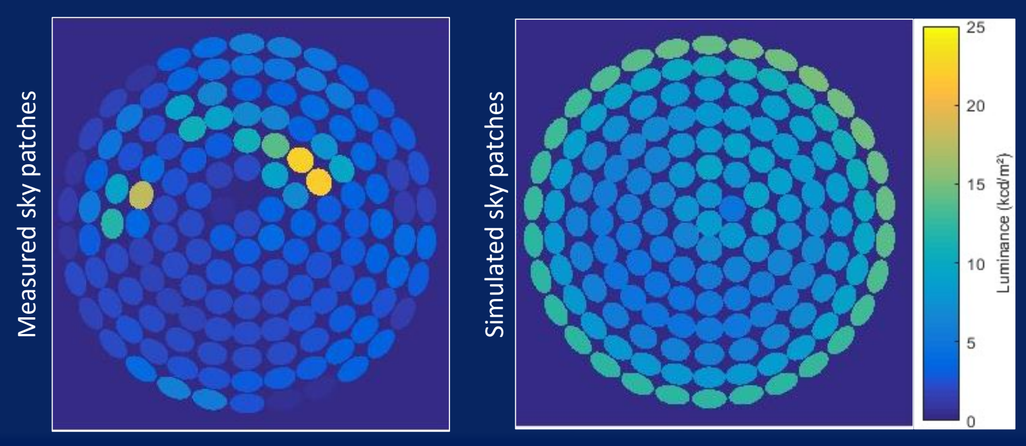
31 data sets were recorded of simultaneous measurements of the sky and display.

Simulations were then performed to mimic this set-up and the conditions for each measurement.

3. Processing data

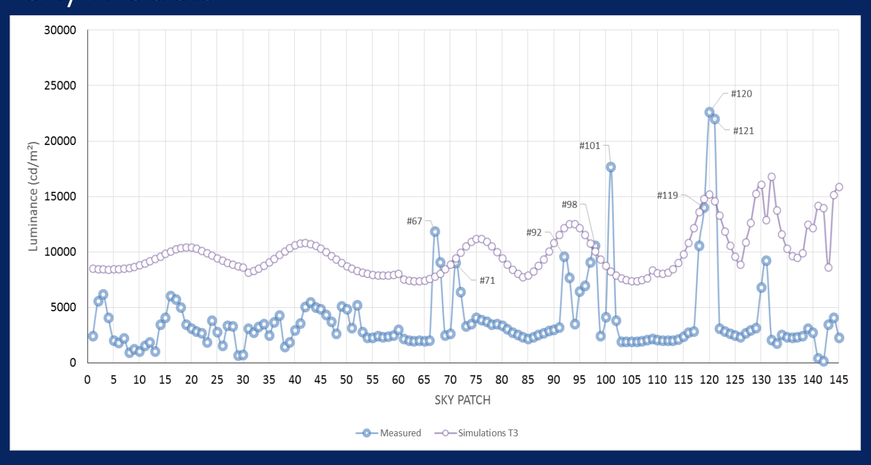
- Measured and simulated displays are divided into 16 patches to compare like-for-like features
- 12 pixel sample of background and foreground feature selected to extract brightness and colour data

- Measured and simulated skies are sub-divided into 145 patches
- Mean luminance of each patch compared to assess the model used in simulation against real skies



4. Results

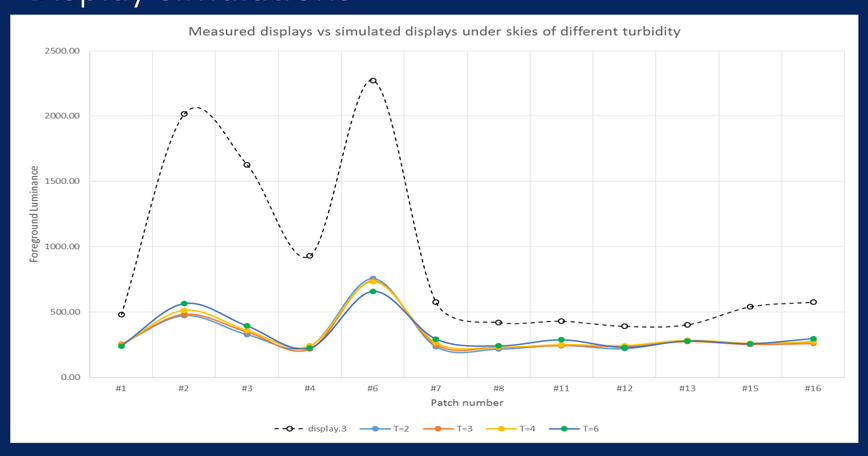
Sky models



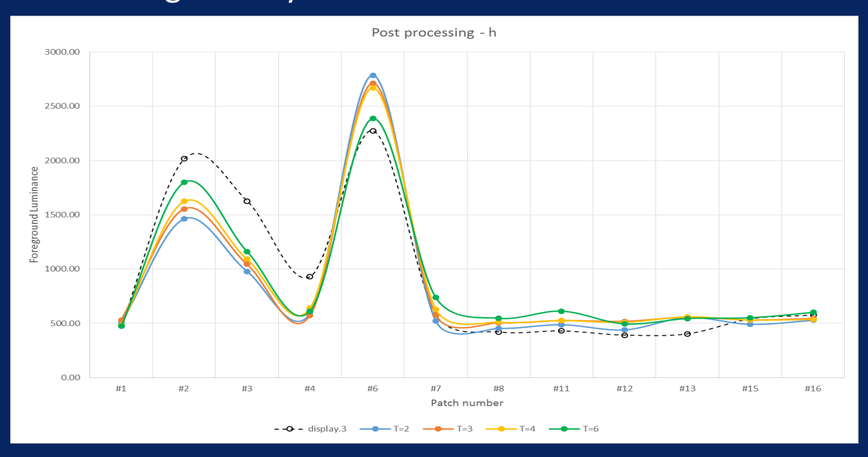
- Simulations over estimate luminance
- Clouds are indicated by peaks in the measured data

- Overall illuminance of daylight is underestimated
- Model generally correlates well to measurements

Display simulations



- Simulations underestimate luminance at display
- Model generally correlates well to measurements



- By increasing the sky luminance by 400% and display by 200%, the RMSE is reduced from 56% to 23%

5. Conclusion

SPEOS as a tool to simulate light has previously been validated to CIE171 which specifies simplified models to verify the performance of the software. The validation procedures give confidence that the software simulates the interaction of light to a suitable accuracy, however the software is only as good as the parameters input into the simulation.

This study has verified the use case for in-vehicle display evaluations and recommends the reporting of the standard case as well as a 'worst case' through post-processing operations.

This work supports the validity of past simulations while allowing for improvements to future simulations by closing the gap between simulations and real world.

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