2021 Shanghai DVN Workshop Report

Published April 27th, 2021

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22nd DVN International Workshop - Shanghai

EXECUTIVE SUMMARY

In the report, DVN presents its 10 main takeaways:
- ADB and the technologies behind, Matrix, DLP, MicroLEDs and even dynamic laser.
- New functions as guiding lines, projection of symbols, light around the car, functional and for styling effect
- Software and simulation, the two skills we must develop
- CASIC will increase the communication between the Chinese SC21, and the UNECE-GRE, with an important role for GTB and DVN; a MUST to open worldwide regulations to new functions and technologies."
- Styling differentiation mainly in RCL as OLED or "like OLED",
- Sensors integrated in the HL/RL
- New generation of displays, HMI, and interior lighting for higher level of safety and user experience
- LED light source and light shaping industry is embracing the opportunities of digital lighting with performance related innovative concepts and products to move the market forward.
- Growing importance of specialist companies providing solutions to make the new advanced lighting systems possible.
- High level of innovations shown in the exhibition booths

DVN summarizes the lectures of the 35 speakers and describes the innovative systems and components presented at the exhibition booths.

The first session is dedicated to the achievements and the needs of OEMs to improve safety and style, integrating regulations,
- **SVW Kiel,** talks on advantages and challenges of new exterior lighting technologies, with personalized welcome communication and lit logos, and also with new interior lighting providing information for comfort and safety functions
- **Audi Kobbert** details 2 surveys showing Dynamic Light Functions doesn't cause distraction and improve safety.
- **Stellantis Goncalves** presents the challenges of communication by light, then explains how his Group will use the 3 ways for lighting communication, guiding lines, projection of symbol and

light around the car.

- FAW VW Yang develops her lecture around matrix technology, showing the benefit of 11 segments against 32 segments in performances vs cost and later the benefit of MicroLED with 20kpixels

- BMW Übler presents the specific BMW ADB concept using dynamic laser matrix beam adding few words on the rear innovative lights of the BMW 5 series

- Volvo, Matha talks on the Volvo plans to be fully electric by 2030 and its impact for exterior lighting. "Range decreasi by ADB is not an issue if SUV but could be an issue if a city car"

- GM Larsen details the 10 year road to not yet legalize ADB in the US

The second session is dedicated to technical offer of set makers to improve safety and style.

Jinlong Ao, Hasco Vision showed his clear future vision with a broad lighting system approach including sensors, electronics and software.

Hossein Nafari, Mind Optoelectronics made one of the best presentations of the WS. He announced the serial introduction of a 10 kpixel ADB system for Q1- 2022, and 100kµLED module in 2025.

Sebastian Hirsch, Marelli AL said the sensors, mainly lidars, will be integrated into the headlamps, but not before 2024-2025.

Chris Kirchenbauer, Hella said the new Flatlight technology for signal with 5mm thickness and floating appearance is effectively giving a similar style as OLED, but with a reduced cost. first SOP in beginning 2023

Cho Yeonggi, Hyundai Mobis was presenting Lighting and ADAS developments, with an ADAS sensor integrated in ADB system.

Luc Brisson, Varroc, and Ralf Muenster, SiLC showed us object tracking with 4D+ imaging using Lidar sensors with advanced dimensions.

Lei Fan, Valeo was talking about Valeo's monolithic MicroLED technology for making ADB.

The third session is dedicated vehicle interior.

Pr. Dr. Blankenbach, Pforzheim University explains the new display technology, the system approach with new shapes, higher pixels, holograms, augmented reality and up to emotion.

Inova, explains the new lighting network, with the HW/SW structure behind the screen.

Ansys talked about Interior optical design workflow with its development tools

Osram/Arm and Melexis talk on fusion of safety display function with ambient light

J. Gourlay, DesignLED talked on Interior personalization, becoming more and more important, from integrated lighting, with very thin backlight,.

Novem R&D addresses how combining physical and digital for seamless user experience, putting together new functions in premium materials, such as wood, aluminum or carbon, anywhere in the interior, and how it will influence OEM/Supplier relationship.

W. Clemens, PolyIC, explains how the combination of decoration and light, using capacitive touch sensors with haptic feedback creates the new generation of HMI.

The 4th session is the 18th in the series of DVN Regulatory Sessions, bringing together worldwide rgulators.

Wang Wei, SMVIC presents an overview of the updates to the GB Standards and the 14th Five-Year Plan. This is of major major interest for the DVN community in the context of High-Tech innovation and answers many questions and concerns of foreign experts.

Zhu Caiping, Xingyu Lighting summarises the evolution of vehicle lamps, the principles of regulation formulation and identified the hot topics of Reversing Lamp Performance, Stop Lamp Glare, Position Lamps with the Luminous Logo.

Rainer Neuman, Varroc provides the latest status on research projects sponsored by the GTB Scientific Working Group (SVP)..

Davide Puglisi, GTB Secretary General, presents the main topics at GRE with GTB involvement, the Time required to introduce new functions into the UN Regulations and the impact of exemption approvals for new technologies.

Xie Dongming, CATARC explains the CASIC organisation and its objectives. He highlights the opportunities and challenges.

The 5th session is dedicated to 4 leading light source suppliers will give their view on the future development of LED front lighting technology.

Keanu Ma, Lumileds   gives insights into leading edge standard LED technology in combination with Micro-LED applications.

Carsten Setzer, Osram talks on the combination of visible light with infrared sources which will take an increasing area of interest for vehicle safety through direct obstacle detection

Terry Yuan, Texas Instruments addresses a bucket of new digital lighting opportunities.

Norman Hung, Everlight gives insights about the market introduction of matrix technology

In the 6th session, specialist companies provide solutions to make the new advanced lighting systems possible.

Xu Dong, Dian Hong, AML Systems demonstrate how to improve: precision, cycle time and accessibility of headlamp aiming.

Andy Zhang, Covestro shows the latest material trends for automotive exterior lighting,

Victor Wang, NXP proposes considerations and solutions for matrix headlighting

Pengyuan Lu, ANSYS explains why future complex headlamp systems will be impossible to design without use of simulation tools.

Tany Gu, Ningbo Sunny Automotive explains the importance of optics in headlamp imaging applications.

An important part of the report is focus to the products, systems, components, devices presented by the exhibitors. These exhibitions were the central point of the workshop.

A last part of the report present the main information from the VISION congress which was held one month ago. The Q/A sessions were developed in detail.

SESSION 1
CAR MAKERS ACHIEVEMENTS and NEEDS TO IMPROVE SAFETY and STYLE
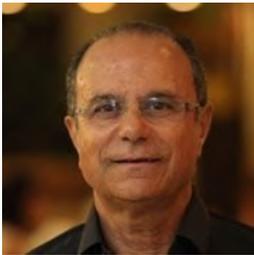
H.Fratty- Chair
DVN

H.Kiel
SVW

J.Kobert
Audi

W.Goncalves
Stellantis

L.Yang
FAW VW

R.Ubebler
BMW

P.H. Matha
Volvo cars

M.Larsen
GM

SVW Dr. Henning Kiel, Section Manager Front Lamps
"Lighting Technologies for Human – Vehicle communication"

Audi - Jonas Kobbert, Headlamp Development
«Attention and Distraction by Dynamic Light Functions»

Stellantis - Whilk Goncalves, Head Lighting and signalization Innovation
«Stellantis: a global strategy for communication using Lighting HD headlamps "

FAW VW - Lili Yang, Group Leader Frontlamps
"Matrix Headlamp technology"

BMW - Rene Übler, Pre-Developement lighting functions
«Dynamic Laser Matrix Beam»

Volvo - Paul-Henri Matha, Technical leader Exterior Lighting
"Volvo plans to be fully electric by 2030 : impact for exterior lighting"

GM - Michael Larsen, Exterior Lighting Technical Lead.
"The long road to legalize ADB in the US".

Henning Kiel, SVW presents the new night appearance of SAIC Volkswagen
SAIC Volkswagens new night appearance allows personalized welcome communication
The Volkswagen Logo for Electric cars is challenging for color conformity with challenges :

2021 ID.4
- Day appearance color CI "pure white"
- Night appearance color equal to light line and headlamp in color temperature / Kelvin
- "Perfect" homogeneity in wide angles - Illuminated area different than white area

Challenges of the new Volkswagen light lines and its lit appearance:
- Color conformity in white color and high sensitivity of human perception
- Lamps mixed with different light technology
- Long light guides with tendency for yellowing if PC is applied

Challenges of the 3D light guide technology for SAIC Volkswagen stylings
- New Volkswagen tail lamp concept: flat standalone light elements
- High homogeneity requirements in a thin package
- SAIC VW special task: large areas to be illuminated

New Interior Light of SAIC Volkswagen
The ID.Light i
- is a new light element which provides information for comfort and safety functions
- can support existing functions by giving light signals in a suitable position.
- shall make the user react correctly using a logical sequence and informing in the right direction

Outlook in Light function for communication at of SAIC Volkswagen
- Exterior light information should be known or combined with something known for passerby's and road users
- Future exterior light elements can add comfort and safety in a similar way, using known and easy symbols and the combination with known information

Jonas Kobbert, Audi presents two surveys answering the question: what is the current situation of these animated and dynamic light functions
Part 1: Study on Impairment of Animation and Sequential Activation
- Test set up :
The **c**riterion for location was in a city with traffic lights, in a parking. The pedestrians were concerned.
- Conclusion:
"We did not find any Comment on Impairment"
 "There was no distraction, no annoyance, no disturbance".

Part 2: Study on Dynamic Turn Indicators
- Test set up
Test Persons in a real Car
Front view shows big screen with nighttime , dashboard video from Downtown Miami, FL
Nighttime driving original sound Visual Task was to follow, oncoming cars with a cursor
Silhouette appeared on a separate Video screen (with 4 different TI)
Luminance adjusted to create standard TI illuminance at Test person's eye
24 Test Persons
Each setting 48 TI presentations (4 variants)
- Conclusion
"34% found quicker reaction time for Dynamic Turn Indicator (Sequential ON)
" Factor of 5 in correct direction detection was found (6,25% vs. 30,21%)

Whilk Goncalves, Stellantis, after presenting Stellantis and its 14 brands, talks on the new ways of communication with light which is a complex task, bringing together different domains up to now quite distinct: Lighting, ADAS, Head-up displays, Signalization, User experience Lighting communication is concerning car to user,car to other car, car to infrastructure.
- 1st way to communicate is projection of GUIDING LINES
Guiding lines are well adapted to head-lighting with Placement on the lane, Assistance / Working areas, lane keeping assistance, Trajectory forecasting, but also several challenges are as Guiding lines interference, Head up display, ADAS functions; Camera behaviour, User perception on day.night, on Quality and Distraction.
- 2nd way to communicate is **projection of symbol projection**, which is also interesting, but the best compromises must be determined concerning their contents, standardization, priority, risk of distraction, and light pollution.
- 3rd way to communicate is projection of the **Light around the car** by extension other functions: Turn indicator for cyclists, , Back-up light when leaving a park, , Rear fog for message, Door opening warning for cyclists or cars, Danger nearby, Carpet light
Congratulations Whilk on this presentation where you presented an overview of the the different ways of communication between user and car or between own car and other car.

Lili Yang, FAW VW, considering Matrix technology, presents a comparison betwween 11 segments and 32 segments with the conclusion the 11 segments is the best solution in performances vs cost, even the difference of light flux 600Lm vs 800Lm with same Emax
A survey done on the light projection shows the drivers prefer both a static and dynamic projection, with text and aimation
- DLP (Digital Light Procession)
1.3million pixel (1152x1152) high cost
Highest resolution of ADB module creates glare-free High Beam. Projection of signs and symbols, to achieve V2X, as well as animating effects and Coming-Home Leaving-Home function.
- MicroLED
20,000+ pixels（320x80 accepted cost
Lighting platform approach by coverage of full field of view.
Easy implementation of new attractive features. Long term customer engagement via software updates and functions on demand.

René Übler, BMW present the lighting systems of the 5 Series.
BMW develops here a different concept for ADB, no DMD or microLED but Matrix + swiveling laser module, with vertical cutoff.

The front light uses for the ADB, a 12 segments/side matrix beam with a dynamic laser booster. No DMD to increase the resolution, but there are swiveling modules to make the Dynamic Laser Matrix Beam.
A video presented in the lecture very well shows the addition of a fix matrix light and a swiveling laser beam
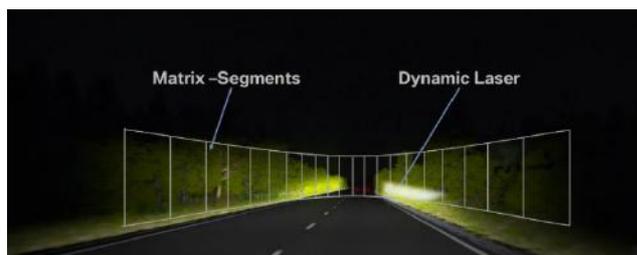
Dynamic Laser Matrix Beam

BMW 5 series presents several innovations, improving the styling differentiation
• Sculptural styling—rear lamp with highly 3D aesthetics
• No insight through outer lens, thanks to microöptics in the outer lens hiding the technlogy inside
• Tail and stop from one signature, implemented as bifunction
• High level of homogeneity
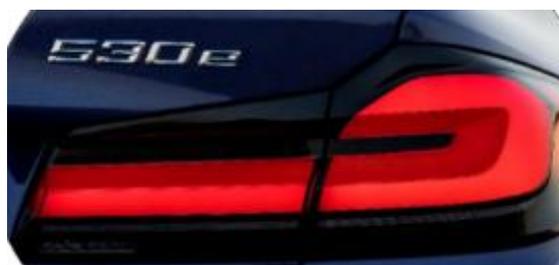
BMW 5 series rear lamp

Paul-Henri Matha, Volvo cars, presents the stakes of consumption, starting by a comparison between a big car, the Volvo XC40 and a small car, the Smart.

The XC40 range is 418 km (battery of 78kWh) and the Smart range is 130km (battery of 17kWh). It is explaining 100Wh consumption represents 0,1% for Volvo XC40, and 0.5% for the Smart ; 5 times more.

Example with DRL working by daytime, consumption represents 0.06% for Volvo and 0.3% for Smart.

Exterior lighting power consumption-total :

	DRL	Low Beam	High Beam	folamp	front Position lamp	rear turn indicator	rear turn indicator	reverse	stop	Rear fog	Rear position lamp	total / car
XC40	20	25	22	20	2	28	21	3	21	21	3	372
halogen car	25	65	65	65	5	25	25	25	25	25	5	710

The total of real consumption during one hour is 66W for Volvo with LED and 107W for Smart with halogen, which is 0,08% of the 78kWh of Volvo XC40 and 0,6% of the 17kWh of the Smart.

About use of the different functions, a study from Darmstadt shows
• Manuel high beam is used 3% of time
• Automatic high beam activation : 10% of time
• ADB is used 20% of time (10% with partial high beam, 10% with full high beam)

Synthesis–powerconsumption–lowbeam+ ADB

Concept / Watt/lamp	Low beam	LB / Car	High beam	HB / car	ADB	ADB / car
xc40	25	50	47	94		
Sail Beam	30	60	57	114	38	76
Matrix 11 segment	20	40	54	108	44	88
Pixel + foreground	55	110	100	200	95	190
DLP (min)	30	60	107	214	97	194
DLP (max)	80	160	107	214	97	194
MicroLED	25	50	110	220	94	188

Conclusion: Power consumption at average usage
- Data
LED vs bulb : - 30W
ADB "low resolution" vs LED : + 10W
ADB "high resolution" vs ADB "low resolution": + 30W
DLP vs µLEDtechnology: + 10W
- The three issues
1) Average usage exterior lighting ADB "high resolution" cost is 210€ (home] or 1050€ (motorway) in the total life of the car.
2) Range is not an issue if SUV and could be an issue if a city car, where lighting consumption can be 1% of battery capacity / hour
3) After the 1st generation system with Pixel 84 or DLP, the 2nd generation with MicroLED, we need a 3rd step with a drastically reduction of global power consumption

Michael Larsen, GM presents the history of the decade considering ADB
- 2011-2013 Start discussion with NHTSA : Adaptive Driving Beam is allowed under UN regulations, followed by a request for interpretation submitted to NHTSA by an OEM, with a proposed rationale for why ADB was already allowed under FMVSS 108
In January 2012, during Rochester DVN workshop, discussion between the SAE Lighting Group and NHTSA re-established a cooperation between SAE and NHTSA
In April 2013, SAE Lighting Systems Group presented ADB to NHTSA. NHTSA requested a recommendation from SAE for how ADB might be regulated under FMVSS 108.
- 2013 -2016: NHTSA's ADB Research : NHTSA requested the use of European ADB vehicles to study the performance of ADB at their test facility. Vehicles were provided, and research was conducted by NHTSA at the Vehicle Research and Test Center 2014-2015
In August 2015, NHTSA publishes their findings
- 2018 -2020: NHTSA Rulemaking : In September 2018, Transport Canada updated CMVSS 108 to allow ADB under SAE J3069 or UN Regulations. In October 2018: NHTSA published their ADB NPRM "NHTSA-2018-0090". NHTSA's ADB requirements were substantial, and did not follow SAE J3069. The proposal required dynamic test track evaluations of 34 driving scenarios, including straight and curved roads at different speeds , with glare to be measured continuously over all the testing scenarios
In February 2020: NHTSA published their Final Rule Timetable
- 2019 -2021: Auto Innovators : In August 2020, the Auto Innovators submitted their findings from the testing of 4 ADB vehicles following the NHTSA's NPRM. The testing was conducted in 2019-2020 using 4 ADB vehicles from European and Japanese OEMs. The report is available through the ADB docket NHTSA-2018-0090.
In 2021, the ADB Final Rule has not been published. We are hopeful that the final ADB rule will be published soon, perhaps before this effort reaches its 10-year anniversary

- Conclusion and lesson learned : The US Regulatory change process is slow. The update to allow ADB under FMVSS 108 has taken a decade. Regardless, it seems the regulatory update process moves sequentially and requires about 2 years for each step : (1) Petition + (2) Research + (3) Industry Standards Review + (4) Notice of Proposed Rulemaking + (5) Final Rule = 10 years
If a NHTSA Request for Interpretation is determined to be the best solution, the request should be thoroughly discussed and vette. Or else, the request may lead down a long and time-consuming path, and, the answer from NHTSA may have unintended consequences

Q/A Session 1 *Chairman Hector Fratty*

Audi's Jonas Kobbert, on the design of the research he presented:
"We didn't conduct a survey with drivers; we wanted to have unbiased people, especially during the current situation it was basically impossible for us to set up a test situation with multiple people getting into the same car over and over and driving the same road. So for us at the moment, the only possible solution was to conduct the survey with pedestrians.
Would we get same results with drivers? I think pretty much yes, because for the drivers in this situation the pedestrians, cyclists, traffic lights, and other vehicles would be much more of a concern than one of the parked vehicles that is displaying the lock/unlock lighting animation. All the people recognised there was some kind of animation in the parked vehicles, and immediately understood it as such—nobody thought the vehicle was deparking or something like that. I think drivers would focus on something entirely different, like pedestrians and traffic signals, and not on lights on parked vehicles. If it's possible at some point we'd like to study it."

Stellantis' Whilk Gonçalves on his company's brandwise strategy for launching new light functions:
"The strategy concerning application of communication by lighting: we'll start with the Opel brand, which was traditionally linked to high technology; presenting early ADB and early to market with 84-pixel ADB, etc. So this brand will be for us the first to use symbol projection and guide lines. We expect SOP 2023-24. Progressively this technology will be deployed on other brands: Peugeot and DS, particularly, in ways linked to the overall light signature and image of the brand. For the Citroën brand, we have great interest in projections around the car like the turn indicator and others, for the immediate interest of the driver and pedestrians. Afterwards, in a broader context of Stellantis, we're still discussing with our new colleagues from FCA—the maserati brand will have a similar track as with Opel. We are still unifying the wishes and brand signatures [after the FCA-PSA merger]."

Shanghai VW's Dr. Henning Kiel on the regulatory status of new lighting functions in China:
"Talks are going on in different directions. We need to quantify what we mean by new lighting functions. There are things going on for projection, things going on for ambient lighting, and for logos. Logos are simply homologated as position lamps, and it's connected with the light lines, and with the headlamp. All homologated as one part. When you just take the homologation for a position lamp, it's easy, you can just combine them into one lamp."

BMW's Rene Übler on the future of laser-based lighting in cars:

We are really interested in laser lighting; it's a very important topic for us. At BMW we will continue to develop it; there will be more cars with laser technology in the headlamps. We're also investigating it for other applications, like signature lamps, so there is more to come, but for now it's confidential. We already have a horizontal cutoff in our laser distribution in the current concept, so we're using it for this low-beam booster activated on the motorway. Technically you can create a low beam with the laser, but you have to think about whether it's really necessary or if it's the right topic, for a high-intensity light source to create a wide light spread on the road Technically yes, it's possible, and we've built concepts, but you have to consider eye safety and if it's really necessary to have a laser as a low beam."

FAW VW's Lili Yang on user attitudes toward smart and digital lighting:
"As I presented, we have done some user surveys. According to the result, pepole have showed a positive expectation of the digitalisation and smart lighting. We forecast that in the coming 10 years, there will be fast development. We have seen LED makers have made a lot of effort and achieved a lot. We hope just like microLEDs on the market and popularised. And I believe there will be broad application with increased function and increasingly reduced cost."

Volvo Cars' Paul-Henri Matha, about power consumption and cost reduction:
"Average power consumption of lighting is about 100w, or 200w for adb. What does it mean? In Europe the penalty if you have too much CO_2 is around €100. One ton CO_2 is about 50w. So if you can get a 50w power reduction, then you can save significant money. If we have good technology to reduce power consumption, then you can spend that money on it. This is possible for other carmakers, too, not just Volvo. Yes, we have to develop new ADB technology because 200w is too much. Too much for CO_2 and too much for EVs. We can develop new optical systems because we have seen with µLED the efficiency is not very good for example. It's better if you use HP LEDs. Also we can improve the optical system with increased field of illumiantion. This is a job for tier-1 and tier-2. As carmakers, what can we do? We can work on functional development to put the light exctly where we want. We need to develop new software, and that is exactly what we're doing. We're doing the software in house to put the light where we want. If you can save lives—life has no price. At Volvo Cars you can select ADB on any Volvo model. Yes, you should buy it because it is good for safety."

Audi's Jonas Kobbert on the necessity of end-user education:
"One of the big challenges to us as carmakers is to increase communication to lighting non-experts regarding the benefits of ADB and additional lighting because the people who buy a car, they only see a cost associated with high-end lighting, but they don't really know what the benefits are. So this is one of the main positions we have to work on as well."

FAW VW's Lili Yang on Chinese ADB regulations:
"We have been participating in the committee of the regulation. China is an open country encouraging innovation. ADB headlamps have been widely adopted in China, it's quite prevalent here. But the focus of the topic here is high-def or dynamic projection. These have been intensively studied by automakers. Recently shanghai had a car show and we could see a lot of new function s have been achieved on the road. About our company strategy, we have the strategies in place."

Link to VOD session 1   **Link to VOD session 1 -For China Mainland**

SESSION 2
SET MAKERS TECHNOLOGICAL OFFER TO IMPROVE SAFETY and STYLE

W.Huhn, chairman **Jinlong Ao** **H. Nafari** **S. Hirsch**

C. Kirchenbauer **C. Yeonggi** **L.Brisson** **Lei Fan**

Hascovision , Jinlong AO, Vice General Manager
"Beyond Lighting".

Mind Optoelectonics, Hossein Nafari, VP of Lighting, Thermal, and Electrical Systems
"Popular Lighting System in China = 10K pixels level lighting or 1M pixels lighting"

Marelli AL Sebastian Hirsch, R&D Director for Asia,
"Future Challenges for Digital Style"

HELLA - Chris Kirchenbauer, Head of R@D Lighting, China
"FlatLight - Technologies Enabling New Styling for Automotive Signal Lighting"

Hyundai Mobis, CHO, YEONGGI, Head China R&D Center Shenzhen Branch,
"ADAS sensor integrated ADB System"

Varroc - Luc Brisson, R&D Dir. and SiLC - Ralf Muenster, VP Business Dev[t] & MKT
« Headlamp Integrated 6D LiDAR advances safety for ADAS and AVs »

Valeo (Lei Fan), Advanced R&D Manager,
Monolithic Systems for high definition lighting and roadmarking

Jinlong Ao, Hasco Vision showed us his clear future vision.

He gave an innovation firework beyond lighting. Some of his examples show Hasco's Lighting Systems in production cars like HiPhi X, some of his flashlights went some years into the future. He showed a broad lighting system approach including sensors, electronics and software. Hasco's technological bandwidth, like a headlamp integrated NIR Camera in a serial project, is really surprising. At Q/A session, Jilon Ao however answered that their integrated IR camera in headlamp is not yet in production as some technical difficulties need to be solved.

At a question about the requested number of pixels useful, he stipulates that 1M pixels is not necessary for road marking

Hossein Nafari, Mind Optoelectronics made one of the best presentations of the WS. He announced the serial introduction of a 10 kpixel ADB system for Q1- 2022, and 100kμLED module in 2025. He also expressed the fact that despite using DMD technology in production since 2019, he does not think to use it for headlamp in the future.

He said that China has solutions for everything and proved it with several examples. He believes that lighting signatures will become even more important and visible with the growth of electric cars. One of his remarkable sentences was addressed to the regulators: «Regulation shall not be an obstacle for technology"

He highlighted the fact that Electric cars makers and particularly the new ones are much more demanding for their lighting signatures.

Sebastian Hirsch, Marelli AL said the sensors, mainly lidars, will be integrated into the headlamps, but not before 2024-2025.

In China timing is the most challenging part of a project, developments in China are faster than in Europe.

About the number of pixels necessary, he said that naturally there is an important gap between 20k and 1M pixels, but that between 20k and 100k pixels, there is not a huge gap really seen on the road.

Chris Kirchenbauer, Hella said he is a lighting guy in the 3rd generation. He followed the passion of his father and grandfather and earned spontaneous applause of the audience for this nice personal story.

The new Flatlight technology for signal with 5mm thickness and floating appearance is effectively giving a similar style as OLED, but with a reduced cost, standard technology, and 1W electrical consumption. First SOP will be beginning 2023

This technology can also be used for front lighting, considering naturally the specific temperature constraints

Cho Yeonggi, Hyundai Mobis was presenting Lighting and ADAS developments, with an ADAS sensor integrated in ADB system. He pointed out that he has a safety technology background and showed us some pics of the facilities in Shenzen, where Hyunday Mobis uses a complete proving ground with high-speed test track and light tunnel to better combine ADAS and lighting development.

Luc Brisson, Varroc, and Ralf Muenster, SiLC showed us object tracking with 4D+ imaging using Lidar sensors with advanced dimensions. Both' focus is the functional integration. SiLC is a Varroc supported start up in California with 52 people. Ralf was life in our workshop, despite it was 2 am Californian time.
There will be two distinguished parts behind the same lens of the headlamps, particularly as asked by Wolfgang Huhn to keep the service cost acceptable

Lei Fan, Valeo was talking about Valeo's monolithic technology which is also known as Micro LED ADB. Monolithic technology will be used for high resolution high beam as well as for projections on the road. First cars lighting up Chinese roads with Valeo's monolithic high-tech headlamps are expected in 2023.
To a question concerning the third revolution of lighting, he thought that it will no more be around optics, but with 360° view and for AV, Wolfgang Huhn stating that this third revolution would be a software centric lighting.

Q/A Session 2 *Chairman Wolfgang Huhn*

Hasco Vision's Jinlong Ao on IR camera integration in headlamps:
"The cameras are integarated in the lamps. We have already achieved mass production. In this process in terms of engineering we still encounter some difficulties. Through R&D we have solved a lot of them. There will be some problems with distortion of the light source in the lamp, and we have found some egnineeting solutions to resolve that. And in cameras installed in lamps, you can compensate the problems or shortcomings of ADAS, and this we have detected in R&D. Especially for foreground."

Mind Optoelectronics' Hossein Nafari on pixel count roadmaps:
"We've got 10-kilopixel SOP planned for Q1-2022, and we are focusing on developing 100-kilopixel setups to be ready for 2025—that's our two main milestones. "

Marelli AL's Sebastian Hirsch on sensor integration in lighting:
"The timing is most challenging part, because the timing in China is different than in Europe or the rest of the world. Going through pre-development with Audi you have plenty of time and you will likely succeed to commercialise a new technology. In China if you wait until you get an RFQ...you're dead; you'll never hit the SOP with a new technology. So here in China it's even more imporant to engage early, whether it's predevelopment or a tech day—you have to find the right people. Talking about sensors, we have sensors that have already SOP with our partner. Radar is pretty advanced, lidar takes a bit more. For lidar I don't dare to talk about anything before 2025, which is a time horizon that doesn't even exist in China. I haven't seen any project where we have been able to engage with a customer with SOP 2025. We have to be realistic for sensor integration; it will take more time."

Hella's Chris Kirchenbauer on FlatLight:
"It's definitely not a real OLED. It's using standard technologies and microoptics to achieve very similar appearance. The purpose of this tech is to procide an affordable replacement for OLED. It's a different market. It's LEDs piping light down into the element. First SOP in early 2023."

Hyundai Mobis' Cho Yeonggi on ADAS and lighting co-development:
"Our lighting and ADAS teams work together to converge the products."

Varroc's Luc Brisson and Ralf Münster on serviceability aspects of lidar integration in lights:
"It's a fair question and it's a concern from our customers when we're atalking about this kind of integration of complex and expensive systems. The study we're doing together with SiLC is with functional integrations—to use the space at the front of the vehicles, in the eadlamps, to make this integration. It's not really a packaging integration but a functional integration. We look at two separate areas of the headlamps for the light versus the sensing. From the external perspective, it's seamless integration: it looks like one element nicely integrated into the front of the vehicle."

Valeo's Lei Fan on SOP for PictureBeam Monolithic:
"First SOP is 2023; in 2022. We're already ready in terms of product maturity, but the first product on the market will be in 2023."

Mind Optoelectronics' Hossein Nafari on how 10- and 100-kilopixel resolutions coexist:
"We continue to improve the 10-kilopixel chips and decrease the price, and it will continue to have applications until it dies naturally around 2028-29. Now we are developing 100-kilopixel systems. Still a cost problem with it, but it will take over form the 10-kilopixel chip five or six years from now. It is a natural evolution. We are not yet ready for 100-kilopixel technology or cost. But we're working on it!"

Marelli AL's Sebastian Hirsch on resolution priorities:

"In fact we work on the two technologies: microLED right now in 2, 10, 20, 40 kilopixels; we haven't seen a 100-kilopixel chip yet. And DLP with megapixel resolution. If we look at ther reseult on the road, the DLP can give a little better sharpness of the projections, versus a 20 kilopixels. It's not such a big gap. There is a gap, it's visible, but hard to justify the difference between 20 and 100 kilopixels. Hard to say if 100 kilopixel is technially needed; right now we're focusing on 20 kilopixels."

Hasco Vision's Jinlong Ao on resolution applicability:
"Between 10 kilopixels or 1 megapixel, due to the point of view and the decrease in energy if the beam is on the vertical screen with high resolution will bring apparent benefits. But on the road, it's different. I think DLP with 1.3 megapixels is more than what's needed for good road projections."

Mind Optoelectronics' Hossein Nafari on the resolution race:

"Every company have their own strategy of productive movement; I can't comment on other companies. In terms of pixel deployment—all the customers also have evolutive requirements. There's no specific fixed requirement by customers for what they want. What they want comes from their marketing research and techniological ability and what the lighting suppliers can provide. We have technological evolution very fast, especially in China, and customers, automakers, are very active about what they ask, what they want from new lighting technology. We mustn't forget that EVs will also come, and it will be a game-changer because they're much more aggressive in terms of having new products and new rquirements and implementing new technologies. That's not the case so much with the classic automakers. EV makers are much more aggressive to have a much ore effective signature for their cars. In China, the EV buyer wants to show that he has an EV. It's also an argument of marketing: to be able to show this is a new-brand EV on the road. Always it will be duality between cost and marketing effect and customer satisfaction. Luxury sales in China are still high. High expensive brands are still on the upward trend."

SESSION 3
HMI and DISPLAY IN TOMORROW COCKPIT
SMART INTERIOR LIGHTING

P.Aumont, chairman
DVN

PG Bravo
Grupo Antolin

K. Blankenbach
DisolayForm

S. Hoffmann
Inova

S.Zhang
Ansys
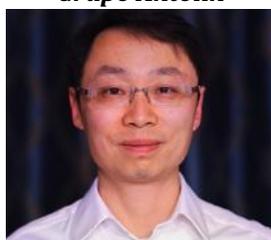
M.Dou
Osram
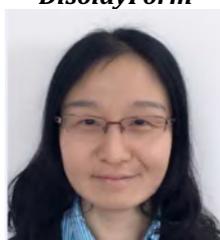
L.Song
Melixis

J.Gourlay
DesignLED

Grupo Antolin - Pablo García Bravo and Weijie Huang, Shanghai Tech./Commercial Office
"The intelligent cabin by Grupo Antolin"

Pforzheim University - Prof. Blankenbach
"New Design Visions and Holistic HMIs by Advanced Display Technologies

Inova - Stefan Hoffmann, Manager Applications
"ILaS – the new lighting network for the car"

Ansys - Sen Zhang
"Interior optical design workflow"
Chairman of the session Philippe Aumont

Osram-Melexis - Mingjie Dou, Osram Senior Marketing Manager-Automotive - Linhong Song
Melexis, Senior Field Application Engineer ou bleu?
"Ambient light takes the next step towards ASIL"

DesignLED - Dr. James Gourlay, CTO
"Backlighting Technologies

Novem - Dominique Heilborn, R&D Head of light and function
"Light & function integrated interiors - supply landscape challenges"

PolyIC - Dr Wolfgang Clemens, Head of project management
"Innovative HMI panels with integrated touch sensors- shytech decoration for backlighting"

Pablo García Bravo, Antolin presents the Intelligent Cabin perspective. Intelligent Cabin means what could be / will be the future of car interior thanks to new cockpit features and technology, in cabin monitoring, interior lighting, air purification, using natural materials, whenever it is possible.

This Intelligent Cabin, as shown in the Elin Concept, presented first at 2021 virtual CES, starts with safe and smart access with face recognition (with EPP - Elastic Preserving Projections - technology integrated in the B-pillar), multiuser configuration. It goes on with closing an acoustic door made out of natural materials, backlighting and active and functional surfaces. This door can integrate a capacitive pad, for instance for seat adjustments, and backlighting. Air cabin is sanitized by an air purifying overhead console, with a headliner integrating ambient and functional LED lighting. Sun visor, which becomes a kind of available surface, because of lower usage, can be transformed in a projectable surface.

Prof. Dr. Karlheinz Blankenbach, **Pforzheim University** founded the Display Lab, which focuses on applied R&D on displays: Optical measurements, image processing algorithms, driving electronics and evaluation.

Continental-Leia source: Leia

This lecture presents the concept of Holistic User Experience (UX), and where new display technology will support a full system approach, along the complete mobility process, starting from an App or from the web, to access the vehicle, and then to drive it. "This process creates an increasing number of interfaces between the user and the machine, in its extended meaning; not only in the interior, but also around the car (access), Apps, and websites. Intuitive usability

includes mobility itself, but also infotainement, and all the bunch of services becoming available from your vehicle (pay, toll, gas, food, hotel…). Thanks to progressive automation, driver will have more time to interact, becoming more a passenger, what we have named here at DVN Interior, having "passenging" activities.

Pr Dr Blankenbach presented what would be next generation displays, what we would name advanced displays, covering new shapes (curved, 3D), higher pixels, holograms, augmented reality. These displays will have a major influence on interior/cockpit architecture and user experience design, laid out all around the occupants, from A pillar (for mirrors) and to even windows (through projection, with limitation, because of privacy), from augmented HUD to holograms and gesture controls. That means that a display will be not anymore like being just put on a table, like a computer on your desk, but really integrated.

This seamless integration into the cockpit system is key, being physical integration into the trim elements, but also with functional surfaces, and also integration from a user interaction perspective with consistent look and feel at any interaction point.

Mercedes Hand UI Projection

BMW Holographic screen

Pixel's density could then exceed the 100M, requiring then higher computing capacity, and more complex interface management. For HUD, next generation will be around from extended field of view. From a safety standpoint, to see properly lane, side road, and cyclist/pedestrian, vision has to extended beyond traditional 10°X5°, up to 60°.

Stefan Hoffmann, Inova explains what is needed behind the scene, meaning behind the screens, to make all of that possible, the hardware/software structure you need to build, the electronic network which will support, with light and sensors, targeting efficiency, and to minimize development, while ensuring full reliability.

Inova is leading ISELED (Intelligent Smart Embedded LED), an innovative technology based on highly integrated, smart LED modules enabling dynamic ambient and functional lighting solutions. The ISELED Alliance is an open, industrial alliance with the objective of developing a comprehensive ecosystem – i.e., a complete system solution for innovative automotive lighting – based on ISELED technology. Today, various ISELED products from several manufacturers are available, such as LED modules from Dominant (SeddLED), Osram (Osire) or Everlight (Smartled).

Sen Zhang, Ansys talks about "Interior optical design workflow", as a development and simulation tool to preview the targeted user effect, and the user perception. Within the validation process, step by step, from quick preview, to live preview and then, final validation, it includes visibility and perception criteria. It covers also DMS (Driver Monitoring System) and simulation of alerts, including light alerts.

Ansys SPEOS' is a dedicated workflow for creating an opto-mechanical system, using optical part design module, with benefits such as easy usage for non-experts, and communication between CAD systems, and even between different Catia versions. Based on generative optical design, this workflow dramatically increases development productivity and reduces engineering development time and cost, while improving style convergence.

Mingjie Dou, **Osram** and **Linhong Song**, **Melexis** held a joint lecture in the field of smart ambient light with the next step towards safety Applications.
The image below shows the process flow of a RGB light system with Osram Standard LEDs in comparison to the new OSIRE LEDs with DMC and RGB-LED-drivers from Melexis.
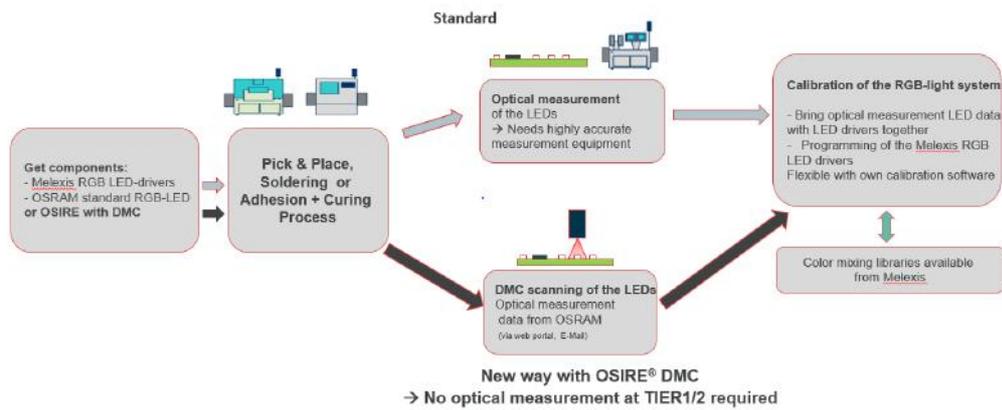
Melexis has the mission to create innovative micro-electronic solutions for smart automotive, medical and industrial applications (see Melexis Company Profile in DVN-I Newsletter No.54). Melexis has the following targets for automotive RGB LED lighing applications: wiring across the car by using standard bus systems, cost sensitive solutions, easy to use and to implement in tight space requirements and fusion of safety display function with ambient light.

Dr. James Gourlay, CTO of **DesignLED** gave a lecture about "smart interior surface backlighting" for personalization and an ultimate user experience.

Cars are the "third living space" with different functions and users, e.g. executive, family and privacy. Therefore fixed hardware must be personalized and interior light can be modified by software. Some examples for personalization user interaction scenarios:

To integrate these technologies in the car interior, the smart backlighting requirements are:
- thin (< 5mm) and curved systems with low tooling costs

- dynamic animation capability with small number of addressable LEDs
- edge to edge homogeneity with a surface luminance 100 – 1000 cd/m²
- integration of sensors and light aligned with sensor functions
- varying LED density and dynamic RGB animation for transition from screen to trim

Dr. Gourley makes a comparison between different backlighting solutions and explained, that the composites from DesignLED have some advantages regarding space, performance, power and costs over OLEDs, LCDs, direct-lit, edge-lit and molded solutions. He showed impressive examples and inspirations with his static and dynamic backlighting technology:

Dr. Dominique Heilborn, **Novem** introduced his company. Novem works with the full spectrum of materials like wood, aluminium, carbon, premium synthetics and many combinations for door trims, dashboardand center consoles. Light integration in car components comprises the conceptional phase, series implementation and production.
Dr. Heilborn said, for the next generation it is completely natural, that you get all light colors in a car in the same easy way like in your smart phone or living room. All functions will be under control by combining physical and digital life. He sees the light & function integrated interiors like in the image below:

Novem - Light & function integrated interiors

Dr. Heilborn explains, that a large part of the added values will shift from the OEMs to the suppliers and at the same time bigger platforms and a greater number of vehicles will be introduced to the market with a strategy for synergies. He said that a lot of automotive suppliers will die within the next decade and new ones will rise according to numerouseconomic economic studies. This is a great challenge for the supply landscape accept it.

Examples of light integrations in décor trims from Fa. Novem with hidden until lit effect
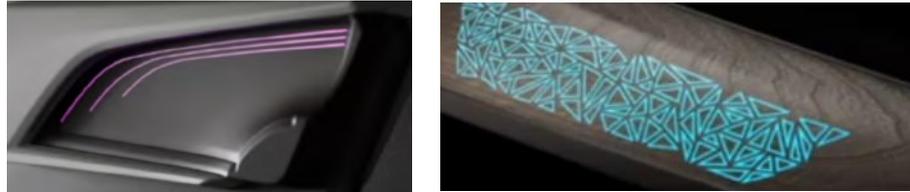
Dr. Wolfgang Clemens, Head of project management of Fa. **PolyIC**, presented HMI automotive trends, PolyIC as a KURZ Company, PolyTC touch sensors, smart HMI surfaces with touch sensors, products, use cases, decoration and light & function.

The focus of PolyIC is on engineering and product management, production, infrastructure and sales is done by KURZ, a global leader in thin-film technology for surface finishing, decoration, labelling and protection.

One trend in terms of automotive HMI: light & function are everywhere in the car interior, large, curved, seamless and shytech components with hidden until lit light features. Another trend is capacitive switches with active haptic feedback substitute the mechanical switches.

The touch sensors are manufactured in a "roll-to-roll" production with a PET substrate and silver metal mesh technology for a high electrical conductivity and optical quality. The sensors are thin, flexible and light weight with multiple integration options on a low price level.

Case studies:

1. Seamless, curved, large and integrated instrument panel with an IMD top coat by KURZ and 3 touch silver sliders by PolyIC

2. Door trim with capacitive transparent touch sensors (3 buttons and 1 slider), IMD decoration with day / night effect and integrated active control of backlight.
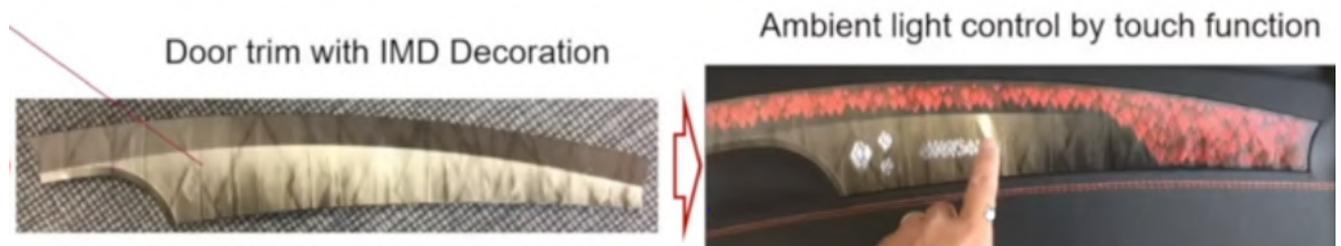
3. HMI-Instrument panel (reddotwinner 2020 for innovative products /):
Organically shaped multicolor IMD decorated surface with shytech backlighting effects, seamless and transparent (PC mold) touchscreen area (> 90cm width), and hidden until lit buttons for intuitive active touch operation. The touchscreen sensor is integrated by IML or lamination, the buttons, slider and the capacitive proximity sensor by FFB or lamination.

Q/A Sessions 3 *Chairman Philippe Aumont*

Grupo Antolin's Pablo Garcia Bravo on providing capacitive pads and haptc feedback:
"This capacitive surface, these pads, are not only to be integrated on the IP. We can put them ont he door panels or centre console. And related to the haptic feedback we have different tech to provide these functions. To avoid issues when drivers are driving, we have a tech using solenoids and motors to provide haptic feedback. Depending on the surface, and the size of the surface, we provide different technologies with different powers for different motors and solenoids."

DesignLED's Dr. James Gourley on LED backlighting and what comes next:
"That's a good question. I've got some experience in OLED technology, and we see this already in some of the more advanced mobile phones and automotive interior displays, so I can see how OLEDs are being used for some rear lighting inautomotive, too. When it matures enough—right now it's expensive and maybe has some reliability issues—I can see it becoming integrated very effectively because it's thin and homogeneous. Another tech we're interested in is μLED, which is really jsut scaling down standard LEDs to make very small dies, which you can create arrays of devices with. It's more a packaging problem. I guess our friends in Osram have more expertise on that. Certainly μLED tech is being deployed as large-area displays instead of LCD, and we're interested in that for surface backlighting."

DesignLED's Dr. James Gourley on variable-pitch embedded LEDs:
"The Pitch of the LED is perhaps 10mm, and some maybe 100mm. So we can tune the pitch of the LED for the use case. But the thickness of the system is always 2 to 3 mm. So we can go from small pitch to very large pitch between LEDs with a very thin system. Again, it depends on use case. For high luminance you need high density, and for low luminance with lower cost you have low density. You can mix high and low density in the same light tile system."

Osram's Mingjie Dou on EMC and EMI with new lighting technology:
"About EMC of smart lighting: we have several solutions. First, we are working with Melexis to develop a standalone deiscrete driver. This is a mature solution and it can deliver dynamic functions. Another solution: smart light itself is evolving. At Osram we're developing a new transmission protocol based on new hardware. We are able to address the pain points regarding EMC. We are significantly improving the EMC erformance. IseLED protocol is helping, too, and will continue to do so. Based on current ISELED, I think in terms of design we will see cost increase, but that will also address the problems with EMC."

DVN-Interior's Philippe Aumont on UV-C light for in-car sanitisation:
"Many suppliers are presenting technologies related to IAQ and sanitization. UV-C is one technology. I don't know that it wlll be the only tech, but if you look at all the prototypes recently presented, it's more than a weak signal for the future of the market."

SESSION 4
REGULATION

Chaired and summarized by Geoff Draper- DVN Senior Regulatory Advisor

Geoff Draper
Chairman

Wang Wei
SMVIC

Zhu Caiping
Xingyu Lighting

Rainer Neumann
Varroc

Davide Puglisi
GTB

Xie Dongming
CATARC

Bu Weili
SMVIC

He Yuntang
CATARC

The Session Agenda

- Introduction to the Session and Presentations
  Geoff Draper- DVN Senior Regulatory Advisor
- Progress of SAC/TC114/SC21 to update GB Standards.
  Wang Wei Secretary of SAC/TC114/SC21
- Some Hot topics in the Drafting Process of new GB Regulations on Light Signalling Devices
  Zhu Caiping Vice Chair of C-GTB and Project Leader for the new GB Regulation on Light Signalling Devices
- Current and Planned Research Projects Sponsored GTB
  Rainer Neumann - Chairman of the GTB WG-SVP
- GTB Activities at GRE
  Davide Puglisi- GTB Secretary General
- Introduction to the "China Automobile Standards Internationalization Centre (Geneva)"
  Xie Dongming - Vice-President and Chief Representative of CASIC
- Panel Session
  Bu Weili, He Yuntang, Wang Wei, Xie Dongming, Zhu Caiping

Geoff Draper opened the 18th Regulatory Session by explaining that the objective was to focus upon the activities of C-GTB and SAC/TC114/SC21 in the context of the development of the Chinese GB Standards and to review the work in GTB.

Wang Wei presented an overview of the updates to the GB Standards and the 14th Five-Year Plan". This is of major interest for the DVN community in the context of High-Tech innovation and answers many questions and concerns of foreign experts. Of particular interest is the detail of the process to update the GB standards and the key work of the 14th Five-Year Plan.

Zhu Caiping summarised the evolution of vehicle lamps, the principles of regulation formulation and identified the hot topics of Reversing Lamp Performance, Stop Lamp Glare, Position Lamps with the Luminous Logo, Front Position Lamps with Variable Intensity, Signal Projection, the "n-1" rule, and Lighting Priority of ADS sign lamps reciprocally incorporated with other signal lamps.

Rainer Neumann Rainer Neumann summarised the research activities on Road Projections, AV Communication with Other Road Users, Risk of Discomfort Glare by Super Small Headlamps, Photobiological risk with "bluish" LEDs, and the Potential of reducing electrical power and CO2 in Automotive Lighting with intelligent solutions in specific traffic conditions.

The following are extracts from Rainer Neumann's presentation that can be downloaded **HERE.**

Davide Puglisi's presentation, done by Geoff Draper, was focussed on the Main Topics at GRE with GTB Involvement, the Time Required to Introduce New Functions into the UN Regulations and the Impact of Exemption Approvals for New Technologies.

Xie Dongming is a senior engineer, working on Exterior Noise & Complete Vehicle Performance for the Automotive Standardisation Research Institute (ASRI) of CATARC in Tianjin, China.

He also has a long experience of working with the UN World Forum on Harmonisation of Vehicle Regulations (WP.29) in Geneva as Head of China Delegation, UN WP.29 GRBP on "Noise and Tyres" and is Co-Chair of IWG ASEP on "Additional Sound Emission Provisions".

Xie Dongming also has a new and very important role, as Vice-President and Chief Representative of the China Automotive Standards Internationalisation Centre (Geneva).

Xie Dongming took the opportunity to present the new CASIC organisation to the public for the first time. He explained the Purpose, Summarised the Organisation and explained how it is under construction and finally highlighted the Opportunities and Challenges.

The Panel Session
This was a live session dedicated to the opinions of our distinguished Chinese Regulatory
Experts who answered to the question:
"Could the recently launched China Automobile Standards Internationalisation Centre be the key
to synchronise the adaption to technical progress of the GB standards and the UN Regulations?".

The Panel

Bu Weili
Secretary General,
SAC/TC114/SC21

He Yuntang
C-GTB President

Wang Wei
Secretary,
SAC/TC114/SC21

Xie Dongming
Vice-President and Chief
Representative of CASIC

Zhu Caiping
C-GTB Vice Chair
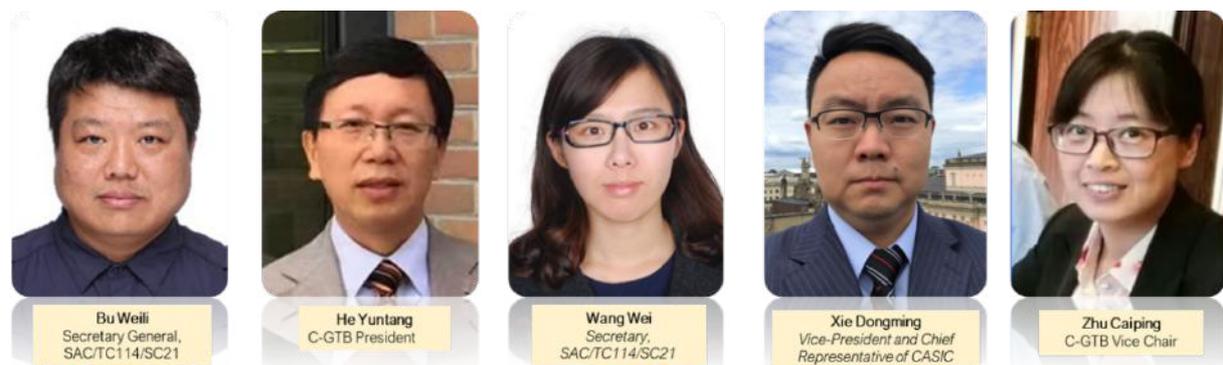
BU Weili
"I think CASIC is a very good initiative that is starting with the GB amendments. In terms of the
national strategy, the GB committee in the past few years is encouraging the enterprises to
participate in the drafting and amendment of the international regulations. I think this is very
aligned with the direction for the industry.
In terms of the making of the standards I would say standards are not purely technical terms, it's
more of a coordination of communication, so the establishment of CASIC is actually promoting
this kind of communication. I think the development of international standards or China GB will
be more harmonised through this centre.
The GB lighting standards are actually taking reference of UNECE technical requirements. In the
management of the GB standards, I think we should not just understand or translate from the
UNECE regulations; we should understand the rationale behind them. Also, we need to
understand the process our foreign counterparts have followed, and we need to understand
some history behind the UNECE regulations. I think this will help our subcommittee as well as
the drafters of the standards. It is a very important, however, to understand that they may not
have the time or accumulated experience and, therefore I appreciate the work of CASIC in terms
of the consolidation of experiences and the sharing agreement. Communication from both sides
is very important.

He Yuntang
"CATARC, the China Automotive Technology and Research Centre manages NTCAS, a separate
National Technical Committee of Automotive Standardisation, that is connected to SAC/TC-114.
NTCAS has the role of organising and managing the standardisation position in the field of
automobiles and TC-114 plays the very important role of international harmonisation.
Just now Xie Dongming introduced CASIC; I think this is a wonderful announcement. CASIC is a
bridge to reach stakeholders such as government departments, industries and standardisation
organisations. Most importantly, CASIC will build very good relationships with WP 29, that is

responsible for the UN regulations under the 1958 agreement and UN Global Technical Regulations under the 1998 agreement, and also with the standardisation organisations of ISO and IEC.

I think this is the very best chance and time for China and other countries to harmonise on the CASIC platform when the UN is simplifying its lighting regulations and, at the same time, China is also simplifying its GB standards. We will keep a close communication on harmonisation and in the future, we will continue to work to ensure we take full advantage of the CASIC platform.

Wang Wei

"Speaking on behalf of the Shanghai Motor Vehicle Inspection Certification & Tech Innovation Centre (SMVIC), I share the comments of the two previous speakers. SMVIC and TC-114/ SC.21 play an important row as Xie Dongming has introduced in his presentation. He made a remark that in this process we need to pay more attention to the process of making the regulation rather than just on the results. However, usually we just see a release of the regulation, but we do not know a lot about the process of amendments that has been followed.

The overseas countries have lot of advanced processes regarding amendments. I think we can learn about the philosophy behind the process of making amendments that will help to improve the efficacy in the development of the GB standards. Also, SMVIC does not just serve the lighting industry; but we also have GTB as our partner and we can learn from them. Some other industries may not have a such a reference organisation so I would like to say that we appreciate the GTB because we can take lessons or references from their work.

Zhu Caiping,

'In addition to my roles as Vice-Chair of China-GTB and project leader for the new GB Regulation on Light Signalling Devices, I am a member of the manufacturer community and I would like to share my views on this question.

The previous speakers talked about advanced standards and regulations in overseas countries. Previously we have only known about the results rather than the process of making such regulations, so there will be some deviation in terms of understanding and importation of such regulations. However, through the partnership and communication with GTB, we can be better informed and, also in the auto show and in yesterday's meeting, we know that China is developing very fast in terms of the automotive sector. I think that maybe China will take the leadership in some areas of the automotive sector or maybe there will be some new requirements in China's automotive sector which are not available in overseas countries. I also think that maybe China will fill the gap in some ways and will somehow set the standard in some aspects of automotive sectors.

I have wanted to find a better channel to communicate with the regulators in overseas countries but, now we have the CASIC platform, we can find the liaison person to have better communication and to facilitate the technical R&D and marketing strategies in China.

Xie Dongming

"I think all my colleagues on this panel have well understand the objectives and have given their opinions, so let me summarise.

You will see the name of the new organisation includes "Standards Internationalisation" that means it is between nations. This word "inter" says everything; "inter" is a co-direction; if we

have more competition, we will have more discussion, then there will be less misunderstanding, fewer questions and higher efficiency.

In future we will not only consider the relationship between the countries and between the organisations, but we will also consider the national differences and human relations.

SESSION 5
LIGHT SOURCES EVOLUTIONS
Status and trends of LED, OLED, Matrix, µLED

Ralf Schäfer
Chairman

Keanu Ma,
Lumileds

Carsten Setzer
Osram

Terry Yuan
TI

Bruce Zhang
Everlight

- Lumileds - Keanu Ma, China Technical Application Lab Director
"A high-resolution headlighting system based on hybrid light-source architecture"

- Osram, Dr. Carsten Setzer, Head of Automotive OEM Sales Region APAC
«The Future of visible and invisible lighting: An outlook».

- Texas Instruments - Terry Yuan, TI DLP® Auto Product Marketing Manager
"TI DLP® Technology is enabling smart & dynamic lighting all around the vehicle"

- Everlight, Bruce Zhang
" Everlight Matrix Product Launch"

Four leading Tier2 suppliers have presented their view on the future development of LED sources. In line with the technology trends in the market, the topic of digital lighting was attracting all the attention of the speakers. The presentations of the respective companies have shaded light on the contributions of LED sources and light shaping technologies to improve HD lighting systems, but also look at the aspect of cost effectivity. The goal is to reach higher market adoption and quicker market introduction speed.

LED light source and light shaping industry is working in four main directions:

- Further improve the conventional parameters like luminous efficacy, luminance, thermal resistance etc. Benefit of such improvements should be lowering LED system cost through smaller or avoided heat sinks, cheaper materials, more compact design and others. Overwhelming goal of this approach is to make LED systems more cost competitive to support broad market introduction.

- Follow the trend of digital light by optimizing the standard LED technology to its limits. This incorporates to reduce the spacing between distinct LED chips on an array as much as possible and to limit side emission. Target is to support performance as well as system cost reduction by cheaper optics and potentially more compact systems.

- Follow the trend of digital light by a direct switch to the new technology of microLEDs with an integrated unit incorporating control electronics with one big pixelated LED chip.

- Following the trend of digital light through flexible beam shaping elements like DMD. The interesting new message is that DMD beam shaping technologies are no longer focused on high pixel count only, but also address applications with less performance requirements.

Keanu Ma, Lumileds. Keanu focused on combining different LED source technologies as a basis for an efficient HD headlamp architecture enabling ADB and projection applications. The design of a demonstrator with a height of 40mm and a width of about 130 mm was outlined. The demonstrator consists of a foreground module, an ADB module and a high-resolution module based on a single micro-led with about 20Kpxls. More details about the parameters of the design you can find in the picture below.

Foreground Module 近场模组
- Horizontal range 水平范围: ± 40°
- LED product 产品: LUXEON NeoExact
- Light-emitting area 发光面积: 4 mm²
- Optical concept 光学实现方式: Direct image 直接成像
- Optic size 镜头尺寸: 60 mm x 40 mm

ADB Module / ADB模组
- Field-of-View 视场范围: 6° x 40°
- LED product 产品: LUXEON NeoExact
- Light-emitting area 发光面积: 18 mm²
- Optical concept 光学实现方式: Direct image
- Optic size 镜头尺寸: 43 mm x 40 mm

Micro-LED Module / Micro-LED模组
- Field-of-View 视场范围: 7° x 21°
- LED product 产品: Micro-LED
- Light-emitting area 发光面积: 32 mm²
- Optical concept 光学实现方式: Direct image
- Lens diameter 镜头尺寸: 40 mm
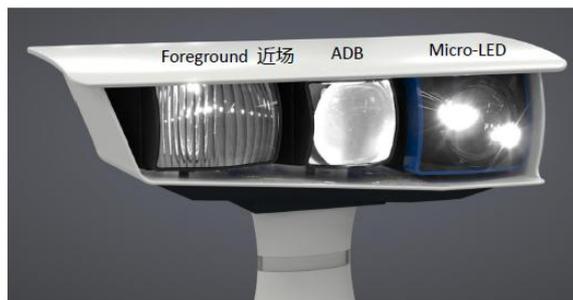
Full field-of-view demonstrator design

The presentation mentioned the optical concept of direct imaging as a highlight, but no further details were disclosed. The flexible mixture of the light emission of the three units creates ample possibilities of variable beam patterns on the road. The basic architecture of such a headlamp beam is schematically shown in the figure below together with range, intensity and luminous flux data.

During the presentation, the speaker showed application films of curved country road with swiveling and projection of warning signs, a straight country road with sharp or smooth projection of road markings and last but not least an ADB application.

A key element of interest is of course the microLED source allowing the high-resolution features necessary for projections. The source presented has a surface of 32mm2 in an arrangement of 82*256 pxls (~ 20 Kpxls) . A highlight is the contrast ratio between adjacent pixels of 1:500. Please see picture and diagram below.

Another interesting feature of this product is the announcement that the electronic circuits addressing the single pixels are not bonded to the LED arrays after a separate production process, but manufacturing of the micro-led occurs in one integrated single-chip process.

Dr. Carsten Setzer, Osram outlined the existing product portfolio of his company for the exterior lighting applications in the current focus.

From an application point of view, the LED light source range can be subdivided into products tuned to static lighting applications and products tailored for adding dynamic features. For both segments the luminous efficacy and brightness progress is a key factor. Osram showed in their presentation an impressive double-digit brightness increase for high power white LEDs as depicted in the diagram below.

Continuous improvement of LED performance will help to reduce system cost and thus give a further push for market penetration. An important element in this context is the reduction or even avoidance of heat sinks.

Another cost improvement opportunity is the reduction of optics complexity, especially for matrix and pixel applications. A key parameter in these applications is the spacing of the single LED chips in an array and Osram announced a next generation of products with 8-40 chips on one submount which will allow significantly simplified optics.

This product range will incorporate a very small gap between the single chips and is intended also to show no side emission. Due to these features, it is expected that primary optics close to the LED sources are no longer necessary and will thus considerably reduce complexity and cost of the optical system.

Terry Yuan from Texas Instruments addresses the three main topics.
- TI is not only targeting to the extreme high pixel count applications but has started to offer more versatile products for a full bucket of applications. This is demonstrated in the highly informative diagram below.
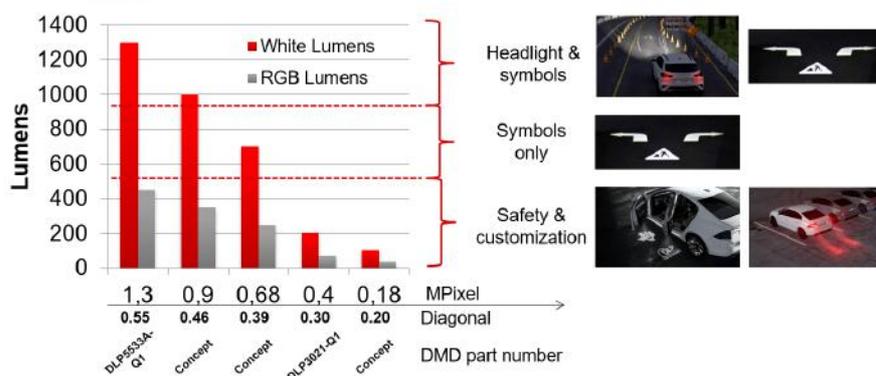
Lumen package versus pixel count versus application area has been clearly explained during the speech. The target of this product portfolio is to offer solutions tailored to application and thereby reducing cost of not only DMD, but also other components like light sources, optics etc. and making the whole DLP system more compact. The overwhelming target of this activity is to boost market adoption and market introduction speed.

- A second pillar is to support the development of new market application areas. A very interesting field are sophisticated animated Digital Ground Projections (DGP). The figure below exhibits some thoughts about this topic together with some more technical information.

TI just released a new Evaluation Module (EVM) which should allow interested parties toengage in a quick research on their intended use cases all around the vehicle.

- As a third pillar, the speaker touched upon innovations for HD headlighting not yet fully exploited. In his opinion, DLP technology for high resolution headlight provides a broad platform for OEM and Tier 1s to develop new applications and examples are shown in below picture.

While DLP technology is supporting ADB and symbol projection functions today, OEMs & Tier 1s will find new and exciting ways to use the system for applications like "Structured Light", "Weather Detection" and "Object Detection" and even more.

Norman Hung, Everlight first presents the current Everlight roadmap of light sources for matrix beam applications. After launching 1mm2 chips in 2020, improved versions will follow this year and for 2022 a 0.5 mm2 chip is in the pipeline (see figure below)

From a technological point of view the speaker explained two parameters of key importance for matrix applications: pixel pitch between adjacent chips and size of the light emitting area (LEA). This was underpinned with optical simulations; an example is shown in the figure below for various pixel pitches from 50 to 500μm with a LEA of 30 x 30 mm2.
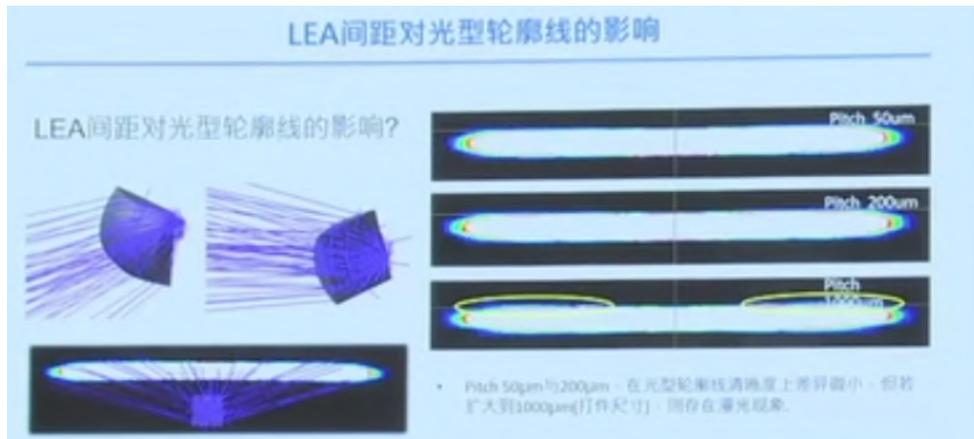
The smaller the pixel pitch, the more homogenous the light pattern looks and the imaging optics can be designed less complex.

At the end of his talk, the speaker announced a project with a local Taiwanese carmaker. The market launch of the product is expected in near future.

Q/A Session 5 *Chairman Ralf Schäfer*

Texas Instruments' Terry Yuan on resolution versus cost and complexity:
"We are working to evolve the system for optics and heat. If we drive down the resolution, the system is simplified and smaller, and heat is less."

Texas Instruments' Terry Yuan on expanded applications for projected automotive light functions:
"In the rear projection there are two main applications. First, the road marking and the other thing is to project on the windshield. As to the user experience. They are different. On the expressway if you project to the surface this will be a higher requirement, as high as the headlamps! So maybe we can actually project on the rear window instead, so the car behind us can't see it."

Session 5 panellists on whether standard and digital LED lighting will coexist:
"Will digital lighting replace standard lighting? To a large extent standard lighting headlamps and digital lighting, they are not in competition. Fundamentally, the standard headlamp started very early on from halogen to LED in its journey. We can see it becoming brighter and brighter. But at the beginning LED was very costly. So now we should also take consideration of the cost. That being said, the standard lighting is already satisfying the demand or requirement for safety. Digitalisation can augment safety. We can project symbols, warnings, or make adb. I would say more advanced functionalities. Or, to increase the perception, to enhandce safety. As a driver I can't intuitively tell if my car becomes safer. But with market participants and user education to help drivers to see by themselves the road projection efficacy. So road projection, not necessarily will contribute to users' safety perception. It's all about value proposition. We need to make the users associate road projection with safety through more user education. While standard lighting is more for basic functions. DIgital lighting is to auxment the exitsing functions. In some scenarios, 'good enough' is enough. In future, standard and digital will run in parallel. In mid and long term, I think the time to penetration will be very short with DLP and µLED evolution so fast, I think maybe 5 years to 30 to50 percent.'

"In terms of tech road map we have a lot of journeys. For standard LED, more efficiency is called for. You can see in our slides that the efficacy has improved to 400-460 and in future as high as 500. So highly efficient light source. That will help customers achieve cost-effectiveiness and high efficiency and reduce headlamp build costs. In terms of LED headlmps in China, China is quite advanced; we have seen a lot of projects. I think medium and premium brands are standardly equipped with LED, and I think the technology is quite mature. European market and Chinese markets are very robust. In future we will target the Indian market as well. As far as digital lighting: Osram has 20,000 pixels Four or five years ago we launched a high-resolution product, and we work with TI to promote this strategy. We see the same strategy from our competitors."

"From TI and my personal view I'm very positive about digital lighting. DLP is evolving. Internally, our management and data operation management are all based on digitalisation. In lighting, my view is there will be two features: illumination and display/warning. Digital lighting is focusing on warning at first, to replace the old ways of drawing attention (like flashing). Next step is how to improve the luminance to change other lighting functions to digital. Maybe in future we have just one digital light source for every car, and the differences are made with software."

"In future we'll see that lamps will be very complicated. At the DVN Workshops we see that lighting is

coming to include cameras and sensors, and 5G connectivity is coming. I think the application will become more and more complicated. Children near the car not seen by the driver can get hurt or killed. So maybe there'd be a projection to show the driver what they can't see otherwise"

Session 5 panellists on what the mainstream resolution will wind up being in the near term:
"It's controversial! Regarding pixelisation, it depends on user scenarios. Two years ago at the DVN Workshop, a lot of people talked about 1.3 megapixels. I don't think every scenario needs that many. Quantified measures can decide where we need such resolution. For small dimension applications, we don't need such high resolution, but for image projection, we can also reduce resolution. It's a tricky question. It depends on specific scenarios. The important thing is we need to go to digitalisation."

"What is mainstream? It means large quantity mass produced. We have to consider cost. Let's take excample mobile phones. Very cheap now, and nobody cares how many pixels, but 10 years ago everyone was talking about pixels because mobile phones were expensive back then. Instead of how many pixels we needed back then, it was considering how many we could afford. Same logic for automotive. Why do we need 20 kilopixels? It's more about making compromise between cost and effectiveness. If the cost is really high, we need to minimise our feature requirements."

"With the volume of manufacturing, the cost will be driven down. But we have seen that within 3 to 5 years there won't be dramatic increase. I think in the forlllowing five years, maybe 20 kilopixesl will be the mainstream, but we see rapid development."

Sunny Optech's Tany Gu on material selections and lens coatings on plastic versus glass:
"From the optics to imaging optics, the solutions are not limited to plastics or glass; maybe we will bring them together for instance the one close to the light source we will consider to use glass because the stability of the material is better and the imaging performance will be maintained. But if it's far from the light source maybe we consider to use plastic materials so we can make a balance between performance and cost-reduction. Coating, no matter glass or plastic, is a Sunny Optech activity. We make core components ourselves, and there's a big difference to coating on palstic versus glass. The materials have temperature tolerance problems. Plastic in high-temperature service will be distorted out of shape, and the coating on the surface of the plastic along with it. So the coating on the plastic's performance would be compromised, so we have stricter requirements. The temperature tolerance for glass coatings is +120° C. But for plastic it has to be +150° C, so the temperature tolerance is a differentiator."

SESSION 6
SKILLS TO HELP HIGH TECH LIGHTING
Material and Electronics and Simulation and testing

L. Metzemaekers
Chairman

Dian Hong
AML Systems

Andy Zhang
Covestro

Victor Wang
NXP

Pengyan Lu
Ansys

AML Systems - Xu Dong and Dian Hong
"Digital Aiming for High Tech Lighting"

Covestro - Andy Zhang
« Driving Ahead of the Curve: Visionary Headlamp Concept with Polycarbonates»

NXP, Victor Wang (Regional Marketing Manager Great China
"Functional Safety considerations and solutions for Matrix Headlighting"

Ansys - Dr. Pengyuan Lu
"Glare-free Head Lamp"

Session 6 was the last session of the DVN Shanghai workshop. But this is not at all a reflection of the importance of the topics to be presented in this session. Five specialist companies gave their views on their enabling technologies which will bring the automotive lighting industry forward to the next level.

AML, was represented by Xu Dong / Senior R&D Manager, supported by Dian Hong / R&D Department Head, with the following presentation: "Digital aiming for high tech lighting ".

Very often Headlamp aiming is an underestimated topic, but as a matter of fact it is very crucial for road safety. AML demonstrates how to improve: precision , cycle time and accessibility of headlamp aiming.

▶ Precision/ 调光精度：can improve
▶ Cycle time/ 周期时间: can reduce
▶ Accessibility/ 可及性: can improve

JOHNSON ELECTRIC

Aiming at car assembly line

An interesting concept, is the further digitalisation of the aiming function, by using actuators and advanced measurement systems. And, in a service mode, to use existing knobs on the steering wheel to adjust the headlight system. This is very convenient and a fast way to adjust the headlight system, hence it will also contribute to additional road safety.

How to digitalize the aiming : car inspection

In the end, the final adjustment of many headlight systems will be made via an actuator for horizontal and vertical aiming. AML presented their product solution by the actuators they offer to the OEM's and T1's.

▶ Vertical aiming/ 竖直方向上的校准：
  ▪ 1) Long stroke stepper motor without reference run
    大行程步进电机不带初始化过程

Standard Leveling 3° up and down
标准调光上下各3°

Leveling + Aiming 3°+3° up and down + Hall sensor
上下调光和校准各3° + 霍尔传感器

  ▪ 2) Do the reference run at charging phase (EVs)
    在整车充电时进行初始化过程
❖ Horizontal aiming : « 10 shots » Leveller
  水平方向上的校准：10次运动行程的电机

JOHNSON ELECTRIC

COVESTRO gave a presentation by Mr Andy Zhang, Marketing Manager, with the following title: "Driving Ahead of the Curve: Visionary Headlamp Concept with Polycarbonates" As already indicated by the title, Covestro is looking at innovative solutions for future headlamp systems.

Covestro's vision is to make the complete headlamp out of polycarbonate plastics. The replacement of "traditional" materials such as glass and metal, used for bezels and heat sinks are included. By making this transition, Covestro makes big claims for the benefits related in the field of: cost, design, performance, manufacturability, parts count ...

Another element, which is also addressed by Covestro is about sustainability. It is good to see that this important topic is also at their agenda.

Sustainability : the concept aligns with UN sustainable development Goal 12

As a summary, Covestro is making the following claims for their full PC headlamp concept:

This almost looks like an offer OEM's and T1's cannot refuse.

ANSYS was represented by Dr, Pengyuan Lu, Application Engineer, with the following presentation: "Glare-free Head Lamp"
ANSYS introduced us in the power of simulations in the design and validation process of headlamp systems. In the past simulation tools were supportive to engineers, it looks like for future complex headlamp systems it will be impossible to design them without the use of simulation tools.
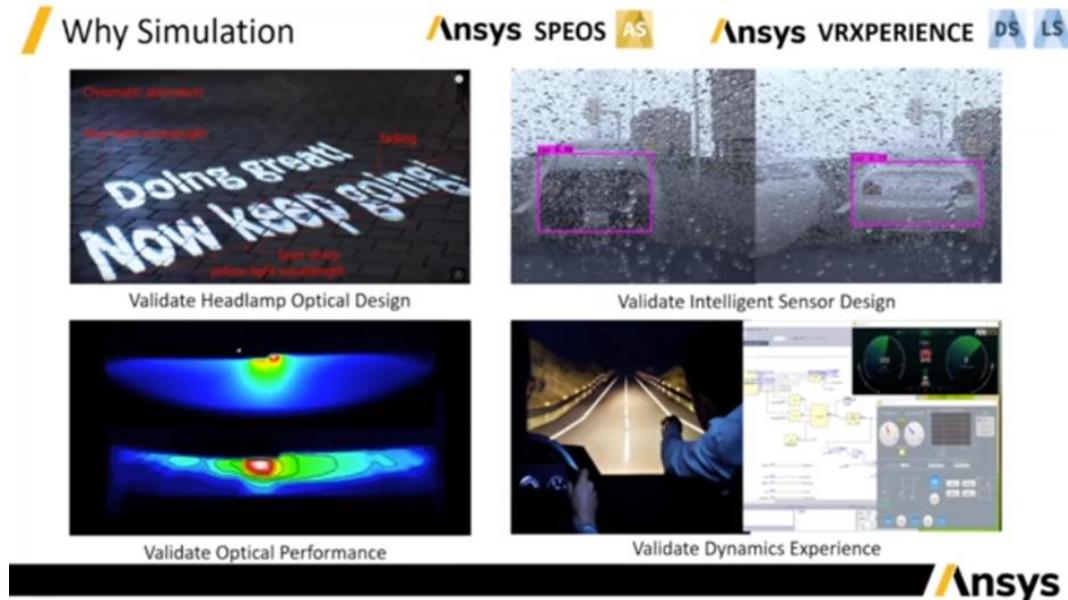
It's amazing to see that it is almost possible to simulate anything: the virtual world is getting close to the real world. ANSYS did provide us with many examples during their presentation, such as:

- to validate the optical design from a headlamp
- to validate intelligent sensor design
- to validate the optical performance from a headlamp system
- to validate dynamic system behaviour, based on different use cases.

Interesting example is the availability of standard driving scenarios as described by NCAP. These scenarios do include: pedestrians, signs and other vehicles. The users can download these scenarios as standard data bases, and start simulations on how their system will perform under these NCAP scenarios based on the different design parameters as defined by the user. Needless to say that this approach can save a lot of time and other resources.

Another simulation tool is the availability of a toolbox to do testing according IIHS. It will allow the user to test their system according IIHS, and the test report is automatically generated.
Off course, the proof of the pudding remains eating, or in other words: real testing will and remains to be required. However, with simulations, engineers can do so much pre-filtering and design optimising fast and in an early stage, such that it only will lead to better test results in real.

Tani Gu, Deputy General Manager of SUNNY Optics, our latest and most recent DVN Gold member, presented the difference between illuminating optics and imaging optics for Headlamps and the challenges associated to the destructive aggressions of acid rain, sun, powerful laser, on imaging optics.

Technical difficulties in imaging optics associated to color edges can be partly solved by a proper choice of optical materials but only microstructure process on the surface of the optical lens will eliminate color edges.

Q&A session 6 *Chairman Leo Metzemaekers*

Session 6 panellist on whether aim can be improved systemically:
"Yes indeed, automatic aiming can save a lot of trouble and hassle, and increase accuracy and efficiency. So I think this is really influential in the prosepect to automakers and tier-1s."

Covestro's Andy Zhang on whether new materials will join or supplant traditional ones:
"Lighting itself is a very mature and important industry, and the function of the lighting is very important for safety. So approved materials and processes have to be used in lighting. But there are more functions being integrated into the lighting assembly, including lidar, radar, camera, or other functions. THere are more secenarios for lighting in the future. I think the materials will be decided by the functions of these lighting. Those, in turn, are determined by the scenarios of the car. In future, AD will create scenario where you don't need to drive a car, there's no driver, so what functions are needed for lighting? Then there's no requirement for dedicated for position for lighting. The lights can be anywhere or everywhere on the car body. So then you think aout how to integrate the functions into the materials as we wish."

Ansys' Dr. Pengyuan Lu on simulation veracity versus physical testing:
"In real time we can connect with hardware ECU to validate our hardware, for example the execution of matrix headlamps, to validate the robustness ."

Covestro's Andy Zhang on sustainability and recyclability:
"We propose if the amount of material can be reduced, then it's easier to recycle. Normally in production, polycarbonate lenses can be recycled. The challenge for us is after the life cycle of the lighting whether the material can be recycled. This topic is very hot in the electronics industry. Psotconsumer products can be collected and put into the recycling industry, generating the new grades of materials, called PCR products, used in laptops and tablets. Can similar process be used in automotive industry? Broken down into granules? We are looking at this question. Maybe the materials could be used in auto interiors. We are looking to close the loop for polycaronate material and recycling technology especially for PC and ABS materials."

AML's Xu Dong and Dian Hong on lamp aim without human intervention:
"Just now in our presentation we talked about further digitalisation and smarter headlamps. In terms of technology road map, we're going to be more digitalised, that's for sure. About application scenarios: We are transitioning from manual to automaotic and from there to digital. So in future we want to have cutoff line can be automatically aimed, but it takes time to be accepted by the market. For now, the solution is costly. So further cost reduction needs to be achieved first."

NXP's Victor Wang on power consumption trends in lighting:
"Safety functions are more relevant to people's lives and safety. It's defined by the automakers. While talking to them, we get feedback like some of the performance reuqiemntes are very strict, while some headlight functions are very relevant to safety. The MCU and driver losing contact with each other, no communication means no light. In this case, according to GB standards, we will have requirements for severity, degree of controllability, and frequency of happening—three factors to assess what level of safety requirement is needed. In future, if the lighting is correlated to AD, then the requirement will be stricter."

Ansys' Dr. Pengyuan Lu on whether simulated and real-world test results agree:
"We have integrated the modules in the regulation. We have templates and you can run it in our system and we can give you a score automatically with an assessment report. We have the comparison between real and simulation, but it's under protection and can't be revealed because it's proprietary"

LINKS TO SESSIONS Video-On-Demand in ENGLISH

For China Mainland

Link to Opening and Keynote: https://v.qq.com/x/page/q3241qmp2bg.html
Link to VOD session 1 :   https://v.qq.com/x/page/g32414jswae.html
Link to VOD session 2 :   https://v.qq.com/x/page/v3241sjqxjc.html
Link to VOD session 3a: https://v.qq.com/x/page/l3242qjxaoj.html
Link to VOD session 3b: https://v.qq.com/x/page/r3242xoq8yw.html
Link to VOD session 4:   https://v.qq.com/x/page/i3242g53jkj.html
Link to VOD session 5:   https://v.qq.com/x/page/p3242op0hhj.html
Link to VOD session 6:   https://v.qq.com/x/page/k3242xqdl12.html

For all other countries

Shanghai Workshop Online Platform
https://shanghai2021.b2b-wizard.com/expo/vod

EXHIBITIONS

Marelli Automotive Lighting

Marelli Automotive Lighting presents some of their latest innovations : innovative headlamps, impressive rear lamps, smart front lighting modules and sophisticated electronics and sensors.

Front lighting modules
The presented modules cover the wide variety of needs: from entry matrix with 24 segments, through 84-pixel matrix module to the novel high-resolution micro-LED module "h-Digi microLED" with more than 20,000 pixels. With their slim lens module, Marelli Automotive Lighting show a very thin solution designed for futuristic styling needs.

Electronic control units
All the adaptive lighting functions desired by customers and drivers, demand sophisticated electronics. The Marelli Automotive Lighting ECU portfolio serves front and rear lighting technologies that range from basic to HD solutions. A selection of standardized, optimized and scalable solutions for headlamps and rear lamps can be seen at the booth.

Adaptive headlamp with integrated radar

The adaptive headlamp is equipped with the intelligent 84-pixel matrix module and a 77 GHz corner radar.

The 84-pixel matrix with 84 LEDs in three rows allows for realizing all adaptive lighting functions in electronical way. The radar integration in the lamp enhances radar's reliability since the sensor is well protected from dirt and its field of view is optimized.
Customers appreciate the styling freedom and benefit additionally from cost reduction resulting from economization referring to assembly and testing in one step with the headlamp.

Digital OLED rear lamp

The rear lamps of the Q5 incorporate the digital OLED technology.

Thanks to geometric arrangement in the lamp, the OLED elements create impressive 3D effects in both switched off and switched on mode. Each OLED panel is composed of 6 segments, which allow for a variety of dynamic lighting scenarios. In addition, some predefined tail signatures can be chosen by the driver – even while driving.

Digital OLED's key features are extreme homogeneity and independently controllable segments. The light of this very thin light source is infinitely dimmable, achieves very high contrasts and the segments with just minimal gaps can develop diverse levels of brightness (fading in and out).

All these features enable personalization of lighting designs for digital signatures. Q5's digital OLED rear lamp has been engineered by Marelli AL Tolmezzo (Italy) and is produced in AL's Toluca plant in Mexico.

Lidar

With a line-up of LiDAR modules, Marelli Automotive Lighting leverage, alongside with XenomatiX, their strong background in optics and electronics. The full solid-state LiDAR

modules, using mature VCSEL and CMOS technologies, are the base of a reliable and affordable product offering. The module types range from standalone LiDAR units to modules embedded into lamps (SmartCorner™) to achieve short, mid and long-range distance measurement sensors. Having various fields of view (FoV) and resolutions, the LiDAR modules match with our customer's use case requirements. Marelli Automotive Lighting embed their inhouse developed tracking and classification software, combining neural networks and rule-based algorithms. A-Spice, ISO26262 and SOTIF are observed during the development. They support ADAS functionalities, such as valet parking, traffic jam chauffeur or highway pilot (i.e. reinforced L2 to L5, acc. to SAE J3016™).

Lumileds

- LUXEON Mosaic is a 20k pixel monolithic light source designed for high-resolution direct-imaging projection systems with ultracompact built-in depth. Along with the ability to generate an infinite number of customized light distributions, it offers superior contrast for perfect road projection and sharp cut-off lines.

- High-performance low beam and adaptive driving beam in a slim design with LUXEON Altilon Intense Gen2
- High-performance low and high beam in a slim design with LUXEON Altilon Intense. Four modules provide low and high beam in a slim headlamp format. Each module utilizes reflector-based projection optics with 12 mm lens height.
- Entry-level matrix system utilizing direct imaging of a single row of LUXEON NeoExact 1.0 mm^2 and high-end high-resolution matrix system with simple optics and LUXEON NeoExact 0.5 mm^2
- Standard LED headlight source (LUXEON Go) for mainstream car segments to reduce system complexity and cost: one demo for reflector system; the other demo for projection system.
- LUXEON Versat portfolio for versatility of rear lighting.

ams-Osram

In 2020, ams-Osram publish the new OBF-S Automotive high power multi-chip product family. The optic efficiency was further increased in the new OBF-S multichip product, as well as the luminance flux andthe surface luminance
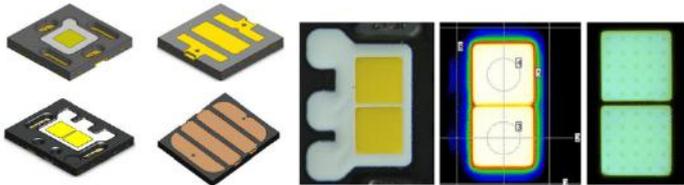
Based on the brilliant performance of OBF-S product, the heatsink-less headlamp concept was raised byams-Osram. The new heatsink-less concept could use only Aluminum PCB for heat dissipation. Not only the weight of the headlamp but also the cost could befurther reduced. The heatsink-less headlamp concept provides a brilliant idea for further headlamp design

AML Condensation Management Device
CMD enabled by GORE™ Condensation Management Products

Headlamp condensation is a recurring problem for the automotive lighting industry. It will become even more of a challenge as the industrymoves to full-LED headlamps,because existing venting solutions can only reduce, not sustainably prevent, such condensation

AML Condensation Management Device—CMD enabled by GORE™ Condensation Management Products Headlamp condensation is a recurring problem for the automotive lighting industry. It will become even more of a challenge as the industry moves to full-LED headlamps, because existing venting solutions can onlyreduce, not sustainably prevent, such condensation.
AML Systems (AML) and W. L. Gore & Associates (Gore) introduced a new technology to actively prevent condensation and put headlamps on a new level of protection.
AML's Condensation Management Device (CMD) enabled by GORE™ Condensation Management Products leverages electrical power and regenerative desiccants to actively remove recurring moisture from automotive headlamps.
CMD is an electromechanical device that is installed on the headlamp housing. This device, equipped with a breathable membrane and a radial seal, allows the headlamp to remain completely sealed, yet it also provides pressure equalization and ingress protection.
CMD helps to improve time-to-market and focus your activities on the essential functions in a headligh

MIND Innovation Products

MIND 曼德
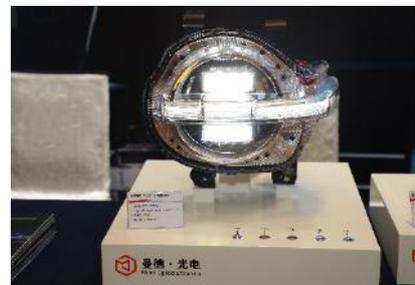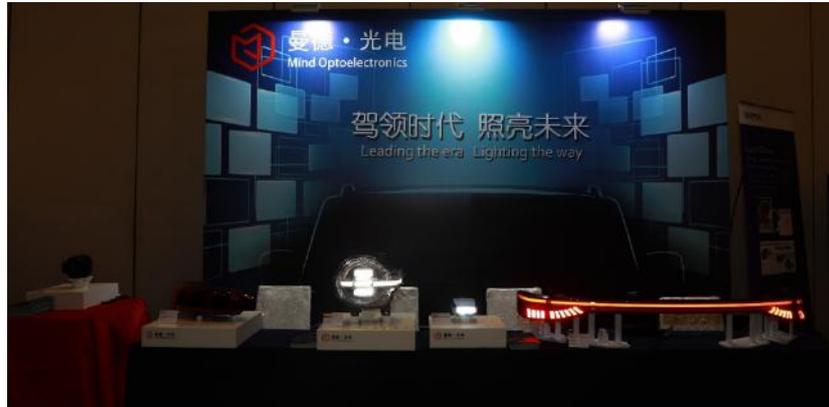
- ### MICRO LED

The first micro LED module in Asia-Pacific lighting field，it brings over 16.000 pixels resolution for ADB, AFS and projection functions. It has a compact optical design according with the small packaging trends.

This one offers a reduced cost for HD level illumination.

Micro LED

- ### LB & HB LASER MODULES

One of the first full laser illumination modules in the world，equipped with an innovative laser safety device integrated in the laser diode.

This laser technology brings a high lighting performance with an ultra slim size including laser risk free.

Laser HB   Laser LB

Covestro Mono material headlamp concept PCS

Covestro advocates a forward-looking approach to forward lighting, with a headlamp module concept comprised of a reflector/housing, collimator lens, bezel and outer lens cover that results insignificantly fewer parts. Multi-shot molding of Makrolon® TC thermally conductive polycarbonate and Makrolon® DS dimensionally stable polycarbonate, along with a molded-in-place design strategy,enables the low-and high-beam LED modules and their corresponding reflectors to be produced lessexpensively throughelimination of added heat sinks, attachments and other components.

The bezelof Makrolon® polycarbonate uses multi-shot molding to consolidate turn signal and daylight runninglamps while hiding sensors behind a lidar-transparent mask. Beyond reducing system complexityand costs, simplifying assembly and saving valuable space, this novel approach also reducesheadlamp weight, which aids better fuel mileage and lower emissions or increased battery range.Future automotive headlamps will integrate electronics suchas LiDAR, radar and cameras in additionto light sources. This will require use of thermally conductive materials to dissipate the heatgenerated by the electronics and light sources. The headlamp demonstrator is the first of its kind todo so with Makrolon® TC polycarbonate.

Due to its smart design, the LED headlamp system uses only four different materials: Makrolon®polycarbonate; Bayblend® polycarbonate/ABS blend, a scratch-resistant coating (outer lens cover)and metallization (reflectors). This simplifies recycling by reducing separation, sorting and storage inthe recycling streams at the end of the headlamp's useful life. The mono-material headlamp is 2-3centimeters thinner than traditional designs—a designer's dream! It is also over 1.5 kg lighter, whichcan help reduce fuel consumption and, therefore, emissions.Key Benefits

•Improve production efficienciesMakrolon® polycarbonate and smart headlamp designreduces parts, streamlines assembly

•Lighter by designLightweight polycarbonates providehigh performance while reducingmodule weight

•Integrated functionsIntegrates electronics, such as LiDAR, radar and cameras, as well as lightsources

•Greater design freedomBroadens possibilities for aesthetics, progressive styling anddifferentiation

•Eyeon sustainability Reducing weight, parts and materials contribute to greatersustainabil

CovestroFunctional exterior front grille demonstrator

Shifting consumer tastes, autonomous technologies and electric vehicles are changing how cars look,particularly the front end design. Covestro is shining a spotlight on front end design with a forwardlighting demonstrator and front grille concept.Grilles serve as the face of the car and are an important branding element for automakers. Electricvehicles require less cooling air, which means the classic, open front grille design that allows air toenter can be transformed to a closed grille, completely changing the look of a car. Signature light, 3Dpatterns and color effects can be integrated into front end designs by the use of a transparent andimpact-resistant polycarbonate. The shift toward autonomous driving also requires sensorsintegrated into the vehicle's body to monitor its surroundings. In contrast to traditional exteriormaterials like metal orpainted polyolefins, polycarbonate can hide sensors seamlessly withoutdisturbing their operation

The front grille demo part combines design with dynamic light and display integration. The seamless polycarbonate grille features a metallized 3D rear structure as a design element when not lit. Withrear projection unit, the 3D structured front grille is a display for pedestrian communication. This highlights the unlimited possibilities of rear projection, which can also be used for high dynamic lighteffects or as a daytime running light. The newly developed Makrolon® AG2677 ST grade in combination with Makrofol ® ST film enables seamless lidar integration into automotive exterior parts, including with silver printed design,andwithout post processing steps. The 2K molding technology shows opportunities for the integration oflocal light effects andholding fixtures for mounting or sensor integration.Covestro developed technologies to seamlessly integrate functionalized films into the design.Forinstance, 5D film insert molding (FIM) combines rear 3D structures with color and decoration due tothe design freedom enabled by printed Makrofol® films. Two-dimensional flat films are overmolded to create 3D shapes and provide high accuracypositioning on the B-Surface. Local dynamic heating of the mold enables a seamless partialintegration of functionalized films on the A-surface and can be used for example for deicing to keepsensor areas clear.

Yejia

Gobo Lamp/ Light Carpet

- Multi -Lens Solution
- MLA Solution
- Sharp Image
- High Brightness
- Cost Effective
- Automotive Reliability Tests
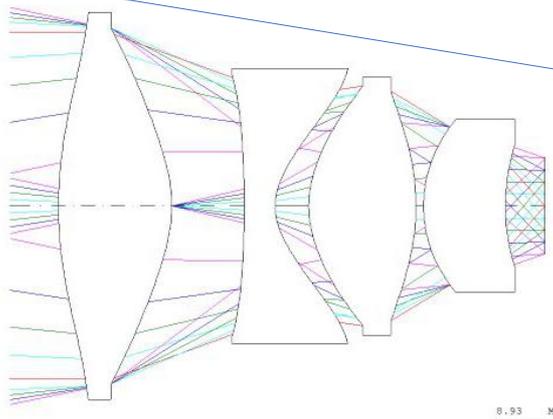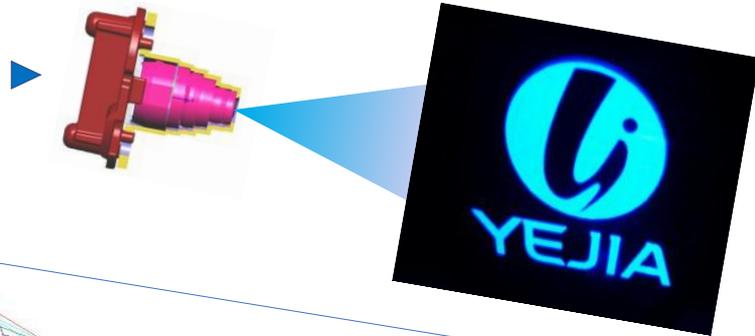
Lens for Micro-pixel Matrix Headlamp

- Cost Effective with 2P2G
- High Efficiency over 40%
- Very Fast F/# = 0.66
- High Resolution for 40 µm/pixel
- Athermalization Design for Diverse Ambient Temperatures
- Automotive Reliability Tests

8.93 MM

BICOM products introduction

LED Headlamp Module

The product isanautomotive headlamp lighting system, which can achieve LB and HBlighting function.The product divides into two parts, Headlamp controller and LEDheadlamp lens module.The LED lens module meets ECE optical requirementsand thevehicle exterior headlights of the regulations,theheadlamp controllercandrive2LED stringsfor LBandHBfunction. whichmeets the electrical/environmental /EMC and materialrequirements of the vehicle
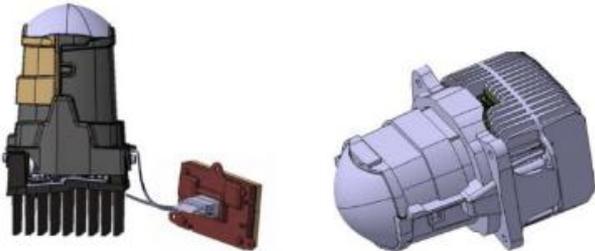
Angel wings

Multi-color& Smart Angel Wings,thedesign concept is from BMW radiant blanket lamp.Upgraded from single color to multi-color, the smart color and mode light can switch freely,plug colorful angel wings into your car in the dark and light
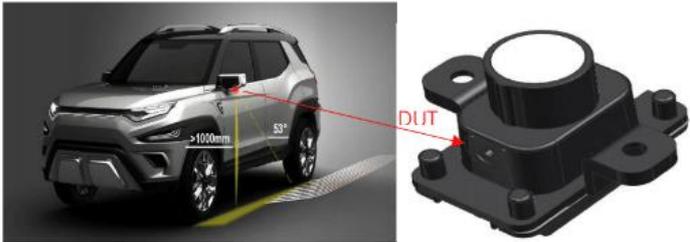
Ambient light

Ambient light divides into two parts, LED driver and lightguide.

LED driver is a module which can drive the RGB LED according to the LIN signal.

All inputs are from LIN Bus. LDF file contains address information, luminance information, light color information, diagnostic information, etc.

The light guide ensures uniformity and consistency of light

EVERLIGHT

ENOR

XINGYU

HASCO VISION

SYNOPSYS

10th VISION CONGRESS- Paris March 18&19, 2021
Highlights: VISION Panellists in Q&A Discussions

Session 3 // Q&A Lighting Communication Functions - Wolfgang HUHN - DVN

This year's VISION Congress featured generous 30-minute interactive panel discussions with the presenters after each lecture session. Here we present some highlights:

• **Benoist Fleury (Valeo)** *on virtual safety barriers projected around cyclists by vehicle-based lighting equipment:*
"With current regulations, the signal is visible only at night. But this is when there is a need for improved signalisation; the major casualties are at nighttime. So it's important to have it visible at night, at first. Now it's not visible in daytime, but there are some discussions at the regulatory level to have this kind of signalisation also visible in daylight. This will require increased intensity, but this is an ongoing discussion at GTB. In our experiments with cyclists the feedback is quite positive. Also: with the movement of the light, the cyclist can anticipate the movement of the vehicle."

• **Benoist Fleury (Valeo)** *on the use of animated light when the vehicle is in motion, versus when it's parked:*
"Today it's alowed only when the vehicle is static. There are discussions—not as advanced as the road-projection discussions—to make it available when the vehicle will be in motion. Perhaps in a couple of years."

• **Reza Larimian (ZKW)** *on headlight performance ratings:*
"In general for IIHS ratings, there are two requirements: range and intensity, which I think with good performance of any HD system and appropriate foreground light will do well; the same contrast introduced for the micro module for the ECE regulation will also be fine for the IIHS rating—we got almost zero demerits with our DLP system. For IIHS ratings, compared to ECE the conditions are looser, so you can have a nice low beam according to the ECE regulation, and then with a slight change in the beam shape you can also be US-legal, and this actually should work very well for IIHS ratings. You have to take care of the stray light for the glare points, but I think for the HD system that amount of contrast and MTF (modulation transfer function; how well an imaging system can reproduce contrast as details in the image get smaller) for the package you will be clear."

• **René Übler (BMW)** *on the future of laser headlamps, and the risks of aiming laser light at pedestrians:*
"There are more laser headlamps to come, more applications for laser light at BMW. We're always looking for new applications and functionalities with the laser light source. Of course we're also looking into μled and further pixelisation. The most important thing is we're introducing new technologies with new functionalities to give clear benefit to the driver. We started with three laser diodes per headlamp, now down to just one. The part itself can be purchased more readily, so I think there is a price reduction.
"The pedestrian detection is not done with the laser; the highlighting is, but we are not aiming toward the pedestrian. We aim on the road in front of the pedestrian as kind of a line or arrow toward the pedestrian so there will be no pedestrians glared by the laser."

• **Benjamin Willeke (Hella)** *on efficiency and production-plausibility of FF microöptics*:
"This is a basic research topic. If we succeed within the next two years we'll continue working on FF microöptics. Our target is to reduce down to _one_ optical part inside the module; in terms of cost, weight, and optical efficiency there are a lot of benefits if we can do that. So of course we'll continue with predevelopment, but I can't answer when will it be available in a headlamp on a production car. There are too many open challenges yet to be faced. Materials, for example; you know the requirements for headlamps are very high compared to other applciations fields, and we'll see if we can find a material to withstand all this.
"Optical efficiency, I define it as the ratio between light from the LED and light that hits the street. This is defined in percent. I prefer this value, because it's independent of the light source—LPW has to include light source, cooling system, and whole headlamp circumstances. Typical MLAs (micro-lens array) are in the range of <20%, so under 20% of the light from the source hits the street at useful angles. So that means we have to waste a lot of light—at the shutter, half the light is absorbed to provide a sharp cutoff. We hope FF optics will allow us to achieve a cutoff without using a shutter. It will be very hard, and we're not 100 per cent sure it'll work, because the gradient is a very high challenge. We'll see where we will get, and our target is to come as close as possible to 50% optical efficiency. That's where we see a possibility to reach, in theoretical simulations. We'll see if the reality will match."

• **François Bedu (Renault)** *on colour management with low and high beam with different light source characteristics:*
"To manage this we have designed the low and high beam light distribution to have not just two beams which are one above the other, but the idea is in high beam mode we can meld the two light sources together so you have something more homogenous in terms of colour. We change the colour from low to high beam, but we don't have a sensation of one area that's cold white and another area that's warm white.

• **Benoist Fleury and Benoit Reiss (Valeo)** *on how lighting people can support sensor-integration:*
"For sure the lighting team is definitely leading because they have to integrate sensors that work by themselves. We have to take care that we are keeping the performance when integrating sensors into headlamps. For sure our goal is to provide safety, but we're also fully aware that with the change in body architecure we'll face integration issues, and we have to come to customers with solutions—the integration of more and more sensors on the body of the car. The two competencies, lighting and sensing, can provide a global solution that guarantees that we don't compromise the performance of the sensor in the course of integration."
"On the lighting side we integrate all the characeristics of the sensors in our design and we have simulation models and design solutions to integrate the sensors iwthout disturbing their performance. Today when we design a headlamp, we simulate the low beam module, the matrix, and so on, and at the same time we simulate

the sensor inside the complete system. So it's a work-together development, which has to be taken up from the beginning to optimise the different element according to sensor characteristics."

• **Stefan Grötsch (Osram)** *on power consumption:*
"Power consumption is a matter of discussion. In active-pixel LEDs there's a difference btween the total power consumption of all LEDs lit up at the same time, but the actual use case takes advantage of the fact that most pixels are usually dimmed down or even switched off. So it comes down to a relatively small number. Of course the active creation of the beam distribution is not as efficient as if you do a FF reflector optic. But it is in the range of today's market expectation of less than 40 watts for low and high beam."

• **Whilk Gonçalves (Stellantis)** and **Stefan Grötsch (Osram)** *on resolution and segment counts*:
"The resolution, or number of pixels, depends a lot on what you want to project. If you're interested in guidelines, you don't need megapixel resolution; something between two and 10 kilopixel is enough, but not if you want to do fine symbols. For our current objectives, around 10 kilopixels is a very good compromise. But the future will tell, depending on applications. As for the limit of resolution, it's like our TVs. Today you can buy a high-megapixel-resolution TV. Is the customer really taking advantage of such fine precision? There could be a technical limit and perhaps you don't need it. The answer here again depends on what we're projecting and where. There are also thermal issues and other factors that have to be weighed and put into the balance. Personally I believe about 10 kilopixels or a little less is largely enough for current applications."
"It's about the use case and the field of view, more than it is about the number of pixels. That gives you the angular resolution you need, and if you're below a tenth of a degree, it becomes feasible as long as you look at it from the driver's perspective."

• **Stefan Grötsch (Osram)** *on lenses and chip power in the Osram Eviyos:*
"We didn't use a mincrolens array, just conventional 6-lens projector array. We tried to make most of them as a glass spherical lens, with one polymer aspheric. MLA is a challenge to do the light ocllection first before you could make use of the microlenses.
The target, of course, is to have the chips powerful enough to make low and high beam, and with the brightness we anticipate, I only see the need for an additional foreground module, as our FoV goes down to -5° and so a separate module for lower than that."

• **Whilk Gonçalves (Stellantis)** *on the high power consumption of HD lighting with high pixel counts:*
"One good strategy would be not to have the segments or pixels of equal power, depending on position. For peripheral parts of the beam we can use much less power and we don't need so much contrast, so we can concentrate energy to the centre of the beam. I think that will be the general strategy, and HD will follow this pattern even when it will be generalised in future for creating a larger and larger part of the beam."

• **Rainer Neumann (Varroc)** *on whether, when, and how ADB should be mandatory:*
"Very good question. Consider the history, like with DRL becoming mandatory in 2012. At the moment maybe 10-15 per cent of vehicles have ADB, and it's one of the best systems we've invented. In the U.S., a study has shown with automatic high/low beam switching you have about 35 per cent crash reduction on rural roads with animals and VRUs. Once ADB is more or less accepted as normal in the ECE world, we should bring the discussion in GTB to see how a mandate could be compatible with everything from 1.3-megapixel premium systems to affordable systems for lower-segment vehicles."

• **John Bullough (RPI LRC)** *on how his study on ADB safety efficacy accounts for glare:*

"We looked primarily at forward visibility for raised pavement markers. This was on a divided highway where glare wasn't much of an issue. We can use the same method for two-lane roads where glare will be an issue, because we can look at the contrast reduction. In another study I'll be presenting at SAE, we do take account of disability glare. Nevertheless, that extra forward illumination [from ADB] is a strong benefit for visibility. In North America, where the high beam intensity is lower than in the UN Regs, it calls into question whether the US low limit on intensity is really needed, when we have full automation with ADB."

• **Rainer Neumann (Varroc)** *on the prospects for ADB in the United States*:
"There is a new president!"

• **Mark Urlaub (Lumileds)** *on how light source advances can make their way into tier-1 toolboxes, and how µLEDs can be applied for various beam configurations:*
"MicroLED is a young technology, not yet on the road, but we're in contact with every T1, and we'll probably see it starting in 2023. We're closely engaged with setmakers all over the world. It's not impossible for a tier-2 to bring this tech into the market. So it's not true that tier-1 is blocking it or preventing it.
"We have microLEDs overlapping in the centre of the beam so it can be used to boost the intensity. The intensity of one microLED can easily be doubled, then that can be swivelled and modulated to create cutoffs and hot spots, etc. When it comes to road projections this is more difficult for alignment with microLEDs. Probably you use one µLED for one symbol, or you have a symbol on the road that you can easily separate it— from the left lamp you project the left lane symbol, from the right lamp the right lane symbol, so there's no overlap and alignment issue."

• **Shéhérazade Azouigui (ELS)** *on achieving true-to-life, adequate contrast levels in virtual modelling environments:*
"We had to decrease the background luminance during VR experiment to achieve the necessary contrast. Road surface characteristics are a big qustion because so many different road surface conditions and ambient light conditions affecting the appearance and colour of the road surface. In this first study we just wanted to know the immediate contrast, so we need to look at a variety of different environments, not just the road surface and ambient light, but how many other cars are in the parking lot, whether you are distracted or not—these factors may also influence the needed performance for road projections."

• **Michael Kruppa (Audi)** *on why OLEDs aren't found on a lot of Audi models yet:*
"There are many more models to come. We've got it in the Q5 now. The designers have understood the really gorgeous segmentation from OLED. We see more and more coming, especially on the Asian market, who are going to convert the rear of the car into displays, and you can clearly see the difference. If you go for single LED and working on getting LEDs smaller and smaller—mini and micro, and even smaller—a major contribution from OLED is small details, like the fill factors. MicroLEDs give a micromillimetre area. If you want to display a simple symbol like a triangle, that's 50,000 µLEDs to create it, and then you still have a pixellated appearance. With OLED you have one single lighting area you have to activate, a triangular area with no pixellation. Also lower power consumption with OLED versus µLED, so that's an intrinsic benefit. As soon as our Digital OLED 2.0 is on the road there will surely be more models going that direction! Companies like OLEDworks are showing how to apply the technology. It is so important to talk to the tier-2s to design it in a proper way along the complete manufacturing process. With our A8 we could halve the OLED taillight cost just by whole-process adjustments."

• **Mark Urlaub (Lumileds)** *on what energy must be put into μLEDs for high beam, and whether μLEDs can do road projections like DMD:*
"Carmakers and setmakers define performance. In an ADB situation, that's kind of "worst case", hardest light projection. We foresee 50 to 60 watts for the light source. And everything else (low beam, etc) about 30 watts. The lower end depends on the lowest-demand power consumptions for signal markingsand so on—single-digit wattage.
"On the μLED side, with 20 kilopixels we can already do some road projections, and future generations will have more pixels, but we have to ask: is megapixel resolution necessary? There are affordability issues. MicroLED is more efficient than DMD because of direct lighting rather than complicated optics with losses. I expect once μLED is in place, I think DMD will disappear in the mid-20s."

• **Rainer Neumann (Varroc)** *on safe-zone projections around bicyclists*:
"This is not yet approved, all these signals and symbols and opportunities presented by DLP or μLED or whatever; it's more a question of what is a real safety aspect for the traffic participants. This has to be proven by surveys and studies. Bicycle drivers, as we know, are VRUs. Their accident rate is very high, while at the same time we have reduced accident and fatality rates in cars. With more bikes in the future, that means signals and hints for the driver to maintain a safe distance to a bicyclist, that makes sense, and results (in the study) in larger passing distance between cars and bicycles, and that improves safety. So once we have a definition of this device, we can get an approval. Whereas for a zebra crossing, it's more complicated because the pedestrian we have nicely called attention to with the spot marking light, we can't just project a zebra crossing because then the pedestrian steps into it without the other road users being aware, and then you have to have a funeral!"

• **Shéhérazade Azouigui (ELS)** *on whether road projections might grow dynamic:*
"We have done some experiments, in limited number, to see if it is interesting to have this kind of study. There is an impact of the blinking, known in the literature, as an impact on conspicuity."

• **John Bullough (RPI LRC)** *on his study's findings of relative visual performance improvements (five to 12 per cent) and safety margins (+2.5 seconds) with ADB, versus larger improvements found and expected by some other researchers:*
"In the case of road markings, the driver is aware that the road has these markings, so you can use the visibility distance as the threshold, so when there's a change in the road geometry, you can respond quickly enough to slow down, change lane, etc. Depending on the type of hazard, in a general situation—a pedestrian or animal or some other object to avoid—the contrast and size are going to be different, so you get these different percentages of reduction in nighttime crashes that you might expect based on visual performance. It's a good point that we want to maintain high visual performance. There's this big area of high performance before it begins to drop off sharply. ADB helps us maintain a large plateau of high visual performance before that dropoff."

• **Michael Kruppa (Audi)** *on future plans for 360° projection around the car:*
"Next to microlens or DMD approach, we're working to bring light more around the car. Prrojection systems are the tech of choice. We' have very nice functional and design-based approaches to put a lot of projectors in the car to contribute to safety on the road. The big qustion: what content do we project on the road, and what do we display on the car? In Bavaria, regular daytime light in summertime, if you project on the road you can't recognise it, so is the safety contrribution given while most drivers are on the road? Normally at night you

don't have too many pedestrians or cyclists on the road. It should be a proper tradeoff of what you project and what you display."

• **Sophie Clade (Valeo)** *on spot marking light system configuration and performance:*
"Radar is the first sensor to detect the objects, then position the lighting so the driver can see the object. To ensure the system won't blink at every object on the road, there are different algorithms to filter the radar info to confirm what is detected is real, potentially dangerous to the driver in terms of position and movement, etc; so we will only spot-mark only relevant, important objects. "

• **Frédéric Giraud (Valeo)** *on lens treatments and conditioners for sensors integrated in lamps:*
"Hydrophobic coatings are useful with sensor integration into headlamps, because with these coatings the droplets fly off the lens quicker, so we reduce the rotation speed of the components, which means lower power consumption. For heating elements, it's different because our system—a camera inside a motor—is heating already. We have no need for additional heating to defrost or de-ice the lens."

• **Ralf Münster (SiLC)** *on the necessity of lidar:*
"I have admiration for much of what Elon Musk is doing, but in the case of lidar he's wrong. Wasn't it just last week, Tesla admitted to the California Government that the Tesla "full self driving" system is really just ADAS L^2, and they admit they can't get L^3 with their current system.
"Look at Mobileye: a month ago they will go to FMCW lidar. More and more people are realising that you have to have more than just cameras and radar for ADAS. I would go one step further: you don't need just any lidar, you need FMCW lidar for velocity information, and additional info that's critical for the perception. In spite of more computer power and more and more camera resolution we're still far off from mimicking human perception, so we need additional sensors like lidar.
"With velocity as an additional dimension, a big advantage is the processing power decreases because most of the processing can be reduced since you can focus on the important part of the environment, things that are moving, so a lot of the landscaping you're sensing, the pixels don't change, so you can reduce the amount of processing to focus on the important things. Similar to human perception. If you see motion blur out of the corner of your eye, you immediately turn and look and focus your attention on it."