
Contents

I. General Topics

RENAULT Full LED Headlamp Strategy	3
<i>BEDU François, RENAULT S.A.S., France</i>	
Future of lighting: Aesthetic, Dynamic and Interaction	9
<i>Stephan Berlitz, Vesna Krstajic, AUDI AG, Germany</i>	
Lighting innovations of future BMW vehicles	19
<i>Dr. Tim Gocke & Stefan Weber & Marcel Sieler, BMW AG, Germany</i>	
An auto-leveling system using an acceleration sensor	29
<i>Yusuke Kasaba, KOITO Manufacturing co., ltd., Japan</i>	
Possibilities to introduce a High End Lighting System in the Non- Premium Market	39
<i>Langkabel, Frank Adam Opel AG, Ruesselsheim, GERMANY</i>	
The Mercedes-Benz Headlamp of the Future: Higher Resolution with Greater Intelligence for Enhanced Safety	49
<i>Björn Böke, Dr. Markus Maier, Dr. Jörg Moisel, Florian Herold; Daimler AG, Germany</i>	
Styling Oriented: Graphic Light Technology	59
<i>Christophe DUBOSC, François GERMON, VALEO Lighting Systems, France.</i>	
Optical concepts with microstructures	69
<i>Tomáš Gloss, Jakub Hruška, Varroc Lighting Systems, Czech Republic</i>	
„HOW REALISTIC IS PHOTOREALISTIC NIGHT DRIVING?“ – A REALITY CHECK with CORRELATION TO ACTUAL ROAD ASSESSMENT	79
<i>Mirko Gottschalk, Ford Motor Company, Germany</i>	
D9S: DUAL MODE SHORT ARC HID SYSTEM	87
<i>Flesch, Prof. Dr. P., Grundmann, D. T., Sarroukh, Dr. H., Schrenk, Dr. R. OSRAM GmbH, Berlin, Germany</i>	
New chances, new challenges – How looks the future for exterior lighting in Ford 95	
<i>Warwel T., Ford Motor Company, Germany</i>	
Flexible styling Exterior Light Lens Having Both good Transparency and luminance control	103
<i>Shunsuke Iwao, Honda R&D Co. Ltd., Automobile R&D Center , Japan</i>	

II. Glare Free High Beam

Visual Performance and Safety Evaluation of High Beam Headlighting Functions	115
<i>John D. Bullough, Lighting Research Center, Rensselaer Polytechnic Institute, USA</i>	
LED Matrix Glare-free High Beam Application – Experiences during Development and Validation	121

<i>Feid, Thomas, Neitzke, Carsten, Adam Opel AG, Germany</i>	
New world of lighting based driver assistance systems – ‘Good bye low beam’ ...	131
<i>Dr.-Ing. Christian Funk, Johannes Reim, AUDI AG, Said Omerbegovic, KIT, Germany</i>	
Analysis and Experience with the first 6 Matrix LED Headlight Platforms in the field	137
<i>Michael Hamm, Audi AG, Germany</i>	
Pixel Light — Challenging & Innovative cooling	147
<i>Jan Kratochvil, Vladimir Kubena, Varroc Lighting Systems, Czech Republic</i>	
New Concept for a Best Cost Glarefree LED High Beam.....	153
<i>Johannes Manz, Ernst-Olaf Rosenhahn, Automotive Lighting, Germany</i>	
REQUIREMENTS FOR FUTURE HIGH RESOLUTION ADB MODULES	161
<i>Jörg Moisel, Daimler AG, Germany</i>	
Opti-Matrix-LED Headlamp - Future Light for Everybody	171
<i>Dr. Rainer Neumann, Varroc Lighting Systems GmbH, Germany</i>	
SOLUTION PATHS TOWARDS HIGH-RESOLUTION ADB-SYSTEMS	177
<i>Reinprecht Markus, M.Sc., Dipl.-Ing. Winterer Nina, Dr. Hartmann Peter; Zizala Lichtsysteme GmbH, Austria</i>	
ZKW PIXEL-LITE A SCALABLE MULTI-BEAM-LED-SYSTEM FOR VERSATILE AND DYNAMIC MARKET NEEDS	187
<i>Taudt L.¹, Moser A.¹, Bauer F.¹, Plank J.¹, Kieslinger D.², Weber E.², ¹ Zizala Lichtsysteme GmbH, Wieselburg, Austria, ² ZKW Elektronik GmbH, Wiener Neustadt, Austria</i>	
Glare-free LED High Beam System - Segments – Pixel – High Resolution Matrix..	197
<i>H. Vogt, A. Austerschulte Automotive Lighting Reutlingen GmbH, Germany</i>	
Silicone Optics for Automotive Matrix Lighting	205
<i>Thomas Luce, Matthias Künstner, Frank Prass, Optoflux GmbH, Germany</i>	
New Front lighting Possibilities through High Definition Digital Lighting.....	211
<i>M. Courcier, B. Reiss, V. Sanchez, VALEO LIGHTING SYSTEMS, France</i>	
Evaluation system of adaptive lighting systems in dynamic situations at night-time	221
<i>Dmitrij Polin, Carsten Bruns, Stefan Klir, Tran Quoc Khanh, Technische Universität Darmstadt, Germany</i>	
Comparing the glare load of low beam, high beam and glare-free high beam under different traffic conditions on the road.....	229
<i>K. Kosmas, D. Polin, C. Schiller, J. Kobbert, T. Q. Khanh, Laboratory of Lighting Technology, Darmstadt, Germany</i>	
III. LED/OLED Technology	
Integrated High Resolution LED Light Sources in an AFS/ADB Headlamp	241

Stefan Grötsch¹, Alexander Pfeuffer¹, Thomas Liebetrau², Hermann Oppermann³, Morten Brink³, Roland Fiederling⁴, Ingo Möllers⁵, Jörg Moisel⁶

COMBINED LB/HB FROM A SINGLE 2000 LM AND UP SMT LED BASED ON A MOVING SHUTTER 251

Michael Zitzlsperger¹, Stefan Groetsch¹, Alexander Guenther¹, Rainer Huber¹, Paola Altieri-Weimar¹

OLED – Innovative Graphics and Future Possibilities 261

Michael Kleinkes¹, Wolfgang Pohlmann¹

LED Adaptive Driving Beam headlamps..... 267

Hiroaki Kurosu, Stanley Electric Co.,Ltd., Japan

Wafer Level Packaging (WLP) based LED for advanced head lighting – LUXEON Neo 275

S. Rao Peddada¹, Benno Spinger², Lin Li¹, Kevin Mai¹, Sridevi Vakkalanka¹, Kenneth Vampola¹, Michael Deckers², Nico Bienen², Astrid Marchewka², Nils Benter², Norbert Lesch², Dirk Vanderhaeghen²,

Breakthrough technology for automotive LED lamps 285

Albrecht Kraus, Paul Martin, Ding Chao, Carisa Chu, Lumileds, China

Intelligent light Management for OLED on foil Applications (IMOLA): Automotive rear light demonstrator 293

Franco Marcori, Michele Antonipieri, Sara Padovani, Antonio Filipuzzi, Centro Ricerche Plast-optica S.p.A., Italy

Durability of polymer materials in high intensity semiconductor light engines ... 301

Meyer, J., Tappe, F., Schmidt, N., University of Applied Sciences Hamm-Lippstadt, Lippstadt, Germany

Alternative to Luminous Flux in Type Approval Requirements For LED Headlamps 307

Tomasz Targosinski, Motor Transport Institute,

IV. Laser Technology

LARP: Applications for Ultra High Luminance 319

Dr. Roland Fiederling, Oliver Hering, OSRAM GmbH, Germany

Laser-based remote white light sources for automotive applications 329

Roman Hohn¹, Ulrich Hechtfisher², Josef Schug³, Steffen Zozgornik⁴, Helmut Bechtel⁵, Roy Engelen⁶, Christian Kleijnen⁷, Ralph Maessen⁸, Genia Patent⁹, Alexander Vdovin¹⁰

Study the effect of Laser headlights on the brightness of road surfaces and traffic signs..... 339

Shigeto Iwamoto, Honda R&D Co. Ltd., Automobile R&D Center Japan, Yuki Tsukada, National Traffic Safety and Environment Laboratory, Japan

Laser Headlamp Based on Laser Activated Remote Phosphor 347

Namhyeok Kwak, Gun-Duk Kim, Jung-young Kim, Hyundai MOBIS, South Korea,
Byoungsuk Ahn, Hyundai Motor, South Korea

Challenges for MEMS based Scanning Laser System.....	355
<i>Petersen A.^{1,2}, Hager J.^{1,3}, Gut C.^{1,4}, Jahn P.^{1,5}, Seitz M.^{1,2}, Schwaiger S.^{1,3}, Schlöder U.^{1,2}, Helmer M.^{1,5}, Berlitz S.^{1,4}, Neumann C.^{1,5}, Hering O.^{1,3}</i>	

Field Test of Visibility distances and recognition rates – comparison of LED and Laser systems	365
<i>Kobbert, J. M.Sc., Kosmas, K. M.Sc. Dipl. –Ing Polin, D., Englisch, D, M.Sc., Schneider, K, M.Sc., Prof.Dr.-Ing Khanh, T.Q.,</i>	

Reality Check: Laser High Beam Performance in Real Driving Tests	375
<i>K. F. Albrecht, A. Austerschulte, E.-O. Rosenhahn, Automotive Lighting Reutlingen GmbH, Reutlingen, Germany</i>	

RGB-LASER SCANNING MODULE FOR ONROAD PROJECTION	385
<i>Joscha Roth, Prof. Dr. Jörg Wallaschek, Gerolf Kloppenburg, Prof. Dr. Roland Lachmayer, Benjamin Meyer, Sebastian Thomschke, Institute of Dynamics and Vibration Research, Institute of Product Development, Volkswagen AG, Germany</i>	

SUBJECTIVE AND OBJECTIVE PERFORMANCE OF LASER HEADLAMPS	395
<i>Mitsuhiro Uchida¹, Yoshiaki Nakazato², Ryuji Ueki³, Yasushi Kita⁴, Stanley Electric Co., Ltd.; Kanagawa, Japan</i>	

Laser Headlamps. Key factors and improvement	405
<i>Jürgen Wilhelmy, Carsten Gut, Audi AG, Germany</i>	

Electronic drivers for laser headlamps	415
<i>Chandrajit Basu¹, Martin Royer², Prem Sharma² and Bernhard Roth³</i>	

V. Special Headlamp Aspects

Artificial intelligence for future light-based assistance systems.....	423
<i>Said Omerbegovic, Karlsruher Institut für Technologie, Tanja Kammann, Technische Universität München, Dr.-Ing. Christian Funk, AUDI AG, Prof. Dr. rer. nat. Cornelius Neumann, Karlsruher Institut für Technologie, Germany</i>	

ASSIST – Concept of a Self-adjusting Headlamp Technology	431
CAR-TO-X: EFFECTS OF DISTURBANCES ON VISIBLE LIGHT COMMUNICATIONS	441
<i>Bogdanow, S.; Pankratz, P.; Marutzky, M.; Kleinert, B., IAV GmbH, Gifhorn, Germany</i>	

Defogging simulation method for headlamp	445
<i>B. Prosperi, M. Hamlaoui, A.-M. Ochoa, C. Roucoules, Valeo Lighting System, Bobigny, France</i>	

Diffraction Optics in automotive Headlamps – Design and Simulation.....	455
<i>Schöne, M¹, Sandfuchs, O.², Neumann, C.³</i>	

Marking Light – Glare and Acceptance.....	463
<i>Philip Stroop, Boris Kubitzka, Udo Venker, HELLA KGaA Hueck & Co., Jürgen Locher, L-LAB, Lippstadt, Germany</i>	

VI. New Headlamp Technology

POTENTIALS OF MEMS-BASED SCANNERS AND DMD ARRAYS WITH HIGH LUMINANCE LED AND LASER LIGHT SOURCES..... 473

Reisinger B.¹, Reinprecht M.², Pürstinger J.¹, Moser A.¹, Böhm G.², Bauer F.¹

High resolution adaptive headlight using Texas Instruments DLP® technology 483

Vikrant R. Bhakta, Ph.D., Brian Ballard, Texas Instruments Incorporated, Dallas, USA

BMBF-Project VOLIFA 2020 - High resolution light distribution by using a LCD .. 495

Representative for the VoLiFa 2020 research cooperation Henrik Hesse, Hella KGaA Hueck & Co., Germany

Examination of the effectiveness of road surface drawing headlamps 503

T.Masuda, Y.Shibata, M.Hayakawa, S.Yamamura, KOITO MANUFACTURING CO., LTD. , Japan

Eye-gaze detection for beam pattern control..... 513

Philipp Röckl, Adam Opel AG, Germany

Holograms in automotive Headlamps with LED Illumination..... 521

Karthaus, D.¹, Koren, N.², Sandfuchs, O.³, Sinzinger, S.⁴

High Resolution Headlamp – Investigation towards a RGB-Laser LCD Backlight . 531

B. Willeke¹, F. Schüler¹, F. Kley², G. Fischer²,

VII. Signaling Functions

Application of laser diodes in signalization functions 539

Dr. Whilk GONÇALVES, M. SURUGUE, F. BLANCHET, PSA Peugeot Citroën, France

Holographic Optics for Signalights – Concepts, Stylings & Challenges 545

Dipl.-Ing. Martin Mügge, HELLA KGaA Hueck & Co., Germany

Luminance homogeneity of rear-lamps lighting functions: comparison of some OEM's analytical evaluation criteria 555

Paroni Sara, Londero Alessandro, Svettini Marco, Automotive Lighting, Tolmezzo, Italy

Perception of brightness differences in complex signal functions 565

Mathias Daumüller, Heike Fröhlich, Pia Tölle, Automotive Lighting Reutlingen GmbH, Germany

Backup Function – more than a signal light? 575

Rouven Haberkorn, Adam Opel AG, Germany

VIII. Interior Lighting

Interior lighting in autonomous vehicles 587

Dr. Ana Bižal, Dr. Herbert Wambsganß, HELLA Innenleuchten-Systeme, Wembach, Germany

Impact of biologically active light on performance-based alertness and vigilance 595

<i>Sophie-Christie Farkas, Anika Leib, Daniel Betz, Siegfried Rothe, Daimler AG, Germany</i>	
Acceptance of Gesture Control for Automotive Interior Lighting	605
<i>Dr. Herbert Wambsganß, HELLA Innenleuchten Systeme, Sören Schäfer, Franziska Kley, HELLA KGaA Hueck&Co</i>	
The lateral signal image of vehicles - an open Potential for Safety and Styling....	615
<i>Detlef Decker, Bertrandt Ingenieurbüro GmbH, Tappenbeck, Germany</i>	
Implementation of vitalization and unique impressions by RGB-interior light....	621
<i>Marcus Pfeil, AUDI AG, Germany</i>	
Interior Lighting: From Commodity to new functionalities	631
<i>Laurent Evrard, Benoît Reiss, VALEO LIGHTING SYSTEMS, France</i>	

IX. Physiology – Detection and Glare

Innovative motorcycle headlight configurations as a short-term solution for improving motorcycle visibility.....	643
<i>V. Cavallo, M. Ranchet, S. Espié, F. Vienne, N.-T. Dang, Ifsttar, France</i>	
Spectral sensitivity in the mesopic range for Objects in the periphery	653
<i>Daniel Englisch, Christoph Schiller, Tran Quoc Khanh, Technische Universität Darmstadt, Germany</i>	
Quantifying the distraction potential of blue accent light used in headlamps.....	663
<i>Melanie Helmer, Tuan Nguyen Duy, Prof. Cornelius Neumann, Karlsruhe Institute of Technology (KIT), Light Technology Institute (LTI), Germany</i>	
Effects of Cutting Light in a Wavelength Range on Discomfort Glare	671
<i>Yasuko Koga, Kosuke Takao, Kyushu University, Japan, Naotaka Saita, HASEKO Corporation, Japan</i>	
Influence of Luminance and Illuminance on Headlamp Glare	679
<i>Locher, J.¹, Aldiek, L.², Stroop, P.³</i>	
Detection models and their validation for the optimization of ADB lighting distributions.....	687
<i>Peter Bodrogi, Christoph Schiller, Tran Quoc Khanh, Technische Universität Darmstadt, Germany</i>	
Glaring effects of stop lamps in LED or incandescent bulb technology.....	697
<i>Patric Jahn, David gr. Austing, Melanie Helmer, Prof. Cornelius Neumann, Karlsruhe Institute of Technology (KIT), Light Technology Institute (LTI), Germany</i>	
CAGE – Computer Aided Glare Evaluation of Automotive Headlamps.....	707
<i>Kleinert, B.¹; Werner, Ch.¹; Bogdanow, S.¹; Marutsky, M.¹; Schierz, Ch.²</i>	
X. Market Potential	
A Survey of Horizontal Road Curvature for Fatal Nighttime Crashes	719
<i>Matthew L. Brumbelow, Insurance Institute for Highway Safety, USA</i>	

Impact of Emerging markets, such as China and India, on developing a Global beam pattern and Technology Strategy	729
<i>Dr. Luciano Lukacs, Ford Motor Company, China</i>	
Free Fall of LED System Efficiency - Performance Evaluation of current LED Headlamps	739
<i>Michael Scholl, Automotive Lighting Reutlingen GmbH, Germany</i>	
PRELIMINARY RESEARCH ON ADB MARKETABILITY IN KOREAN MARKET: USING THE QUALITATIVE INVESTIGATION	749
<i>Yi Yeo Kyoung, Kim Hye Won, Future Strategy Team of SL Corporation, Han Kwang Hyun, Strategy Execution Team of SL Corporation</i>	