Michael Bargende · Hans-Christian Reuss
Andreas Wagner *Hrsg.*

20. Internationales Stuttgarter Symposium

Automobil- und Motorentechnik

Band 2

FKFS
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Ein stetig steigender Fundus an Informationen ist heute notwendig, um die immer komplexer werdende Technik heutiger Kraftfahrzeuge zu verstehen. Funktionen, Arbeitsweise, Komponenten und Systeme entwickeln sich rasant. In immer schnelleren Zyklen verbreitet sich aktuelles Wissen gerade aus Konferenzen, Tagungen und Symposien in die Fachwelt. Den raschen Zugriff auf diese Informationen bietet diese Reihe Proceedings, die sich zur Aufgabe gestellt hat, das zum Verständnis topaktueller Technik rund um das Automobil erforderliche spezielle Wissen in der Systematik aus Konferenzen und Tagungen zusammen zu stellen und als Buch in Springer.com wie auch elektronisch in Springer Link und Springer Professional bereit zu stellen. Die Reihe wendet sich an Fahrzeug- und Motoreningenieure sowie Studierende, die aktuelles Fachwissen im Zusammenhang mit Fragestellungen ihres Arbeitsfeldes suchen. Professoren und Dozenten an Universitäten und Hochschulen mit Schwerpunkt Kraftfahrzeug- und Motorentechnik finden hier die Zusammenstellung von Veranstaltungen, die sie selber nicht besuchen konnten. Gutachtern, Forschern und Entwicklungsingenieuren in der Automobil- und Zulieferindustrie sowie Dienstleistern können die Proceedings wertvolle Antworten auf topaktuelle Fragen geben.

Today, a steadily growing store of information is called for in order to understand the increasingly complex technologies used in modern automobiles. Functions, modes of operation, components and systems are rapidly evolving, while at the same time the latest expertise is disseminated directly from conferences, congresses and symposia to the professional world in ever-faster cycles. This series of proceedings offers rapid access to this information, gathering the specific knowledge needed to keep up with cutting-edge advances in automotive technologies, employing the same systematic approach used at conferences and congresses and presenting it in print (available at Springer.com) and electronic (at Springer Link and Springer Professional) formats. The series addresses the needs of automotive engineers, motor design engineers and students looking for the latest expertise in connection with key questions in their field, while professors and instructors working in the areas of automotive and motor design engineering will also find summaries of industry events they weren't able to attend. The proceedings also offer valuable answers to the topical questions that concern assessors, researchers and developmental engineers in the automotive and supplier industry, as well as service providers.

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ISSN 2198-7432 ISSN 2198-7440 (electronic)
Proceedings
ISBN 978-3-658-30994-7 ISBN 978-3-658-30995-4 (eBook)
https://doi.org/10.1007/978-3-658-30995-4

Die Deutsche Nationalbibliothek verzeichnet diese Publikation in der Deutschen Nationalbibliografie; detaillierte bibliografische Daten sind im Internet über http://dnb.d-nb.de abrufbar.

Verantwortlich im Verlag: Markus Braun
Springer Vieweg ist ein Imprint der eingetragenen Gesellschaft Springer Fachmedien Wiesbaden GmbH und ist ein Teil von Springer Nature.
Die Anschrift der Gesellschaft ist: Abraham-Lincoln-Str. 46, 65189 Wiesbaden, Germany

WELCOME IN STUTTGART

The car is currently undergoing a complete reinvention. And for us there is a lot at stake: our role as technological pioneers, our economic strength, many jobs and conservation of our natural resources. The Stuttgart International Symposium for Automotive and Engine Technology, now in its 20th year, is intended to enable a fruitful exchange of expertise and creative ideas in order to meet this great challenge. I am delighted to be the patron for this event, and I welcome the participants from all around the world to our state capital!

The automotive industry is an especially important component of our economic power, particularly in Baden-Württemberg. Going forward, these key industries must adapt to ecological and political climate requirements. But we can only shape the future of our automotive economy by working together with everyone involved in this process. My state government is also supporting this development with the cross-sector "Baden-Württemberg Automotive Industry Strategic Dialog", because the transition to sustainable and digital mobility requires expertise from diverse areas – from business, science, trade unions, associations, civil society and politics.

With more than 100 lectures and 800 participants, the Stuttgart International Symposium is one of the largest congresses for vehicle and engine development in Europe. So I would like to take the opportunity to thank the organizers of this congress, and wish all the guests inspiring conversations and exciting new knowledge!

Winfried Kretschmann
Prime Minister of the State of Baden-Württemberg

A WARM WELCOME

The zero carbon car – technical challenges of the future

The mobility transition and intermodal mobility; car sharing versus shared space, digitalization, automation and networking, e-fuels, batteries or fuel cells after all? The current discussions concerning the future of personal transport are generally characterized by uncertainty and open questions, rather than clear answers and confidence. This is perturbing the industry: unsettling it on the one hand and on the other hand making it more important than ever to get to grips with the issues involved.

With its focus on "The challenges of future technology" and its diverse program of lectures, the 20th Stuttgart International Symposium grapples with these questions. It hopes to help the industry approach these future-related topics and provide a platform for – potentially controversial – discussions.

The program structure has also changed. In response to requests from our participants we are now offering more opportunities for collaboration and networking:

» In the World Café, you can work on specific solutions for current problems in our industry. The results of this creative unit will be presented directly to a wide audience directly before the podium discussion.

» We'll be celebrating the Stuttgart International Symposium's 25th birthday with a stand party in the exhibition.

» A poster session and a tour of the exhibition are further new features.

You can also expect some optical changes on location, along with some familiar elements!

We are curious to hear your feedback and look forward to seeing you in Stuttgart on March 17 and 18, 2020!

Prof. Dr. Michael Bargende
Prof. Dr. Hans-Christian Reuss
Prof. Dr. Andreas Wagner

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The future of combustion engines from the perspective of rail applications

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M. Bargende et al. (Hrsg.), *20. Internationales Stuttgarter Symposium*, Proceedings, https://doi.org/10.1007/978-3-658-30995-4_1

Strategies for commercial vehicle drivetrains 2030

Philip Scarth, FPT Motorenforschung AG

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M. Bargende et al. (Hrsg.), *20. Internationales Stuttgarter Symposium*, Proceedings, https://doi.org/10.1007/978-3-658-30995-4_2

The commercial vehicle in 10 years and beyond – Still with a classic ICE?

Dr.-Ing. Christian Weiskirch, Dr. rer. nat. Andreas Kammel

TRATON GROUP

M. Bargende et al. (Hrsg.), *20. Internationales Stuttgarter Symposium*, Proceedings, https://doi.org/10.1007/978-3-658-30995-4_3

Abstract

The Commercial Vehicle Business is at the beginning of more disruptive change driven by electrification, automation and digitization. New technologies will be introduced with growing frequency. In the same time the demands from legislation but even more important from society to step out of fossil energy sources towards CO2-neutral transport solutions forces the manufacturers of Commercial Vehicles to continue to improve on the classic technologies but as well manage the transition into the new areas.

Long term the future for the Commercial Vehicles will be electric without any doubts, but the point in time when this will happen is discussed controversially between governments, politicians, manufactures but even within departments in the companies. And this discussion is not based on TCO-calculations, the purely TCO based tipping points will be reached in only a couple of years. Necessary infrastructures, customer acceptance, global scale and various uncoordinated incentives and initiatives are discussion topics that lead to a diffuse and fuzzy view on the total picture – which crystal ball is really the right one?

Same goes for the transition period, where the manufacturers will earn the majority of their income with the classic technologies also to finance the development of the next generations. Various opportunities are already available, from more evolutionary green drop-in fuels to more revolutionary hydrogen in internal combustion engines or fuel cells. Also in this more or less well known technologies it's unclear on which horses to put the bets on, but it is clear that it is impossible to develop solutions for all options.

Looking back in time the engineers have already demonstrated that whatever challenge a new fuel brings – the necessary technology will be made available. But can that be afforded for shrinking volumes or even niche-applications?

The future for in city applications like busses, distribution trucks and typical special vehicle for garbage collection, street cleaning and such is quite clear electric. The ecosystem is known and aside some infrastructure challenges and also necessary adoptions in operations the transition will happen quite fast. Also regional distribution and regional haulage can be handled with electrified vehicles quite soon. For busses operating interurban but for sure long distance maybe different solutions need to applied. Long haulage operation on the other hand can be handled with electric vehicles if you change the typical operation pattern or with the expected improvement in battery and charging technology. The situation becomes different, if the vehicle is used for work instead of transport. It makes heavy machinery mobile and with the internal combustion engine it delivers the power for the operation in almost every accessible spot in the world. And a refill of the high density energy storage is in this case easy to handle.

Can we change this within 10 years or will the modern ICE survive much longer?

5G network infrastructure & autonomous driving – The next generation C-V2X technology

Walter Haas, HUAWEI TECHNOLOGIES Deutschland GmbH

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M. Bargende et al. (Hrsg.), *20. Internationales Stuttgarter Symposium*, Proceedings, https://doi.org/10.1007/978-3-658-30995-4_4

Welcome to the photonic age in automotive industry

Martin Enenkel, Jenoptik Optical Systems GmbH

M. Bargende et al. (Hrsg.), *20. Internationales Stuttgarter Symposium*, Proceedings, https://doi.org/10.1007/978-3-658-30995-4_5

1 The Photonic Age in Automotive Industry at start of page

The Photonic Age within the Automotive Industry has started already long time ago for more than 100 years. Coming from candles to illuminate drive ways to today's PIXEL Lighting and Laser beams in car headlamps or Organic-LED (OLED) in Backlighting.

Long Range LiDAR-Systems (Figure 1) supports Autonomous Driving and adequate driver information systems inform pilots from multicolor head up displays (Figure 2).

Car to Car commutation is used as a bi-directional communication to ensure safety handshakes.

Femto-Second Laser Equipment enables manufacturers to do micro drilling to define weakness sweat points at structure elements (Figure 3 +4) with batch size one.

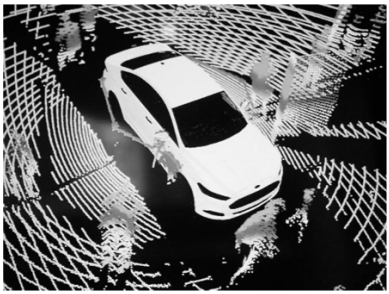

Figure (1)

Figure (2)

Photonics is enabler for:

- Autonomous driving and connected cars
- Digitalization

Figure (3)

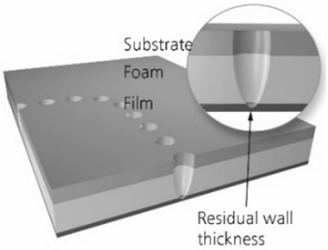

Figure (4)

Beam shaping optics allows to adjust laser tools to the customer needs in terms of material to handle, process timing and fit, from and function. Compared with multi axis robot cells, photonics makes the car production fast, more stable and more flexible (Figure 5+6).

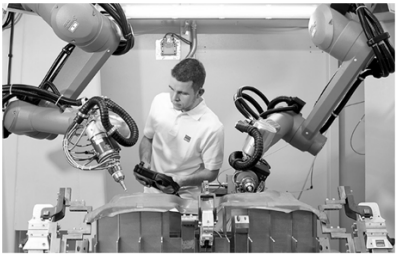

Figure (5)

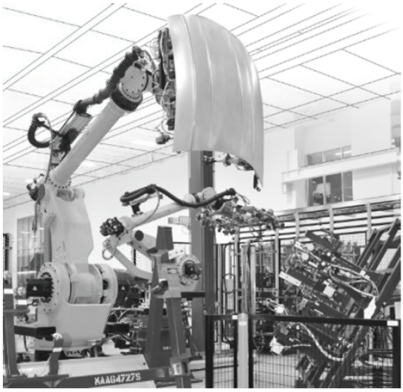

Figure (6)

Today's automotive industry is not only about car manufacturing or car parts and equipment, it is also about the environment. Traffic control, law enforcement (Figure 7) and safety and security (Figure 8) are major investment areas for photonics in the automotive industry.

Figure (7)

Figure (8)

Photonics makes roads and communities safer

2 Jenoptik Divisions are addressing areas in the Automotive Industry

Jenoptik addresses the automotive industry with his 3 divisions

- Light and Production (L&P)
- Light and Optic (L&O)
- Light and Safety (L&S)

Light and Production Division (L&P) provides engineering with focus on smart manufacturing and process automation for automotive industrial customers (Figure 9).

Therefore Photonics makes the car production faster, more stable and more flexible.

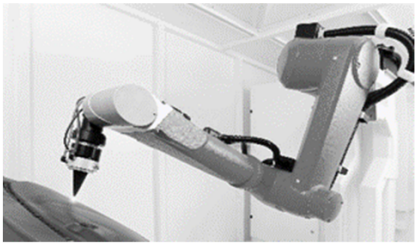

Figure (9) Division Light & Production for car manufacturing

Light and Optics Division (L&O) provides engineering with focus on state of the art opto-electronics. From component level, over modules (Figure 10) to full system solution for full integration as Tier#2 supplier.

Therefore Jenoptik brings Photonics at the heart of our OEM customers.

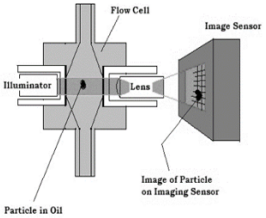

Figure (10) Division Light & Optics for car on board systems