

Proceedings

Michael Bargende · Hans-Christian Reuss
Jochen Wiedemann Hrsg.

14. Internationales Stuttgarter Symposium

Automobil- und Motorentechnik



Springer Vieweg

Proceedings

Michael Bargende · Hans-Christian Reuss
Jochen Wiedemann *Hrsg.*

14. Internationales Stuttgarter Symposium

Automobil- und Motoren-technik



Proceedings

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 der Konferenzen und Tagungen zusammen zu stellen und als Buch in Springer.com wie auch elektronisch in SpringerLink und Springer für Professionals bereit zu stellen.

Die Reihe wendet sich an Fahrzeug- und Motorenengineeringeure 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 Entwicklungingenieuren in der Automobil- und Zuliefererindustrie sowie Dienstleistern können die Proceedings wertvolle Antworten auf topaktuelle Fragen geben.

Michael Bargende · Hans-Christian Reuss
Jochen Wiedemann (Hrsg.)

14. Internationales Stuttgarter Symposium

Automobil- und Motorenmechanik

Band 1

Herausgeber

Prof. Dr.-Ing. Michael Bargende
Prof. Dr.-Ing. Hans-Christian Reuss
Prof. Dr.-Ing. Jochen Wiedemann
FKFS Forschungsinstitut für Kraftfahrwesen
Stuttgart, Deutschland

ISBN 978-3-658-05129-7
DOI 10.1007/978-3-658-05130-3

ISBN 978-3-658-05130-3 (eBook)

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

Springer Vieweg

© Springer Fachmedien Wiesbaden 2014

Das Werk einschließlich aller seiner Teile ist urheberrechtlich geschützt. Jede Verwertung, die nicht ausdrücklich vom Urheberrechtsgesetz zugelassen ist, bedarf der vorherigen Zustimmung des Verlags. Das gilt insbesondere für Vervielfältigungen, Bearbeitungen, Übersetzungen, Mikroverfilmungen und die Einspeicherung und Verarbeitung in elektronischen Systemen.

Die Wiedergabe von Gebrauchsnamen, Handelsnamen, Warenbezeichnungen usw. in diesem Werk berechtigt auch ohne besondere Kennzeichnung nicht zu der Annahme, dass solche Namen im Sinne der Warenzeichen- und Markenschutz-Gesetzgebung als frei zu betrachten wären und daher von jedermann benutzt werden dürften.

Umschlagbild: © [M] Peugeot

Gedruckt auf säurefreiem und chlorfrei gebleichtem Papier.

Springer Vieweg ist eine Marke von Springer DE. Springer DE ist Teil der Fachverlagsgruppe Springer Science+Business Media
www.springer-vieweg.de

WELCOME

Within the field of mobility, an independent turnaround in the energy policy is taking place. Environmental protection and the conservation of dwindling resources are important driving forces of this development, which represents major technological challenges for companies and research institutes. For this purpose, new technologies must be developed and existing ones improved. Accordingly, the Research Institute of Automotive Engineering and Vehicle Engines in Stuttgart is placing the 14th Stuttgart International Symposium on Automotive and Engine Technology under the motto »Renewable energies and future mobility concepts«. I was very happy to assume patronage of the event.

With over 800 professional attendees, more than 110 lectures and an accompanying exhibition, the Stuttgart Symposium is considered as one of the most important discussion boards for the range of automotive and engine development in Europe. It is an excellent platform for the representatives of industry and research to discuss new ideas and to present the performance of the industry in Baden-Wuerttemberg.

With this year's focus on the main topic the symposium will go far beyond the development of vehicles and engines. It includes both the integration of diverse transport modes and systems as well as energy efficiency control of various types of motor vehicles.

Another important objective of the Baden-Wuerttemberg state government is the resource-conserving energy production. In the field of transport alternative forms of propulsion must be developed with future technologies and corresponding IT solutions, which enable an intelligent integration and application for all road users and participants.

It is about nothing less than the future of mobility! Speed, flexibility and environmental friendliness will be the main criteria. The well working cooperation between science and industry in Baden-Wuerttemberg is a key prerequisite for the development of modern mobility concepts.

My thanks go to the event organizers and promoters, whom I would like to congratulate for the extensive and exciting program of the 14th Stuttgart International Symposium of automotive and engine technology. To all indoor exhibitors, as well as visitors, I wish inspiring and productive discussions.

Winfried Kretschmann
Prime Minister
of the State of Baden-Wuerttemberg

RESEARCH AND DEVELOPMENT IN AUTOMOTIVE AND ENGINE TECHNOLOGY

The automotive industry is globally facing a number of challenges: The legal limitation of CO₂ emissions, the finite nature of reserves of fossil fuels and the increasing traffic congestion in urban areas and megacities are important issues. The need for affordable mobility systems which are resource-efficient as well as sustainable and climate neutral, but which also meet high safety standards and high levels of social and political acceptance, is increasingly clear. The automotive industry is therefore intensively working on alternative vehicle and mobility concepts. Additionally, previous research approaches are joined more and more by concepts from the fields of electricity and electronics, mechatronics, information technology and computer science. To promote research in the various areas it is important to share and unify the research results from academia and industry.

The

14th Stuttgart International Symposium Automotive and Engine Technology

18th and 19th March 2014

provides an important platform for the automotive industry. The program of the symposium was expanded from four to six parallel sessions in order to meet the increased topics as well as the very high number of excellent submissions of papers. Due to the resulting variety of topics that will be presented by leading experts in more than 110 lectures, we hope to have arranged an interesting program for you. The lecture related discussions and the accompanying exhibition offer an opportunity for further professional exchange.

We look forward to welcoming you in Stuttgart, the birthplace of the automobile and wish you enjoyable and informative days at the 14th Stuttgart International Symposium.

Prof. Dr.-Ing. Michael Bargende

Prof. Dr.-Ing. Hans-Christian Reuss

Prof. Dr.-Ing. Jochen Wiedemann

INDEX – Volume 1

SECTION 1

INNOVATIVE VEHICLES

Chairperson: Prof. Dr. Frank Gauterin

Urban EV project Visio.M – Concept highlights and latest prototype test results	1
Stefan Riederer, BMW Research and Technology	
Performance and efficiency – technical solutions for high-performance sports cars to achieve future CO₂ limits	3
Bernhard Bähr, Gabriele Pieraccini, Holger Hofmann, Stefanie Freudenstein, Bosch Engineering GmbH	
E-generation / Key technologies for electric vehicles	19
Michael Dimitrov, Dr. Ing. h.c. F. Porsche AG	

CI ENGINES – COMPONENTS

Chairperson: Prof. Dr. Wolfgang Thiemann

Advanced diesel fuel injection equipment – A never ending BOSCH story	31
Jürgen Hammer, Michael Raff, Dirk Naber, Robert Bosch GmbH	
Cascaded indirect integrated charge air cooling for passenger car diesel engines	47
Simon Schneider, MAHLE International GmbH; Andreas Eilemann, MAHLE Behr GmbH & Co. KG; Jürgen Stehlig, MAHLE Filtersysteme GmbH	
Thermal management for a light-duty-vehicle with diesel engine: Evaluation of an optimized cooling system with variable cooling components	61
Wolfgang Wenzel, John Shutty, Jeri Tsai, BorgWarner, Inc.; Thomas Buchholz, BorgWarner Thermal Systems	

BATTERIES

Chairperson: Prof. Dr. Werner Tillmetz

A123 battery life simulation and validation test results	79
-----------------------------------------------------------------	-----------

Jeff Kessen, Roland Jeutter, Christoph Fehrenbacher, A123 Systems

Integrated electronics for battery sensors	89
---------------------------------------------------	-----------

Jürgen Kernhof, Ayman Ghazi, Marko Radovic, ZMDI

Development of active Battery Management System for test car and test results	99
------------------------------------------------------------------------------------------	-----------

Dan Jiang, M. Hübner, HTW Dresden

DRIVING DYNAMICS I

Chairperson: Prof. Dr. Ferit Küçükay

An effective process for trackside vehicle development	125
---------------------------------------------------------------	------------

Paolo Bortolussi, Leonardo Pascali, Dr. Ing. h.c. F. Porsche AG;
Nico Castrup, RWTH Aachen

Integrated Vehicle Dynamics Control – an optimized approach for linking multiple chassis actuators	139
---------------------------------------------------------------------------------------------------------------	------------

Lars König, Thomas Walter, Benjamin Gutmayer, Dominik Merlein,
Bosch Engineering GmbH

Integration of chassis control system networking into the vehicle dynamics development process	151
-----------------------------------------------------------------------------------------------------------	------------

H.-C. Reuss, Jan-Hendrik Herold, University of Stuttgart;
Leonardo Pascali, Dr. Ing. h.c. F. Porsche AG

ELECTRICAL POWER MANAGEMENT

Chairperson: Prof. Nejila Parspour

Modular modeling of a PEM fuel cell system for automotive applications	167
-----------------------------------------------------------------------------------	------------

Raphael Hans, ETAS GmbH; Ferdinand Panik, HS Esslingen;
Hans-Christian Reuss, University of Stuttgart

Photovoltaic based inverter charger 181

Martin Neuburger, University of Applied Sciences Esslingen

Range extending for electric vehicle operation in urban-regional areas 199

Jens Bachstein, Andreas Daberkow, Heilbronn University;
Hans-Christian Reuss, University of Stuttgart, FKFS

PRODUCTION + DESIGN I

Chairperson: Prof. Dr. Rainer Gadow

Experimental study of unstretched fiber shifting during hemming processes for automotive aluminum alloys 215

Severin Hönle, Mathias Liewald, Philipp Schmid, IFU, University of Stuttgart;
Manfred Sindel, AUDI AG

Virtual production planning and dimensional accuracy prediction of sheet metal components in the bodyshell work 227

Christian Kästle, Daimler AG;
Mathias Liewald, Karl Roll, University of Stuttgart

SECTION 2

ADVANCED DRIVER ASSISTANCE SYSTEMS I

Chairperson: Prof. Dr. Tobias Flämig-Vetter

Ego-motion estimation in urban areas 241

Claudius Gläser, Lutz Bürkle, Frank Niewels,
Robert Bosch GmbH

New working model for collaboration of OEM and supplier in development of advanced driver assistance functionalities for series production 255

Ulrich Zoelch, Claus Dorrer, Martin Krenn, Martin Peller, Peter Varadi,
BMW AG; Dirk Böttcher, Jürgen Diebold, Hagen Stübing, Continental AG

An efficient environmental model for automated driving 267

Ralph Grewe, Andree Hohm, Stefan Lueke, Continental AG

HYBRID I

Chairperson: Prof. Karl-Ernst Noreikat

Emission optimized hybrid vehicle operation with thermal exhaust model 281

Florian Kunkel, Rolf Isermann, TU Darmstadt, Institute for Automatic Control and Mechatronics

Automated process integration and design optimization of a mathematics-based series-hybrid electric vehicle 297

Johannes Friebe, Thanh-Son Dao, Maplesoft GmbH;
Christine Schwarz, ISKO engineers AG

Definition and implementation of a benchmarking in order to derive success factors of hybrid powertrains 321

Albert Albers, Matthias Behrendt, Friedrich Brezger, Kevin Matros,
Benedikt Steiger, IPEK – Institute of Product Engineering at Karlsruhe Institute of Technology (KIT); Heidelinde Holzer, Wolfram Bohne, BMW AG

SI ENGINES – IGNITION

Chairperson: Prof. Dr. Christian Beidl

Spark plugs for modern engines: challenges and solutions 337

Igor Orlandini, Arnold Schneider, Sabrina Rathgeber, Tobias Ruf,
Robert Bosch GmbH

Simultaneous spatially resolved visualization of fuel/air ratio and residual gas distribution in an optically accessible SI-engine 349

Thomas Mederer, Wolfgang Friedrich, Johannes Trost, Lars Zigan,
Michael Wensing, LTT, Friedrich-Alexander-University Erlangen-Nuremberg

Potential of corona ignition on gas engines using EGR and lean combustion 373

Alexander Schenk, Georg Rixecker, Volker Brichzin, BorgWarner BERU Systems GmbH; Michael Becker, BorgWarner Inc.

DRIVING DYNAMICS II

Chairperson: Prof. Dr. Oliver Sawodny

- Improvement of collision avoidance systems by using a propulsion system for advanced brake performance** 389
Sven Knecht, Jens Neubeck, Jochen Wiedemann, FKFS

- Design of a decision maker for an evasive or braking maneuver for collision avoidance** 401

Carlo Ackermann, R. Isermann, Institute of Automatic Control and Mechatronics, TU Darmstadt; Sukki Min, Changwon Kim, Hyundai Motor Company

FVV PROJECTS

Chairperson: Dr. Karl Kollmann

- Characterization of gasoline biofuels regarding combustion anomalies** 417

Marco Günther, Bastian Morcinkowski, Florian Kremer, Stefan Pischinger, RWTH Aachen University

- In-cylinder causes of particle emissions on DISI engines** 435

Helge Dageförde, Heiko Kubach, Thomas Koch, IFKM, Karlsruhe Institute of Technology (KIT); Ulrich Spicher, MOT GmbH

- Particle number measurement techniques:** 461

**PMP particle number counting methodology,
PMP-HD measurement system comparison**

Thomas Maier, Georg Wachtmeister, LVK, TU Munich

PRODUCTION + DESIGN II

Chairperson: Prof. Dr. Thomas Maier

- Investigation on the tribological behavior of thermally sprayed cylinder liner coatings** 477

Andrei Manzat, Rainer Gadow, IFKB, University of Stuttgart

INDEX – Volume 1

Chances and risks when using high strength steel sheets in structural parts of modern car bodies	493
M. Liewald, S. Wagner, R. Radonjic, University of Stuttgart, Institute for Metal Forming Technology (IFU)	
Competitive fiber reinforced composite materials for increased service temperature usable in exhaust systems	509
Patrick Weichand, Rainer Gadow, IFKB, IMTCCC, University of Stuttgart	

SECTION 3

VEHICLE DESIGN

Chairperson: Prof. Dr. Lutz Eckstein

Aerodynamics development of road and racing cars – similarities and differences	521
Jörg Müller, Jan Monchaux, AUDI AG	
The role of aerodynamics at Mercedes Benz	533
Teddy Woll, Daimler AG	
Potentials of virtual chassis development	535
Andreas Wagner, AUDI AG	

EMISSIONS I

Chairperson: Prof. Dr. Georg Wachtmeister

Advanced systems and trends for powertrain emission measurement	549
Kozo Ishida, Masayuki Adachi, Hiroshi Nakamura, HORIBA, Ltd.	
Reduction of engine-out emission and fuel consumption by variable EGR distribution in diesel and multi fuel engines	565
Yunyu Hu, Thomas Körfer, Thorsten Schnorbus, FEV GmbH; Michele Miccio, FEV Italy S.r.l.; Joschka Schaub, RWTH Aachen	

Regeneration control of a LNT via a dynamic NO_x-Sensor	581
Bernhard Breitegger, Albert Beichtbuchner, AVL List GmbH; Christian Doppler, Virtual Vehicle Research Center GmbH; Muammer Kilinc, Continental Automotive GmbH; Klaus Hadl, TU Graz	
Impact of engine combustion on the reactivity of diesel soot from commercial vehicle engines	597
Sven Lindner, Alexander Massner, Uwe Gärtner, Daimler AG; Thomas Koch, Institute for Reciprocating Engines, Karlsruhe Institute of Technology (KIT)	
POWER SUPPLY NETWORK	
Chairperson: Prof. Dr. Klaus Dietmayer	
Online thermal monitoring for power semiconductors in power electronics of electric and hybrid electric vehicles	611
Manuel Warwel, Gerd Wittler, University of Applied Sciences Esslingen; Michèle Hirsch, Robert Bosch GmbH; Hans-Christian Reuss, Institute for Internal Combustion Engines and Automotive Engineering, University of Stuttgart	
Control concept for the electrical integration of thermoelectric generators into a vehicle power supply	627
Jan Hendrik Carstens, Clemens Gühmann, TU Berlin	
Breakthrough of an electrically driven air-conditioning compressor due to 48V?	643
Jan Ackermann, T. Steinmetz, C. Brinkkötter, IAV GmbH; S. Hertel, Consulting4Drive; D. Kettner, A/C Innovations GmbH	
48V at Mercedes-Benz – options for further applications	645
Michael Timmann, Martin Renz, Daimler AG	