

25th Enhanced Safety of Vehicles Conference 2017

Innovations in Vehicle Safety:
Opportunities and Challenges

Detroit, Michigan, USA
5 - 8 June 2017

Volume 1 of 3

ISBN: 978-1-5108-5175-7

Printed from e-media with permission by:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571



Some format issues inherent in the e-media version may also appear in this print version.

Copyright© (2017) by National Highway Traffic Safety Administration (NHTSA)
All rights reserved.

Printed by Curran Associates, Inc. (2018)

For permission requests, please contact National Highway Traffic Safety Administration (NHTSA)
at the address below.

National Highway Traffic Safety Administration (NHTSA)
1200 New Jersey Avenue, SE
West Building
Washington, DC 20590
USA

Phone: 888-327-4236

www.nhtsa.gov

Additional copies of this publication are available from:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571 USA
Phone: 845-758-0400
Fax: 845-758-2633
Email: curran@proceedings.com
Web: www.proceedings.com

TABLE OF CONTENTS

VOLUME 1

ORAL PAPERS

ASSESSMENT OF NEW AND IMPROVED FIELD DATA COLLECTION, ANALYSIS AND BENEFITS ASSESSMENT METHODS

The Eclipse Working Group OpenPASS - an Open Source Approach to Safety Impact Assessment Via Simulation	1
<i>J. Dobberstein, J. Bakker, L. Wang, T. Vogt, M. Doring, L. Stark, J. Gainey, A. Prahl, R. Mueller, G. Blondelle</i>	
Prospective Effectiveness Assessment of Adas and Active Safety Systems Via Virtual Simulation: A Review of the Current Practices	9
<i>S. Alvarez, Y. Page, U. Sander, F. Fahrenkrog, T. Helmer, O. Jung, T. Hermitte, M. Duering, S. Doering, O. Camp</i>	
A Comprehensive Evaluation Approach for Highly Automated Driving	23
<i>C. Roesener, A. Zlocki, F. Fahrenkrog, L. Wang, A. Varhelyi, E. Gelder, J. Dufils, S. Breunig, P. Mejuto, F. Tango, J. Lanati</i>	
IGIAD - International Harmonized In-Depth Accident Data	36
<i>J. Bakker, H. Jeppsson, L. Hannawald, F. Spitzhutti, A. Longton, E. Tomasch</i>	
Assessing the Potential Benefits of Autonomous Emergency Braking System Based on Indian Highway Road Accidents	48
<i>A. Penumaka, P. Ghosh, V. Kalakala, J. Bakker, H. Buerkle</i>	
Consideration of Accident Avoidance Technology Within GIDAS	59
<i>H. Johannsen, C. Krettek, L. Hannawald, K.-D. Schaser</i>	
Improved Field Measurements in NHTSA's CISS Program	67
<i>M. Mynatt, J. Brophy</i>	
Estimated Triage Improvement and Societal Cost Savings with Nationwide Implementation of an Advanced Automatic Crash Notification Algorithm in the U.S	77
<i>J. Stitzel, A. Weaver, J. Talton, R. Barnard, S. Schoell, R. Martin, J. Meredith</i>	
Evaluation of Vehicle-Based Crash Severity Metrics Using Event Data Recorders	83
<i>G. Wusk, H. Gabler</i>	
Accuracy of WinSMASH in Rear Crashes Using Event Data Recorders	92
<i>H. Gabler, D. Sharma</i>	
Animal Street Crossing Behavior - An In-Depth Field Study for the Identification of Animal Street Crossing Behavior Using the AIMATS - Methodology	98
<i>C. Erbsmehl, T. Landgraf, H. Yuasa</i>	
Comparison of Computer Humanoid Simulation and Practical Forensic Pedestrian Dummy Testing	110
<i>A. Thomas</i>	
Naturalistic Observations to Investigate Conflicts Between Drivers and VRUs in the PROSPECT Project	124
<i>M.-P. Bruyas, A. Aparicio, M. Kozel, S. Ambellouis, C. Estraillier, F. Moreau, L. Sanz, J. Costa, T. Soltesz, M. Banfi</i>	

BIOMECHANICS #1: ADVANCES IN EXPERIMENTAL AND MATHEMATICAL BIOMECHANICS AND INJURY RESEARCH

Lower Extremity Fracture in Patients with Obesity in Real-World Crash Data	135
<i>S. Ejima, C. Kohayada-Inglis, S. Holcombe, B. Derstrin, P. Zhang, R. Goulson, J. MacWilliams, S. Wangs</i>	
A Numerical Approach to Identify Injury Risk Regions Within Soft Tissues of Dynamic Human Body Finite Element Models	143
<i>J. Gaewsky, D. Jones, A. Weaver, J. Stitzel</i>	
Effects of Male Stature and Body Shape on Thoracic Impact Response Using Parametric Finite Element Human Modeling	149
<i>J. Hu, K. Zhang, A. Fanta, E. Hwang, M. Reed</i>	
Investigation of Pelvis Kinematics for Various lap Belt Positions and an Inflatable Pelvis Restraint Cushion Using a Human Body Model of a Female Occupant	160
<i>K. Mroz, B. Pipkorn, H. Kim, J. Crandall</i>	
Evaluation of the Effects of Skull Deflection on Brain Tissue Response Using Finite Element Simulation	176
<i>D. Jones, J. Urban, A. Weaver, J. Stitzel</i>	
A Study of Injury Criteria for Brain Injuries in Traffic Accidents	182
<i>Y. Takahashi, T. Yanaoka</i>	
Axial Dependence of Rotationally-Induced Brain Injuries in Frontal and Oblique Crashes	189
<i>M. Katagiri, J. Zhao</i>	
A Study of Muscle Control with Two Feedback Controls for Posture and Reaction Force for More Accurate Prediction of Occupant Kinematics in low-Speed Frontal Impacts	198
<i>D. Kato, Y. Nakahira, M. Iwamoto</i>	

BIOMECHANICS #2: ADVANCES IN CRASH TEST DUMMIES, INSTRUMENTATION AND DATA ANALYSIS

Thor 5Th Percentile Female Atd Design	209
<i>Z. Wang, J. McInnis, L. Benfant, Z. Feng, E. Lee</i>	
Development of the THOR-05F Crash Test Dummy FE Model and Synergy with Hardware Design Support	237
<i>C. Shah, Z. Feng, G. Hu, R. Jagadish, J. Wang, M. Jagadish, P. Renuka, S. Chintan, M. Pradeep</i>	
Investigation of THOR-M Thorax Behaviour	247
<i>R. Brown, G. Stokes, Z. Zhou</i>	
Comparison of Thor IX Xversion and Dorsiflexion Response in Component Tests, Sled Tests and Full Vehicle Crash Tests	256
<i>B. Gepner, V. Bollapragada, S. Acosta, G. Park, J. Forman</i>	
Response Corridors to Evaluate the Biofidelity of the lower limbs of Pedestrian Dummies	273
<i>H. Asanuma, T. Yanaoka, Y. Takahashi</i>	
Comparison of Objective Rating Techniques Vs. Expert Opinion in the Validation of Human Body Surrogates	281
<i>M. Davis, B. Koya, J. Schap, F.-C. Hsu, F. Gayzik</i>	
Biofidelity Evaluation of the WorldSID 5th Percentile Female Side Impact ATD Fitted with a Modification Kit	291
<i>G. Crawford, E. Drzyzga, J. Athey, J. Jensen, A. Irwin, S. Tylko</i>	
Characterization of WorldSID Rib Directional Dynamic Response	305
<i>J. Hallman, J. Buck, E. Kimber, S. Ham</i>	
Comparison Between Old and New WorldSID 50th Percentile Male Shoulder Clevis Designs	314
<i>M. Martinez, A. Vernet, N. Sallent, O. Martinez</i>	
A New Generic Frontal Occupant Sled Test Set-Up Developed Within the EU-Project Seniors	323
<i>A. Eggers, B. Pipkorn, D. Brase, K. Mroz, F. Valdes, D. Hynd, S. Peldschus</i>	

CLEARING THE REGULATORY & ENFORCEMENT HURDLES OF NEW TECHNOLOGY

Defining & Regulating Automated Driving	334
<i>M. Avery, I. Knight</i>	
Database Approach for the Sign-Off Process of Highly Automated Vehicles	345
<i>A. Putz, A. Zlocki, J. Kufen, J. Bock, L. Eckstein</i>	
Crash lab Adaptation for Era Glonass Validation and Homologation Tests	353
<i>S. Vovk, S. Martin, M. Gallego</i>	

CONSUMER INFORMATION APPROACHES TO IMPROVE GLOBAL SAFETY

Consider of Occupant Injury Mitigation Through Comparison Between Crash Test Results in KNCAP and Real-World Crash Data	356
<i>S. Kim, Y. Park, W. Park, J. Lee, B. Kang, M. Suh</i>	
The Proposed New KNCAP Frontal Crash Test Based on the In-Depth Accident Data	362
<i>Y. Youn, J. Lee, B. Kang, G. Kim, H. Kwon</i>	
Euro NCAP Frontal Impact Working Group Report	368
<i>V. Sandner, J. Ellway, M. Ratingen</i>	
Communicating the Value and Maintaining Relevance of a Five-Star Safety Rating to Consumers and Industry	378
<i>J. Goodwin, R. Robson</i>	
Web Traffic on Iihs.org Vehicle Rating Pages	383
<i>M. Brumelow</i>	
Installation Patterns for Emerging Safety Technologies 2000 - 2015	392
<i>K. Balavich, S. Gregory, T. Brown, R. Lange, H. Pearce</i>	
Taking Corporate Social Responsibility - SAFE ROADS in India and China	404
<i>J. Feese, R. Schoneburg</i>	
BMW's Approach to Maximize the Correct Usage of Child Restraints and Number of Properly Restrained Children	409
<i>J. Olivier, P. Wernicke</i>	
2010 Mazda Adaptive Front lighting System Time of Day Analysis	417
<i>N. Basch, M. Moore, D. Zuby, L. Hellinga</i>	

CRASH AVOIDANCE #1: ADVANCED DRIVER ASSISTANCE SYSTEMS: PRODUCT EVOLUTION; EVALUATION; AND REAL WORLD DEPLOYMENT CHALLENGES

A Method for the Simulation-Based Parameter Optimization of Autonomous Emergency Braking Systems	425
<i>T. Hierlinger, T. Dirndorfer, T. Neuhauser</i>	
AEB Performance in the UK; A Decade of Development	434
<i>Z. Sari, D. Brookes, M. Avery</i>	
Performance Comparison Between a Camera Only AEB-FCW and a Camera-Radar Fusion AEB-FCW	445
<i>M.-E. Caspar, M. Dabek, R. Zeitouni</i>	

Study of the Application of Steering Support Systems to Complement Autonomous Emergency Braking Systems for Active Collision Avoidance Strategies	453
<i>A. Esquer, A. Aparicio, S. Baures, L. Sanz</i>	
Emergency lane Keeping (ELK) System Test Development	461
<i>C. Grover, M. Avery</i>	
Research on Road Edges for ISS (lateral Support System) Development in US and Europe	468
<i>R. Fujishiro, R. Sherony, Y. Chen, A. Esquer, A. Aparicio</i>	
Vehicle-In-The-loop: Augmenting Real-World Driving Tests with Virtual Scenarios in Order to Enhance Validation of Active Safety Systems	477
<i>R. Kallweit, P. Prescher, M. Butenuth</i>	
Evaluation of 3D Surrogate Vehicles for Automotive Safety Tests	484
<i>W. Buller, N. Lundin, K. Karlsson, D. Aloï</i>	
Initial Views on Teen Drivers' Perceived Value of Advanced Driver Assistance Systems	492
<i>E. Weiss, M. Fisher-Thiel, N. Sultana, C. Hannan, T. Seacrist</i>	
Does All-Wheel-Drive (Awd) on Passenger Cars Have Any Safety Benefits on Roads Covered with Ice or Snow? Analysis of Real-World Crashes Involving Awd Cars with Esc (Electronic Stability Control)	497
<i>M. Rizzi, A. Kullgren, J. Strandroth, A. Ydenius</i>	
Real-World Benefit of Adaptive Headlights (ADHL) on Passenger Cars in Sweden	511
<i>J. Strandroth, A. Lie, M. Rizzi</i>	
Estimation of the Effect of Autonomous Emergency Braking Systems for Pedestrians on Reduction in the Number of Pedestrian Victims	516
<i>T. Yanaoka, Y. Takahashi</i>	
Advancing Active Safety Towards the Protection of Vulnerable Road Users: The Project PROSPECT	524
<i>A. Aparicio, L. Sanz, G. Burnett, H. Stoll, M. Arbitmann, M. Kunert, F. Flohr, P. Seiniger, D. Gavrilã</i>	
Collision Avoidance System for Buses, Managing Pedestrian Detection and Alerts Near Bus Stops	532
<i>B. Englander, M. Cacic, C. Diop, Y. Elimelech</i>	
Bicycle Speed Analysis for Assessment of Bicyclist Pre-Collision System	542
<i>L. Fu, R. Tian, L. Li, Y. Chen, R. Sherony</i>	
Advanced Driver Assistance Systems for Motorcycles: Concept of a Lane Change Assist	549
<i>M. Kirjanov, P. Grzyb, J. Hoffmann, A. Osman</i>	
Evaluation of Two Stage Crash Warning System on Inner City Buses	557
<i>E. Nadler, J. Young, D. Fisher</i>	
Heavy Vehicle Hardware-In-The-loop Crash Avoidance Safety System Simulation with Experimental Validation	570
<i>M. Salaani, D. Elsasser</i>	
Using Naturalistic Data to Evaluate Heavy Vehicle Crash Avoidance System Performance	578
<i>A. Svenson, K. Grove, J. Atwood, M. Blanco</i>	

CRASH AVOIDANCE #2: DRIVER MONITORING SYSTEMS AND DRIVER-VEHICLE INTERFACE DESIGN FOR ADVANCED DRIVER ASSISTANCE SYSTEMS

Driver Alcohol Detection System for Safety (DADSS) - A Status Update	591
<i>A. Zaouk, M. Wills, N. Dalal, E. Traube, R. Strassburger</i>	
Development of a Solid State, Non-Invasive, Human Touch Based Blood Alcohol Sensor	601
<i>B. Steeg, D. Treese, R. Adelante, A. Krintz, B. Laaksonen, T. Ridder, M. Legge, N. Koslowski, S. Zeller, L. Hildebrandt, Johannes Koeth, L. Cech, D. Rumps, M. Nagolu, D. Cox</i>	
Driver Alcohol Detection System for Safety (DADSS) - Preliminary Human Testing Results	608
<i>S. Lukas, A. Zaouk, E. Ryan, J. McNeil, J. Shepherd, M. Willis, N. Dalal, K. Schwartz</i>	
Feasibility Study on Detecting Drunk Driving by Driving Maneuver and Vehicle Behavior: Discriminating Between Drunk Driving and Drowsy Driving Using Data from Vehicle-Based Sensors	619
<i>T. Tagawa, A. Kuriyama, B. Atsumi</i>	
A Lightweight, Cost Efficient, Solid State LiDAR System Utilizing liquid Crystal Technology for laser Beam Steering for Advanced Driver Assistance	626
<i>B. Luey, S. Davis, S. Rommel, D. Gann, J. Gamble, M. Ziemkiewicz, M. Anderson, R. Paine</i>	
Predicting Driver Lane Change Maneuver Using Vehicle Kinematic Data	635
<i>R. Chen, H. Gabler, R. Sherony</i>	
Blind Spot Warning Interface Adapted to Older Drivers with Early Stage Visual Impairment	644
<i>J. Adrian, J. Pieyre, J. Lebrun, S. Mohand-Said, E. Gutman</i>	

VOLUME 2

Driver Understanding of Adas and Evolving Consumer Education	653
<i>A. McDonald, M. Reyes, C. Roe, D. McGehee</i>	

CRASH AVOIDANCE #3: ENHANCING SAFETY WITH CONNECTED AND AUTOMATED VEHICLES

Comprehensive Definitions for Automated Driving and ADAS	663
<i>T. Gasser, A. Frey, A. Seeck, R. Auerswald</i>	

Preliminary Estimates of Target Crash Populations for Concept Automated Vehicle Functions	669
<i>M. Yanagisawa, W. Najm, P. Rau</i>	
Takeover Times in Highly Automated Driving (level 3)	681
<i>M. Kuehn, T. Vogelpohl, M. Vollrath</i>	
The Influence of Driver Fatigue on Take-Over Performance in Highly Automated Vehicles	692
<i>C. Kreuzmair, C. Gold, M.-L. Meyer</i>	
Transfer from Highly Automated to Manual Control: Performance and Trust	699
<i>C. Schwarz, T. Brown, J. Gaspar, C. Keurn</i>	
A Novel Method to Evaluate the Safety of Highly Automated Vehicles	710
<i>J. Every, F. Barickman, J. Martin, S. Rao, S. Schnelle, B. Weng</i>	
Prospective Safety Assessment of Highly Automated Driving Functions Using Stochastic Traffic Simulation	722
<i>L. Wang, F. Fahrenkrog, T. Vogt, O. Jung</i>	
Method to Evaluate level 2 Mixed-Function Automation in Naturalistic Settings	735
<i>M. Blanco, S. Russell, V. Fitchett, J. Atwood, T. Trimble, P. Rau</i>	
Driving Tests for the Approval of Automatically Commanded Steering Functions	744
<i>O. Bartels, A. Hellmann, P. Seiniger</i>	
Simulation Investigations of lane Change Process with Automatic Steering System	756
<i>M. Gidlewski, D. Zardecki</i>	
The Potential of Applying Machine learning for Predicting Cut-In Behaviour of Surrounding Traffic for Truck-Platooning Safety	763
<i>I. Cara, J.-P. Paardekooper</i>	
3D Car Target for Future Vehicle Testing	771
<i>C. Grover, M. Avery, J. Silberling</i>	
Data Requirements for Post-Crash Analyses of Collisions Involving Collision Avoidance Technology Equipped, Autonomous, and Connected Vehicles	779
<i>R. Lange, S. Kelly, C. Senatore, J. Wilson, R. Yee, R. Harrington</i>	

ELECTRONIC SYSTEMS SAFETY – CYBERSECURITY AND RELIABILITY

NHTSA Cybersecurity Research	793
<i>J. Martin, A. Carter</i>	
A Study on Thermal Energy at Fire Resistance Test for Reess	800
<i>H. Jung, B. Moon, S. Lee, J. Bae</i>	

INTEGRATED SAFETY FROM PRE-CRASH TO CRASH TO POST-CRASH

Pre-Crash Triggered Pretensioning of the Seat Belt for Improved Safety	809
<i>B. Pipkorn, J. Wass</i>	
Study of the Effect of Pre-Crash Seatbelts in Side Impact and the Necessary Work load of Pre-Crash Seatbelts	818
<i>Y. Maebo, R. Maekawa, S. Kotama, M. Esaki</i>	
A Simulation Study on the Effect of AEB on Injuries on 50% Occupants	825
<i>F. Bosma, P. Hooijdonk, M. Tyssens, K. Kietlinski, M. Unger</i>	
Virtual Development Process for Integrated Safety System	834
<i>J. Lee, H. Chu, K. Hurh</i>	
The Cooperative Control of AEB and Passive Safety Systems for Minimizing Occupants' Injury in High Velocity Region	840
<i>E. Kim, D. Sung, Y. Kwon, B. Seo, D. Lim, H. Cho, M. Unger</i>	
Next-Generation Active Safety and Testing: The Horizon 2020 Project PROSPECT	848
<i>P. Seiniger, A. Hellmann, O. Bartels, I. Gohl</i>	
Effectiveness Potential of PRE-SAFE® Impulse Using the Scenario of a Major Accident at an Intersection as an Example	860
<i>R. Schoneburg, M. Fehring, J. Richert, M. Glashagel, J. Ruf, M. Walz, R. Bogenrieder</i>	
Safety Benefit Evaluation of Secondary Collision Mitigation Braking	869
<i>S. Vitet, H. Schebdat</i>	
Obstacle Detection Task in Real-World Traffic Contexts for the Purposes of Motorcycle Autonomous Emergency Braking (MAEB)	878
<i>G. Savino, S. Piantini, G. Gil, M. Pierini</i>	
Second Generation Aacn Injury Severity Prediction Algorithm: Development and Real-World Validation	891
<i>S. Wang, C. Kohoyda-Inglis, S. Ejima, J. MacWilliams, P. Zhang, L. Stacey, A. Melocchi, D. Gorman, J. Kral, J. Joyner</i>	
Predicting Severe Injury in Motor Vehicle Crashes	898
<i>J. Enriquez, E. Lee</i>	
Development and Evaluation of an Advanced Automatic Crash Notification Algorithm for Pediatric Occupants	908
<i>A. Weaver, S. Schoell, R. Barnard, J. Talton, A. Doud, J. Stitzel</i>	
Requirements for a New Vehicle Test Center for Physical Testing of Integrated Safety Systems	914
<i>R. Schoneburg, N. Schaub, H. Ruoff, M. Struck</i>	

PROTECTION OF VULNERABLE ROAD USER

Rear Seat Safety for Children Aged 4-12; Identifying the Real-World Needs Towards Development of Countermeasures	921
<i>L. Jakobsson, K. Bohman, I. Stockman, M. Svensson, M. Wimmerstedt, K. Arbogast</i>	
Injury Risks of Children Travelling in Cars	936
<i>H. Johannsen</i>	
Safety Enhanced Innovations for Older Road Users (Seniors): Further Development of Test and Assessment Procedures Towards an Improved Passive Protection of Pedestrians and Cyclists	944
<i>O. Zander, J. Ott, M. Wisch, A. Fornells, T. Fuchs, D. Hynd, P. Lemmen, M. Burleigh, F. Lopez-Valdes, A. Luera, C. Lundgren</i>	
Road Traffic Crashes in Europe Involving Older Car Occupants, Older Pedestrians or Cyclists in Crashes with Passenger Cars - Results from Seniors	960
<i>M. Wisch, M. Lerner, E. Vukovic, R. Schafer, D. Hynd, A. Fiorentino, A. Fornells</i>	
The Potential of Vehicle and Road Infrastructure Interventions in Fatal Pedestrian and Bicyclist Accidents on Swedish Rural Roads - What Can In-Depth Studies Tell Us?	975
<i>A. Kullgren, M. Rizzi, H. Stigson, A. Ydenius, J. Strandroth</i>	
Car-To-Cyclist Crashes in Europe and Derivation of Use Cases as Basis for Test Scenarios of Next Generation Advanced Driver Assistance Systems - Results from PROSPECT	986
<i>M. Wisch, M. Lerner, J. Kovaceva, A. Balint, I. Gohl, A. Schneider, J. Juhasz, M. Lindman</i>	
An Overview of Car-To-Two-Wheeler Accidents in China: Guidance for AEB Assessment	1001
<i>B. Sui, S. Zhou, X. Zhao, N. Lubbe</i>	
Micro-Doppler Based Classifying Features for Automotive Radar VRU Target Classification	1013
<i>H. Yan, W. Doerr, A. Ioffe, H. Clasen</i>	
Potential Reduction in Pedestrian Collisions with an Autonomous Vehicle	1021
<i>M. Detwiller, H. Gabler</i>	
Electric Vehicle Detectability by the Vision Impaired: Quantifying the Impact of Vehicle-Generated Acoustic Signatures on Minimum Detection Distances	1029
<i>M. Neurauter, M. Roan, M. Song, L. Harwood, D. Moore, D. Glaser</i>	
Backover Collisions and the Effectiveness of Reversing Cameras	1043
<i>B. Fildes, M. Keall, S. Newstead</i>	
Research of Aluminum Hood Construction for Pedestrian Protection by Optimization CAE	1052
<i>O. Ito, K. Sasaki</i>	
Effectiveness of Pedestrian Safety Measures at the Vehicle Front with Regard to Cyclists	1064
<i>M. Hamacher, M. Kuhn, T. Hummel, L. Eckstein</i>	
Development of Child Finite Element (FE) Models and Vehicle-To-Pedestrian Collision Simulations	1075
<i>K. Ito, M. Tokuyama, H. Miyazaki, S. Hayashi, Y. Kitagawa, T. Yasuki</i>	
Development of a Representative Seat Assembly for FMVSS No. 213	1092
<i>K. Wietholter, C. Echemendia, A. Loudon</i>	
The Effect of ISOFIX on Booster Seat Performance in UN Regulation No. 129 Front Impact Tests	1104
<i>C. Visvikis, C. Thurn, C. Krebs</i>	
Revision of Passive Pedestrian Test and Assessment Procedures to Implement Head Protection of Cyclists	1114
<i>O. Zander, M. Hamacher</i>	

RESTRAINT SYSTEM DESIGN AND PERFORMANCE CHALLENGES: ADDRESSING THE NEEDS OF DIVERSE POPULATIONS (AGE, GENDER, STATURE)

A Usability Study of Seatbelts in Conjunction with Booster Seats	1128
<i>N. Bandaru, C. Sarros</i>	
Development of a Child Restraint System Seat to Meet Euro NCAP 2016 Crash Performance Requirements	1163
<i>F. Bendjellal, R. Frank, M. Haas</i>	
Performance of Restraint Systems in Accidents - Does Every Occupant Benefit Equally?	1168
<i>H. Liers, R. Robler, J. Ziegler</i>	
A Study of Airbag Design & Optimization Methodology	1180
<i>W. Park</i>	
Assessing the Performance of Steering Wheel Air Bags for Drivers Seated in Wheelchairs During Frontal Crash Tests	1193
<i>C. Wiacek, A. Prasad, D. Weston, N. Orton, L. Schneider</i>	
Proximity to the Steering Wheel for Obese Drivers	1208
<i>M. Jones, S. Ebert, J. Hu, B.-K. Park, M. Reed</i>	
Development of Proposed Dynamic Crash Tests and Performance Criteria for the Australian Concession Go-Karts Standard	1216
<i>R. Grzebieta, G. Rechnitzer, K. Simmons, D. Hicks, R. Nevo, D. Sherry</i>	
The Need to Better Control Belt Routing for Silver NCAP Ratings	1233
<i>K. Digges, D. Dalmotas, P. Prasad, B. Mueller</i>	
The Introduction of a New Elderly Anthropomorphic Test Device (EATD)	1243
<i>M. Beebe, I. Ubom, T. Vara, M. Burleigh, J. McCarthy</i>	

SAFETY PERFORMANCE IN FRONTAL CRASHES

Validation of Material Models: Design and Analysis of Composite Front Bumper Crush-Can System	1257
<i>P. Pasupuleti, M. Douroudian, R. Dwarampudi, A. Tramecon, S. Muller, A. Coppola, L. Berger, D. Board, O. Faruque J. Truskin, M. Mehta</i>	
Adult and Child Dummies Tests for Safety Assessment of Seated Occupants in Urban Bus Collisions	1280
<i>L. Martinez, M. Espantaleon, M. Loma-Ossorio, E. Alcalá, C. Torres</i>	
Are Small Females More Vulnerable to lower Neck Injuries When Seated Sufficiently Away from the Steering Wheel in a Frontal Crash?	1291
<i>C. Thorbole</i>	
Investigation of Front Seat Occupants' Acetabulum Injury in Front Impact	1301
<i>S. Hayashi, R. Ootani, T. Matsunaga, T. Watanabe, C. Pal, S. Hirayama</i>	

VOLUME 3

The Expected Impact of UN Regulation No. 137 Tests on European Cars and Suggested Test Protocol Modifications to Maximise Benefits	1318
<i>M. Seidl, M. Edwards, A. Barrow, D. Hynd, P. Broertjes</i>	
Analysis of the Proposed Frontal Oblique Crash Test	1332
<i>S. Barbat, X. Li</i>	
Evaluation of Moving Progressive Deformable Barrier Test Method by Comparing Car to Car Crash Test	1348
<i>S. Shibata, A. Nakata, T. Hashimoto</i>	
Comparison of Ankle Injury Mechanism in Full Frontal and Oblique Frontal Crash Modes with THOR Dummy and Human FE Models	1359
<i>K. Nambu, H. Sugaya, H. Mai</i>	
"Front Center Pole" and "Rear car to Car" Crash Test in Development of Clarity Fuel Cell Vehicle	1365
<i>S. Matsunaga, R. Murai, T. Kamiyama</i>	
Fatal Car to Moose Collisions: Real-World In-Depth Data, Crash Tests and Potential of Different Countermeasures	1373
<i>A. Ydenius, A. Kullgren, M. Rizzi, E. Engstrom, H. Stigson, J. Strandroth</i>	
Development of a Driver-Side Airbag Considering Autonomous Emergency Braking	1383
<i>G. Jeong, H. Park, K. Lee, S. Ko, H. Choo, H. Lee</i>	
A Draft Program for the Through-life Assurance of Technical Integrity of Impact Bag Inflators	1391
<i>G. Wilcock, P. Knights</i>	
Improvement of Gas Flow in Airbag Simulation for OOP Test	1397
<i>M. Aoki, I. Hitoshi, M. Asaoka, K. Ohtani</i>	

SAFETY PERFORMANCE IN SIDE IMPACT AND ROLLOVER CRASHES

Status of NHTSA's Ejection Mitigation Research	1402
<i>A. Prasad, A. Loudon, S. Duffy</i>	
Investigating Potential Changes to the IIHS Side Impact Crashworthiness Evaluation Program	1409
<i>M. Brumbelow, B. Mueller, R. Arbelaez, M. Kuehn</i>	
Comparison of Thorax Responses Between WorldSID-5th and SID-IIs in lateral and Oblique Impacts	1419
<i>M. Ikeda, H. Mae</i>	
An Evaluation Method of Cervical Spinal Injury for Car Passenger in Dynamic Rollover Using a Human FE Model	1433
<i>Y. Dokko, S. Tobaru, K. Ohashi</i>	
Rollover Simulation Using an Active Human Model	1444
<i>A. Chhor, D. McGuckin, H. Choi, M. Han, I. Lee</i>	
Protection of Children in Child Restraint Systems in Oblique Impacts: Relative Motion of the Child and Child Restraint	1455
<i>H. Hauschild, J. Humm, K. Arbogast, M. Maltese, F. Pintar, N. Yoganandan, B. Kaufman</i>	
light-Weight Metal-Plastic Body-In-White Solutions for Automotive	1464
<i>D. Munjurulimana, A. Tiwari, T. Koning, J. Thambi, M. Delaney, D. Nagwanshi</i>	
Thermoplastic Carbon Fiber Reinforced Body-In-White Structures for Vehicle Crash Application	1481
<i>L. Keuthage, D. Heider, J. Gillespie, B. Haque, J. Tierney, S. Yarlagadda, A. Campbell, D. Rinehardt</i>	
Passive Safety Strategy for Electric lightweight Vehicles with Multi-Material Body and Centered Driver Position - Opportunities and limitations	1491
<i>R. Fresnillo, E. Almarza, L. Zink, M. Edwards, J. Holtz, M. Pedersen, R. Heras</i>	
A Development of Panorama Sun Roof Airbag	1506
<i>B. Min, G. Jeong, J. Song, H. Park, K. Lee, J. Lee</i>	
Side Crash Detection Using Vehicle Behavior Change	1513
<i>K. Okamura, K. Daido</i>	

WRITTEN PAPERS

GOVERNMENT STATUS REPORT

Government Status Report Sweden	1522
<i>A. Lie, J. Strandroth, M. Krafft</i>	
Government Status Report United States	1531
<i>N. Beuse</i>	
Government Status Report the Netherlands	1532
<i>N/A</i>	
Government Status Report Japan	1533
<i>H. Kubota</i>	
Road Safety in the European Union	1538
<i>N/A</i>	
Government Status Report Republic of Korea	1563
<i>C. Kim</i>	
Government Status Report Germany	1571
<i>C. Theis</i>	

ASSESSMENT OF NEW AND IMPROVED FIELD DATA COLLECTION, ANALYSIS AND BENEFITS ASSESSMENT METHODS

European TeleFOT Project: Benefit-Cost Analysis: Sat Nav and Eco Drive Technologies	1587
<i>B. Fildes, A. Morris, R. Montanari</i>	
Estimation of the Head Injury Severity Using the Head Impact Speed Based on Real Pedestrian Collisions	1590
<i>S. Sanchez, F. Paez, A. Furones, F. Martinez</i>	
Evaluation of Future Advanced Driver Assistance Systems Using Property Damage Insurance Claims	1597
<i>J. Schatz, P. Feig, M. Lienkamp, J. Gwehenberger, M. Borrack, R. Behling</i>	
Monetary and Prospective Benefit Assessment Method for Advanced Driver Assistance Systems	1610
<i>P. Feig, J. Schatz, M. Lienkamp, K. Gschwendtner, M. Borrack</i>	
Emerging Data Collection Partnerships: FHWA and NHTSA Develop the Framework for the Next Generation In-Service Performance Evaluation of Guardrail End Terminals	1620
<i>M. Evans, A. Eigen</i>	
Documenting Injuries in NHTSA's CISS Program	1629
<i>M. Mynatt, R. Rudd, N. Alpert, K. Loftis, A. Kulaga</i>	
Comparison of Injury Severity Between Near Side and Far Side Occupants on the Side Collisions	1639
<i>Y. Youn, J. Park, D. Kim, S. Kim, J. In</i>	
Real-World Analysis of Fatal Run-Of-lane Crashes Using the National Motor Vehicle Crash Causation Survey to Assess lane Keeping Technologies	1645
<i>C. Wiacek, J. Fikentscher, G. Forkenbrock, M. Mynatt, P. Smith</i>	

BIOMECHANICS #1: ADVANCES IN EXPERIMENTAL AND MATHEMATICAL BIOMECHANICS AND INJURY RESEARCH

An Investigation of Brain Injury Risk in Vehicle Crashes (Second Report)	1660
<i>T. Kikuchi, K. Tatsu, C. Pal, S. Hirayama</i>	
Probability Model Relating Contact Velocity and Pediatric Head Injury Severity	1665
<i>N. Rangarajan, T. Shams, T. Fukuda</i>	
Reconstruction of a Side Impact Accident with Far Side Occupant Using HBM - Discussion of Potential Application of Virtual HBM Within a Far Side Occupant Protection Assessment	1673
<i>C. Mayer, J. Dobberstein, U. Nagel, R. Chitteti, G. Pronoy, S. Pandharkar</i>	

BIOMECHANICS #2: ADVANCES IN CRASH TEST DUMMIES, INSTRUMENTATION AND DATA ANALYSIS

Comparison of the Harmonized Hybrid III 5th Female Dummy Chest Response to the FTSS and Denton Dummies	1685
<i>J. Dix, A. Bukhtia, A. Cardinali</i>	
NHTSA Oblique Test Data Analysis Method by IS-DYNA Modeling	1695
<i>E. Lee, A. Shrivatri, S. Ohara</i>	
Repeatability and Reproducibility of Upper Thorax Responses of THOR-50M Dummies	1705
<i>K. Hikida, K. Maehara, H. Mikami, H. Mae</i>	

CRASH AVOIDANCE #1: ADVANCED DRIVER ASSISTANCE SYSTEMS: PRODUCT EVOLUTION; EVALUATION; AND REAL WORLD DEPLOYMENT CHALLENGES

Establishment and Analysis on Typical Road Traffic Near-Crash Scenarios Related to Pedestrian in China	1714
<i>J. Su, J. Chen, H. Wang, W. Chen, K. Wang</i>	
Potential Effects of Automatic Braking on Accident Fatalities and Serious Injuries	1722
<i>K. Friedman, G. Mattos, J. Paver</i>	
Potential Application of the NHTSA-Honda-DRI ACAT "Safety Impact Methodology" (SIM) to the Evaluation of Automatic Emergency Braking System Effectiveness In Avoiding And Mitigating Collisions With Motorcycles	1728
<i>R. Auken, J. Lenkeit, T. Smith</i>	
Hands Off Detection Requirements for UN R79 Regulated lane Keeping Assist Systems	1735
<i>T. Mousel, A. Treis</i>	
Active Safety-Collision Warning Pilot in Washington State	1739
<i>R. Huyck, J. Spears, Y. Wang, R. Ke, B. Englander, J. Lutin</i>	
NTSB Investigative Process for Crashes Involving Highly Automated Systems	1748
<i>K. Poland, D. Bruce</i>	
Road Vehicles Passive Safety Rating Method	1758
<i>S. Ranfagni, D. Vangi, A. Fiorentino</i>	
Selection of NHTSA's Sound Analysis Code	1767
<i>W. Garrott, R. Hoover</i>	

CRASH AVOIDANCE #2: DRIVER MONITORING SYSTEMS AND DRIVER-VEHICLE INTERFACE DESIGN FOR ADVANCED DRIVER ASSISTANCE SYSTEMS

Driver Alcohol Detection System for Safety (DADSS) - Development of the Subsystems Performance Specifications	1777
<i>W. Biondo, A. Zaouk, S. Sundararajan</i>	

CRASH AVOIDANCE #3: ENHANCING SAFETY WITH CONNECTED AND AUTOMATED VEHICLES

A Hierarchical Clustering Analysis (HCA) in Automatic Driving Regarding to Vehicle-to-Vehicle Pedestrian Position Identification	1785
<i>J. Xue, Z. Huang, J. Zhou, Y. Chen, S. Chien</i>	
Development of Requirements and Tests for Automatically Commanded Steering Functions	1795
<i>J. Gail, O. Bartels, A. Hellmann, P. Seiniger</i>	
Single Unit Truck and Bus Considerations for V2V Implementation	1806
<i>A. Svenson, L. Stowe, A. Krum</i>	
Functional Safety Considerations for Foundational Steering Systems	1821
<i>C. Becker, J. Brewer, W. Najm, L. Yount, P. Rau</i>	
Reducing Delay in V2V-AEB System by Optimizing Message in the System	1832
<i>S. Bhatanagar, S. Chien, Y. Chen</i>	

INTEGRATED SAFETY FROM PRE-CRASH TO CRASH TO POST-CRASH

Sensitivity Analysis of Injury Pattern in C2C Collisions at Intersection	1841
<i>C. Pal, S. Hirayama, S. Narahari, M. Jeyabharath, G. Prakash, V. Kulothungan</i>	
Clarification of Priority Factors for the Reducing Traffic Accident Fatalities in U.S. and Benefit Estimation AEB System for Oncoming Vehicles	1852
<i>T. Hasegawa, H. Takahashi, S. Udaka</i>	
Crash Involved Occupant Count Prediction	1865
<i>S. Vitet</i>	

PROTECTION OF VULNERABLE ROAD USERS

Probability of Pediatric Skull Fracture at Various Contact Velocities	1869
<i>N. Rangarajan, T. Shams, J. Carole, T. Fukuda</i>	
Unattended Children in Cars - Radiofrequency-Based Detection to Reduce Heatstroke Fatalities	1880
<i>T. Mousel, P. Larsen, H. Lorenz</i>	
Development of Fit Envelopes to Promote Compatibility Among Vehicles and Child Restraints	1885
<i>K. Boyle, L. Malik, M. Manary, B. Eby, J. Hu, K. Klinich</i>	
Accident Risks of Cyclists Using the Bicycle Path Depending on the Side of the Road	1898
<i>H. Johannsen, M. Jansch</i>	
A Draft Regulation for Driver Assist Systems Addressing Truck-Cyclist Blind Spot Accidents	1911
<i>P. Seiniger, J. Gail, B. Schreck</i>	
Pedestrian Protection : FIEX-PII Versus TRI leg Impactor	1918
<i>C. Pinecki, R. Zeitouni, M. Caspar, J. Vincent, M. Dieudonne, C. Chapelet</i>	

Collisions Between Cars and Unprotected Road Users - Is There More to Address Than the Front of the Car? 1926
M. Kuehn, A. Lang, J. Bende, R. Strzeletz

SAFETY PERFORMANCE IN FRONTAL CRASHES

Study on Car-To-Car Frontal Offset Impact with Vehicle Compatibility 1936
C. Lee, J. Shin, H. Kim, K. Park, Y. Park

Inflator Performance Optimization with New PAB Concept for OMDB, IRD 1943
R. Jang, Y. Choi, D. Yang

Car to Car Front Crash Equivalent Protocol 1952
M. Peru, M. Caspar, R. Zeitouni, M. Dieudonne, P. Couvidat

SAFETY PERFORMANCE IN SIDE IMPACT AND ROLLOVER CRASHES

US Side NCAP Rating Trends Since 2011 1962
J. Buck, J. Hallman, S. Ham

Author Index