

International Research Council on the Biomechanics of Injury

2008 INTERNATIONAL IRCOBI CONFERENCE

ON

THE BIOMECHANICS OF INJURY

17. – 19. September 2008 – BERN (Switzerland)

PROCEEDINGS

**Papers of this book have been collected by Kai-Uwe Schmitt
in charge of the IRCOBI Secretariat.**

**Copies are available at the IRCOBI Secretariat c/o AGU Zurich
Winkelriedstrasse 27 – 8006 Zurich (Switzerland)**

Tel: +44 41 251 54 65 - Fax: +44 41 251 54 31 - E-mail: secretariat@ircobi.org

Copyright © 2008 IRCOBI

ISBN 978-3-033-01580-7

All rights reserved. Printed in Switzerland.

The IRCOBI Council,
the speakers, presenters and other participants,
gratefully acknowledge the following institutions
for their various contributions
in this year's IRCOBI annual conference:



FOUNDATION FOR ACCIDENT
AND LOSS PREVENTION



KEIPER

KISTLER
measure. analyze. innovate.



TOYOTA

TABLE OF CONTENTS

Bertil Aldman Memorial Lecture Dose-response models and EDR data for assessment of injury risk and effectiveness of safety systems	3
<i>A Kullgren Folksam Research and Department of Clinical Neuroscience, Section of Personal Injury Prevention, Karolinska Institutet Sweden</i>	
 SESSION I – INVESTIGATING FRONTAL IMPACTS AND ROLLOVERS	
AIS 3+ head injury mechanisms and crash characteristics - a review of airbag deployed frontal crashes	17
<i>R Welsh, S Reed, A Morris VSRC, Loughborough University</i>	
Biomechanical Investigation of Injury Mechanisms in Rollover Crashes from the CIREN Database	33
<i>S Ridella, A Eigen National Highway Traffic Safety Administration, US Department of Transportation</i>	
Roof Strength and Injury Risk in Rollover Crashes	49
<i>M Brumbelow, E Teoh, D Zuby, A McCartt Insurance Institute for Highway Safety</i>	
Invited Discussion	63
<i>J Padmanaban, JP Research Inc. E Moffatt, Biomech Inc.</i>	
 SESSION II – BIOMECHANICS OF THORAX AND HEAD INJURIES	
Viscoelastic Response of the Thorax under Dynamic Belt Loading	73
<i>R Salzar, C Bass, D Lessley, J Crandall, R Kent, J Bolton The University of Virginia, Center for Applied Biomechanics</i>	
Lung Response and Injury in Side Impact Conditions	87
<i>K Yuen, D Cronin, University of Waterloo Y Deng, General Motors</i>	
Mathematical Occupant Models in Side Impacts – A Validation Study with Particular Emphasis on the Torso and Shoulder and their Influence on Head and Neck Motion	99
<i>B Pipkorn, K Mroz, Autoliv Research P Halldin, D Lanner, S Kleiven, KTH L Jakobsson, M Backlund, Volvo Cars J Iraeus, Epsilon K Holmqvist, Chalmers University of Technology</i>	
Brain lesions in motor vehicle crashes: differences between side and frontal impacts	115
<i>C Compagnone, F Tagliaferri, N Yoganandan, T Gennarelli Medical College of Wisconsin and VA Medical Center, Milwaukee</i>	

Mathematical Modeling of Cerebral Concussion: Correlations of brain strain with clinical symptoms	123
<i>L Zhang, K Yang, Wayne State University, Detroit</i>	
<i>T Gennarelli, Medical College of Wisconsin, Milwaukee</i>	

SESSION III – CONSIDERING PRE-CRASH SITUATIONS

Influence of pre-impact occupant properties on the injury response during frontal collisions	135
<i>D Bose, J Crandall, C Untaroiu, E Maslen</i>	
<i>Department of Mechanical and Aerospace Engineering, University of Virginia</i>	

Pre-crash factors influencing drivers of older ages in intersection collisions	149
<i>T Broberg, Volvo Car Corporation/Chalmers University, Göteborg</i>	
<i>L Jakobsson, I Isaksson-Hellman, Volvo Car Corporation, Göteborg</i>	

Prediction of the Physical Motion on Human Body based on Muscle Activities during Pre-Impact Breaking	163
<i>S Ejima, Y Zama, F Satou, S Holcombe, K Ono, Japan Automobile Research Institute</i>	
<i>K Kaneoka, Waseda University Faculty of Sports Sciences</i>	
<i>I Shiina, Department of Orthopedic Surgery, University of Tsukuba</i>	

SESSION IV – INVESTIGATING FRONT AND SIDE IMPACTS

Head kinematics, neck loads, and injuries in side impact sled tests	179
<i>N Yoganandan, F Pintar, D Maiman, Department of Neurosurgery, Medical College of Wisconsin and VA Medical Center, Milwaukee</i>	
<i>M Phillippens, TNO Defence</i>	
<i>J Wismans, TNO Science and Industry</i>	

Evaluation of Dummy Shoulder Kinematics in Oblique Frontal Collisions	195
<i>F Törnvall, K Holmqvist, J Davidsson, M Svensson, Chalmers University of Technology</i>	
<i>J Gugler, H Steffan, TU-Graz,</i>	
<i>Y Håland, Autoliv Research</i>	

A parametric study of hard tissue injury prediction using finite elements: consideration of geometric complexity, failure theory, sub-failure material properties, thresholding, and element characteristics	211
<i>C Arregui-Dalmases, E Del Pozo, European Center for Injury Prevention, Universidad de Navarra</i>	
<i>S Duprey, F Lopez-Valdes, A Lau, D Subit, R Kent, Center for Applied Biomechanics, University of Virginia</i>	

SESSION V – ANALYSING PEDESTRIAN IMPACTS

A new detailed multi-body model of the pedestrian lower extremity: development and preliminary validation	227
<i>J Kerrigan, D Parent, C Untaroiu, J Crandall, University of Virginia, Center for Applied Biomechanics</i>	
<i>B Deng, Vehicle Development Research Lab, General Motors R&D Center</i>	

Influence of vehicle shape and stiffness on the pedestrian lower extremity injuries: Review of current pedestrian lower leg test procedure.	243
<i>L Martínez, L. Guerra, INSIA, Universidad Politécnica de Madrid</i>	
<i>S Compigne, TOYOTA Motor Europe</i>	
Injury Mechanism of Pedestrians Impact Test with a Sport-Utility Vehicle and Mini-Van	259
<i>G Schroeder, Hannover Medical School</i>	
<i>K Fukuyama, K Yamazaki, Japan Automobile Research Institute</i>	
<i>K Kamiji, T Yasuki, Japan Automobile Manufacturers Association</i>	
Pedestrian-vehicle interaction: kinematics and injury analysis of four full scale tests	275
<i>D Subit, J Kerrigan, J Crandall, Center for Applied Biomechanics, University of Virginia</i>	
<i>K Fukuyama, K Yamazaki, Japan Automotive Research Institute</i>	
<i>Ki Kamiji, Ti Yasuki, Japan Automobile Manufacturers Association</i>	
Injury Thresholds and a Measurement Technique for the Thigh and Leg of a Pedestrian	295
<i>Y Takahashi, M Okamoto, Y Kikuchi, A Akiyama</i>	
<i>Honda R&D Co., Ltd. Automobile R&D Center</i>	
 SESSION VI – TESTING BIOMECHANICAL RESPONSE	
Repeatability and Sensitivity to Seat-position of THOR-NT and Hybrid III based on Hyge sled Tests	309
<i>M Masuda, Japan Automobile Manufacturers Association</i>	
<i>M Yaguchi, K Ono, Japan Automobile Research Institute</i>	
Biofidelity of Rear Impact Dummies in Low Speed Rear-end impact - Comparison of rigid seat and mass production car seat in human volunteers	323
<i>K Yamazaki, K Ono, M Ishii</i>	
<i>Japan Automobile Research Institute (JARI)</i>	
Spinal loading on wheelchair occupants with postural deformities in a rear impact during surface transport	339
<i>J. Walsh, C. Simms, Trinity Centre for BioEngineering, Trinity College Dublin</i>	
<i>D. FitzPatrick, Dept. of Electrical, Electronic and Mechanical Engineering, University College Dublin</i>	
<i>J. Tiernan, Eastern Region Postural Management Services, Enable Ireland</i>	
 SESSION VII – INVESTIGATING SPINAL INJURIES	
Reinterpreting the neck injury index (NII) using experimental cadaveric tests	353
<i>C Bass, J Crandall, R Salzar, K Rafaels, A Damon, University of Virginia - Center for Applied Biomechanics</i>	
<i>S Lucas, Exponent Inc.</i>	
Minor rear aligned crashes in the United States: a pilot study of 98 crashes	367
<i>A Bartsch, L Gilbertson, Cleveland Clinic, Cleveland</i>	
<i>V Prakash, Case Western Reserve University, Cleveland</i>	
<i>D Morr, J Wiechel, S.E.A. Limited, Columbus, The Ohio State University, Columbus</i>	

Research Study on Whiplash Injury Lessening with Active Head Restraint using Human Body FE Model 381
Y Kitagawa, T Yasuki, J Hasegawa
Toyota Motor Corporation

Cadaveric Lumbar Spine Responses to Flexion with and without Anterior Shear Displacement 397
A Belwadi, K Yang
Wayne State University, Detroit

SESSION VIII – SHORT PRESENTATIONS

The development of a software tool for classification of injuries in the Abbreviated Injury Scale 413
W Owczarczyk
Warsaw University of Technology

Comparative Analysis of a Vehicle Impacting a Rigid Barrier, an Offset Deformable Barrier, and a Rigid Pole 417
S Hong, C Park, P Mohan, R Morgan, C Kan, The George Washington University
K Lee, S Park, H Bae, Hyundai-Kia Motors

Rollover Crash Neck Injury Replication and Injury Potential Assessment 421
J Paver, J Bish, J Caplinger, D Rhode, Consultants
D Friedman, Xprts, LLC
F Carlin, University of California Santa Barbara

Development of a wheelchair headrest for rear impact protection 425
C Simms, B Madden, Centre for Bioengineering, Trinity College Dublin
J Tiernan, Enable Ireland Seating Clinic, Dublin
D FitzPatrick, Mechanical Engineering, Trinity College Dublin

Laminated versus tempered lateral windows under head impact: experimental and numerical analysis 429
M Munsch, N Bourdet, C Deck, R Willinger
University of Strasbourg

Reconstruction of a Multi Vehicle Collision on a Highway: Combining Forensic Evidence Examination, 3D-Scanning and 3D-Photogrammetry with Numerical Accident Reconstruction Methods 433
J Arnold, H Bösch, Scientific Forensic Service, Zurich City Police, Switzerland
M Braun, Technical Accident Reporting Service, Zurich City Police, Switzerland

DEMONSTRATION:

Virtopsy: Expert opinion based on 3d surface and radiological scanning and documentation in forensic medicine 437
M Thali, U Buck, S Näther
University of Bern, Institute of Forensic Medicine

Brain viscoelasticity measured by magnetic resonance elastography 441
J Vappou, E Breton, P Choquet, A Constantinesco, R Willinger
Institut de Mécanique des Fluides et des Solides, ULP, Strasbourg

Inducing Head Motion with a Novel Helmet during Head-First Impact Can Mitigate Neck Injury Metrics: An Experimental Proof-of-Concept Investigation using Mechanical Surrogates	445
<i>T Nelson, P Crompton</i>	
<i>Injury Biomechanics Laboratory and Division of Orthopaedic Engineering Research, Departments of Mechanical Engineering and Orthopaedics, International Collaboration on Repair Discoveries (ICORD) University of British Columbia Vancouver, Canada</i>	
New Motorcycle helmets with Metal foam shell	449
<i>P Pinnoji, P Mahajan, Indian Institute of Technology Delhi</i>	
<i>N Bourdet, R Willinger, Institut de Mécanique des Fluides et des Solides, ULP-CNRS, Strasbourg</i>	
The effectiveness of safety equipment in horse racing falls	453
<i>T Gibson, Human Impact Engineering</i>	
<i>K Thai, UNSW formerly Human Impact Engineering</i>	
<i>J Saxon, Consultant</i>	
<i>R Pollock, Australian Harness Racing Council</i>	
Scaling of neck performance requirements in side impacts	457
<i>J Wismans, R Meijer, C Rodarius, TNO Science and Industry</i>	
<i>B Been, First Technology Safety Systems (FTSS)</i>	
Female Volunteer Motion in Rear Impact Sled Tests in Comparison to Results from Earlier Male Volunteer Tests	461
<i>A Carlsson, A Linder, VTI, Swedish National Road and Transport Research Institute</i>	
<i>M Svensson, J Davidsson, Chalmers University of Technology</i>	
<i>S Schick, S Horion, W Hell, LMU, Ludwig-Maximilians-Universitaet Muenchen</i>	
Active controlled muscles in numerical model of human arm for movement in two DOFs	465
<i>P Budziszewski, K Kędzior, Warsaw University of Technology</i>	
<i>E van Nunen, J Mordaka, TNO Automotive</i>	
Response of lower extremity in car-pedestrian impact - influence of muscle contraction	469
<i>A Soni, A Chawla, S Mukherjee, Department of Mechanical Engineering, Indian Institute of Technology</i>	
<i>R Malhotra, Department of Orthopaedics, All India Institute of Medical Sciences</i>	