

# Contents

## Keynote Papers

*Peter Bearman*

Bluff Body Flow Research with Application to Road Vehicles ..... 3

*David Schimel*

Climate Change and the Energy Economy ..... 15

## Flow Field Characteristics

*G. Iaccarino, F. Ham, Y. Khalighi, D. Bodony, P. Moin, B. Khalighi*

Large Eddy Simulations and Acoustic Predictions in Automotive Applications ..... 19

*B. Khalighi, S. Jindal, J.P. Johnson, K.H. Chen, G. Iaccarino*

Validation of the Immersed Boundary CFD Approach for Complex Aerodynamic Flows ..... 21

*B. Khalighi, J.P. Johnson, K.-H. Chen, R.G. Lee*

Experimental Characterization of the Unsteady Flow Field behind Two Outside Rear-View Mirrors ..... 39

*P. Merati, C.H. Leong, K.H. Chen, J.P. Johnson*

Investigation of Bouyancy Driven Flow in a Simplified Full Scale Underhood – PIV and Temperature Measurements ..... 53

*K.H. Chen, J.P. Johnson, P. Merati, C.H. Leong*

Investigation of Bouyancy Driven Flow in a Simplified Full-Scale Underhood – Numerical Study ..... 75

*Simon Watkins, Riccardo Pagliarella*

The Flow Environment of Road Vehicles in Winds and Traffic ..... 101

## Separation Control for Drag Reduction

*L. Taubert, I. Wygnanski*

Preliminary Experiments Applying Active Flow Control to a 1/24<sup>th</sup> Scale Model of a Semi-Trailer Truck ..... 105

*A. Seifert, O. Stalnov, D. Sperber, G. Arwatz, V. Palei, S. David, I. Dayan, I. Fono*  
 Large Trucks Drag Reduction using Active Flow Control ..... 115

*R. Spivey, R. Hewitt, H. Othman, T. Corke*  
 Flow Separation Control on Trailing Edge Radii using Single Dielectric Barrier Discharge Plasma Actuators: An Application to Vehicle Drag Control ..... 135

*L. Cattafesta, Y. Tian, R. Mittal*  
 Adaptive Control of Post-Stall Separated Flow Application to Heavy Vehicles ..... 151

*Jason Ortega, Kambiz Salari, Bruce Storms*  
 Investigation of Tractor Base Bleeding for Heavy Vehicle Aerodynamic Drag Reduction ..... 161

*C.N. Nayeri, J. Haff, D. Greenblatt, L. Loefdahl, C.O. Paschereit*  
 Drag Reduction on a Generic Tractor-Trailer using Active Flow Control in Combination with Solid Flaps ..... 179

## **Design Optimization Techniques Related to Vehicle Aerodynamics**

*Ilhan Bayraktar*  
 Advanced Aerodynamics and Cooling System Solutions for Higher Fuel Efficiency and Decreased Emissions ..... 195

*Siniša Krajnović*  
 Optimization of Aerodynamic Properties of High-Speed Trains with CFD and Response Surface Models ..... 197

*Bhaskar Bhatnagar, Dan Schlesinger*  
 Design Considerations for Maximizing Cooling Package Performance ..... 213

*Clinton Lafferty, Kevin Horigan, Ales Alajbegovic*  
 Optimization and Correlation of a Class 8 Truck Cooling System ..... 215

## Train Aerodynamics

|  |     |
|--|-----|
| <i>Alexander Orellano, Stefan Sperling</i>   |     |
| Aerodynamics Improvements and Associated Energy Demand<br>Reduction of Trains .....  | 219 |
| <i>Andreas Dillmann</i>  |     |
| The use of Aeronautical Experimental Facilities and Measurement<br>Techniques for the Aerodynamic Investigation of High Speed Trains ..... | 233 |
| <i>Sigfried Loose</i>  |     |
| Reduction of Skin-Friction Drag on a Generic Train Configuration .....   | 235 |
| <i>Arnd Rueter</i>   |     |
| Head Pressure Effects of Trains and Locomotives – Engineering<br>Calculation Approaches for Homologation Purpose .....                     | 237 |
| <i>Jing Zhao, Renxian Li</i>   |     |
| Numerical Analysis for Aerodynamics of High-Speed Trains Passing<br>Tunnels .....  | 239 |

## Poster Session

|   |     |
|---|-----|
| <i>Renxian Li, Jing Zhao, Shu Zhang</i>   |     |
| A Study of the Influence of Aerodynamic Forces on a Human Body near<br>a High-Speed Train .....   | 243 |
| <i>James C. Paul, Richard W. Johnson, Robert G. Yates</i>   |     |
| Application of CFD to Rail Car and Locomotive Aerodynamics .....                                  | 259 |
| <i>Gandert M.R. Van Raemdonck, Michel J.L. van Tooren</i>   |     |
| Data Acquisition of a Tractor-Trailer Combination to Register Aerodynamic<br>Performances .....   | 299 |
| <i>Eddy Willemsen</i>   |     |
| Automotive Testing in the DNW-LLF Wind Tunnel .....   | 311 |
| <i>Bruce Storms, Jason Ortega, Kambiz Salari</i>  |     |
| An Experimental Study of Tractor Base Bleed for Heavy Vehicle<br>Aerodynamic Drag Reduction ..... | 317 |

## CFD, Numerical Methods and Application

|  |     |
|--|-----|
| <i>Parviz Moin</i><br>Application of High Fidelity Numerical Simulations for Vehicle<br>Aerodynamics .....   | 321 |
| <i>Florian Menter</i><br>Scale-Adaptive Simulation in the Context of Unsteady Flow Simulations ....  | 323 |
| <i>K. Sreenivas, B. Mitchell, S. Nichols, D. Hyams, D. Whitfield</i><br>Computational Simulation of the GCM Tractor-Trailer Configuration .....                          | 325 |
| <i>Ramesh Pankajakshan, Brent Mitchell, David L. Whitfield</i><br>Full-Scale Simulations of Drag Reduction Devices for Class 8 Trucks .....                              | 339 |
| <i>David Pointer, Tanju Sofu, Jimmy Chang, David Weber</i><br>Applicability of Commercial CFD Tools for Assessment of Heavy Vehicle<br>Aerodynamic Characteristics ..... | 349 |
| <i>Christopher J. Roy, Harshavardhan A. Ghuge</i><br>Detached Eddy Simulations of a Simplified Tractor/Trailer Geometry .....  | 363 |
| <i>Kambiz Salari, Paul Castellucci</i><br>A Hybrid RANS/LES Turbulence Model for use in the Simulation of<br>Turbulent Separated Flows .....                             | 383 |

## Vehicle and Tire Spray and Vehicle Interaction

|   |     |
|---|-----|
| <i>Simon Watkins</i><br>Spray from Commercial Vehicles: A Method of Evaluation and Results<br>from Road Tests .....   | 387 |
| <i>Charles Radovich, Dennis Plocher</i><br>Experiments on Spray from a Rolling Tire .....   | 403 |
| <i>Florian Iser, Raimund A. Almbauer</i><br>Computational Simulation of the Flow Field of a Filter System inside<br>Self-Ventilated Road Tunnels due to Heavy Vehicle Traffic ..... | 419 |
| <i>B. Basara, S. Girimaji, S. Jakirlic, F. Aldudak, M. Schrefl</i><br>Experiments and Calculations Relevant to Aerodynamic Effects during<br>Highway Passing Maneuvers .....        | 433 |

## Drag Reduction

*Mark Page*

- Design & Test Techniques for Drag Reduction at Swift Engineering – A  
Racecar Manufactures Perspective ..... 449

*Jason Leuschen, Kevin R. Cooper*

- Summary of Full-Scale Wind Tunnel Tests of Aerodynamic  
Drag-Reducing Devices for Tractor-Trailers ..... 451

*Réjean Laflamme*

- A Fleet Operator’s Perspective on Commercial Vehicle Drag Reduction ..... 463

*Kenneth D. Visser, Kevin Grover*

- Class 8 Vehicle Fuel Savings using Sealed Single and Dual Open Aft  
Cavities ..... 465

*Alec Wong, Kevin Horrigan*

- A Novel Approach to Heavy Vehicle Drag Reduction ..... 467

*Linus Hjelm, Björn Bergqvist*

- European Truck Aerodynamics – A Comparison Between Conventional  
and CoE Truck Aerodynamics and a Look into Future Trends and  
Possibilities ..... 469

*Mike Camosy, Andre Brown, Henri Kowalczyk, Gaylord Couthier*

- Advanced Experimental Methods for the Analysis and Aerodynamic  
Design of Heavy Vehicles ..... 479

- Author Index** ..... 481