INTRODUCTION

The ESV Program originated more than three decades ago under the North Atlantic Treaty Organization (NATO) Committee on the Challenges of Modern Society, and was implemented through bilateral agreements between the Governments of the United States, France, the Federal Republic of Germany, Italy, the United Kingdom, Japan, and Sweden. The participating nations agreed to develop experimental safety vehicles to advance the state-of-the-art technology in automotive engineering and to meet periodically to exchange information on their progress. Since its inception the number of international partners has grown to include the Governments of Canada, Australia, The Netherlands, Hungary, Poland, Republic of Korea, and two international organizations -- the European Enhanced Vehicle-safety Committee, and the European Commission. A representative from each country/organization serves as a Government Focal Point in support of the Program.

In the interest of information exchange, The National Highway Traffic Safety Administration, U.S. Department of Transportation, distributes this CD-ROM which contains the Proceedings of the 21st International Technical Conference on the Enhanced Safety of Vehicles (ESV). The technical papers included in this publication detail safety research efforts underway worldwide, and share the common interest of reducing motor vehicle related fatalities and injuries globally. The opinions, findings, and conclusions expressed in the publication are those of the author(s) and not necessarily those of the U.S. Department of Transportation, National Highway Traffic Safety Administration. Final papers are accepted after the corresponding abstracts undergo technical review. The technical papers contained on this CD-ROM are the unmodified written work of the author(s).

The Conference Organizers thank our international participants for their dedication and support of the 21st ESV Conference and look forward to your future participation.

Donna E. Gilmore
ESV Technical Coordinator
DOT/NHTSA
21st ESV INTERNATIONAL TECHNICAL PROGRAM DELEGATES

United States – 21st ESV Conference Sponsor

THE HONORABLE RAY LAHOOD
Secretary
United States Department of Transportation

RONALD L. MEDFORD
Acting Deputy Administrator
National Highway Traffic Safety Administration

JOHN MADDOX
Associate Administrator for Vehicle Safety Research
National Highway Traffic Safety Administration

DONNA E. GILMORE
ESV Technical Coordinator
National Highway Traffic Safety Administration

Germany – 21st ESV Conference Host

WOLFGANG TIEFENSEE
Federal Minister of Transport

DR.-ING. PETER REICHELT
President
Federal Highway Research Institute (BAST)

DR.-ING. EKKEHARD BRUEHNING
Director and Professor
Federal Highway Research Institute (BAST) (Retired)

ANDRE SEECK
Director and Professor
Federal Highway Research Institute (BAST)
## 21st ESV Government Focal Point Members

<table>
<thead>
<tr>
<th>Country</th>
<th>Focal Point Member</th>
</tr>
</thead>
</table>
| **AUSTRALIA**    | Mr. Peter Robertson  
                   | Assistant Secretary  
                   | Vehicle Safety Standards  
                   | Department of Transport and Regional Services |
| **GERMANY**      | Dr. Peter Reichelt  
                   | President  
                   | Federal Highway Research Institute (BAST) |
| **CANADA**       | Mr. Christian Lavoie  
                   | Director, Motor Vehicle Standards  
                   | Research and Development  
                   | Transport Canada |
| **FRANCE**       | Mr. Bernard Gauvin  
                   | Ingénieur général des mines  
                   | Ministère des Transports |
| **EUROPEAN COMMISSION** | Mr. Philippe Jean  
                   | Head of Unit, Directorate General  
                   | Enterprise and Industry  
                   | European Commission |
| **HUNGARY**      | Mr. Sándor Szabó  
                   | Head of EU-UNECE Centre  
                   | KTI/Institute for Transport Sciences |
| **EUROPEAN ENHANCED VEHICLE-SAFETY COMMITTEE** | Dr. Dominique Cesari  
                   | Scientific Director  
                   | INRETS |
| **ITALY**        | Dott. Ing. Antonio Erario  
                   | Director of the International Regulation Division  
                   | Ministry of Infrastructure and Transport  
                   | Department of Land Transport |
| **JAPAN**        | Mr. Masayuki Shima  
                   | Director  
                   | International Affairs Office, Engineering and Safety  
                   | Department, Road Transport Bureau  
                   | Ministry of Land Infrastructure and Transport |
| **THE NETHERLANDS** | Mr. Kees Doornheim  
                   | Head of Vehicle Standards Development  
                   | RDW Vehicle Approval and Information |
| **POLAND**       | Mr. Wojciech Przybylski  
                   | Technical Development Director  
                   | Motor Transport Institute |
| **UNITED KINGDOM** | Mr. Ian Yarnold  
                   | Deputy Head of Vehicle Technology and Standards  
                   | Department for Transport |
| **REPUBLIC OF KOREA** | Mr. Seong Yeol-San  
                   | Deputy Director  
                   | Ministry of Land, Transport & Maritime Affairs of Korea |
| **UNITED STATES OF AMERICA** | Mr. John Maddox  
                   | Associate Administrator for Vehicle Safety Research  
                   | National Highway Traffic Safety Administration |
| **SWEDEN**       | Mr. Anders Lie  
                   | Specialist, Head Office  
                   | Swedish National Road Administration |
# 21st ESV Technical Session Chairpersons/Co-Chairpersons

## Data Acquisition and Analysis for Future Safety Enhancement
- **Ekkehard Bruehning, Germany**
- **Koshiro Ono, Japan**

## Developments in Frontal/Side Impact Protection
- **Bernie Frost, United Kingdom**
- **Dominique Charlebois, Canada**

## Vehicle Stability and Control Systems and Rollover Prevention
- **Young Han Youn, Republic of Korea**
- **Antonio Erario, Italy**

## Integrated Safety Approach: From Prevention to Severity Reduction and Post-Crash Safety
- **Rodolfo Schoeneburg, Germany**
- **Peter Robertson, Australia**

## Biomechanics: Injury Criteria and Virtual Test Procedures/Tools Development
- **Philippe Vezin, France**
- **Stephen Ridella, United States**

## Safety Performance and Effectiveness of Driver Assistance Technologies, Test & Evaluation Procedures, Benefits Assessment
- **Anders Lie, Sweden**
- **Andre Seeck, Germany**

## Effect of Fuel Economy Strategies on Vehicle Safety
- **Jac Wismans, The Netherlands**
- **Kyong Han Yoon, Republic of Korea**

## Rear Impact Injury Prevention and Protection
- **Lynne Bilston, Australia**
- **Ola Boström, Sweden**

## Human Machine Interface – Issues, Driver-Vehicle Interaction Related Research, Impaired Driving and Human Factors Guidelines Development
- **Claudio Lomonaco, Italy**
- **Lex van Rooij, The Netherlands**

## Deployment Strategies of Safety Technologies – Voluntary Standards, Regulations and Ratings
- **John Hinch, United States**
- **Dominique Cesari, France**

## Structural Integrity and Restraint Performance
- **Suzanne Tylko, Canada**
- **Stephen Summers, United States**

## Vulnerable Road Users: Pedestrian Safety
- **Hideki Yonezawa, Japan**
- **Wojciech Przybylski, Poland**
ADVANCES IN VULNERABLE OCCUPANT PROTECTION SYSTEMS

Jerzy W. Kownacki, Poland

Donald MacDonald, United Kingdom

ADVANCES IN TRUCK SAFETY/BUS & TWO WHEELED VEHICLES SAFETY

Matolcsy Mátyás, Hungary

Steve Sopp, United Kingdom
ESV 2009 U.S. GOVERNMENT AWARD RECIPIENTS

SAFETY ENGINEERING EXCELLENCE

Anton T. van Zanten, Germany
Koji Mizuno, Japan
Joseph N. Kaniathanra, United States
Priya Prasad, United States

SPECIAL AWARD OF APPRECIATION

Ekkehard Bruehning, Germany
Hideo Inoue, Japan
Masao Fukushima, Japan
Han-Il Bae, Korea
Jan L. Ivarsson, Sweden
Andrew P. Morris, United Kingdom
ESV 2009 INTERNATIONAL STUDENT SAFETY TECHNOLOGY DESIGN COMPETITION FINALISTS

ASIA-PACIFIC, REGION 1
REGIONAL COORDINATOR: MR. KAZURO IWATA, JSAE, JAPAN

The University of Tokyo, Japan
“Brake Stopping Distance Shortening System with Sticky Liquid”

EUROPE, REGION 2
REGIONAL COORDINATOR: DR. DOMINIQUE CESARI, INRETS, FRANCE

Technische Universität München, Germany
“Emergency Braking System for Pedestrian Protection Using Cooperative Sensor Technology”

Institute of Automotive Engineering RWTH Aachen University, Germany

Loughborough University, United Kingdom
“Energy Absorbing Car Seat Design for Whiplash Mitigation”

NORTH AMERICA, REGION 3
REGIONAL COORDINATOR: MR. ARTHUR CARTER, NHTSA, UNITED STATES

California Polytechnic State University, United States
“Sensor Integration and Algorithm Development for Truck Crash Avoidance”

George Mason University, United States
“SLIC: The In-Vehicle Speed Management Device”

University of Minnesota, United States
“Non-Intrusive Driver’s Sleepiness Detection System”