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Accident Characteristics of Severe Motorcycle Accidents in Germany

Unfallcharakteristik von schweren Motorradunfällen in Deutschland

Thorsten Facius, Dietmar Otte

Verkehrsunfallforschung der Medizinischen Hochschule Hannover, Deutschland
Accident Research Unit Medical School Hannover, Germany

Abstract

The overall number of severely injured participants and fatalities in road traffic accidents has decreased enormously in the last decades. These casualties in the group of riders of motorcycles in traffic accidents have only decreased in a smaller percentage, in some countries there was even an increase registered.

The aim of this study is to analyze the accident situation of motorcycles with cubic capacity > 125 cm³ in Germany, the so called heavy motorcycles, especially with severely injured and killed riders. The characteristic and reasons of these accidents shall be analyzed and countermeasures shall be developed.

The accident data of 1,580 drivers of motorcycles were analyzed, collected by a scientific research team of GIDAS (German In-Depth Accident Study) in the area of Hannover and Dresden within the years 2000 up to 2013. This data is a statistical representative sample of the real accident occurrence in Germany.

The study points out that 218 (13.7 %) motorcycle accidents lead to severe injured riders with MAIS 3+, whereas 46 (3.0 %) of the riders were killed. The most MAIS 3+ accidents with 45.1 % occurred in accidents with objects (including falls), 39.8 % in accidents with cars. Severely injured (MAIS 3+) riders with 22.1 % were clearly higher in the age group above 60 years compared to 13.4 % in the age group 41-60, 11.7 % in the age group 26-40 and the youngest below 26 years had the lowest amount of MAIS 3+ riders with 10.2 %. The causes for these differences will be described and discussed in the paper. It is shown that the majority of 34.5 % of MAIS 3+ riders resulted from driving accidents (so called single-vehicle accidents) without other involved participants which led to falls or object impacts, 19.8 % resulted from accidents in longitudinal traffic, 17.8 % from turning in and crossing accidents and 17.3 % from turning off accidents. The study shows which injuries occur in different accident conditions.

Countermeasures can be seen in the two different parts of driver and vehicle assistant systems to influence the driver behavior and to reduce the driving speed and give concrete information for the avoidance of accidents, especially with severely injured persons (MAIS 3+). There will also be suggestions regarding the optimization of the infrastructure design and the design of the peripheral areas to avoid severe injuries. The study will also show where such accidents happened within the different street structure and for which collision types the most effectiveness of such assistance systems is given.

Zusammenfassung

Die Gesamtanzahl von schwerverletzten und getöteten Personen bei Straßenverkehrsunfällen hat in den letzten Jahrzehnten stark abgenommen. Die Anzahl an Verunglückten Motorradfahrern hat hingegen nicht in gleichem Maße abgenommen, es kann sogar in einigen Ländern eine Zunahme registriert werden.

Das Ziel dieser Studie ist die Analyse der Unfallsituation von Motorrädern mit Hubraum > 125 cm³ in Deutschland, den sog. schweren Motorräder, insbesondere mit schwerverletzten und getöteten Fahrern. Es sollen Charakteristik und Gründe für diese Unfälle analysiert und Lösungsvorschläge erarbeitet werden.

Unfalldaten von 1.580 Motorradfahrern wurden analysiert, die von einem wissenschaftlichen Forschungsteams im Rahmen des GIDAS Projekts (German In-Depth Accident Study) in Hannover und Dresden in den Jahren 2000 bis 2013 gesammelt wurden. Dabei handelt es sich um eine statistisch repräsentative Stichprobe aus dem realen Unfallgeschehen in Deutschland.

Die Studie zeigt, dass 218 (13,7 %) Motorradunfälle zu Schwerverletzten (MAIS 3+) geführt haben, wobei 46 (3,0 %) der Fahrer getötet wurden. Der Großteil der MAIS 3+ Verletzten mit 45,1 % trat bei Unfällen mit Objekten (inklusive Stürzen) auf, 39,8 % entstanden bei Unfällen mit Autos. MAIS 3+ Verletzte traten mit 22,1 % deutlich höher in der Altersgruppe über 60 Jahren auf verglichen mit 13,4 % in der Altersgruppe 41-60, 11,7 % in der Altersgruppe 26-40 und in der jüngsten Altersgruppe unterhalb 26 Jahren gab es mit 10,2 % die wenigsten MAIS 3+ Verletzten auf. Die Ursachen für diese Unterschiede werden in der Studie erläutert. Es zeigt sich, dass 34,5 % der MAIS 3+ Verletzten der Motorradfahrer aus Fahrunfällen ohne weitere Beteiligte resultieren (sog. Alleinunfälle), die zu Stürzen oder Anprall an Objekte führten, 19,8 % entstanden bei Unfällen im Längsverkehr, 17,8 % bei Einbiege- und Kreuzungsunfällen und 17,3 % bei Abbiegeunfällen. Die Studie zeigt welche Verletzungen bei unterschiedlichen Unfallbedingungen auftreten.

Gegenmaßnahmen können in zwei verschiedenen Ansätzen gesehen werden, nämlich in Fahrer- und Fahrzeugassistenzsystemen, die das Fahrerverhalten beeinflussen und die Fahrgeschwindigkeit reduzieren und konkrete Informationen geben, um Unfälle zu vermeiden, insbesondere mit MAIS 3+ Verletzten. Auch werden Vorschläge zur Optimierung der Straßengestaltung und des Seitenraumes zur Vermeidung von schweren Verletzungen gegeben. Die Studie zeigt außerdem wo diese Unfälle im Hinblick auf das Straßennetz passierten und für welchen Kollisionstyp die größte Effektivität für solche Assistenzsysteme besteht.

Risk of serious motorcycle accidents among ordinary motorcyclists – A nationwide register-based cohort study.

Das Risiko von schweren Motorradunfällen – Eine landesweite bestandsdatenbasierte Kohortenstudie

C Michael Fored, MD PhD

Fredrik Granath, PhD

Karolinska Institutet, Department of Medicine - Solna,
Clinical Epidemiology Unit, Stockholm, Sweden

Abstract

Question

Present knowledge on serious motorcycle accidents mainly derive from in-depth studies of lethal cases. These motorcyclists tend to differ from the majority of motorcycle drivers. To assess serious accident risk among ordinary motorcyclists in general we performed a nationwide cohort study including all Swedish motorcycle owners.

Methods

From national registries of road traffic vehicles during 2003 to 2009 were identified 313,271 licensed motorcycle owners and their 319,547 motorcycles registered for road traffic, as well as information on mileage.

Information from national health care registries on all treatment of injuries, or death from motorcycle accidents were linked to the motorcycle owners. Serious accidents were defined as any injury requiring medical care.

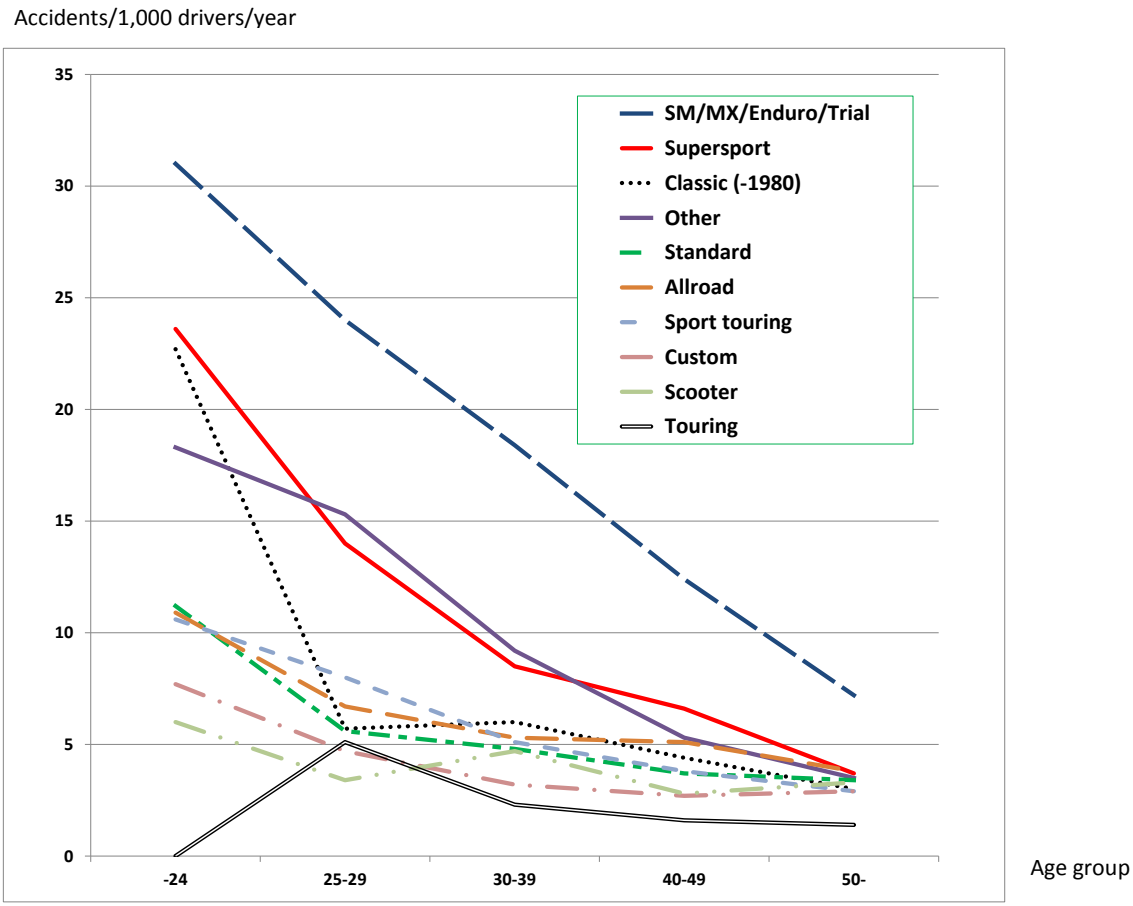
Absolute risk was estimated from the observed number of injuries divided by the total mileage. Accident risk with respect to the risk factors investigated was analysed in Poisson regression models with mileage as offset.

Results

The total number of serious accidents was 6,296 and the total mileage was 3.6 billion kilometres, meaning 1.8 serious accidents per 1,000,000 kilometres, or 4.5 serious accidents per 1,000 motorcycle drivers, per year.

Women had a 10% non-significant lower relative risk than men. In relation to drivers 30-39 years of age, the youngest drivers had twice the risk (age -24; 2.1 (1.6-2.6)) while drivers' age of 25-29 year was associated with a 40% risk increase (1.4 (1.2-1.7)). Relative crash risk continued to decrease with increasing drivers' age with a 40% decrease among the oldest (50+, 0.6 (0.5-0.7)).

Only small risk differences were seen between owners of different motorcycle types, except among the owners of motorcycles classified as "Supermotard (SM) / Motocross (MX) / Enduro / Trial" who had a tripled risk (3.3 (2.7-4.0)) in relation to "Standard motorcycle" owners. The corresponding relative risk among owners of a "Supersport motorcycle" was 1.8 (1.4-2.2), an 80% risk increase. The risk differences between motorcycle types were increased among younger owners.



Impacts

Risk assessment within well-defined cohorts of motorcyclist provide valuable knowledge on the general risk of motorcycling. We have shown that motorcycle accident risk strongly decreases with drivers' age. Motorcycle type risk difference is highest among the younger drivers.

Riding Left Hand Corners: Facts and Measures

Motorradfahren in Linkskurven: Fakten und Maßnahmen

Martin Winkelbauer

Kuratorium für Verkehrssicherheit

Abstract

According to the official police-recorded Austrian road accident database, run-of-the road accidents in left hand corners are the second most frequent accident type with motorcycles involved. “Corner-cutting” is a potential reason in particular where forward visibility is poor and was, hence, made subject of two independent studies. For both studies, Naturalistic Observation was found to best suit the task. Video Cameras were placed at four different corners along typical motorcycle routes. The corners were selected based on accident records and previous experience in observation of riders, mainly taking place during on-road rider training.

For study 1, two corners with low forward visibility were selected and observed for almost 40 hours. Stills were extracted from the video and the lane position of more than 800 riders at the vertex of the corner was validated against the lane position of oncoming buses and trucks. Only 5% of the riders kept a safe path, reasonably close to the right side of the road. That means, for the remaining 95%, they would have had to change their path and swerve around an oncoming bus or truck.

The corners selected for study 2 had neither a particular accident record nor low forward visibility, but were known as typical places for corner-cutting by PTW riders (and car drivers as well). A simple before/after method was applied. It was found that placing different kinds of floor markings effectively reduces the number of riders within the dangerous area close to the centre line.

The two studies prove that corner-cutting is a quantitative problem and a potential reason for the large number of run-off-the-road accidents in left hand corners. It may be assumed that a majority of riders is not fully aware of the problem; hence, dissemination of this issue to the riders is urgently required by any channels available. Floor markings can be considered a very effective way to keep PTW riders away from oncoming vehicles in left hand corners. “Corner-cutting” is probably not the best term, since most of the riders remain on their own side of the road, but ride too close to the centre line.

Keywords (ITRD)

1221 Motorcycle, 1752 Motorcyclist, 1665 Safety, 2872 Bend (Road), 1855 Driving, 9112 Impact Study, 0562 Road Marking

Kurzfassung

Abkommensunfälle in Linkskurven sind – der amtlichen Unfallstatistik für Unfälle mit Personenschaden in Österreich zufolge – der zweithäufigste Unfalltyp mit Motorradbeteiligung. Kurvenschneiden wurde als eine mögliche Unfallursache identifiziert und deshalb in zwei unabhängigen Studien untersucht. Für beide Studien wurde naturalistische Beobachtung als passendste Methode gewählt. In vier verschiedenen Kurven an typischen Motorradstrecken wurden Videokameras aufgestellt. Diese Kurven wurden auf Basis der Unfallstatistik und früheren Beobachtungen bei Motorradfahrern, hauptsächlich den Teilnehmern von Straßentrainings, ausgewählt.

Für die erste Studie wurden zwei sehr unübersichtliche Kurven ausgewählt und zusammen für fast 40 Stunden beobachtet. Aus den Videos wurden Standbilder der Motorradfahrer auf dem Kurvenscheitel ausgeschnitten. Deren Fahrlinie wurde gegen den Platzbedarf entgegenkommender Schwerfahrzeuge bewertet. Nur 5% der Motorradfahrer hielten eine sichere Fahrlinie am Außenrand der Kurve ein. 95% hingegen hätten bei Gegenverkehr ihre Fahrlinie ändern müssen, um eine Kollision zu vermeiden.

Die beiden Kurven die für die zweite Studie ausgewählt wurden, sind übersichtlich und keine Unfallhäufungsstellen, aber bekannt dafür, dass Motorradfahrer (genauso wie Autofahrer) dort besonders oft links der Mitte fahren. Hier wurde ein einfacher Vorher-Nachher-Vergleich angestellt. Es stellte sich heraus, dass Bodenmarkierungen, die unmittelbar neben der Mittellinie auf der kurvenäußeren Seite aufgebracht werden, ein sehr effektives Mittel sind, die Anzahl der Motorradfahrer im Gefahrenbereich nahe der Mittellinie zu verringern.

Die beiden Studien beweisen, dass Kurvenschneiden ein quantitatives Problem und mögliche Ursache für die große Zahl von Abkommensunfällen in Linkskurven ist. Es lässt sich annehmen, dass die Mehrheit der Motorradfahrer sich dieses Problems nicht bewusst ist. Daher ist Meinungsbildung auf allen Kanälen dringend erforderlich. Ferner wurde festgestellt, dass sich die Anbringung von Bodenmarkierungen hervorragend dazu eignet, Motorradfahrer von der Gefahrenzone entlang der Mittellinie fern zu halten. Und letztlich, „Kurvenschneiden“ ist möglicherweise gar nicht das richtige Wort; die meisten Fahrer fahren auf ihrer eigenen Straßenseite, aber eben zu nah an der Mittellinie.

Schlüsselwörter (ITRD)

1221 Motorrad, 1752 Motorradfahrer, 1665 Sicherheit, 2872 Straßenkurve, 1855 Fahrzeugführung, 9112 Wirksamkeitsuntersuchung, 0562 Fahrbahnmarkierung

Motorcycle Sliding Friction for Accident Investigation

Erkenntnisse über Motorrad-Rutschverzögerungen für Unfalluntersuchungen

Louis R. Peck, Bill Focha, Toby L. Gloekler

Dial Engineering, Lightpoint Data, S. D. Lyons, North Coast Truck Inspection, and Collision Reconstruction Engineers, USA

Abstract

The subject research examined 15 actual crashes of motorcycles equipped with frame sliders and established the related drag factor using 5 and 10Hz GPS data acquisition systems. The crashes occurred during track days or races and many were also documented with on-board video, which was synchronized with the GPS data when available. 14 controlled tests were then performed with different motorcycles and the sliding friction values were determined using GPS data acquisition and traditional methods for validation. The average drag factor for the 15 track crashes was -0.45 g's (SD = 0.09) and -0.48 g's (SD = 0.08) in the 14 controlled tests, where none of the motorcycles were equipped with frame sliders. These results align with previously published research. Of importance, this data showed frame sliders do not lower the drag factor of a sport bike, but actually increase it. Moreover, a relationship between certain collision dynamics and the sliding friction became apparent. This research will help accident investigators more accurately quantify the pre-impact speed of downed motorcycles.

Motorcycle Velocity Determination from Impact Damage

Rekonstruktion der Fahrgeschwindigkeit von Motorrädern anhand der Deformation am Fahrzeug

Tyler Kress, Ph.D., CIE, CXLT; Reid Kress, Ph.D., PE
Virginia Polytechnic Institute and State University, Blacksburg, VA, USA,
and BEST Engineering, Knoxville, TN, USA

Stein Husher; Michael Varat
KEVA Engineering, LLC

John Steiner
Mecanica Scientific Services Corp

O. Daniel Ansa
Ansa Assuncao, LLP

Abstract

Powered Two Wheeler (PTW) accident reconstruction involves analyses of pre-impact dynamics, impact/crush evaluation and post-crash dynamics. Reliable methods to assess PTW impact damage and deformation along with damage to the crash partner are necessary to determine velocity at impact. Previous research (References [1], [2] and [3], among others) has provided some guidance, but the complexity of computing the impact speed by assessing PTW component (and crash partner) energy dissipated during impact has not been well addressed.

The purpose of this research is to provide a methodology of relevant computations in common real-world PTW (motorcycle) crashes to assess or evaluate the energy dissipated in the motorcycle and the crash partner (or other vehicle; OV). To assess this one must consider the energy dissipated during the crash, most importantly the bending and breaking of various parts and structures. The computations presented are from real-world collisions and a full-scale controlled 80-kph experimental impact test of a motorcycle onto the side of a panel truck. An additional experimental component test; namely deformation data for a motorcycle fuel tank, is also presented.

The presented data and calculations will provide the accident reconstructionist with tools to evaluate real world crashes, particularly the assessment of a deformed, dented, bent and/or broken vehicle. This permits the analyst the ability to determine velocity associated with impact speed.

Analysis of the accident scenario of powered two-wheelers on the basis of real accidents

Analyse des Verkehrsunfallgeschehens motorisierter Zweiräder auf Basis von Realunfällen

Dipl.-Ing. Henrik Liers
Dr.-Ing. Lars Hannawald, Dipl.-Psych. Maria Prohn

Verkehrsunfallforschung an der TU Dresden (VUFO) GmbH

Abstract

For the first time since 20 years the German national statistics of traffic accidents revealed an increasing number of fatalities and seriously injured persons in 2011. This negative development was especially caused by increasing numbers in all groups of vulnerable road users (VRU). Furthermore, the comparison of fatality reduction rates between several categories of road users shows that persons on motorcycles show the worst performance over years. Although every second fatality in German traffic accidents is still a car occupant, users of PTW make up around 20% in the meantime. Assuming further improvements in the field of car occupant protection this trend will continue.

For that reason, a study on the basis of real-world accidents was conducted to describe the accident scenario involving motorcycles and to identify the reasons of the above-described fact. Approximately 1.800 motorcycle accidents out of GIDAS database were used for the analyses.

The first part of the study deals with the question how representative the GIDAS database is for the German motorcycle accident scenario. Afterwards, detailed descriptive statistics on motorcycle accidents were presented considering numerous parameters about the accident scene, environmental influences, vehicle information, individual characteristics, interview data, injury severity and injury causation. One important point is the identification of the most frequent critical situations that are typical for motorcycle accidents. Furthermore, a special focus was on accident causation. Finally, conspicuous facts out of the analysis are emphasized.

All in all, the study gives a comprehensive overview about the German motorcycle accident scenario. One the one hand, the use of weighted GIDAS data allows representative and robust statements on the basis of large case numbers; on the other hand highly detailed conclusions can be drawn. The results of the study help to understand the particularities of motorcycle accidents and provide approaches for further improvements in the field of PTW safety.

Retrospective analysis of fatal motorcycle accidents and derivation of protective measures in complex braking maneuvers

Retrospektive Analyse tödlicher Motorradunfälle und Ableitung von Schutzmaßnahmen bei komplexen Bremsmanövern

Klaus Bauer[1], Steffen Peldschus[2], Sylvia Schick[1]

[1] Institut für Rechtsmedizin, Ludwig-Maximilians-Universität München

[2] Campus Tuttlingen der Hochschule Furtwangen

Abstract

Motorcycle riders have an up to 15 times higher risk for losing their life in an accident compared to car passengers. Since the year 2008 a decline is seen, but in comparison to the overall accident situation this decrease is unsatisfactory.

Therefore 48 fatal motorcycle crashes from the years 2004 to 2007 on Bavarian roads, in which the motorcycle rider was autopsied at the Institute for Legal Medicine of the LMU, were analysed.

These fatal accidents were reconstructed focusing on the braking maneuver, the speed of the motorcycle and the inclination angle, based on police reports as well as expert reports and photo documentation.

In Germany the lives of 100 – 200 motorcycle riders (12.5% -27%) per year could be saved, if every motorcycle was equipped with an antilock braking system.

45% of all fatal motorcyclist accidents on hand happened in bends. No one of the motorcycle riders drove with an inclination angle higher than 20 degrees, which is indicative for a deficit of riding skills. Almost every critical situation could have been avoided with only slightly increasing the inclination angle (up to 30 degrees).

Some riders (~ 30%) tried to escape this situation by braking. But the riders either locked the front wheel in an overreaction or could not compensate the upward roll movement of the bike and followed a path of leaving the lane and collided with oncoming traffic.

In the light of these results, the development of advanced antilock braking systems for motorcycles, being fully effective in bends, is to be addressed. Also, the training of the rider's inclination skills should be improved.

Kurzfassung

Das Risiko, als Motorradfahrer tödlich zu verunglücken, ist im Vergleich zu einem Pkw-Insassen deutlich höher. Auch wenn seit 2008 eine deutliche Reduktion zu erkennen ist, so kann der Rückgang der Getötetenzahlen im Motorradsektor im Kontext des Gesamtunfallgeschehens nicht als befriedigend angesehen werden.

Grundlage dieser Arbeit sind 48 tödliche Straßenverkehrsunfälle der Jahre 2004 bis 2007, bei denen der getötete Motorradfahrer im Institut für Rechtsmedizin der LMU obduziert wurde.

Die untersuchten Unfälle wurden anhand von Unfallberichten, Gutachten und Lichtbildern detailliert rekonstruiert. Hauptaugenmerk lag dabei auf der exakten Darstellung des Bremsmanövers, der Geschwindigkeit und der gefahrenen Schräglage des Motorradfahrers.

12,5% der untersuchten tödlichen Motorradunfälle wären mit einem konventionellen Antiblockiersystem vermeidbar gewesen, im Optimalfall sogar bis zu 27%. Das würde einer möglichen Reduktion von ca. 100 bis 200 getöteten Motorradfahrern pro Jahr im deutschen Straßenverkehr entsprechen.

45% der getöteten Motorradfahrer verunglückten in einer Kurve. Es konnte nachgewiesen werden, dass keiner der Fahrer einen Schräglagenwert von 20° überschritt. Daraus lassen sich Hinweise auf ein fahrerisches Defizit ableiten. Es wären annähernd alle kritischen Situationen ohne Reduzierung der Geschwindigkeit rein durch Vergrößerung der Schräglage (bis ca. 30°) vermeidbar gewesen. 30% der Fahrer versuchten zudem, ihre Kurvengeschwindigkeit durch ein Bremsmanöver zu verringern. Dabei erreichten sie entweder in einer Überreaktion die Blockiergrenze oder konnten das entstehende Aufstellmoment nicht kompensieren und wurden in den Gegenverkehr getragen.

Vor dem Hintergrund dieser Ergebnisse erscheint die Entwicklung eines voll kurventauglichen Antiblockiersystems zur weiteren Reduktion von Schwerstunfällen sinnvoll. Außerdem ist die Forderung nach verbesserten Aus-/ und Fortbildungsmaßnahmen zu stellen, um dem Schräglagendefizit der Motorradfahrer entgegenzuwirken.

Motorcycle Stability Control – MSC
The next step into safety solutions for motorcycles

Motorcycle Stability Control – MSC
Der nächste Schritt zur Fahrsicherheit für Motorräder

Gerald Matschl
KTM SPORTMOTORCYCLE AG

Matthias Mörbe
Bosch Engineering GmbH

Christian Gröger
Robert Bosch GmbH

Abstract

Antilock Braking Systems ABS for motorcycles has already contributed significantly to the safety of powered two wheelers on public roads. Another step forward to the improvement of the controllability of PTW has been achieved with MSC by combining traction control and the essential sensors.

By taking account of all available vehicle information from brakes, power train and vehicle dynamics the distribution of brake and traction forces is controlled by an algorithm so that in unforeseeable situations the driver can still be supported. This ability can be implemented with reasonable effort by of means of extended software and additional inertial sensors.

These fundamentals generate the basis for more systems which contribute to the safety in public traffic in the future.

The presentation is divided in two parts. Bosch will describe the motivation for the system and the development of function and components. The benefits of system functions and the effects of MSC are presented in an understandable and figurative way. KTM will explain the implementation into the vehicle, the achievements in safety and the feedback of the market by taking the example of the KTM 1190 Adventure.

The presentation will be closed with an outlook of potential system fusions in the future.

Kurzfassung

Nachdem das Antiblockiersystem ABS für Motorräder bereits einen erfolgreichen Beitrag zur Sicherheit im Straßenverkehr mit Zweirädern leistet, ist durch die Verbindung von Traktionskontrolle und der dafür notwendigen Sensorik mit MSC ein weiterer Fortschritt zur Steigerung der Beherrschbarkeit des Zweirades gelungen.

Unter Nutzung aller verfügbaren Fahrzeuginformationen aus Bremse, Antrieb und Fahrdynamik wird mittels eines Algorithmus die Verteilung der Brems- und Antriebskräfte so geregelt, dass in unvorhersehbaren Situationen der/die Fahrzeugführer/in weiter unterstützt werden kann. Da dazu über die vorhandene Ausrüstung des Fahrzeuges eine erweiterte Software und Inertialsensorik notwendig ist, kann diese Fähigkeit mit vertretbarem Aufwand implementiert werden.

Diese Grundlagen bilden die Basis für zusätzliche Systeme in der Zukunft, mit denen ein wesentlicher Beitrag zur Sicherheit im Straßenverkehr geleistet werden kann.

Der Vortrag ist zweigeteilt. Es wird von Bosch die Motivation für das System, die Funktions- und Komponentenentwicklung von MSC und die Vorteile in der Verknüpfung der Systemfunktionen aufgezeigt und die Wirkungsweise allgemeinverständlich und bildlich dargestellt. Von KTM wird am Beispiel der KTM 1190 Adventure die Implementierung im Fahrzeug und der Sicherheitsgewinn durch MSC erklärt und mit Rückmeldungen aus dem Markt ergänzt.

Den Abschluss bildet ein Ausblick in die Zukunft möglicher Systemverknüpfungen.

Improved Safety for Motorcycles, Scooters and Mopeds – Summary and Conclusions of the ITF/OECD Working Group

Verbesserte Sicherheit für Motorräder, Roller und Mopeds – Zusammenfassung und Ergebnisse der ITF/OECD-Arbeitsgruppe

Véronique Feypell de la Beaumelle

International Transport Forum, The Organisation for Economic Co-operation and Development (OECD)

IMPROVED SAFETY FOR MOTORCYCLES, SCOOTERS AND MOPEDS

SUMMARY AND CONCLUSIONS OF THE ITF/OECD WORKING GROUP

FINAL DRAFT

SEPTEMBER 2014

KEY MESSAGES

1. **Powered two-wheeler (PTW) numbers are growing and PTWs play a significant role in mobility**

   The powered two-wheeler population (which includes motorcycles, scooters and mopeds) has been constantly increasing and PTWs play a significant role in mobility in many countries, particularly in many of the world's large cities. Some riders use PTWs as their primary form of transport, others for recreation. For many it is the only affordable or practical means of individual motorized mobility.

2. **It is essential to consider PTWs needs in transport policy.**

   PTWs are becoming an important component of the transport system, which in many countries has given the priority to 4 wheel vehicles. PTWs now need to be properly integrated into mobility plans.

3. **PTW riders are at far more risk than car drivers**

   PTW riders are at far more risk than car drivers per km ridden in terms of fatalities and severe injuries entailing long-term disability. Moreover, they have not benefited at the same pace as car occupants from safety improvements over the recent decades. In OECD countries, they represent 17% of total fatalities on average, while PTWs account for about 8% of the motorized vehicle fleet. PTW fatalities often comprise a much higher proportion of total fatalities in low- or middle-income countries. In addition to human lost and associated pains, the economic costs associated with PTW crashes are significant. Investing in PTW safety can therefore bring important societal and economic benefits.

4. **Failures of perception and control are frequently implicated in PTW crashes**

   The most frequent PTW fatal crashes are: collisions at intersections, commonly involving problems of perception and appraisal by both the driver and the rider, and single-vehicle crashes, due to PTWs being more sensitive to external perturbations (for example road surface or weather conditions). Speeding (which encompasses excessive and inappropriate speed) and consumption of alcohol and drugs are critical factors in the occurrence and severity of PTW crashes, as for other road users.

5. **A safe system approach is required to improve the safety of PTWs**

   Growing PTW traffic makes it imperative to adopt safety interventions targeting this mode of transport, while integrating it into a safe system approach. The safe system approach recognises that road users can make mistakes or take inappropriate decisions. The role of the system is both to minimize the production of these errors and to protect road users from death and serious injuries when errors occur. While a safe system approach concern all countries, a tailored approach is required to take into account the local specificities when addressing powered two-wheeler safety.

6. **Improving PTW safety is a shared responsibility of all stakeholders**

   Improving the safety of PTWs should be a shared responsibility. All relevant stakeholders, including civil society organisations, need to be actively involved in the process of drawing up and

implementing a shared road safety strategy which includes safer behaviour of all road users, safer infrastructure and vehicles with enhanced safety features. PTW safety is not only the responsibility of governments, administrations, and manufacturers, but also PTW associations, insurance companies, the media, etc.

7. A toolbox of measures is required to improve the safety of PTW riders

A toolbox of measures is required to improve the safety of PTW riders within the traffic system. These measures must take into account the specific challenges associated with PTW mobility and also consider the variety of PTW users, insofar as some segments may be addressed with particular measures. A strategic approach should consider the most effective combination of measures according to the specific needs of individual jurisdictions.

8. Promoting appropriate behaviours of road users is a prerequisite

Licensing, training and education are essential tools for improving riding safety. Access to PTWs should be gradual, with a licensing system aiming to manage novice rider risks while riders are gaining experience and maturity.

Training for riders and drivers is an important to promote safer behaviours. In particular, novice riders of every kind of PTW should be trained. Training should not only focus on basic manoeuvring skills and mastering traffic situations, but also address attitudes towards safety, putting a special emphasis on hazard perception and defensive riding. Training should be designed to promote safe behaviours; performance focused training has not proven effective in increasing safety.

Other road users should also be made aware of the specific risks associated with the vulnerability and crash patterns of PTWs.

Enforcement of traffic rules is an indispensable ally of other safety measures. PTW operators, as with other operators of motorized vehicles, must comply with traffic rules. Enforcement activities to control speeding, drink driving, and non-respect of traffic rules apply equally to all motorized vehicle drivers.

Communication campaigns addressing required behaviour changes should be targeted at key groups of drivers and riders.

9. Helmets provide the most important protection against severe injuries and death

A helmet dramatically reduces the risk of being killed or severely injured and should be worn by riders and passengers of motorcycle and moped riders. All countries should have and enforce a helmet law. A 100% wearing rate is the only acceptable objective. In addition, the wearing of protective clothing with adequate safety standards – adapted to regional conditions - is essential to reduce the severity of injuries and should be promoted.

10. Vehicles with enhanced safety features can save lives

The car and motorcycle industries are continuously developing safety devices to both avoid crashes and mitigate their consequences. The prevention of crashes (also called active safety) is crucial for the safety of motorcyclists. Enhanced safety features in PTWs should be adopted, notably with the general introduction of advanced braking systems. Crash avoidance systems on board other vehicles may also contribute to reducing collisions with PTWs.

11. Self-explaining and forgiving roads contribute to lower crash risk

Infrastructure should be improved with the development of self-explaining roads – to guide drivers and riders to adopt appropriate behaviours speeds –, traffic calming measures and PTW-friendly infrastructure (forgiving roads).

The consequences of crashes are particularly exacerbated for PTWs by the aggressiveness of obstacles. Infrastructure measures, including the design of junctions (for example round-abouts) and the choice of barriers and road surfaces, require an integrated impact assessment taking into account all roads users and local conditions.

Engineers, road designers and providers, local authorities, road safety auditors and inspectors should be trained to consider PTWs in the design, construction, maintenance and operation of roads, and be provided with the necessary risk assessment tools to make the right decisions.

12. It is essential to extend our knowledge of PTW mobility and crash mechanisms

Additional research is needed to better understand current challenges related to PTW mobility and safety. There is a great need to develop and apply relevant methods, tools and indicators to measure PTWs in traffic flows and analyse their mobility and behaviour. In particular, exposure data are needed to better understand the specific crash characteristics of PTWs. More in-depth investigations will allow a better understanding of fatal and serious injury crash patterns and causes. Lack of conspicuity and other perception problems deserve further study in order to identify key contributing factors and effective countermeasures.

Operational research and development is needed to achieve a traffic system which better integrates and protects PTWs in a cost efficient manner. Intelligent Transport Systems (ITS) require more research and development on its capacity to prevent and mitigate PTW crashes. Further investigation is required regarding the content and effectiveness of training, including post-licence training, with the aim of improving the behaviour of both drivers and riders.

The Shared Road to Safety – A Global Approach for Safer Motorcycling

Der gemeinsame Weg zur Sicherheit – ein globaler Ansatz für sicheres Motorradfahren

Edwin Bastiaensen

International Motorcycle Manufacturers Association (IMMA)

The Shared Road to Safety
A Global Approach for Safer Motorcycling

IMMA INTERNATIONAL MOTORCYCLE MANUFACTURERS ASSOCIATION

May 2014

The Shared Road to Safety
A Global Approach for Safer Motorcycling

IMMA INTERNATIONAL MOTORCYCLE MANUFACTURERS ASSOCIATION

IMMA Project Leader:
Dr. Veneta Vassileva, Safety Coordinator, ACEM - The Motorcycle Industry in Europe

Editorial Team:
Craig Carey-Clinch, Policy Advisor, Motorcycle Industry Association GB and MD Rowan Public Affairs Ltd (lead Editor)
Jane Stevenson, Government Affairs Manager, EMEA, Harley-Davidson Europe Ltd

Contact:
Edwin Bastiaensen, Secretary General, IMMA
info()immamotorcycles.org

Website:
www.immamotorcycles.org

Content

Preface

At worldwide level there is an increased use of Powered Two Wheelers[1] in both developing and developed countries. As a result of urbanisation, associated congestion and the shift in economic balance, there is an increased need for mobility in developing nations. More and more people choose PTWs as a result of the benefits they provide. At the same time there is a global challenge to ensure sustainability from a road safety perspective.

In many situations, PTWs have not been adequately addressed in local, national and regional policy plans. This needs to change by introducing inclusive policy plans – which means a positive consideration of PTWs in transport plans, in an integrated perspective.

The safety of PTW riders is a high priority of the global motorcycle industry as represented by IMMA. Safer motorcycling leads to more sustainable motorcycling and the realisation of the key benefits that motorcycles can bring to transport and the economy.

As road safety policy and practice evolves in a global sense, it is becoming increasingly clear that there is a role for the global institutions in supporting countries and regions in their efforts to reduce the social and economic toll of road casualties. The UN Decade of Action on Road Safety is a welcome initiative towards this end.

However, equally clear is the fact that the global institutions need to take a holistic approach to road safety issues, particularly in developing countries. The mere 'imprinting' of developed nation road safety policies and strategies on developing countries could otherwise have unintended economic and social effects on such countries.

Road safety strategy should be focused on a progressive improvement of both road safety policy and practice standards of road safety and not on immediate implementation of advanced safety policies in countries and regions which will require time to develop institutions, economics and infrastructure to enable them to move towards the highest standards. As illustrated in this document, still too many countries lack even basic standards for roads and IMMA strongly believes that the path to enhanced road safety comes primarily from first securing basic infrastructure and through the establishment of sustainable and respected traffic and transport policy making processes.

Both in developing and in more developed countries, the sharing of best practices is key, like the sharing of proven techniques in social and safety policy designed to support safer roads. A number of examples are illustrated in this document as they relate to motorcycles.

IMMA believes that the most sustainable route to safer motorcycling lies within taking a comprehensive approach to safety policy and practice, based on a 'shared responsibility' approach.

In order to realise this and ensure that safety is managed with an even hand and on a level playing field, the first and most important step is to recognise motorcycling's place within society and overall transport strategies. Indeed, the OECD firmly stated this key point in their primary recommendations from the 2008 Lillehammer safety conference.

Such an approach will open up the ability to integrate PTW safety as part of broader transport planning. This will result in not only fewer PTW casualties, but also the important role that motorcycling plays in social, business and emergency transport.

1 The term "Powered Two-Wheeler" (PTW) covers a wide diversity of vehicles. The products are divided into different segments such as moped, scooter, street, classic, super-sport, touring, custom, supermoto and off-road motorcycles. In international regulatory environment, PTWs fit under the term vehicles of category L. IMMA represents mopeds, motorcycles and three-wheelers. Therefore, IMMA refers to PTWs as Powered Two and Three wheeled Vehicles.

Cycling is a worldwide important mode of transport which shares many common issues with motorcycling when it comes to safety, infrastructure policy and issues arising from other road users. Like cycling, motorcycling is not in itself dangerous. But riders of both modes are subject to certain vulnerabilities on the world's roads. By recognising the socially positive attributes of cycling, much has been done to improve cycle safety and improve visibility within traffic. The same approach is now needed for motorcycling.

This document 'A Global Approach to Safer Motorcycling' updates and replaces the IMMA motorcycle safety document 'HHRT – Headlight, Helmet, Road Surface and Training' published in 2010. The key principles in HHRT still apply, but the new document includes a selection of global best practices for policy makers' consideration and implies a wider perspective on sustainable road safety – the position of the Powered Two Wheeler (PTW) in society, its economic contribution, how PTWs are used and how infrastructure can be developed to support rider safety. This document emphasises the importance to consider local, national and regional differences of motorcycling in the context of policy making.

IMMA is delighted to have recently become a member of the UN Road Safety Collaboration and looks forward to assisting discussions on key matters of road and motorcycle safety.

IMMA recommends this document for the use by the global institutions, safety managers and policy makers world-wide, as a valuable resource for developing holistic motorcycle safety and transport policies.

Shungo Akizuki,
Chairman,
IMMA Road Safety Working Group 2013-2014

Dato' Syed Mohamad Aidid
Sponsor, IMMA President 2010 - 2012

The safe ride to the future.
The motorcycle industry's commitment to road safety

Die sichere Fahrt in die Zukunft.
Das Engagement der Motorradindustrie für die Verkehrssicherheit

Antonio Perlot

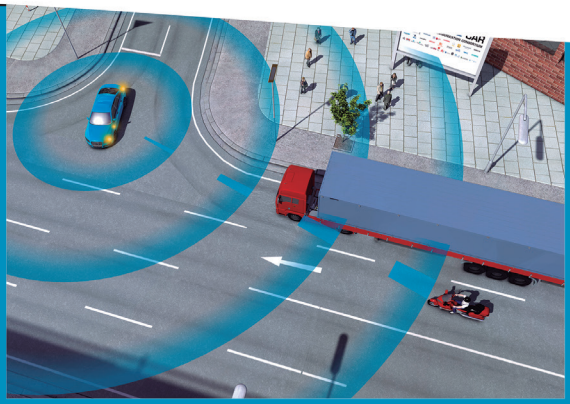
Association des Constructeurs Européens de Motocycles (ACEM)

European Association of Motorcycle Manufacturers

acem

The safe ride to the future

The motorcycle industry's commitment to road safety



September 2014

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Foreword by ACEM President

Over the last decade we have witnessed a substantial decrease in the number of road casualties affecting powered two-wheelers (PTWs). This decrease, albeit less pronounced than in other means of transport, takes place against a substantial expansion of the PTW circulating park. The motorcycle industry's long-term commitment to road safety has played an important part in achieving this positive result.

In 2001, for example, ACEM members voluntarily committed to fit all of their new vehicles with automatic headlamps on (AHO). In 2004, ACEM signed the European Road Safety Charter committing the manufacturing members to offering at least 50% of their street models with advanced braking systems as an option by 2010. After this initial target was surpassed, ACEM manufacturers set a further objective: 75% of street motorcycle models offered on the market in 2015 will be available with an advanced braking system as an option or as standard equipment.

Subsequently, some of these industry commitments were incorporated into Regulation 168/2013 (the type-approval regulation). Furthermore, ACEM strongly advocated for the strengthening of other safety provisions of this text including anti-tampering and market surveillance activities.

The important progress made on road safety, however, should not be a reason for complacency. Road fatalities still affect a high number of vulnerable road users, particularly powered two-wheeler riders. This is an issue that requires decisive action. To effectively address this major challenge, industry efforts must be complemented with action by other key stakeholders. We all have a responsibility for road safety – either as transport providers, road users or road authorities.

For this reason, better and more effective partnerships, particularly between vehicle manufacturers and policy-makers, must be established. We must build on the political momentum generated by the UN Decade of Action for Road Safety[1] and the European Commission's objectives to reduce the number of road deaths on Europe's roads by half[2] . We must redouble our efforts, at European, national and local level, in order to create a safer environment for PTW users.

By improving road safety levels we will also be able to further reap the considerable benefits that motorcycling brings to society. Motorcycling offers quality of life, among other things, through better access to jobs and services, affordable mobility, and the enjoyment of sports, leisure and tourism.

1. United Nations Decade for Action. Resolution A/RES/64/255 of 10 May 2010, the UN General Assembly.
2. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: Towards a European road safety area: policy orientations on road safety 2011-2020.

Moreover, motorcycles produce lower carbon emissions in aggregate than cars, help to reduce traffic congestion, and resolve parking issues. These large societal benefits are sometimes overlooked in the public debate.

I am particularly grateful to all the people who contributed to developing *The safe ride to the future*. This report not only elaborates on past and ongoing safety initiatives, but also contains proposals that are a crucial step in making Europe's roads better and safer for all of us.

Stephan Schaller

ACEM President
BMW Motorrad President

Executive summary

- Data from the International Road Traffic Accident Database shows that between 2010 and 2012, the number of riders killed in Europe decreased from 5,275 in 2010 to 4,566 in 2012, a reduction of 13.4%. An analysis by segments shows that deaths of motorcyclists went down by 11.3%, whilst the number of moped riders that suffered fatal accidents went down by almost 27.9%. All this takes place parallel to the substantial growth of PTW use across Europe (25.2% between 2001 and 2012).
- The motorcycle industry has played a key role in this. Continuous improvement in safety features, including advanced motorcycle design, new intelligent features and new braking, lighting and suspension systems have been instrumental to increase motorcycling safety. Different road safety and training campaigns, often led by the motorcycle industry, have also made significant safety contributions.
- Currently ACEM members are working to improve road safety by deploying Intelligent Transport Systems (ITS) on PTWs in Europe. As part of this process, in March 2014 ACEM members adopted a Memorandum of Understanding on ITS. By signing this Memorandum, the motorcycle industry agreed to initiate the deployment of safety-relevant cooperative ITS on PTWs in Europe and committed to have at least one of their models available for sale with a cooperative ITS, either as standard equipment or as optional equipment, by 2020.
- Furthermore ACEM is currently conducting research on an embedded eCall system for motorcycles. The minimum technical requirements needed for such a system have already been defined and research activities are ongoing in order to address the technical challenges of this emergency system.
- Another key factor to improve safety records for PTWs is training. It is vital that riders receive the appropriate training so that they can ride confidently and safely. In order to help PTW users make informed decisions about their training, ACEM and the German Road Safety Council[3] have joined forces to start promoting high quality post license training schemes across the EU through DVR's Quality Seal. Moreover, other similar quality labels are currently being developed in the EU. Along with the DVR Quality Seal, these schemes could also help to increase the visibility of the best training programmes available and pave the way towards more uniform quality standards for training in Europe.

3. DVR, Deutsche Verkehrssicherheitsrat.

- Over the last decade substantial progress has been made in terms of reducing the number of fatal accidents involving riders. However, there is still room for improvement. The motorcycle industry has taken up the challenge to make a positive difference for motorcyclists across the EU. For this reason, ACEM will organise, in close cooperation with industry associations and other key stakeholders, a series of thematic workshops. Its objective will be to gain a better understanding of what actions can be taken at local, regional and national level in order to improve safety outcomes for PTW riders.
- Some of the topics to be covered by the workshops will include: mainstreaming of PTW needs into national transport strategies, prevention of safety failures through periodical technical inspections, fight against illegal tampering and implications of design and maintenance of road infrastructure on road safety.

Introduction

Powered-two and three-wheeler user[4] safety is an absolute priority for the motorcycle industry. Over the last decades ACEM members have made considerable efforts to develop technologically advanced vehicles with enhanced safety characteristics. The motorcycle industry has also taken the lead on road safety campaigns and promoted pre- and postlicense training among users. This effort has been instrumental in substantially reducing the number of fatal accidents involving powered two- and three-wheeler users in the EU.

As the latest data available from the International Road Traffic Accident Database[5] shows, the number of fatal accidents involving powered-two and three-wheeler users decreased from 7,554 to 4,566 between 2000 and 2012. This represents a reduction of 39%. More recently, between 2010 and 2012, the number of riders killed decreased from 5,275 in 2010 to 4,566 in 2012, which represents a reduction of 13.4%. An analysis by segments shows that deaths of motorcyclists went down from 4,303 in 2010 to 3,815 in 2012, a reduction of 11.3%. In the same period, the number of moped riders that suffered fatal accidents in the EU went down from 975 to 703, a reduction of almost 27.9%. All this takes place parallel to the substantial growth of PTW use across Europe. Between 2001 and 2012 the number of PTWs on Europe's roads increased from 29,230,320 in 2001 to 36,598,620 in 2012 (25.2%).

Although this downward trend is encouraging, it should not be a reason for complacency. ACEM believes that the number of fatalities amongst PTW users can, and must, be further reduced. The industry is also a supporter of the Commission's policy objective of halving the overall number of road deaths in the EU by 2020 which began in 2010.

ACEM members have a long road safety track record, based on innovation. However this is only one part of the integrated approach that is required to responsibly address the issue of road safety. A genuine integrated approach to road safety should include not only vehicle technology but also human behaviour and infrastructure. Therefore industry-led initiatives must be complemented by decisive public action. In particular, decision makers should address strategic policy areas including: enforcement of road traffic rules, riders' behaviour on the road and infrastructure design and maintenance. These areas should be addressed through inclusive policy plans at local, regional and national levels.

Safer motorcycling leads to more sustainable motorcycling and the realisation of the key benefits that motorcycles can bring to transport and the economy. The core motorcycle industry employs about 125,000 people in the EU and the aggregated turnover of the sector (manufacturing, plus direct upstream and downstream activities) amounts to 27 billion euros. Additionally, individual country based economic studies indicate that the economic

4. Throughout this document references made to powered two- powered two- and three-wheelers should be taken to include motorcycles and mopeds, as well as three wheelers.

5. The IRTAD database is an OECD programme that collects international accident, victim and exposure data on a continuous basis. It covers 29 OECD countries including 17 EU Member States.

contribution of the wider activity of motorcycling within society is considerable, with a fiscal multiplier effect that goes far beyond the basic industry figures illustrated above. This is particularly the case when areas such as travel and tourism, accessory manufacture and supply, the aftermarket industry, insurances, sport, fuels and oils are taken into account. All these sectors rely on a vibrant and growing motorcycle industry, with this illustrating how safety and transport policy needs to recognise and support the contribution of motorcycling to jobs, growth and economic recovery.

Furthermore, PTWs are increasingly used by commuters to provide an answer to traffic congestion. In many countries of the EU, for example, leisure machines offer a 'cross over' function, also being used for commuting. In the UK for example, the Government estimates that over 60% of PTW distance travelled is for commuting, utility or socially practical purposes. Further, the majority of motorcycling trips (60%) are for work, business or education purposes compared with only 27% for car trips[6]. PTWs are also used for sport and leisure and attract many around the world for the personal benefits they can bring: social interaction with others, the personal and economic perspective of PTW tourism and the pleasure of riding as an end in itself.

The most sustainable route to safer motorcycling lies within taking a comprehensive approach to safety policy and practice, based on a 'shared responsibility' approach and through exploring proper linkage with 'command' transport policy. Instead of public authorities approaching motorcycling issues via thinking such as 'what do we do about the motorcycle safety problem?', a new approach should be pursued. This will be based around the attitude of: 'Motorcycling carries many socio-economic benefits and an opportunity to offer the public a further alternative to the car for commuting. What do we need to do to support motorcycling, decrease casualties and reduce rider vulnerability?'.

In order to realise this and ensure that safety is managed with an even hand and on a level playing field, the first and most important step is to recognise motorcycling's place within society and the overall transport system. Indeed, the Organisation for Economic Cooperation and Development (OECD) firmly stated this key point in their primary recommendations from the 2008 Lillehammer safety conference. Similar conclusions were reached at "A Shared Road to Safety. A Global Approach for Safer Motorcycling", an event organised by the International Motorcycle Manufacturers' Association during the International Transport Forum, in May 2014.

Such an approach will open up the ability to integrate motorcycle safety as part of broader transport policy/planning and enable a reduction in rider vulnerability and improve accessibility as part of this. This will result in not only fewer motorcycle casualties, but also the important role that motorcycling plays in social, business, practical and leisure transport.

6. United Kingdom Department for Transport, "Transport Statistics Bulletin. Compendium of Motorcycling statistics 2009". The full document is available at http://goo.gl/t2atXR

Document structure

The safe ride to the future is structured in four main sections.

The first one provides an overview of the most significant industry-led initiatives in the field of road safety (e.g. key safety technology developments, advocacy actions, accidentology research).

The second section looks into the future of motorcycling. It discusses the industry's vision of intelligent transport systems and includes a memorandum of understanding agreed upon by ACEM members, which commits industry players to equip new vehicles with ITS features.

The third section of this document explains why there is an urgent need for tailored policy interventions at the national level and outlines upcoming industry initiatives in this area.

The fourth section elaborates on the DVR Quality Seal, an initiative to identify and promote high quality post license training schemes.

Lastly, the conclusions summarise the key points of this document. They also provide concrete policy recommendations to national and European decision-makers, with the aim of improving the road safety outcomes for PTW users.

The quality seal of the German Road Safety Council for Motorcycle Safety Trainings in Europe

Das Qualitätssiegel des Deutschen Verkehrssicherheitsrates e.V. für Motorrad-Sicherheitstrainings in Europa

Hartmut Kerwien
Dr. Kerwien Forschung-Beratung-Training

Jürgen Bente
Deutscher Verkehrssicherheitsrat (DVR)

Abstract

The DVR quality seal can look back on a successful seven-year history. During this period, more than 40 training providers have made use of the possibility to provide their training with the DVR seal of quality. The vast majority of providers has the seal of quality for training programmes involving the use of motorcycles. Where the distribution of the seal has mainly been limited to Germany, it is now possible to apply for the seal of quality throughout Europe, to shift motorcycle safety training to a consistently high level of quality.

The focus of the scientifically based DVR seal of quality has so far been to apply a uniform set of criteria with the following quality dimensions to the various types of training:

- Content
- Method
- Training and continuing training system for trainers
- Quality assurance

Innovations in the training landscape made it necessary to adapt and expand the list of criteria. In the future, there will be five different catalogues for training on closed practice areas (classical form of training), for training in actual traffic and for three types of training with the use of simulators. The latter three types are mainly related to truck and bus simulator training for professional drivers as well as training for action teams from emergency services and the fire brigade.

The seal will continue to provide customers with a simple guide and the information that the trainee can expect a defined degree of quality and a reputable offer with the core objective of 'improving road safety'.

The content, structure and the assessment system of the DVR quality seal are introduced; information about the guidelines on and experiences with the awarding of the seal is also provided. Particular emphasis is placed on motorcycle training on training grounds and in actual traffic.

Kurzfassung

Das Qualitätssiegel des DVR kann mittlerweile auf eine erfolgreiche siebenjährige Vergangenheit zurückblicken. In dieser Zeit haben bereits über 40 Trainingsanbieter von der Möglichkeit Gebrauch gemacht, ihre Trainings mit dem DVR-Qualitätssiegel zu versehen. Der weit überwiegende Teil der Anbieter besitzt das Qualitätssiegel auch für Trainingsangebote im Bereich Motorrad. Beschränkte sich bislang das Verbreitungsgebiet des Siegels in der Hauptsache auf Deutschland, wird es nun möglich sein, das Qualitätssiegel europaweit zu beantragen, um die Motorrad-Sicherheitstrainings auf ein einheitlich hohes Qualitätsniveau zu bewegen.

Das wissenschaftlich fundierte DVR-Qualitätssiegel war bislang so angelegt, das für verschiedene Trainingsvarianten ein einheitlicher Kriterienkatalog mit den Qualitätsdimensionen

- Inhalt,
- Methode,
- Aus- und Fortbildungssystem für Trainer und
- Qualitätssicherung

Verwendung fand. Innovationen in der Trainingslandschaft machten es notwendig, den Kriterienkatalog anzupassen und auszuweiten. Zukünftig wird es fünf unterschiedliche Kataloge für Trainings auf abgesperrten Übungsgeländen (klassische Trainingsform), für Trainings im Realverkehr und für drei Varianten von Trainings mit Einsatz von Simulatoren geben. Letztere drei Varianten beziehen sich vor allem auf Lkw- und Bussimulatortrainings für Berufskraftfahrer sowie auf Trainings für Einsatzkräfte der Rettungsdienste und der Feuerwehr.

Auch zukünftig wird das Siegel dem Kunden eine einfache Orientierungshilfe bieten und darüber informieren, dass der Trainingsteilnehmer mit einer definierten Qualität und einem seriösen Angebot mit dem Kernziel „Erhöhung der Verkehrssicherheit“ rechnen kann.

Es werden die Inhalte, die Struktur und das Bewertungssystem des DVR-Qualitätssiegels vorgestellt sowie über die Vergaberichtlinien und über Erfahrungen mit der Siegelvergabe berichtet. Dabei wird besonderes Augenmerk auf Motorradtrainings auf Trainingsgeländen und im Realverkehr gelegt.

Long-term effects of a one-day advanced rider training

Langfristige Auswirkungen eines eintägigen Motorradsicherheitstrainings

Saskia de Craen, Marjolein Boele-Vos
SWOV Institute for Road Safety Research, The Hague, The Netherlands,

Arjan Everink
KNMV Royal Dutch Motorcycle Association

Abstract

There is an on-going search for safety measures to improve road safety for motorcyclists. One popular measure is motorcycle training. Although often considered an effective road safety measure, there are only few thorough studies on rider training and they seldom show a positive safety effect. This study aims to assess – in compliance with scientific standards - the safety effects of the advanced rider training 'Risk' by KNMV (Royal Dutch Motorcycle Association).

In 2012 the short term effects of this one-day training were evaluated (Boele & De Craen, submitted). Motorcyclists were randomly assigned to an experimental condition (n=137 followed the 'Risk' training) and control condition (n=85). In 2013 and 2014 the long term effects, 1 to 1,5 year after the 'Risk' training, were evaluated with an extra post-test of the experimental group (n=77) and the control group (n=34) . At pre- and both post-tests, participants completed a questionnaire and their traffic behaviour was assessed in an on-road ride. A selection of participants took a hazard perception test at the post-tests. Results of the short term evaluation showed that trained participants were rated higher on safe riding than the control group in the on-road riding assessment. This effect was still present in the long term post-test. Overall the trained riders performed better on the hazard perception test at the short term post-test, but this difference between control and experimental group was not significant at the long term post-test. At none of the test moments trained riders were more positive about their own riding skills than the control group.

This study is a step forward to demonstrate that motorcyclists' traffic behaviour can be positively influenced by the right training. Crucial for this training is that it did not lead to overconfidence, while it quantifiably improved traffic behaviour even for the long-term.

Conceptual Architecture of Motorcycle Simulators for the Training of Novice Riders

Konzeptionelle Architektur von Motorrad-Simulatoren für die Ausbildung von Anfängern

Prof. PhD. Rodrigo de Souza Vieira[1], Manuel Steidle[2],
Alessandro Vieira[1], Ricardo Antonio Pralon Santos[2]

[1] UFSC

[2] CERTI Foundation

Abstract

Brazilian traffic presents alarming rates of accidents and deaths. There are over 42,000 deaths per year in a country with 202 million inhabitants. These indexes have been growing in recent years, particularly among motorcyclists, and studies show that most of these accidents are determined by human error. Thus, a better traffic education constitutes a social need for security and public health in Brazil. In this context, training in vehicular simulators emerged as an alternative for improving the traffic quality. This article's main objective is to present the study conducted by the authors on motorcycle simulators for training of novice drivers. It also aims to evaluate three models of motorcycle simulators: a commercial one, the "Honda Riding Trainer", a modified version of this and a prototype developed for the study. The study is based on a literature review of motorcycle simulator solutions all around the world. This review was followed by observations of the use of the 3 models, involving 60 students of a Driving School from a Brazilian suburb. As a result, the paper gives a revision of requirements of motorcycle simulators and an optimized architecture proposal of these systems to the Brazilian context, in order to provide better driving training for safer traffic.

Keywords: Motorcycle Simulators; Training for Motorcyclists; Traffic Safety.

In-depth study of rider trainees and novices: impacts for a renovation of licensing test and the design of motorcycle training modules in France

Tiefenstudie über Führerscheinanwärter und Fahranfänger: Ergebnisse für eine Überarbeitung der Führerscheinausbildung und Motorradtrainingseinheiten in Frankreich

Stéphane Espié[1], Samuel Aupetit[2], Flavien Delgehier[3], Samir Bouaziz[3]

[1] Université Paris-Est, Ifsttar, Marne la Vallée, France

[2] DEDALE S.A.S, Paris, France

[3] Université Paris Sud, Orsay, France

Abstract

The risks associated with riding powered two-wheelers for novices (who have held a licence for less than two years) are a major public health issue in France and in Europe. However, scientific attempts to achieve a better understanding of their behaviours are limited although its potential value both with regard to research and public policies. This is why we conducted two in-depth researches focussing on 1) the initial training in motor-school, 2) the problem faced by just licensed novices on road.

In both study we used an innovative (for PTW) methodology called in-depth naturalistic riding study (iNRS) that combine objective data (sensors) but also subjective data (face-to-face interviews conducted by psychologist). The interviews allow to identify the contextual clues gathered by the rider and the motives that underlie his/her decision making process.

Six novice motorcyclists and 20 trainees were studied. A systematic monitoring of all the daily trips made by the novices for more than two months and during training sessions for the trainees was carried out. This paper deals with the novices' study.

The collected data permit to identify 248 risky events, to specify their dynamics and context of occurrence. These situations were then grouped together to form clusters of typical incident scenarios on the basis of their similarities.

In our presentation we will detail the methodology used (iNRS), and the results we acquired that lead to a change in the French licensing test (applied since January 2013) and for the design of new training modules (on-going). The discussion will insist on (1) the benefit of this approach for improving training and licensing systems and gaining a better understanding on PTW riding, and (2) some guidelines for optimizing future naturalistic riding studies.

Development of a method for analysis and effectiveness evaluation of driving safety functions in powered two-wheelers

Entwicklung einer Methode zur Analyse und Wirksamkeitsbewertung von Fahrsicherheitsfunktionen in motorisierten Einspurfahrzeugen

Dipl.-Ing. Kay Büttner, Dr.-Ing. Volker Quarz
TU Dresden

Dipl.-Ing. Franka-Maria Volk
BMW

Abstract

The present study deals with an analysis for sphere of action for especially active safety systems in powered two-wheelers. The aim was to analyse objectively the effectiveness of advanced driver assistance systems (ADAS), vehicle dynamics control systems (VDCS) and other auxiliary functions to increase road safety of motorcycles, based on real accident data. According to a detailed descriptive analysis of accident data using the GIDAS- database, the entirety of accidents of motorcycles was summarized in a multistage process into 11 accident scenarios out of 135 individual accident types. It succeeded to categorise nearly 1600 motorcycle accidents out of GIDAS.

Continuing, the accident emergence phase of the respective accident scenarios has been described in detail to derive specific requirements of ADAS and VDCS according to the particular accident scenario. Furthermore, existing driver assistance systems and control systems have been analysed for basic functionality and transferred into a function-based scheme. Therefrom causal loops and signal flow diagrams were derived. Together with the specific requirements this helped to carry out the weighted evaluations of the effectiveness of individual functions based on the particular accident.

In order to simulate the mentioned accident situations realistically and to study the potential to increase active Safety of assistant systems in simulative researches, it is to model the motorcycle as a dynamic system in the accident simulation environment. Previously, the Matlab/SIMULINK-based simulation environment of “Verkehrsunfallforschung an der TU Dresden GmbH” did not include dynamic motorcycle models. In the cooperation project, the environment has been extended, so that a MBS-motorcycle model can be included in the simulation of accident scenarios. Therefore a code-export-interface was used in the SIMPACK-simulation environment.

The MBS-models are set up in SIMPACK with a motorcycle kit developed at TU Dresden, which allows simple configuration of two-wheeled models from pre-defined and fully parameterised assembly models. During the cooperation project, the functionality of the kit has been extended, especially to represent the bottom contact of an overturned motorcycle and the slide of the overthrown two-wheeler on a road surface.

The driver behavior is taken into account by means of a co-simulation with a Matlab-modeled driver controller. This can be extended by functions of assistance systems. In the project the effect of ABS in a typical accident situation was studied exemplarily.

Motorcycle-Car Multi-Driver Simulation – A new methodological Approach towards increased Powered Two Wheeler safety

Die vernetzte Motorrad-Pkw Simulation – ein neuer methodischer Ansatz zur Steigerung der Verkehrssicherheit für motorisierte Zweiradfahrer

Dipl.-Psych. Sebastian Will[1], Dipl.-Inform. Christian Mark[2],
Dipl.-Psych. Alexandra Neukum[1], Dr. Armin Kaussner[1]

[1]Wuerzburg Institute for Traffic Sciences, Veitshoechheim, Germany (WIVW GmbH)

[2]Center for Traffic Sciences, Würzburg, Germany (IZVW)

Abstract

Motorcyclists are still at high risk of getting involved in accidents that result in injury (DEKRA, 2010). Especially interactions with cars and trucks bear a high risk potential, e.g. if motorcyclists are overlooked or if their acceleration is underestimated. In 2012, in Germany alone, 14.129 crashes between motorcycles and other road users were registered (DESTATIS, 2012). Thus, it seems reasonable to not just focus on motorcycle immanent countermeasures, but broaden the research efforts towards interactions with other road users.

This paper deals with the new methodology of Motorcycle-Car Multi-Driver Simulation realized at the WIVW GmbH. It enables a motorcyclist and a car driver to interact in the same virtual environment. This approach widens the set of research methodologies to investigate safety-relevant aspects of Powered Two Wheelers (PTW). The basic idea of linking driving simulators has already been established for cars (Mühlbacher, 2013). The multi-driver simulation allows deeper insight into interactions and mutual behaviour adoption. Furthermore, it is possible to investigate and evaluate new technologies such as advanced rider assistance systems, on-bike information systems or bike2X-communication under controlled conditions and from a new point of view. The components of the Motorcycle-Car Multi-Driver Simulation (hardware, dynamic maps etc.) as well as relevant characteristics of study planning and conduction will be addressed. Additionally, results from the project UR:BAN, which was funded by the BMWi, will be presented exemplarily. Therein, the influence of a tailgating motorcycle on the car ahead was assessed. Taking eye movements, driving parameters and subjective ratings into account, the study revealed poor influence of the tailgating motorcycle. The car drivers were not significantly distracted and still able to react adequately to sudden critical events.

Based on these first experiences, the Motorcycle-Car Multi-Driver Simulation is a promising methodology in the field of empirical traffic sciences with the potential to increase PTW safety.

Keywords: powered two wheeler, motorcycle, methodology, simulation

A study of visual interface on development of Vehicle to X communication system for motorcycles

Studie über ein visuelles Interface bei der Entwicklung von „Vehicle to X-Kommunikationssystemen“ für Motorräder

Taro Onoue, Yoshiaki Uchida, Kazuyuki Umiguchi, Kenji Seto

YAMAHA MOTOR CO., LTD.

Abstract

We have been developing visual interfaces on an advanced rider assistant system using vehicle to X communication. In providing the information about an object that is not directly visible for a rider, which is a feature of the V2X system, motorcycles have less ways to provide the information, and moreover, can provide less the information at the same time than automobiles. Therefore, we evaluate the best way to provide the information, and what information is useful for riders using the V2X system for a rider by testing on actual traffic environment. In this paper, we focus on the visual interfaces, and will present the experimental study. We have experimentally developed a V2X system for motorcycle based on the DRIVE C2X specifications, and measured the vehicle and rider behavior when the system provides information in the field operational test of DRIVE C2X. The use cases are IVS (In-Vehicle Signage), CBW (Car Breakdown Warning), and RWW (Road Works Warning). Three test riders are not ITS specialists. The motorcycle is equipped with a LCD, 3 LEDs, and a helmet mounted speaker as the interfaces for a rider. As a result, it is found that an effect on rider behavior is different depending on the use cases in using these interfaces. In addition, the information of distance to the object and the information of urgency to the event as well as the event pictogram (symbol/icon) are required by the riders.

Motorcycle riding simulation to assess instrument and operation concepts and informing riding assistance systems

Motorrad-Fahrsimulation zur Absicherung von Anzeige-Bedien-Konzepten und informierenden Assistenzsystemen

Sebastian Guth

BMW Motorrad, Germany

Abstract

Due to the increasing functionalities in the motorcycle sector (entertainment system, navigation, on-board computer, etc.), BMW Motorrad acts within the scope of the company's strategy *Safety 360°* [2] and finds itself obligated to optimize the communication between vehicle and rider. This includes both rider inputs as well as information output by the motorcycle which is presented to the rider in an increased manner during the ride. The aim is to counteract the potential that the rider is overburdened by the new functionalities, system operations or the flood of information which can result in frustration regarding the product or even in a decreasing riding performance. Identifying and eliminating these potential risks accounts for safe riding.

Based on this background, a method has been developed to measure user acceptance, rider workload and distraction by the increase of new functionalities and by new instrument and operation concepts. This allows rating and comparing of different concepts. To provide a reproducible, safe test environment, a motorcycle simulator has been developed in cooperation with the Wuerzburg Institute for Traffic Sciences (WIVW GmbH) and the Institute of Automotive Engineering (FZD) at the Technical University of Darmstadt.

Whereas flight and car simulators are widely used for education, testing and research, the use of motorcycle simulators is still rather uncommon, most of all in the research and testing sector. In this publication the challenges and resulting minimum requirements to develop a motorcycle simulator are presented. Special focus is placed on the subjective riding experience. During a BMW Motorcycles study, an existing static motorcycle simulator was tested and rated in order to find optimization potential for a new dynamic concept. The publication ends with a presentation of future upgrades of the static simulator derived from the developed requirements and based on the identified optimization potential.

Kurzfassung

Durch die stark steigende Anzahl an Funktionen im Motorradsektor (Entertainment-System, Navigation, Bordcomputer, usw.) sieht sich BMW Motorrad im Rahmen der Strategie *Sicherheit 360°* [2] vor der Herausforderung, die Kommunikation zwischen Fahrzeug und Fahrer zu optimieren. Dies betrifft sowohl Fahrereingaben als auch Informationsausgaben durch das Motorrad, die dem Fahrer in gesteigertem Ausmaß während der Fahrt bereitgestellt werden. Ziel ist deshalb dem Potential, dass der Fahrer von neuen Funktionen, Bedienkonzepten oder einer Informationsflut überfordert wird, frühzeitig entgegen zu wirken. Hierdurch kann eine Frustration bezogen auf das Produkt bis hin zu einer Verschlechterung der Fahrleistung vermieden werden. Die Identifikation und Eliminierung dieser potentiellen Gefahrenquellen unterstützt somit das sichere Fahren.

Basierend auf diesem Hintergrund wird ein Verfahren entwickelt, um die Nutzerakzeptanz, Fahrerbelastung und -ablenkung durch die Steigerung der Umfänge neuer Funktionalitäten sowie neuer Anzeige-Bedien-Konzepte zu messen. Hierdurch entsteht die Möglichkeit, unterschiedliche Konzepte bewerten und vergleichen zu können. Zur Bereitstellung einer reproduzierbaren, sicheren Testumgebung wird deshalb in Kooperation mit dem Würzburger Institut für Verkehrswissenschaften (WIVW GmbH) sowie dem Fachgebiet Fahrzeugtechnik (FZD) der Technischen Universität Darmstadt ein Motorrad-Fahrsimulator entwickelt.

Während Flug- und Pkw-Simulatoren ein etabliertes Werkzeug zur Ausbildung, Erprobung und Forschung darstellen, ist die Anzahl der Anwendungen von Motorrad-Simulatoren vor allem im Forschungs- und Erprobungsbereich noch sehr begrenzt. Im Rahmen dieser Veröffentlichung werden die Herausforderungen zur Entwicklung eines Motorradfahrsimulators dargestellt und daraus Mindestanforderungen für einen Simulator abgeleitet. Besonderer Fokus wird auf den subjektiven Fahreindruck – das „Fahrgefühl“ – gelegt. Während einer BMW Motorrad internen Studie wurde hierzu ein vorhandener statischer Motorrad-Simulator bewertet, um weitere Optimierungspotentiale für ein neues dynamisches Konzept zu erarbeiten. Die Vorstellung der aus diesen Anforderungen und Optimierungsmöglichkeiten abgeleiteten Optimierungen bildet den Abschluss der Veröffentlichung.

The Motorcycle Fuel Tank and Pelvic Injury in Crashed Motorcyclists

Der Motorradtank und hierdurch bedingte Beckenverletzungen bei Motorradunfällen

L. Meredith[1, 2], M. Baldock[3], M. Fitzharris[4], J. Brown[1, 5]

[1] Neuroscience Research Australia, NSW, Australia

[2] Prince of Wales Clinical School, The University of New South Wales, NSW, Australia

[3] Centre for Automotive Safety Research, University of Adelaide, SA, Australia

[4] Accident Research Centre, Monash University, VIC, Australia

[5] School of Medical Science, The University of New South Wales, NSW, Australia

Abstract

Pelvic and lower abdominal injuries are a serious concern for motorcyclists involved in collisions. Despite their importance, the limited research that has been undertaken has commonly attributed these injuries to contact with the motorcycle fuel tank. Following earlier studies, Wobrock et al. used MADYMO simulation to investigate the effect of tank angle for an average rider on a sports bike. They found pelvic loads to be exponentially related to tank angle, suggesting minimising tank angle may result in a reduced risk of injury.

Using data from 139 in-depth motorcycle crash investigations in Sydney and Adelaide, Australia, the relationship between tank angle, motorcycle type and the occurrence of pelvic and lower abdominal injuries in crashes associated with a predominantly forward rider movement was examined.

Of the 139 riders involved in crashes, 60 experienced forward momentum following the collision. Of those 60, 27 riders sustained injury to the pelvic/abdominal regions attributable to the fuel tank (45%). Pelvic/abdominal injury occurred in a further four cases however these were not attributed to direct contact with the fuel tank.

Pelvic/abdominal injuries were more common among riders of cruisers (80%) than other motorcycle types (45%). Statistical modelling demonstrated that cruiser riders were seven times more likely to sustain pelvic/abdominal injury than other riders (95% CI 1.3-38.5), and importantly, after controlling for motorcycle type, the likelihood of pelvic/abdominal injury significantly increased with increasing petrol tank angle ($p<0.05$).

These results indicated that, while tank angle does play a role in pelvic/abdominal injuries, the relationship is likely to be complicated by other characteristics of tank and motorcycle design. Further work is required to identify optimum tank and motorcycle design to improve rider protection for pelvic and abdominal injury.

Improving car drivers' perception of motorcycles: Innovative headlight design as a short-term solution to mitigate accidents

Verbesserte Erkennbarkeit von Motorrädern bei Pkw-Fahrern: Innovativer Frontscheinwerfer zur Senkung der Anzahl von Unfällen

S. Espié, V. Cavallo, M. Ranchet, M. Pinto, F. Vienne, N.-T. Dang

Ifsttar, Marne la Vallée, France

Abstract

The most frequent motorcycle accidents involve another vehicle violating the motorcycle's right-of-way at an intersection. The low visual conspicuity of motorcycles (especially because of their small size) is the primary reason why motorcycles are often not detected or seen or too late. The main safety measure in the past has been the use of daytime running lights (DRLs) by motorcycles, which became compulsory in the seventies in many countries. This conspicuity advantage of motorcycles as the only vehicles with DRLs is presently getting lost by the growing use of DRLs by cars as well. In a previous study (Cavallo & Pinto, 2012) we have shown that car DRLs are competing light patterns that create visual noise and decrease the detectability of motorcycles. In addition to detection errors, the misperception of the approaching motorcycle's speed and time-to-arrival also contributes to accident occurrence and severity.

In order to reduce motorcycle accidents, and especially to improve motorcycle perceptibility (both detection and speed perception) by other vehicle drivers, ITS based on vehicle-tovehicle communication will probably provide effective long-term solutions (>15 years). But until then, other solutions have to be found and could quite easily be implemented, by considering innovative headlight configurations for motorcycles.

In two simulator studies, we tested various motorcycle headlight configurations, intended to remedy *simultaneously* the two perceptual errors made by other vehicle drivers. The impact of different headlight configurations (using colour coding and additional lights) was studied in the presence of visual distractors (car front lights: only LEDs, only dipped beams, LEDs and dipped beams) and in different illumination conditions (nighttime, dusk and daytime conditions).

The results indicate that headlight configurations comprising additional yellow lights on the fork and on the motorcyclist's helmet significantly improve motorcycle perceptibility by other vehicle drivers. Furthermore, the simultaneous use of daytime running lights (LEDs) and dipped beams by cars, as frequently observed nowadays, has been shown to be particularly detrimental to motorcycle detectability.

Quo Vadis, Darmstadt Method for Abrasive Testing

Quo Vadis, Darmstädter Methode für Schutzkleidungsprüfung

Raphael Pleß, Kai Schröter, Isabell Kranz,
Jan Deforth, Nicolas Hummel, Hermann Winner

Institute of Automotive Engineering, Technische Universität Darmstadt, Germany

Abstract

The “Darmstadt Method for Abrasive Testing” miniaturizes the sliding process of a fallen 75 kg rider on real road surfaces by means of a three-armed rotor with scaled mass-, inertia, and aerodynamic properties. Over more than 30 years, it has proven to be an appropriate method to determine the friction coefficient and protective potential of motorcyclists’ garments. While the functional principle remains the same since the 1980s, achievements in modern control- and measurement-systems make it possible to analyze the material behavior of the test specimen on a much deeper level.

In advance to the pending revision of the European standard for the testing of protective clothing, the Institute of Automotive Engineering (FZD) of the Technische Universität Darmstadt revised their test-rig accordingly, in matters of control, measurement and mechanics. Moreover, additional test-rigs were built that use the same principle, but work with different parameters such as sliding diameter, mass, inertia, friction, and aerodynamic drag.

This paper explains the functionality of the method in detail, highlighting its pros and cons. Modifications to the test-rig are presented to make it suitable for even more testing scenarios (e.g. testing of motorcycle gloves).

Besides discussing the mechanical improvements to the test-rig, the paper shows how continuous data acquisition is used to extract the material-only behavior from the measured data through computation of a continuous friction coefficient.

With these optimizations, the Darmstadt Method is made suitable for both the use in certification as well as development of motorcyclists’ protective clothes.

Kurzfassung

Das „Darmstädter Verfahren für Schutzkleidungsprüfung“ stellt das Rutschen eines 75 kg Fahrers auf einer realen Fahrbahnoberfläche dar. Dazu werden dessen Massen-, Trägheits- und Luftwiderstandseigenschaften auf einen dreiarmigen Probenträger skaliert, welcher bei gegebener Startgeschwindigkeit auf einer Fahrbahn bis zum Stillstand rutscht. Seit über 30 Jahren wird das Verfahren erfolgreich für die Bestimmung des Materialreibwerts sowie der Schutzwirkung von Motorradfahrerbekleidung angewandt. Wenngleich das Prinzip der Prüfung seit den 1980er Jahren unverändert blieb, ermöglicht moderne Mess- und Regelungstechnik eine weitaus genauere Betrachtung des Materialabriebverhaltens.

Im Vorfeld einer anstehenden Revision der europäischen Schutzkleidungsprüfnorm wurde der Prüfstand des Fachgebiets Fahrzeugtechnik (FZD) der Technischen Universität Darmstadt hinsichtlich Mechanik, Mess- und Regelungstechnik überarbeitet. Zudem wurden bei Projektpartnern weitere Prüfstände aufgebaut, welche zwar nach dem gleichen Verfahren, jedoch mit variierenden Maschinenparametern wie Reibradius, Masse, Trägheit, Reibung und Aerodynamik arbeiten.

Im vorliegenden Paper wird das Verfahren detailliert erläutert. Ebenso werden seine Stärken und Grenzen beleuchtet. Es werden Überarbeitungen des verwendeten Prüfstands vorgestellt, die weitere Testszenarien ermöglichen sollen (z.B. Handschuh-Tests).

Neben der Diskussion der mechanischen Verbesserungen am Prüfstand wird beschrieben, wie die kontinuierliche Datenerfassung es ermöglicht, das materialspezifische Reibverhalten zu ermitteln. Verschiedene Ausprägungen des Reibverhaltens werden aufgezeigt und interpretiert.

Durch die aufgezeigten Prüfstandsoptimierungen wird das Verfahren sowohl zur Verwendung als Zertifizierungs- sowie Entwicklungswerkzeug für Motorradfahrer-Schutzbekleidung tauglich gemacht.

The technology of Multistrada D-Air® motorcycle with airbag

Die Technologie der Multistrada D-Air®

Ing. Federico Sabbioni, Head of Project Management

Ducati Motor Holding

Abstract

Ducati launched in 2014 the Multistrada D-Air® model, featuring a fully integrated, intelligent system of sensors wirelessly connected to Ducati Apparel airbag jackets by Dainese. Marking a ‘world's first' in the motorcycle industry and combining the innovative designs from two famous Italian brands, the new Ducati model takes a significant step forward in two-wheel safety.

Combining the expertise of both Ducati and Dainese, the intelligent passive safety system uses sensors built into the Multistrada's existing electronics to constantly understand the vehicle's dynamic situation and deploying only when subjected to a genuine accident scenario, considerably reducing the risk of injury upon impact.