



# In-depth accident analysis (WP 1)

Andreas Hegewald (BASt)

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WP 1 In-depth accident analysis (NTUA, George Yannis)

Aim: Identification of factors that contribute to PTW crashes

- Activity 1.1 Interaction between rider/driver behaviour and PTW accidents (CEESAR, Vuthy Phan)
- Activity 1.2 Interaction between road infrastructure and PTW accidents (AIT, Peter Saleh)
- Activity 1.3 Interaction between weather conditions and PTW accidents (KfV, Martin Winkelbauer)

Partners: INRETS, CEESAR, TUD, BAST, UNIFI, TRL, AIT, KfV, UNIVIE, NTUA, CIDAUT, VTT

## Activity 1.1



Aim:

- Identification of problems for the riders to understand the specific accident causes

Risk factors:

- Riding attitudes and patterns
- Riding/driving experience (education, training)
- Type of PTW
- Conspicuity, perception of drivers for motorcycles
- Alcohol, drugs, fatigue, inattention, other impairments

## Activity 1.1



Method:

- Nine accident scenarios were analysed with four different accident causation models

Results :

- Single motorcycle accidents involved users who do not ride a lot each year
- Single motorcycle accidents happened either during the day and in a curve, when it is outside urban area or during the night and on a straight road, when it is inside urban area.



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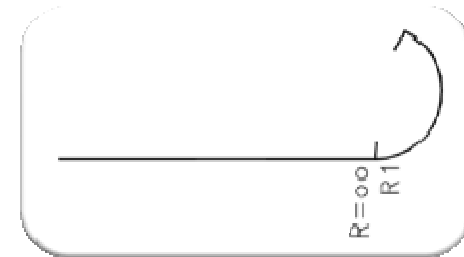
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## Activity 1.2 - STATE OF THE ART



Risk factors:

- Roadway design defects
- Insufficient visibility along road sections
- Insufficient or negative crossfall
- Roadside obstacles
- Insufficient road surface condition
- Negative intersection design



## Activity 1.2 - MACROSCOPIC ANALYSIS



Aim:

- Macroscopic identification of road infrastructure elements that constitute risk factors for PTWs

Results (basics):

- Most PTW accident occur inside urban areas, however, accident severity is higher outside urban areas
- Most PTW accidents inside urban areas occur at intersections (angle collisions, lateral collisions), outside urban areas the most frequent collision type is a single vehicle accident (run-off the road)

## Activity 1.2 - MACROSCOPIC ANALYSIS



Results (specific):

- Critical factors seem to be curves and descending gradients (Greece)
- Roundabouts have a high accident figure given the relative frequencies of these junction type (GB)
- Less front to side accidents at roundabout in comparison to other junction types (Spain)
- Accidents on wet and slippery roads are less severe than on dry roads (Italy)





## Activity 1.2 - MICROSCOPIC ANALYSIS



Aim:

- Microscopic identification of road infrastructure elements that constitute risk factors for PTWs

Method

- Analysis of in-depth accident data (Spain)
- Linkage of crash data, road geometry data and road surface data using special measurement vehicle and software tools (Germany, Austria)



## Activity 1.2 - MICROSCOPIC ANALYSIS



### Analysis of in-depth accident data (Spain)

#### Database:

- Analysed and reconstructed accident data from a special investigation team
- 67 motorcycle accidents from year 2003-2009

#### Results:

- Most of the accidents occurred at left hand bends (72%)  
→ in left hand bends the eyes are fixed in the inner curve therefore possible hazards on the lane do not appear immediately in the field of vision
- Three out of four accidents located at bends occurred at roads with descending gradient

## Activity 1.2 - MICROSCOPIC ANALYSIS



Analysis of in-depth accident data (Spain)

Results:

- Kerbs are identified as potential safety hazard (objects hit in carriageway)
- barriers are identified as most dominant roadside element hit by riders (objects hit off carriageway)
- Riders are almost twice as likely to impact in an upright position as in a sliding position
- Most frequent type of intersection where single vehicle accidents occurred is a roundabout (7 out of 8)



## Activity 1.2 - MICROSCOPIC ANALYSIS



### Analysis of safe and unsafe road sections (Germany)

Database:

- Crash data of injury motorcycle driving crashes (IMDC) outside urban areas 2002-2006 and measurement data from 2009 (road geometry, road surface)

Method:

- Comparison of 32 safe road section and 27 unsafe road sections (crash density = 0,5 IMDC per year and km)

Results:

- The curvature change rate [gon/km] is higher on unsafe road sections than on safe road sections

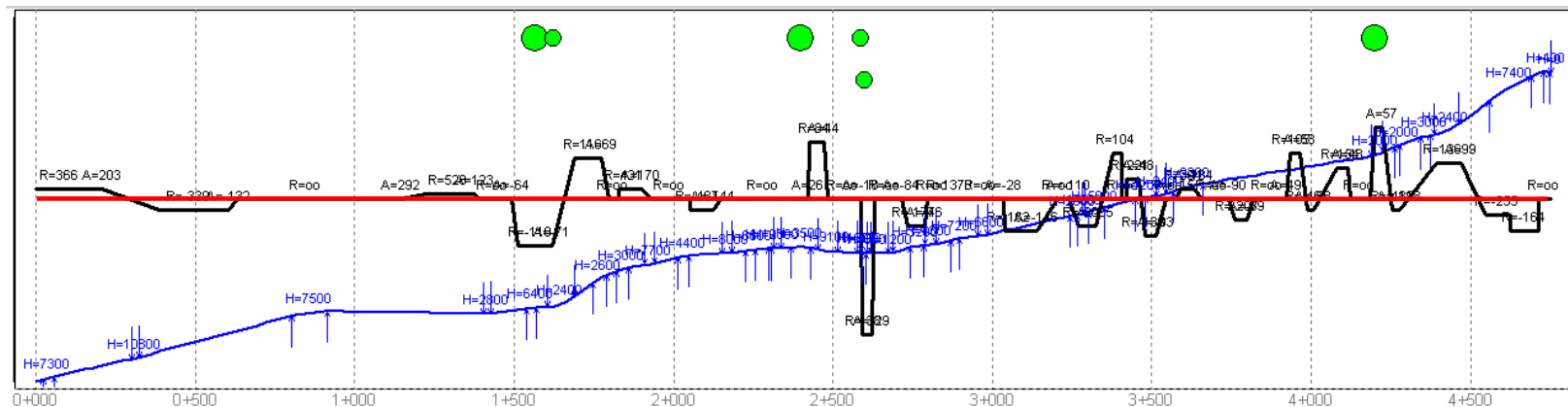
## Activity 1.2 - MICROSCOPIC ANALYSIS



### Analysis of unsafe road sections (Germany)

#### Results:

- Vast majority of IMDC occurred in curves (86%).
- These curves are usually (83%) characterized by very small curve radii ( $< 100$  m).
- Moreover, they are usually in sections with a bad radii relation (unbalanced ratio of successive radii).



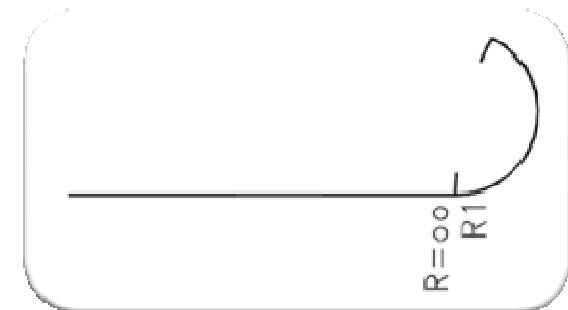
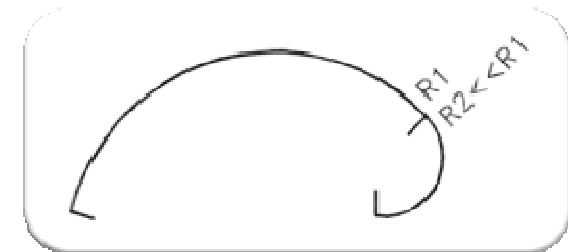
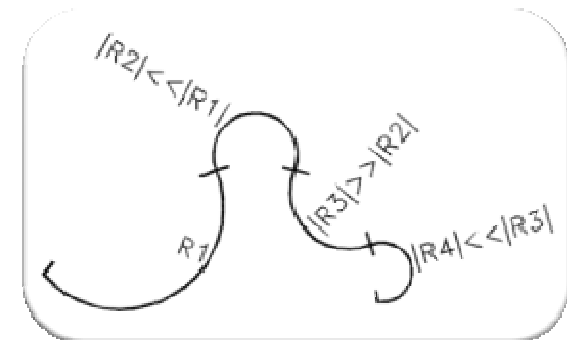
## Activity 1.2 - MICROSCOPIC ANALYSIS



Analysis of unsafe road sections (Germany)

Results:

- Consecutive curves with very different or with decreasing curve radii  
→ 10/26 locations
- Jumps in curve radii within one curve (decreasing radius)  
→ 4/26 locations
- Abrupt change from a long straight into a curve  
→ 7/26 locations



## Activity 1.2 - MICROSCOPIC ANALYSIS



### Analysis of road surface condition at the crash site (Germany)

Database:

- Crash data of injury motorcycle driving crashes (IMDC) outside urban areas 2003 and road surface condition data 2003

Method:

- Comparison of the road surface condition at 106 crash sites of IMDC and at 2107 road sections in the road network



## Activity 1.2 - MICROSCOPIC ANALYSIS



Analysis of road surface condition at the crash site (Germany)

		Condition grade (1 to 5)		Test
		Mean	S.D.	
Longitudinal unevenness	in the road network	1.8391	0.75563	YES
	at the crash site	2.5798	1.30746	
Transversal unevenness	in the road network	1.5776	0.61844	NO
	at the crash site	1.4563	0.70489	
Flick posts	in the road network	1.6191	1.01900	NO
	at the crash site	1.6842	1.38672	
Accumulation of bituminous binder	in the road network	0.0857	1.54712	NO
	at the crash site	0.0000	0.00000	
Skid resistance	in the road network	1.9980	0.86345	NO
	at the crash site	2.0145	0.99399	



## Activity 1.2 - MICROSCOPIC ANALYSIS



### Analysis of RoadSTAR data with MARVin (Austria)

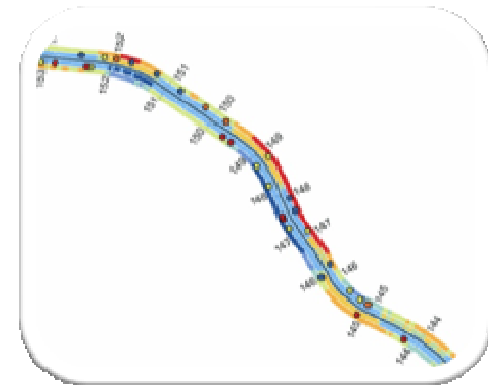
Database:

- 3.203 PTW accidents outside urban areas
- Road surface condition data (e.g. texture, roughness) as well as alignment data (e.g. curve radii, gradient)



Method:

- Comparison of the occurrence of specific condition classes in the road network and the rate of PTW accidents in this specific condition classes



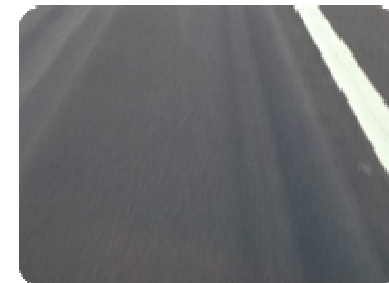
## Activity 1.2 - MICROSCOPIC ANALYSIS



Analysis of RoadSTAR data with MARVin (Austria)

Results:

- Defects concerning the longitudinal unevenness, rut depth and the texture seems to have a low impact on PTW accidents
- Defects concerning the skid resistance have no impact on PTW accidents
- Defects concerning the texture seems to have a low impact on PTW accidents



## Activity 1.2 - MICROSCOPIC ANALYSIS



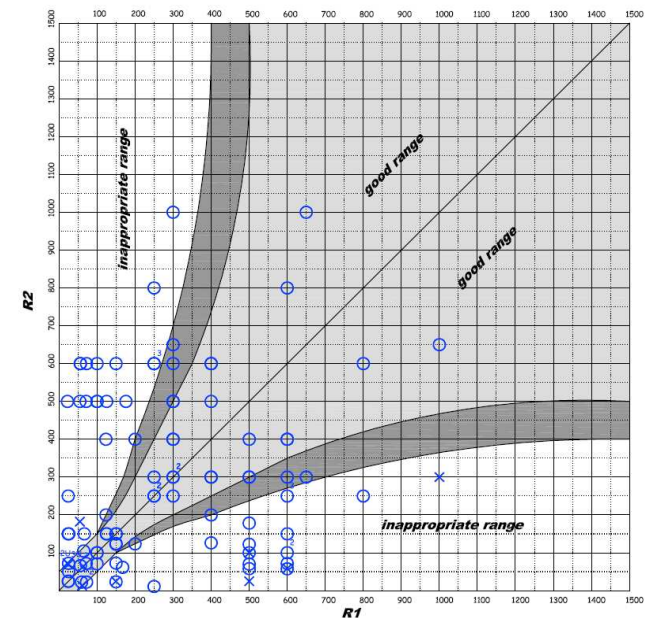
### Analysis of radii relations on PTW accident sites (Austria)

Database:

- Seven defined road sections at typical motorcycle routes
- 140 PTW accidents were analysed in term of radii relation

Results:

- A radii relation larger than 1 is more dangerous than a relation smaller than 1
- The probability of an occurring PTW accident decreases with an increasing radius



## Activity 1.2



### RECOMMENDATION

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- safe/forgiving roadside or protection of obstacle with motorcycle-friendly protective devices
- Reconstruction of road sections with a bad road surface condition or signpost along this sections
- Improvement of conspicuity of roundabouts outside urban areas (e.g. electric lightening, retro reflect materials)
- Less aggressive kerbstones in roundabouts, no obstacles in the central island
- PTW safety as part of RSI and RSA



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## Activity 1.3



Aim:

- Quantify the dependency of weather conditions (precipitation) on PTW accident occurrence
- Determination of motorcyclists' collision types depending on the average rain likeability in Austria

Results:

- Motorcycle accidents correlate with weather conditions
  - The number of PTW accidents per day increases with an decreasing rain likeability
    - The accident record of a year can be normalised using this correlation

## Activity 1.3



### Results:

- Collisions at angle increases due to impaired visibility
- Lateral Collisions and run-off the road crashes decreases due to an adapted behaviour (lower speeds)
- Rear end collisions decreases because it is uncomfortable to ride closely behind a car, as the spray of water impairs visibility and riders get wet more quickly



# Thank you for your attention

Dipl.-Ing. Andreas Hegewald  
Section V1 – Highway Design, Traffic flow, Traffic control  
Federal Highway Research Institute (BASt)  
Brüderstraße 53, D-51427 Bergisch Gladbach  
Phone +49 2204 43-515, Fax +49 2204 43-683  
hegewald@bast.de, [www.bast.de](http://www.bast.de)