Teaching and research in the field of motorcycle safety: What new skills are needed for mechanical/vehicle engineers

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What new skills are needed for mechanical/vehicle engineers

Where are we?
What about Florence and University of Florence?

- City: 400,000 Inhabitants
- University: Est. 1321 → 53,000 Students
Can we make motorcycle riding safer?

What new skills are needed for mechanical/vehicle engineers
What new skills are needed for mechanical/vehicle engineers

- Crash Analysis
- ADAS
- Field testing
- Safety benefit assessment
- Secondary Safety
- Driving Simulator
- Behavioural studies and Training

Skills
Crash Analysis

On-scene crash investigation

Vehicle investigation

Crash Reconstruction

What new skills are needed for mechanical/vehicle engineers

• Maths
• Physics
• Structural Engineering
Injury biomechanics

- Materials
- Machine elements
- Computer Simulation
- Biomechanics
Secondary Safety

Virtual Crash

Physical Crash

• Simulation & Testing
What new skills are needed for mechanical/vehicle engineers

- Sensors
- Radar
- Lidar
- Cameras
- Algorithm
Field testing

- Electronics
- Accelerometers
- Gyros
- Pressure

- Vehicle data
- Rider IMU sensor
- Action cameras
- Questionnaires
- Full protective equipment & airbag jacket
- Outriggers

What new skills are needed for mechanical/vehicle engineers
What new skills are needed for mechanical/vehicle engineers

- Human behaviour
- Big data
- Programming

**Naturalistic studies**

- Lane Filtering
- Overtaking
- Cornering
- Near Missed

**Braking skills**

- Expert
- Advanced
- Intermediate
- Novice

**Braking Deceleration - Test**

- Time [s]
- Deceleration [m/s²]
Driving simulator

- Machine learning
- Artificial intelligence
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Crash Analysis

What new skills are needed for mechanical/vehicle engineers

Calculations

Simulations

Injury causes

\[ v_{	ext{d}} = \sqrt{2a_{	ext{d}}t_{	ext{d}} + v_{\text{impact}}} \]

\[ \frac{1}{2}m_{\text{freq}}v_{f}^{2} = f_{\text{freq}}W_{\text{freq}} + f_{\text{inert}}W_{\text{inert}} + f_{\text{direct}}W_{\text{direct}} \]

\[ E_d = \frac{M}{L \cdot \cos(PDOF)} \int_{0}^{l} \left( \frac{b_{2}^{2}}{2} + b_{0} \cdot b_{1} \cdot C + \frac{b_{3}^{2} \cdot C_{2}^{2}}{2} \right) dl \]

\[ E_{E_{0}} = \frac{1}{\gamma_{0}} \left( b_{0} \cdot \frac{E_{E_{0}} C_{r} - b_{0}}{K \cdot C_{r}} \right) \]

\[ \theta = \phi \cdot \frac{C_{r}}{K} \]
Test PIONEERS Monster 821
May 2019

- 4 days of test - 4 participants
- Four maneuvers
  - Straight line
  - Lane change
  - Slalom
  - Curve
Field Test

Emergency Braking Manoeuvre

1. Front Brake Pressure (bars)
2. Rear Brake Pressure (bars)
3. Speed (km/h)
4. Steering angle (deg)
5. Throttle position (deg)
6. Velocity time series (trial)
7. LED for synchronization

What new skills are needed for mechanical/vehicle engineers
Field Test

Emergency Swerving Manoeuvre

What new skills are needed for mechanical/vehicle engineers
Field Test

Drive-through test protocol

What new skills are needed for mechanical/vehicle engineers
Driving simulator