



**Emergency braking training for motorcyclists:  
instructors' preferences  
&  
new technologies application in a perception-action task**

*Pedro Huertas Leyva,*  
Road Safety Research Engineer  
MObility and Vehicle INnovation Group



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# Motivation

- PTWs mode of transport:
  - more space-efficient than other private vehicles, helping to reduce congestion in cities.
  - can improve the **sustainability**, but their most critical aspect is the **increased risk of injury and death for their riders**.
- The behavioural qualities relevant for safe driving based on: Operational + Tactical + Strategic + General level widely accepted and frequently has become the base of the national training programs. **However...**
  - the tests to obtain the riding license are limited to simple tests that examine part of the program.

higher order skills take longer to be assimilated + main goal of users of driving schools is to get the license



driving schools are often committed to training motorcycle riders to take the test correctly without the time or budget to go into depth at all levels

- New approaches, including **new technologies** and **data analysis**, are essential to improve understanding of rider behaviour and capabilities, and thus to enhance safety through driver training.

# Objectives

- 1) to collect the preferences and requirements of instructors to teach the most frequent emergency manoeuvre
- 2) to develop a method by reproducing a near-real emergency braking scenario with perception-action components
- 3) identifying with data from an instrumented vehicle the difference between the use of brakes by experts versus less skilled riders
- 4) Define a tool to support trainers in providing feedback on performance

# Instructor preferences and requirements

✓ 15 Riding Instructors from 15 Driving Schools over Italy



- ✓ Instructors demand tools to **measure objectively** the performance
- ✓ Very important to **couple braking action with hazard perception.**



# Methods. Preferences & Requirements

- Test emergency braking skill level (real world representative?)
- Features assessed to evaluate braking performance
- Identify hardest task for trainees
- Feedback methods provided to trainees during training
- Tools for teaching (desired)

# Results. Preferences & Requirements

- Test emergency braking skill level (real world representative?)

Only 3 instructors thought the license **test for emergency braking** reflects **the skill level that riders need to have in real-world** riding

# Results. Preferences & Requirements

- Test emergency braking skill level (real world representative?)
- Features assessed to evaluate braking performance

When asked about the two **most important features** when evaluating practice attempts,

- instructors mostly look for balanced front and rear brake use (72.7%)
- followed by the coordination and control of body movements (36.4%)
- the stopping at a specific place (27.3%)
- stability of PTW at completion of braking (27.3%)



# Results. Preferences & Requirements

- Test emergency braking skill level (real world representative?)
- Features assessed to evaluate braking performance
- Identify hardest task for trainees
  - **hardest task for the trainees** is finding the right balance front and rear brake use (63.6%)
  - coordinating the body movements (54.5%).



# Results. Preferences & Requirements

- Test emergency braking skill level (real world representative?)
- Features assessed to evaluate braking performance
- Identify hardest task for trainees
- **Feedback methods provided to trainees during training**

there is not a clear consensus, instructors selected mainly:

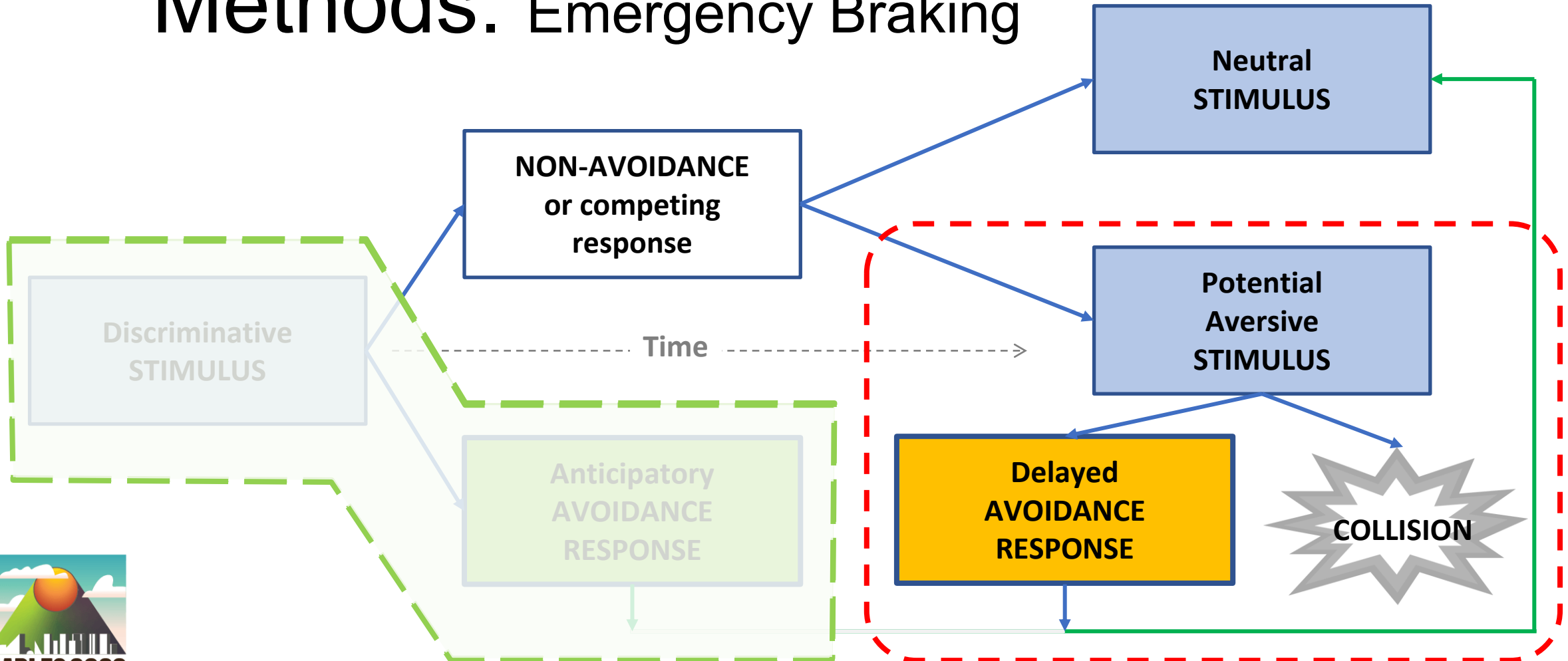
- the description of what could happen as a result
- the practical demonstration of how to correct the error



# Results. Preferences & Requirements

- Test emergency braking skill level (real world representative?)
- Features assessed to evaluate braking performance
- Identify hardest task for trainees
- Feedback methods provided to trainees during training
- Tools for teaching (desired)
  - (55%) considered PTW instrumented as one of the most important tools for teaching

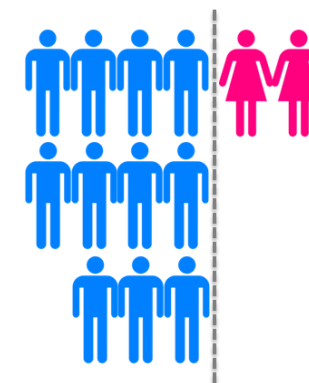
# Methods. Emergency Braking



Simple Avoidance Analysis. Source: (Fuller, 1984)

# Methods. Emergency Braking

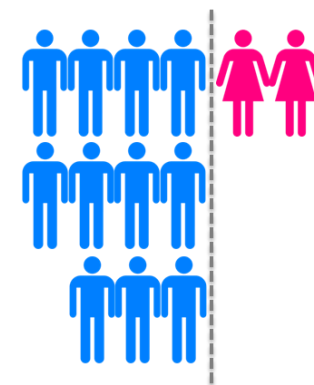
- ✓ 13 riders of varying skill levels and experience
- ✓ aged 23 to 47



# Methods. Emergency Braking

✓ 13 riders of varying skill levels and experience

✓ aged 23 to 47



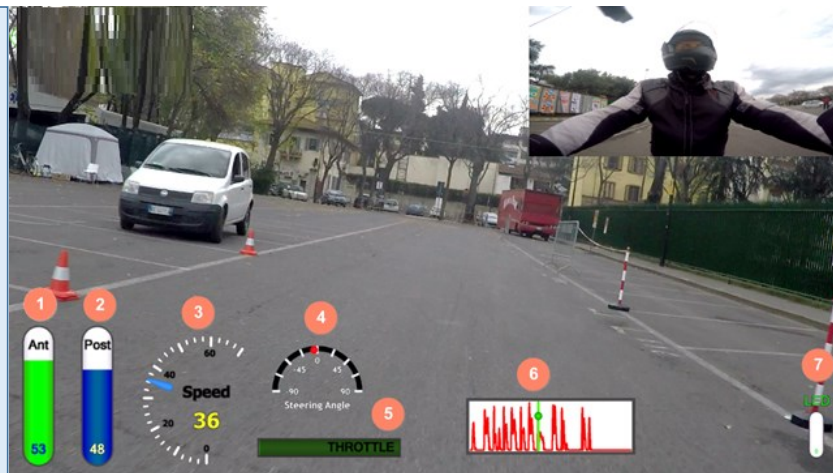
# Methods. Emergency Braking



IMU  
+  
GPS



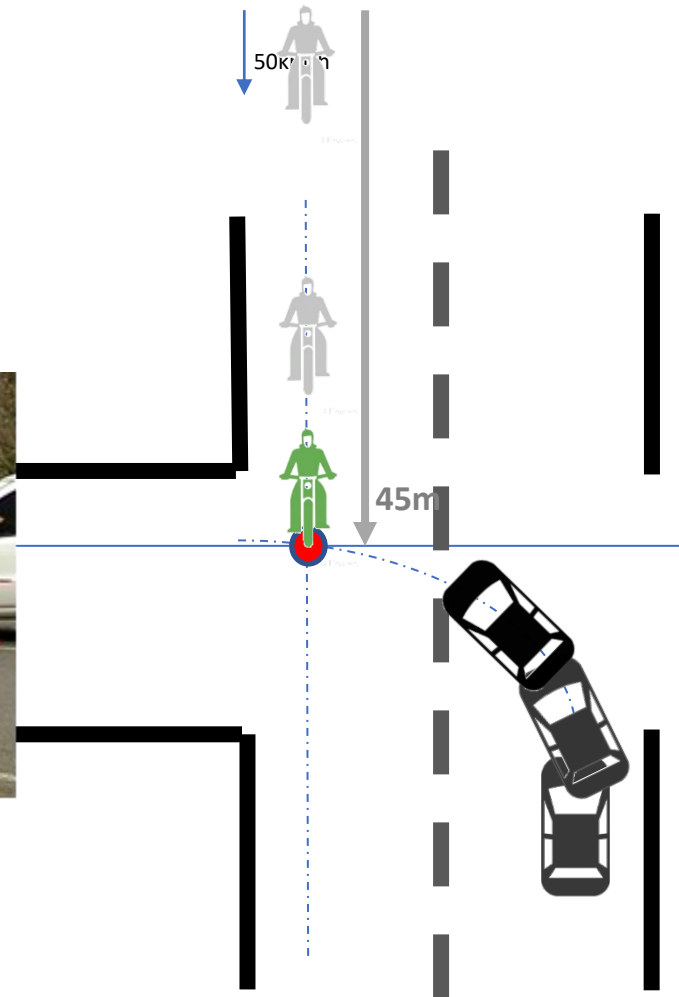
1. Front Brake Pressure (bars)
2. Rear Brake Pressure (bars)
3. Speed (km/h)
4. Steering angle (deg)
5. Throttle position (deg)
6. Velocity time series (trial)
7. LED for synchronization



# Methods. Emergency Braking

More usual with **severe injured**

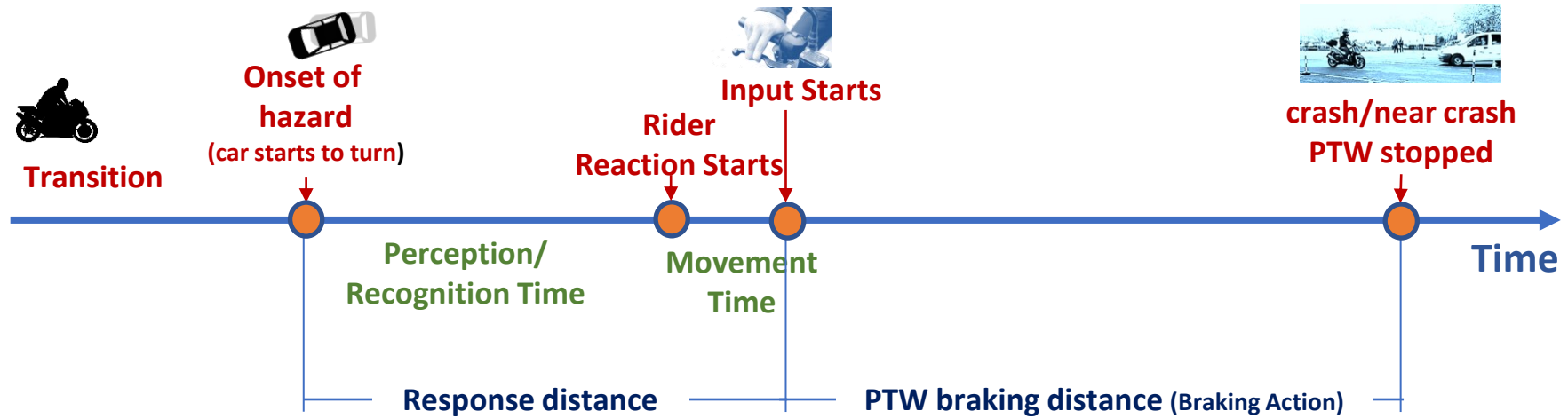
42% cases **no avoidance maneuver**



PTW: Speed of [42-55 km/h]

Car : Speed of 30 km/h

TTC: 1.25 sec





[Click here to see the video examples on youtube](#)



Emergency Test: Poor Response Time



Emergency Test: Novice Example

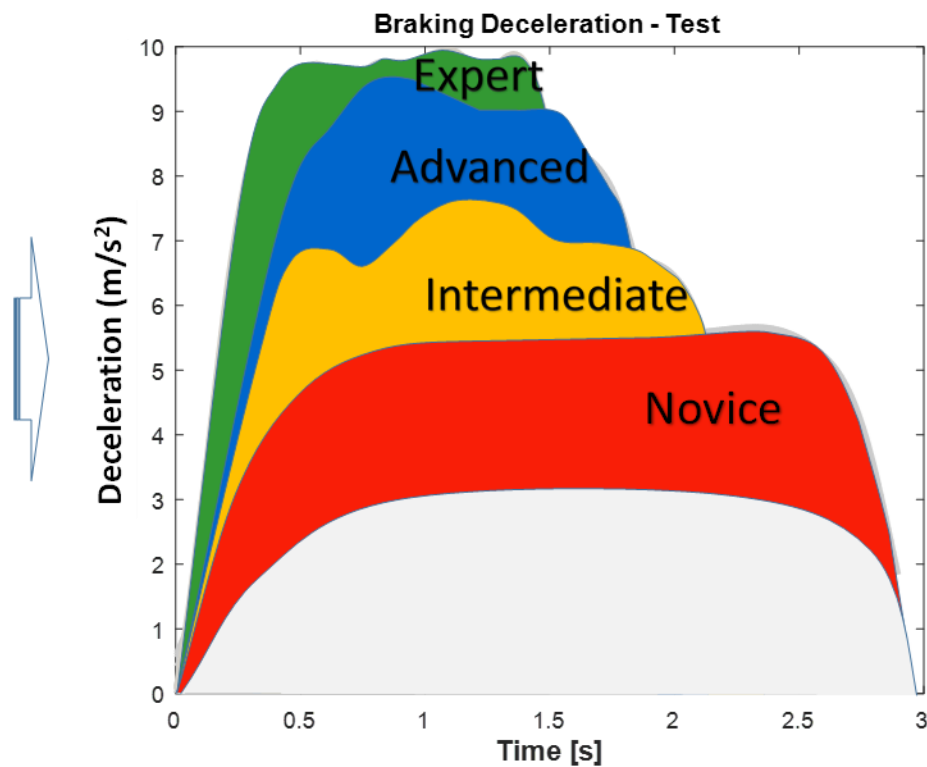
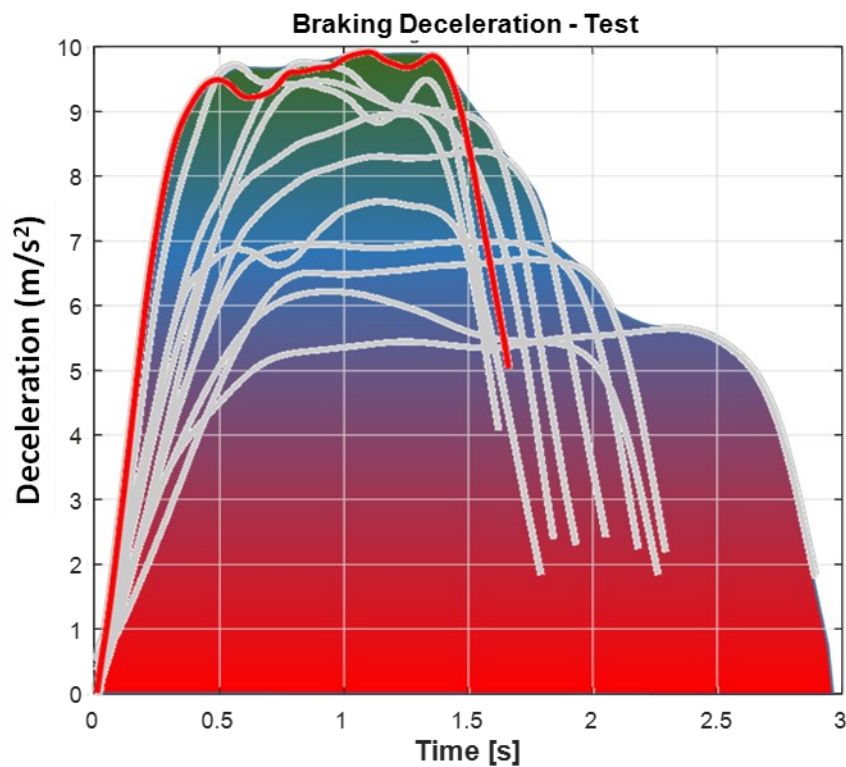


Emergency Test: Expert Example

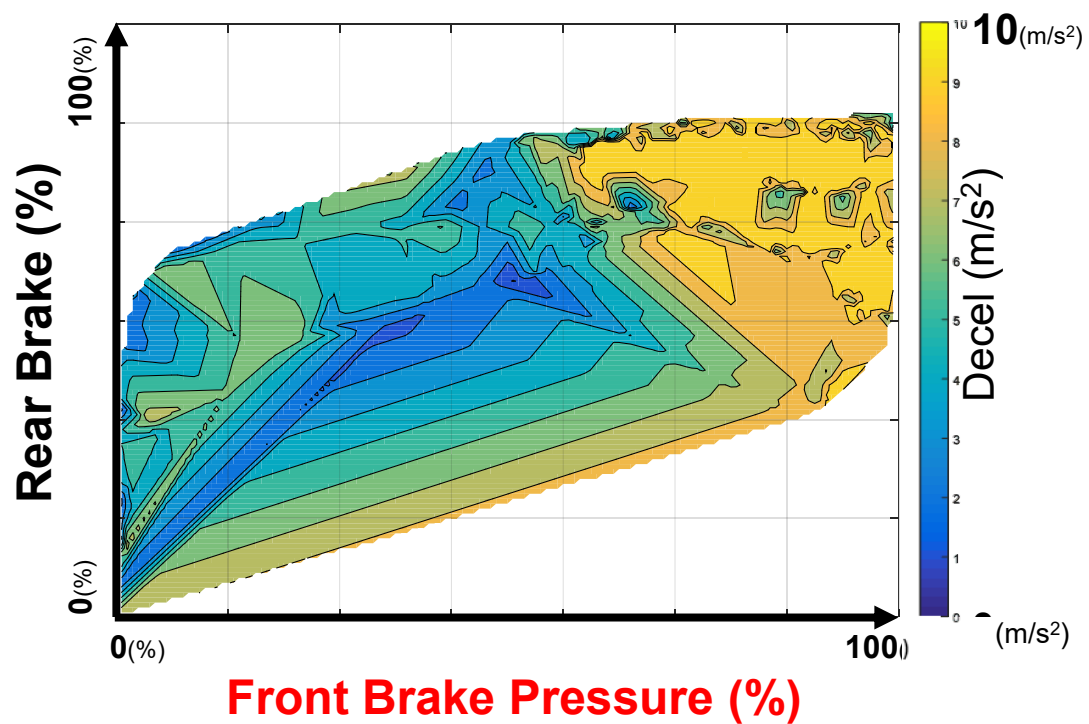


Example Car going Straight

# Results. Emergency Braking



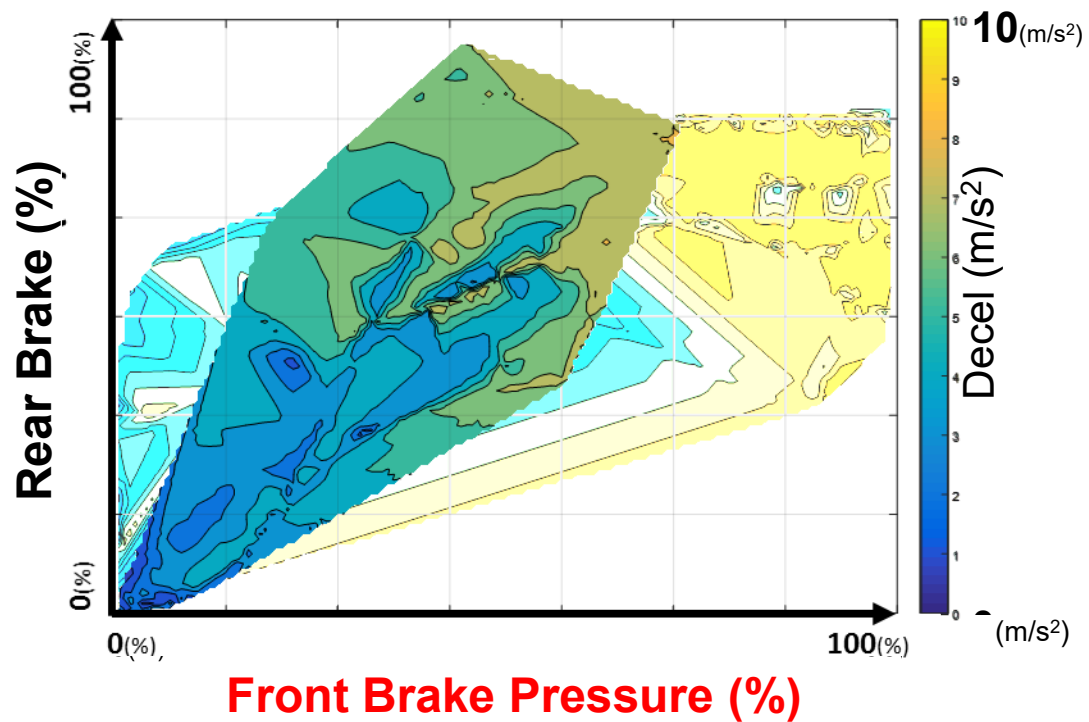
# Results. Emergency Braking



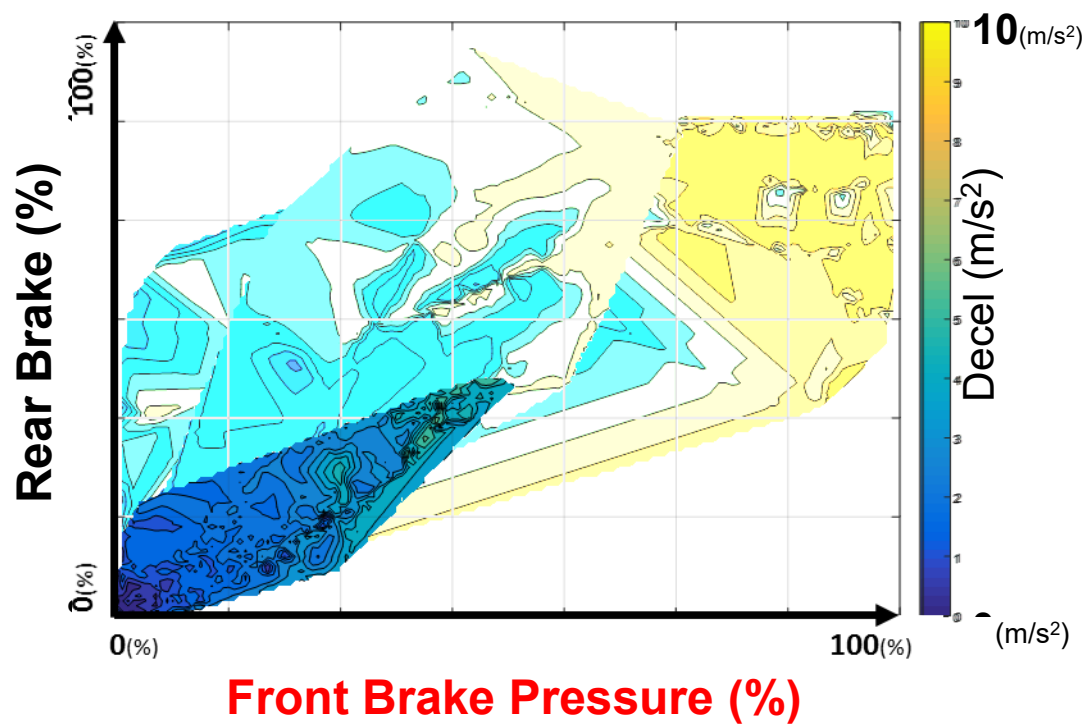
Expert / Advanced



# Results. Emergency Braking



# Results. Emergency Braking

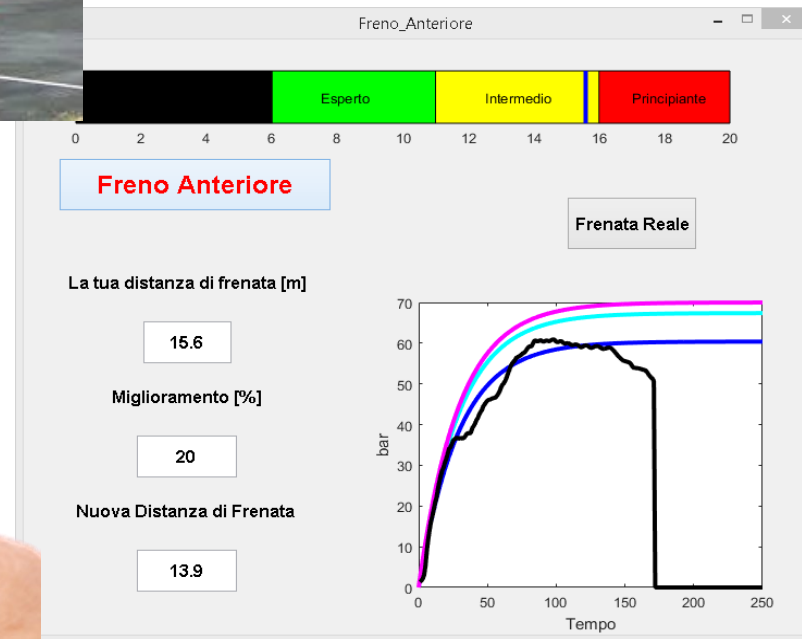
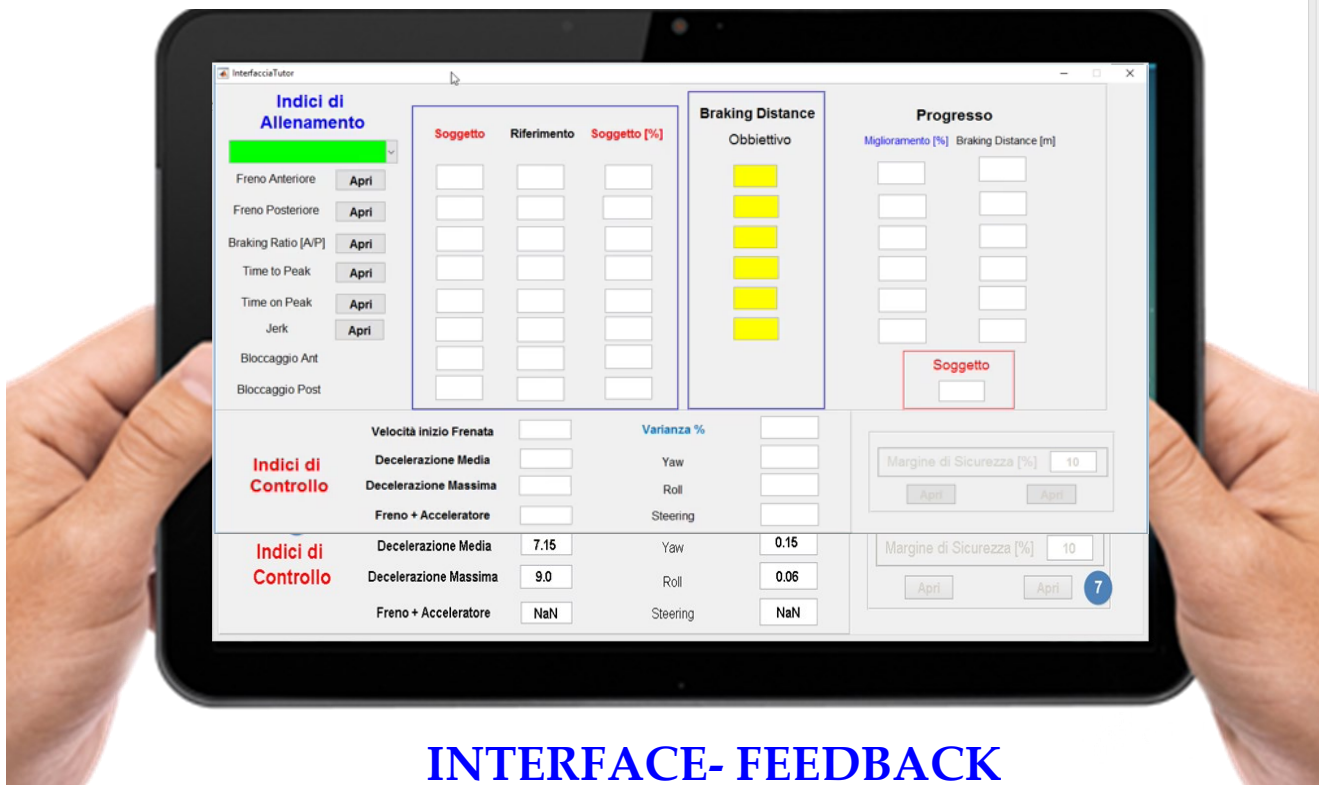


Novice





# Interface Tool to support Training



**INTERFACE- FEEDBACK**  
[\(click to see video on youtube\)](#)

# Discussion

- The work highlighted the need to understand the behaviour of the riders in emergency manoeuvres to define strategies based on new technologies that increase their safety.
- The literature on learning and skill acquisition has noted that there is evidence of gradual and steady improvement in performance given:
  - a well-defined task;
  - detailed and immediate feedback;
  - and the opportunity for learners to perform the same or a similar task repeatedly to improve their performance progressively.
- The study has set the first two components with a **well-defined emergency braking task** coupling perception and action and with a **tool to provide visual feedback of the performance**

# Conclusions and Final Remarks

- ✓ Identification of Preferences and Requirements of Rider Trainers
- ✓ Design of a real-world scenario coupling Perception-Control skills
- ✓ Definition of Objective key parameters associated with the level of competencies
- ✓ Definition of key indicators to assess and train riders in emergency braking and interface tool to support Feedback during training activities
- ✓ Further steps:
  - ✓ Extension of the Survey to new Riding Schools (new countries?)
  - ✓ Validate the Training Interface to assess effectiveness:
    - (perform the same or a similar task repeatedly in different days)
  - ✓ Applications for Riding Schools with simplified Instrumentation (e.g. smartphone)





UNIVERSITÀ  
DEGLI STUDI  
FIRENZE

**MOVING**  
MObility and Vehicle  
INnovation Group

Pedro Huertas Leyva  
email: [pedro.huertasleyva@unifi.it](mailto:pedro.huertasleyva@unifi.it)



c/ieca