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# An intelligent Frontal Collision Warning system for Motorcycles

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**Abstract**

This article illustrate a novel Frontal Collision Warning system for motorcycles which has been developed in the SAFERIDER project [1] of the 7th EU FP, among other Advanced Rider Assistance Systems. The Frontal Collision Warning function (FCW) described here is based on a holistic approach, which combines road geometry, motorcycle dynamics, rider input and riding styles. The warning strategy is based on the correction of longitudinal dynamics derived from a previewed manoeuvre) continuously computed from the actual state of the vehicle. In normal driving conditions the reference manoeuvre fairly match with the rider one and no correction is necessary therefore no warning is produced. However, when large differences between actual and ideal accelerations are found the rider is warned to decelerate or brake. As soon as the correct value of deceleration is achieved the warning disappears improving the system acceptability. Warnings are given to the rider via a proper combination of haptic, visual and audio signals thanks to specific HMI device, which include an haptic handle among, a vibrating glove, a smart helmet, and a visual display.

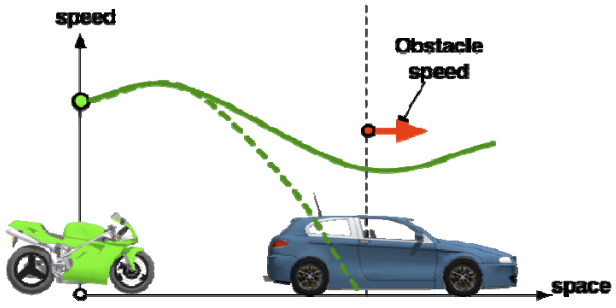


**Figure 1.** Typical scenario managed by the Frontal Collision Warning function

A typical scenario managed by the FCW function is shown in Figure 1: the motorcycle is running on a straight road when suddenly a vehicle ahead brakes, or a new vehicle cut in on the lane. In both cases the remarkable speed difference between the motorcycle and the obstacle

ahead is a potential danger. In this situation, the FCW aims at suggesting the more appropriate action for the correct longitudinal control of the vehicle.

The FCW function calculates a preview "optimal-safe" manoeuvre based on a dynamic optimization approach which accounts for:

- an appropriate mathematical model of the motorcycle dynamics;
- an estimation of the actual dynamic state of the motorcycle;
- a model of the road geometry and attributes;
- the relative position and speed of the obstacle ahead
- riding safety, comfort and style
- the calculation of the riding risk

Figure 2 summarizes the three layers (perception, decision and action) architecture that the FCW function shares with other SAFERIDER functions.

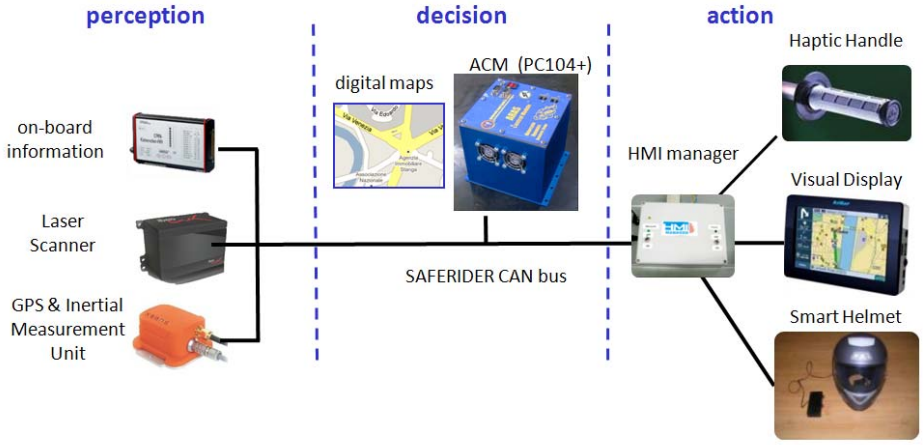


**Figure 2.** architecture of the Frontal Collision Warning System

The perception layer comprises sensors for the measurement of vehicle state and includes a GPS device, an Inertial Measurement Unit (IMU), a Laser Scanner and a Vehicle Interface module (VIF), which interface to the SAFERIDER CAN bus vehicle built-in sensors like speedometer, brake pressures and others. The action layer consist in the ARAS Control Module (ACM), which manages ARAS software and interacts with the other SAFERIDER systems, finally the action layer includes the HMI manager and a set of HMI elements: the visual display, the haptic handle and the smart. The HMI manager processes the warning provided by the ACM and properly activates the different HMI elements.

The article will explains in details the Frontal Collision Warning (FCW) concept, discusses the implementation aspects and presents preliminary tests.

## References

[1] www.saferider-eu.org

[2] Bertolazzi E, Biral F., Da Lio M, "*Real-time motion planning for multibody systems*". MULTIBODY SYSTEM DYNAMICS, vol. 17; p. 119-139, 2007, ISSN: 1384-5640, doi: 10.1007/s11044-007-9037-7.

[3] Bertolazzi E, Biral F., Da Lio M, Saroldi A, Tango F, "*Supporting Drivers in Keeping Safe Speed and Safe Distance: the SASPENCE Subproject within the European Framework Program 6 Integrating Project PReVENT*". IEEE TRANSACTIONS ON INTELLIGENT TRANSPORTATION SYSTEMS, 2010, ISSN: 1524-9050