AUTONOMOUS EMERGENCY BRAKING FOR CORNERING MOTORCYCLE

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ABSTRACT

Research question
Autonomous emergency braking (AEB) has been indicated as a potential safety application not just for passenger cars and heavy goods vehicles, but also for motorcycles and powered two-wheelers (PTWs) at large. Motorcycle AEB (MAEB) was designed to produce autonomous deceleration of a host PTW in case of inevitable collision. Previous studies limited MAEB to the case of a PTW travelling along a straight, as the activation of AEB was considered hazardous for a leaning vehicle. This study aims to extend the applicability of MAEB to cornering scenarios.
Methods
A virtual PTW in a simulated environment was equipped with MAEB and Active Braking Control (ABC). MAEB consisted of a virtual obstacle detection device, triggering algorithms that identify inevitable collision states, and an automatic braking device. When an inevitable collision is detected for the host PTW and at the same time the rider is applying some braking force, MAEB deploys enhanced braking, which assists the rider reaching the maximum feasible deceleration. ABC consisted of control algorithms for the automatic braking device that stabilise the vehicle along the curved path. The complete system named MAEB+ was tested using detailed computer simulation reproducing real world crashes.
Data sources
The crash cases used for the simulations were selected from the in-depth crash dataset "InSAFE", which collects severe road crashes in the metropolitan area of Florence. The selection criteria were the following: a) the PTW crashed into another vehicle; b) the PTW was travelling along a curved path with roll angle above 15 deg; c) the rider applied some braking force prior to impact; d) PTW loss of control was not the main contributing factor.
Results
In the simulation, MAEB+ was able to assist the rider in reducing the motorcycle speed prior to impact with higher deceleration compared to baseline MAEB and in maintaining the stability of the motorcycle.
Limitations
The potential benefits of the proposed system, expressed in terms of impact speed reduction or avoidance of fall events, cannot be directly correlated with actual benefits for the rider in terms of injury mitigation. In fact, risk curves expressing the level of injury for the rider as a function of kinematic quantities (such as impact speed) are not currently available for riders.
Significance of results
Previous studies showed that MAEB would typically apply to situations where the motorcycle is travelling along a straight path. However, this paper shows that MAEB associated to ABC can apply also to those cases where the PTW is leaning, thus contributing to prove and extend the robustness of MAEB.