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Data Article

Dataset on powered two wheelers fall and critical events detection

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A B S T R A C T

In this data article, we will present the data coming from 3D Inertial Measurement Unit (3-accelerometers and 3-gyroscopes sensors) mounted on the motorcycle collected during a motorcycle's falls experiments. Developing a motorcycle's fall events detection algorithms is a very challenging task because the motorcycle falling is multi-factorial and is strongly influenced by many unknown factors. To solve this issue, one solution can be to use a data-set collected during controlled experiments, knowing that the real motorcycle falls cannot be replicated, a stuntman can be chosen to be as close to reality as possible. The experiments have been conducted based on predefined scenarios such as: fall in a curve, fall on a slippery straight road section, fall with leaning of the motorcycle “intentional manoeuvre” and fall in a roundabout. These scenarios have been designed based on realistic falls. Other experiments have been conducted under different extreme driving situations. These extreme manoeuvres were carried out on track by professional riders. The purpose of performing these manoeuvres was to obtain a dataset describing the limit handling behaviour.

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1. Data

In this data article, we present data coming from the 3D Inertial Measurement Unit (combination of 3 individual accelerometer + gyroscope sensors) mounted on the motorcycle. Measurements were collected during:

- Controlled experiments on tracks performed by a stuntman (fall experiments). The fall scenarios were based on accident analysis reports and designed to reproduce as closely as possible the following situations: fall in a curve, fall on a slippery straight road section, fall with leaning of the motorcycle “intentional manoeuvre” and fall in a roundabout [2].
- Near-fall experiments that were carried out by professional riders. For the near-fall condition, the goal was to observe the limit of handling behaviour of the motorbike: extreme braking, accelerating manoeuvres, and fall-like manoeuvres.

Presented in this article are figures and table showing the most important steps in the fall and near-fall scenarios experimental design.

The figures presented in the following sections describe the experimental design of the fall and near-falls scenarios. Fig. 1, shows the instrumented motorcycle and the sensors installed on it. Fig. 2, displays the fall scenarios design on the track, and a video footage of a fall scenario is given on Fig. 3. Finally, Fig. 4, shows a recorded video of sporty driving situation.

Table 1, gives the fall start time and the fall time for each fall scenario.

2. Experimental design, materials, and methods

PTW riding is a very complex compared to driving four wheeled vehicles, due to the fact that the rider must actively maintain the dynamic stability of his/her vehicle. This function is demanding,
particularly during emergency events such as in the case of harsh braking in curves. In such situations, the loss of stability may induce a fall. The detection of initiation of the PTW fall is non-trivial, due to the multi-factorial determinants. Many studies have sought to understand the fall and the factors that contribute to this kind of accident, (see MAIDS, 2009) [1]. During a fall, the PTW is subjected to high dynamic forces due, for instance, to the braking action and its intensity and when hitting the ground, to high frequency oscillations as in bending of the vehicle frame and rotations of the handlebar. For accurate detection of the fall or near-fall signature, a specific data collection system was designed to capture the sensors signals, at a 1Khz sampling rate, using a 4 µs time stamping.

The collected data come from a 3D Inertial measurement unit (accelerometers/gyroscopes). To obtain the linear accelerations (lateral, longitudinal, vertical) and angular velocities (roll, yaw, pitch) of the motorcycle we used a BOSCH automotive sensor, the gyroscope sensor has a 100°/s resolution and the Coriolis acceleration in ±1.8 g, see Fig. 1.

3. Fall scenarios design

The experiments were conducted based on predefined scenarios such as: fall in a curve, fall on a slippery straight road section, fall with leaning of the motorcycle “intentional manoeuvre” and fall in a roundabout [2].

For each scenario, acceleration to reach the target speed of 90 kph was performed within 200 m. A flash lamp installed on the motorcycle was triggered and recorded by high-speed cameras (1000 pictures per second) for offline synchronization between video and vehicle sensor data, 5 m before the beginning of the fall area, see Fig. 2.
The high-speed cameras were also used to get the time of the fall. In Table 1, the different performed scenarios with the corresponding fall start time and the fall time for each scenario are given.

In Fig. 3, a video footage of a fall scenario is given:

The motorcycle takes run up for a distance of 200 m (not presented).

1. Five meters before the beginning of the fall area the flash lamp is triggered and recorded on the video-loggers, and the corresponding time is stamped in the data-logger.
2. The stuntman initiates the fall when he arrives to the line indicating the beginning of the fall area. The differences between the different fall scenarios are in the way stuntman initiates the fall (front or rear breaking).
3. The motorcycle starts falling, the fall start time corresponds to the time where the lowest crash protector pad hits the ground.
4. The stuntman is on the floor, this corresponds to the fall end, this fall end corresponds to the time where the stuntman’s hips hits the floor.
4. Extreme manoeuvres design

Another data collection has been made under different extreme riding situations, such as Zigzags, extreme braking, accelerating manoeuvres, and fall-like manoeuvres. These extreme manoeuvres were conducted on track by professional riders, see Fig. 4. The aim of these experiments was to obtain a dataset describing the limit handling behaviour.

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Transparency document

Transparency document associated with this article can be found in the online version at https://doi.org/10.1016/j.dib.2019.103828.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.dib.2019.103828.

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**Fig. 4.** Recorded video of sporty driving situation. The professional rider is riding at high speed and giving a high lean angle to the motorcycle.

**Table 1**

| Scenario                               | The fall start time \(^a\) (ms) | The fall time \(^b\) (ms) |
|----------------------------------------|-------------------------------|--------------------------|
| Fall on a slippery straight road section | 40132                         | 40428                    |
| Fall with leaning of the motorcycle    | 34288                         | 34502                    |
| Fall in the roundabout                | 35876                         | 36160                    |
| Fall in a curve                       | 43486                         | 43756                    |

\(^a\) This time corresponds to the time where the lowest crash protector bobbin hits the ground. 
\(^b\) The fall end time corresponds to the time where the stuntman's hips hit the floor.
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[1] http://www.maids-study.eu/.

[2] Abderrahmane Boubezoul, Stéphane Espie, Larnaudie Bruno, Samir Bouaziz, A simple fall detection algorithm for Powered Two Wheelers, in: Control Engineering Practice, vol. 21, Elsevier, 2013, pp. 286–297, 3.