Airbag Jacket for Motorcyclists: Evaluation of Real Effectiveness

T. Serre, C. Masson M. Llari, B. Canu, M. Py, C. Perrin

Abstract This paper aims to evaluate the level of protection offered by airbag jackets for Powered Two Wheeler users. This study is based on a double approach which combines real accident data collected with a field survey and experimental data obtained in laboratory.

The accident study shows that the airbag is globally well perceived by their users who highlight their protective effects. But these cases have mainly fallen from the motorcycles at low speeds and less direct impacts against an obstacle. However, some specific cases show that a direct impact at 40km/h or falling at 60km/h with an airbag jackets cannot avoid serious injuries on the trunk (AIS3+).

Experimental tests consist on performing crash-tests with PMHS motorcyclists thrown at about 40km/h against passenger cars. Results show differences between the type of airbag jacket in terms of pressure and trigger time.

The airbag jackets seem to offer limited protection from a threshold speed which can be estimated to an impact around to 30-40km/h but these speeds differ with the impact configuration.

Keywords Accident, airbag jacket, biomechanics, Motorcyclist safety, Powered Two Wheelers..

I. INTRODUCTION

Even if the number of accidents involving cars has declined substantially over the last few years, accidents involving motorised two-wheelers have, on the other hand, gone up sharply and represent a key issue in the field of road safety, especially in France [1]. On European roads, according to [2] more than 12 riders die every day and more than 100 are severely injured. Indeed, Powered Two-Wheelers (PTWs) is the most dangerous mode of road travel [2] and the risk of death with a motorcycle is largely higher than for cars [3]. Indeed, the risk of death for motorcyclists is 20 times that of car occupants. Much thought and study has gone into an improved understanding of motorised two-wheeler accidentality such as the works performed by the National Highway Traffic Safety Administration in 1981 [4], the project "In-Depth Investigation of Motorcycle Accidents (MAIDS)" in 2010 [5] or the Protection of the Motorcyclist, the PROMOTO project, in France in 2012 [6]. In particular, these research projects have studied the behaviour of a motorcyclist's body under impact without protection equipment and evaluated the main biomechanical and accidentologic issues. Results showed that the main scenario of accidents is an impact of the PTW in frontal configuration against an opposite vehicle (mainly cars) or fixed obstacles. An international standard ISO 13232 describes the impact conditions in relation to accidental data [20].Moreover, the most fatal injuries to the accident victims were injuries to the chest and head [7-8, 29].

In order to improve the PTW safety, two main approaches can be followed: active safety which aims to reduce impact speed or avoid the accident and passive safety which aims to reduce injuries. Among active safety system, antilock braking systems (ABS) or Pre-Crash Braking (PCB) allow to reduce speed of impact and consequently injuries [31-32].

Concerning passive systems and more particularly personal protective equipment (PPE), despite the fact that today's protection gear remains relatively basic (apart from wearing a helmet which is now compulsory) and the use of PPEis still significantly low in some European countries [9], recent technical innovations have made it possible to develop promising new safety systems to protect motorcyclist. For example, [5] and [10] showed that the use of personal protection equipment can directly prevent injuries up to 60% for the torso and almost

40% for leg protection. So it appears that such systems should avoid minor injuries (AIS[1] 1) and could mitigate and/or avoid severe injuries (AIS3+). Several works have been performed on this topic such as [4-5,10,21-24,27-28,30]. From a global point of view, the evaluation of the efficiency of PPE appears as difficult and rarely performed due to the complexity of the accident configuration and the lack of information concerning the impact of the motorcyclist, injuries, PPE wore during the accident, etc. But mainly of these studies are agree to conclude that PPE protect against light injuries (AIS 1 or 2) but not necessary against more severe injuries. Moreover, it is convinced that PPE insure protection against burns on soft tissue like skin but are less efficient to avoid fractures.

Among PPE, some new systems concern neck brace [25] but also inflatable devices (airbags) built into the motorbike [11] but also airbags fitted into the clothing worn by the motorcyclist [13, 26]. In the latter instance, the rider or the passenger is able to wear a jacket fitted with one or several inflatable bags which can inflate extremely quickly as soon a specified degree of acceleration is reached.

Lots of airbag jackets are currently present on the market and they can be classified in three main categories according to their trigger systems to inflate the airbag [12, 15-19, 33]:

Cat. 1) A cable linked between the motorcyclist and the PTW which is unhooked during the impact,

Cat. 2) Sensors placed on the front wheel of the PTW which detects the impact and triggers the airbag inflation by radio,

Cat. 3) Autonomous airbag jackets which include the sensors in the jacket.

Except the trigger system, these products differ on different parameters like the pressure of the airbag (which is often kept secret by the manufacturer), the volume of the bag (mainly from 10 to 20 liters), the trigger time which is in general between 20ms to 200ms after the first impact, the inflate time, the gas composition, the location of the gas cartridge, etc.

Some studies have assessed the benefits of using of an airbag jacket as a new protection system. Results showed that it could significantly reduce the sternum deflection and the injury gravity (from AIS=5 without airbag to AIS=2 with the airbag jacket) [13]. Such study proves that airbag jackets increase the safety of the motorcyclist; however this work is based on prototype system and not on existing products found in the market.

This paper aims to evaluate the level of protection offered by airbag jackets currently sold for PTW users. Their recent marketing does not reveal their real effectiveness so the objective of this research is to estimate it in particularly in terms of speed of impact.

II. METHODS

This study is based on a double approach which combines real accident data collected with a field survey and experimental data obtained in laboratory.

Accident Survey

Concerning the real world data, it concerned a national accident investigation performed in France. The objective was to collect data on PTW accidents which involved motorcyclists equipped with airbag jackets. Since a low percentage of motorcyclists wear airbag jacket, this kind of accident is very rare. So, the survey was mainly retrospective and has been based on collaboration with several organisations which are in relation with fleets of motorcyclists wearing airbag jackets or able to provide some accident data.

The different partners for this work were:

- Insurances like the *Assurance Mutuelle Des Motards*.
- Airbag jacket manufacturers.
- Police force.
- Accidentology laboratory which perform surveys like the Laboratoire d'Accidentologie et de Biomécanique PSA-RENAULT in France.

These partners had to alert an investigator when an accident occurred with a motorcyclist equipped with an airbag jacket. Then a specific investigation was performed on each accident. First of all, the investigator collects the record and the information provided by the partner organisations. For some partners, the accident

[1] Abbreviated Injury scale : 1=Minor, 2=Moderate, 3=Serious, 4=Severe, 5=Critical, 6=Unsurvivable

circumstances were well described, for others the injuries were perfectly known, and for others damage to the motorbike is the concern, etc. The quality of accident data depended on the particularities of the database of the different partners. Then the investigator contacted the victims by phone when available in order to obtain more information about the accident. A specific questionnaire has been established to obtain homogenous data of the accidents.

The concerned data through the questionnaire were:

- The PTW: type, mark, year, damage
- The airbag jacket and the other PPE: type, mark, damage
- The configuration of the impact: alone or with obstacles, type of obstacles, angle of impact, estimated speed in approach and at impact
- Injuries: body segment, kind of injuries
- Statements of the involved person in the accident

When available, photos or/and videos were also asked of the victims. Sometimes, the investigator went on the scene of the accident in order to collect more information about the infrastructure or sometimes met the motorcyclist to analyse the airbag jacket.

Injuries are then coded with AIS code.

Kinematic reconstructions were finally performed when possible in order to evaluate the impact speed and, for some cases, a numerical multibody simulation of the accident was performed in order to evaluate the triggering of the airbag. This work was based on the Madymo software. The multibody model used for the accident reconstructions was based on previous development already performed to simulate PTW accidents. This model was already validated for several configurations [14]. It is made up of three main elements: the rider model, the PTW model and the obstacle (mainly a light vehicle). First, these three multibody models are adapted to correspond to the accident: the rider is scaled to the victim characteristics (height, weight), the PTW represents the involved motorcycle and the obstacle is represented as close as possible. Then, several impact configurations were simulated. The parametric study was particularly concerned with the variation of the PTW impact speed. Finally, the chosen configuration as the most probable one is the one which has the most correlations with real clues: impact points on the PTW related to the damages, impact on the body segment related to the injuries, etc.

A survey of statements via the internet was also realised. It concerned website like the French Ministry in charge of road safety, manufacturers, media and discussion group of PTW users. When statements concerned an accident with airbag jacket, the involved person was contacted to collect information on it.

In conclusion, accidentological monitoring was performed in France during one year and half (period end 2015- beginning 2017) and twenty seven accidents have been collected in all.

Experimental Testing

About the experimental data, it concerns crash-tests with Post-Mortem Human Subjects (PMHS). These tests have been performed for a motorcyclist impact speed of about 40 km/k and with four different airbag jackets and four different motorbikes. The choice of the four airbag jackets concerned two *radio* trigger systems of the category 1 (Airbag named *Radio 1* and *Radio2*) and two c*able* trigger systems of the category 2 (Airbag named *Cable 1* and *Cable 2)*.All of these airbags exist on the market and are among the most products sold on the market. In order to keep the brands anonymous, names of the products will not be specified in this paper. Motorbikes are among the most common sell in the market (mainly roadster).

The experimental protocol complies with the ethical rules for the use of Post Mortem Human Subjects (PMHSs) and has been approved by the Ethical Committee of the Université de la Méditerranée in France. Anatomical subjects had been embalmed with Winkler's preserving fluid which maintains joint flexibility and modifies the mechanical properties of tissues, particularly bone, very little. All were male, of normal corpulence and an advanced age.

Before each test 40 anthropometric measurements were made on each subject, whose bone integrity was also verified with radiographs. The age, height and weight of the subjects are given in Table 1.

TABLE I
AGE, SEX, HEIGHT AND WEIGHT OF PMHS

	Age (years)	Sex (M/F)	Height (in m)	Weigth (in Kg)
Test 1	80	M	1.79	78
Test 2	82	M	1.73	81
Test 3	88	M	1.62	55
Test 4	76	M	1.71	84

Full-scale tests consist of frontal impact for the PTW against the lateral side of a static car at a speed about 40km/h. Even if the airbag jacket can protect in all crash configuration (single crash or against an opposite obstacle), this study is focused only on crash against a car because this configuration it represents one of the main impact configurations for a PTW [6, 20]. The impact was performed on the B pillar for all tests. The struck vehicles were similar: two tests were performed with a Renault Clio and two tests were performed with a Peugeot 307 which are common cars found on the French market.

A PMHS had been placed on the motorcycle and five three-axis accelerometers had been placed on the human subject. The impact location on the car and the sensors positions on the PMHS are given in Figure 2.

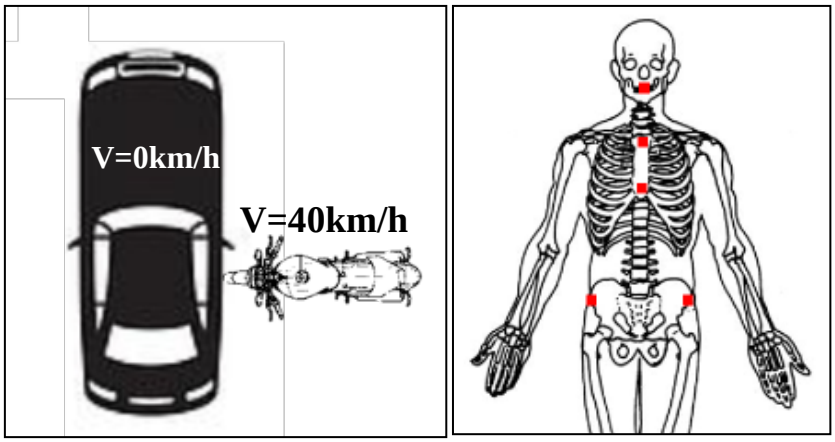

Fig. 2. Crash-test experiments: Impact configuration and sensors location on the PMHS.

High speed numeric cameras were used to film the crash at 1000 im/s in lateral, frontal and top views.

Four crash tests have been performed in this configuration: one for each airbag jacket. Tests 1 and 2 concern airbag jackets with cable. Tests 3 and 4 have been performed with radio airbag jacket. No modification was made on the triggering system and it trigged as it was supposed. During these crash tests, the time has been measured the time to trigger and inflate the airbag (time 0 is considered when the front wheel of the PTW touch the lateral side of the car), the pressure in the airbag (on the left and right sides) and the accelerations on the PMHS. Finally, injuries on the PMHS have been also noted after the post-crash exams; X-ray radio and dissection.

III. RESULTS

Accident Result

Twenty seven accidents involving at least one motorcyclist equipped with an airbag jacket were collected and analysed (see Annex 1).

All these accidents concerned only the riders, no passengers were involved in the accident.

Types of involved PTW were:

- 18 motorcycles with engine size higher than 125cc.

- 3 scooters >125cc.
- 6 PTW undetermined.

The configurations of the accidents were:

- 11 frontal impacts for the PTW against another motorised vehicles. The opposite vehicles were 10 passenger cars and one truck.
- 2 lateral impacts for the PTW against 2 cars.
- 11 losses of control. Among these cases, seven took place in curves.
- 2 back impact for the PTW
- 1 undetermined configuration.

The kinematic reconstructions based on the motorcycle damage and the throw distances allow estimation of the impact speed of all the accidents comprising speeds between 10km/h to 90km/h at the instant of the crash or the fall.

Concerning the protective equipment, all the motorcyclists wore a helmet. All of them were globally well equipped: gloves, jackets, specific boots and of course an airbag jacket.

About the airbag jackets, 26 were airbag with *cable* and only one was a *radio* airbag. All the airbag jackets have been triggered during the accident except one according to the statement (see Annex 1).

Among the 27 persons involved in the accidents, 20 of them were injured and seven remained uninjured. People who had no injuries corresponded to cases of loss of control without impact except with the ground or impact at low speed (10-20km/h). Injuries were observed on the following segments of the body regions:

- 14 at the lower limbs
- 12 at the upper limbs
- 6 at the trunk: thorax, abdomen or vertebral column.

Concerning the gravity of the injuries, they were coded according the AIS. Only the trunk injuries are described since they concern the airbag jacket:

- 3 motorcyclists had an AIS3+ injury and two of them also had a trunk injury AIS 1 or AIS2.
- 3 motorcyclists had and AIS1 or AIS2 injury at the trunk
- 1 had an AIS1 injury at the cervical spine.

About the statements, most of the people declared that they were satisfied with the airbag jacket. Indeed, the majority of involved riders was uninjured or had sustained a minor injury. Thus 21 motorcyclists estimated that they were better protected with the airbag jacket and are convinced that they would have been more injured without it. These elements are however subjective.

Two accidents were studied more particularly because they caused AIS3+ injuries on the thorax and they are detailed hereafter.

Accident n°1

This case involved a Triumph 675 which had been impacted laterally on the the left side of the motorcycle at the rear wheel level by a car during a left turn configuration. The motorcyclist has lost the control and then the driver was ejected and finally fell on the ground. Then he slid for about 30m without hitting an obstacle. Injuries observed include:

- 5 fractures of left ribs
- 3 fractures of right ribs
- Pleura detachment
- Hematoma of the left leg.

Figure 3 shows the configuration of the accident and the numerical reconstruction.

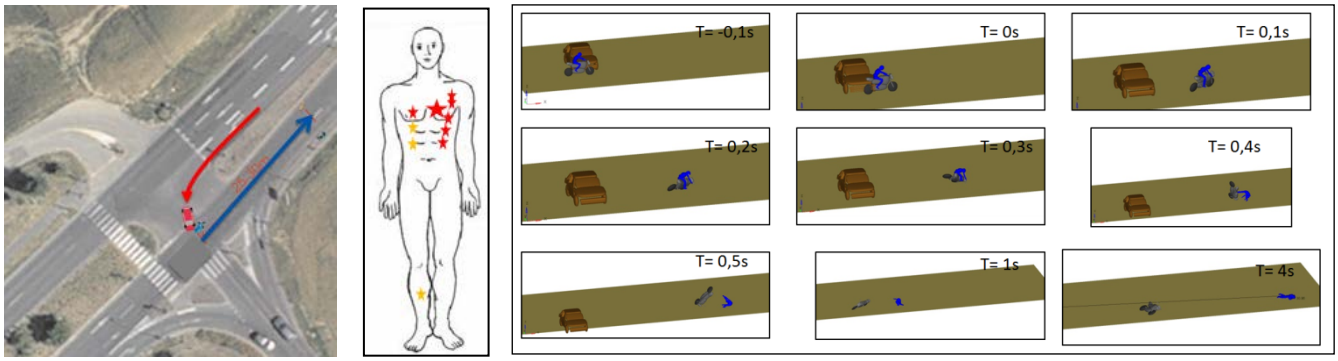

Fig. 3. Accident study n°1: Accident configuration. Injuries locations. Multibody reconstruction of the accident.

The accident reconstruction allowed estimation of the speed of the motorcycle at impact was approximately 70km/h and the car speed 30km/h. It has been determined that the airbag jacket was triggered 0.2 seconds after the impact and was inflated 300ms before the ground fall. The impact on the ground was evaluated at 63km/h on the back of the trunk. Even if this body part was protected by the airbag jacket, the motorcyclist had serious injuries on the thorax.

Accident n°2

This case concerned the rider of a BMW F800 which lost its control in a curve. This accident has been filmed by another motorcyclist who followed the BMW and had a GoPro camera on the front of his motorbike (see Figure 4). After the loss of control, the rider slid on the ground and impacted a barrier. The injuries observed on the trunk were a liver rupture and a sternum fracture. This accident has also been numerically reconstructed using the multibody model and the position at impact has been estimated (see Figure 4).

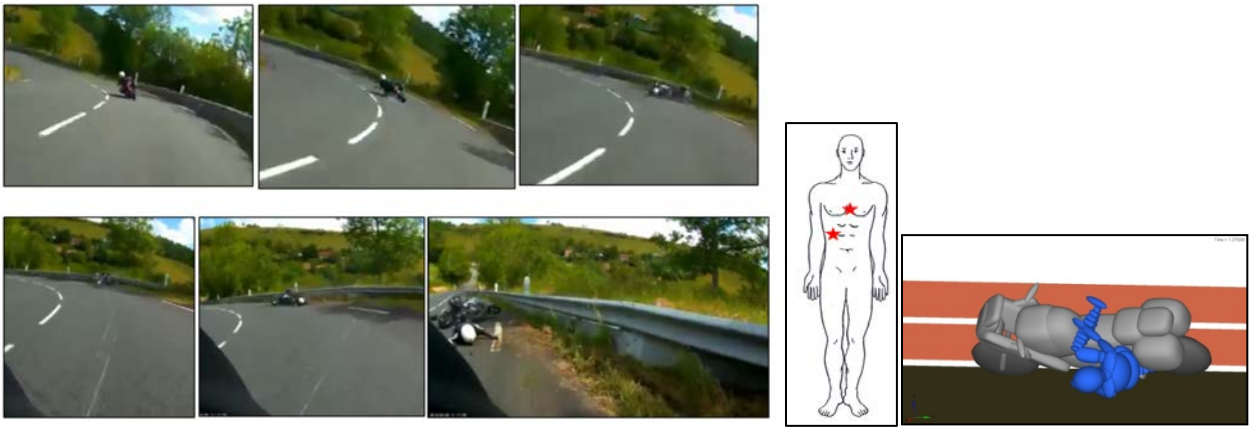

Fig. 4. Accident study n°2: Film of the accident. Injuries locations. Multibody simulation of the impact.

The approaching speed has been estimated at 90km/h while the speed at the loss of control (fall on the ground) was evaluated at 50km/h. The impact speed against the metallic barrier was about 40km/h. According to the multibody reconstruction, it is estimated that the airbag jacket has been triggered 0.4 seconds after the fall on the ground while the impact occurred 1.2s later. The liver injury can be attributed to the impact of the suitcase on the right lateral part of the trunk of the victim (see Figure 4).

In conclusion, the accident study shows that the airbag is globally well perceived by their users who highlight their protect effects. But these cases mainly involved falling from the motorcycles at low speeds and less direct impacts against an obstacle. However, some specific cases show that a direct impact at 40km/h or a falling at 60km/h with an airbag jacket cannot avoid serious injuries on the trunk (AIS3+).

Experimental results

Figure 5 shows the chronology of the four crash-tests in three images:

a) The first image corresponds to the first contact between the front wheel and the obstacle. This contact has been considered as t=0ms.
b) The second image corresponds to the triggering of the airbag jacket.
c) The third image corresponds to the contact between the motorcyclist and the obstacle.

Test 1: Cable 1. a  b  c 

Test 2: Cable 2. a  b & c 

Test 3: Radio 1. a  b  c 

Test 4: Radio 2. a  b  c 

Fig. 5. Chronology of the four crash tests. Test 1 & 2 with mechanical triggering (cable), Test 3 & 4 with electronic triggering (radio).

From a general point of view, it can be observed that the airbag jackets with cable are triggered later than electronic ones. All the airbag jackets except during test n°2 were triggered before the impact of the motorcyclist against the obstacle.
Figure 6 shows, for each tested airbag, the curves of the pressures on the airbag. It can be highlighted that the pressure level can differ in function of the considered airbag (from 0.3 Bar to 1.5 Bar). But the measured pressures were in accordance with manufacturer specifications. No bad functioning has been observed.

Moreover, the two *cable* airbags are triggered after 110ms while the two radio airbags are triggered at approximately 20ms after the first contact. It showed also an inflated time (considered when the pressure is

stabilised) of respectively 100ms for the airbag *Cable 1 (test 1)*, 250ms for the airbag *Cable 2 (test 2)*, 100ms for the airbag *Radio1 (test 3)* and 80ms for the airbag *Radio 2 (test 4)*. This result tends to confirm that the *radio* airbags detect the impact sooner than the *cable* systems.

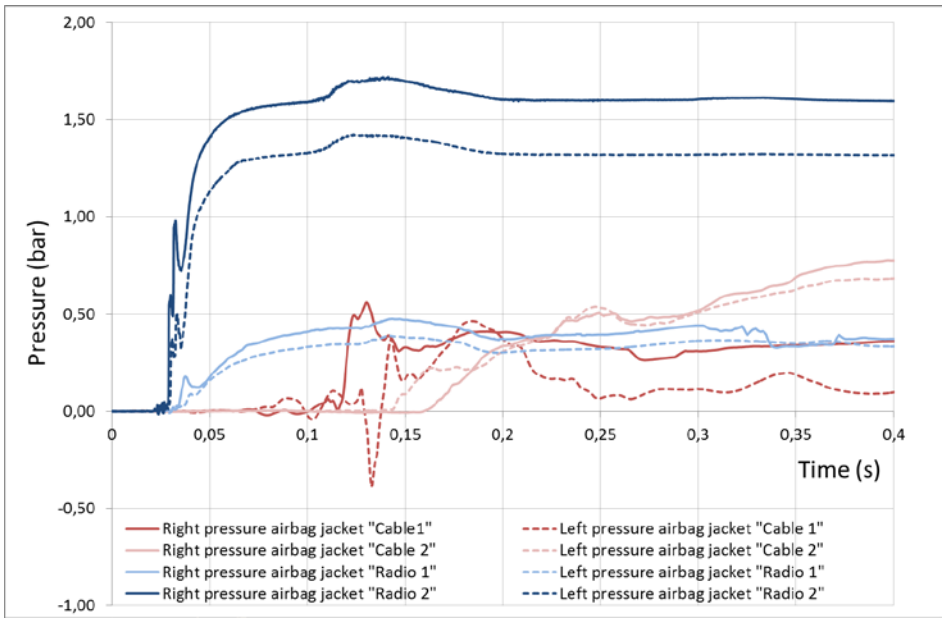

Fig. 6. Pressure curves during the four full scale tests performed with each airbag jacket.

Concerning the level of acceleration of the PMHSs, the A-3ms values are presented in Table 7. Because the head of the motorcyclist is protected by a helmet, the A-5ms values for the head are given too.

These values never extend the injury thresholds, as was confirmed by the dissection performed after each test that showed no injuries. The A-3ms value for the thorax protected by the airbag did not exceed 30g and were in the same order of magnitude than those for the pelvis. However the maximum of the 3ms thorax acceleration were noted between 0.14s and 0.24s after the impact and could precede the airbag jacket inflation, especially for the cable systems. In the same way, in the perspective that the airbag gets useful in the pelvis protection, the inflation must be faster because of the pelvis impact against the tank noted from 0.04s.

TABLE II
RESULTANT ACCELERATION FOR 3MS/5MS DURATION (G) AND CORRESPONDING TIME (IN PARENTHESIS)

	Head 3ms	Head 5ms	Pelvis 3ms	Thorax 3ms
Test 1(Cable)	35 (0.145 ms)	25 (0.144 ms)	27 (0.038 ms)	23 (0.147 ms)
Test 2 (Cable)	29 (0.233 ms)	24 (0.233 ms)	19 (0.043 ms)	21 (0.243 ms)
			28 (0.188 ms)	
Test 3 (Radio)	99 (0.131 ms)	63 (0.131 ms)	25 (0.056 ms)	26 (0.1477 ms)
			15 (0.144 ms)	
Test 4 (Radio)	51 (0.107 ms)	45 (0.107 ms)	32 (0.121 ms)	23 (0.064 ms)

From a global point of view, the objective of this paper was to define a speed until the airbag can protect the user. According to the both approaches (accidentology and biomechanical experiments), it can be considered that this kind of PPE could be efficient until an impact at 30-40 km/h. Indeed, the accident survey has shown that for impact lower than this range of speed and in different configuration (sliding, impact), no injuries or light injuries has been observed. Moreover the crash-tests show that no injuries were observed for such impact at 40km/h. Nevertheless, since at least for one accident (accident reconstruction n°2) trunk injures has been observed, it can be considered that this kind of speed is a limit of their efficiency.

IV. DISCUSSION

The aim of this paper was to evaluate some current airbag jackets found on the market. Results are based on an accidentology survey and on laboratory tests. Both of them show that these new devices can offer good protection for the thorax but it must be consider that this protection is limited.

Concerning the accidentology study, only few accidents (less than 30) have been collected. However, from this small database it can be concluded that the airbag has a global effectiveness and people have confidence in it. Nevertheless, some specific cases showed that it is always possible to be seriously injured with an airbag jacket even if the falling speed or the impact speed is low (about 40km/h). So it should be interesting to extend this study with more accidents. The survey has also concerned mainly airbag jackets with a *cable* system and accident cases with *radio* systems are missing.

About the experimental tests, the configuration of impacts (frontal for the PTW) is representative of the main configuration observed in accidentology and in particular of our sample accidents (11 cases among 27). It has to be considered that only one crash-test has been performed per product. So it appears important to repeat the experimental tests to improve and reinforce these results. Of course, due to the cost of such experiments it has not been possible to perform a large campaign but it could be done in the future. Subjects were elderly persons so they can be considered as more fragile than young ones. So it can be considered that airbags were tested with unfavorable conditions. But despite this, no injury was noted. Concerning the configuration of impact, only frontal crashes against a lateral car were performed. So it should be interested to experiment other configurations like single crashes representative of a loss of control following by an impact against a fixed obstacle.

From a global point of view, this study shows that an airbag can protect in speeds of impact lower than approximately 30-40km/h depending of the type of airbag. Indeed, the accident survey shown that no serious injuries have been observed for different impact configurations at speed lower than this range. Because these levels of speed generate high energy of impact on the human thorax, it can be considered that the airbag jacket offers good protection.

V. CONCLUSIONS

This study has performed evaluation of the current airbag jackets found on the market. The airbag jackets seem to provide limited protection from a threshold speed which can be estimated to an impact around to 30-40km/h but these speeds differ with the impact configuration (direct impact against an obstacle or ground fall). This level of protection can be considered as important since the impact of a human against an obstacle at this range of speed is particularly strong and concern high levels of energy.

This paper shows also differences between the type of airbag jackets in terms of pressure and trigger time. These two parameters are mainly considered to evaluate performance of their protective effectiveness. So it appears important to known these values well in order to determine the best product.

In terms of perspective, this work will continue by testing other airbag jackets. In particular this study concerns only airbag of category one (mechanical triggering – cable) and two (sensors placed on the front wheel of the PTW) but not autonomous airbag jackets which include the sensors in the jacket. So next step will be focus on testing such airbags. This study will be also extended with other test configurations to evaluate the duration of the airbag inflating for example.

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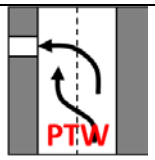
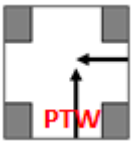
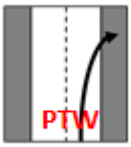
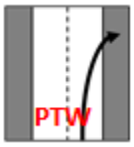
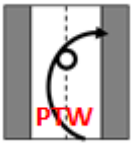
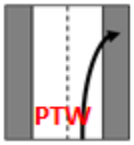
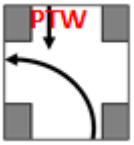
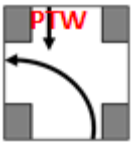
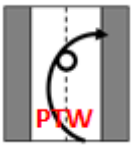
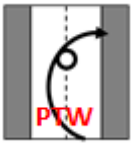
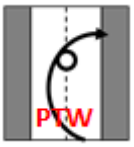
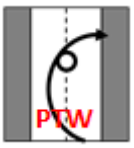
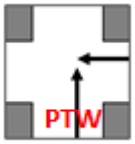
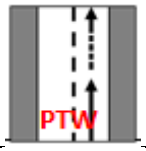
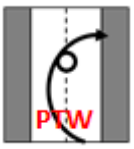
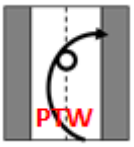
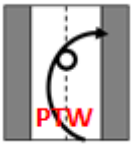
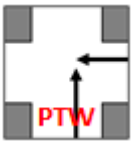
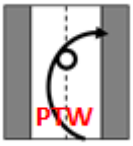
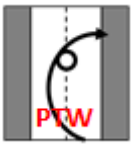
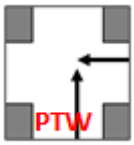
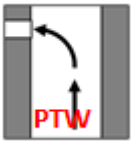
VIII. APPENDIX I

ACCIDENTS INVOLVING AT LEAST ONE MOTORCYCLIST EQUIPPED WITH AN AIRBAG JACKET

Motorcycle	Air bag jacket	Speed *Rider's statement km/h*	Impact speed *Estimate or calculate km/h*	Impact configuration	Rider's injuries	Witness statement *Extracts*
BMW F800R	Helite wired	70	70		Severe pain and large bruise at the bottom of the back, dermabrasions and strain or sprain of the right wrist	*I am thrown from the bike (over or in front of the hood) when the airbag is triggered without hitting the vehicle. I fall on the back (lower back I think from the damages on the airbag vest: bottom of the damaged mesh) on the asphalt and I continue to rolled up to the bottom side without hitting the slightest obstacle.*
?	Helite wired	30-40	30-40		uninjured	*At the approach of a fire that went to orange I slowed down and the vehicle that followed me did not see that he had to do the same. I was violently screened on his windshield in the middle of my back and then flown into the air by the violence of the impact. My race ended on the hard bitumen.*
Piaggio 300 3 Wheels	Helite wired	?	10-20		Right side: Arm bruise, hip, elbow hematoma, tendinitis under thorny shoulder	*I was hit from behind by a rider who could not control his braking. After being thrown forward, I finished lying on the asphalt from the highway.*
Suzuki Burgman 400	Helite wired	30	30		Dislocation of the right shoulder stage 3, multiple bruises on both legs	*I only remember a very dull noise, that of the car that hit me in the right front, I had not seen. I was thrown over 20 meters and the driver gave a steering wheel to avoid rolling over me.*
Kawasaki ER6 ER6-N	Helite Turtle	60-70	?		uninjured	*Too late to brake, deported on the right and the bike slams the pavement violently just before a bridge, takes off, crosses a bunch of trees and ends its course in the creek below (about 15m further and*

						4m below). I was ejected and I landed in the grass, without injuries.
HD 883 sporster	Helite	80	?		uninjured	*I retrograde too quickly causing loss of grip of the rear wheel. I then slipe, the bike goes down and slides on the right side. My brown leather airbag jacket is triggered, the strap remains attached to the bike, I feel tight in the back and chest.*
Scooter	Helite	?	?		Right thigh pain	*Probably due to a diesel fuel plate that I did not detect due to the night, the scooter lost its balance and crashed hard on its right side. My airbag vest had been triggered during my fall.*
BMW F800ST	Helite	95 (estimated from the video)	35-45		liver rupture, fracture of the sternum	*The rear wheel suddenly slides. My companion was ejected on the side. The airbag went off immediately. The bike has finished its course in the barriers happily doubled on this road. My companion slipped and hit the bike with the torso, tearing the left luggage in crash.*
Honda Pan european 1300	Helite leather jacket	?	40		fracture of the right fibula	*A car coming from the opposite lane to mine cuts me off the road to go to park. Impossible to react. Frontal impact. I was screened on the handlebar of the bike.*
Kawasaki ER6	Helite turtle	?	50		Head trauma, Fracture of the 5th left metacarpal, the right radial styloid, and a sprain of the right ankle.	*Impact on the right wing of the car by the front of the bike. Projection of the rider over the bike (impact of the head on the windscreen of the car and falling several meters from the vehicle. The body of the rider falls heavily on the ground.*
Honda Hornet 2008	Helite airnest wired	60-70	?		uninjured	*Straight line, I was surprised by the braking of the car that preceded me, I braked suddenly. My front wheel jammed, which sent me to the ground on the left side. I rolled and slipped on the right side for a few meters. The slip stopped in contact with the car that preceded me. It was*

						my back that touched the bumper of the car.
?	Helite wired	?	?	?	Fracture of the right clavicle and rib bruises	*Bad operating*
?	Helite wired	?	?		Hematoma at the level of the sacrum and another on the left tibia	*The rear wheel stalls (the road was wet) as I was slightly inclined. I'm kicked out of the bike, the AirBag vest triggers and I slide on the lower back.*
triumph speed triple 675 abs	Helite airness	70	50-60		5 broken ribs on the left side, 1 broken rib and 2 cracked on the right	*Refusal of priority of a car. My motorcycle unbalanced from the back. I slide and roll on a thirty meters.*
TDM 800	Helite Wired	150	70		Left shoulder contusions, cervical contusion, sprained right knee.	*Loss of control in a right curve, fall in the right shoulder and impact against a fence.*
honda Goldwing 1800	Bering Radio	34-44	20-27		left hand injuries	*The left front of a car stroke the motorcycle on the right side. The rider thinks that without this jacket, he would probably have been more injured.*
Yamaha Fjr 1300	Helite Wired	0	0		back pain and scapula without details	*The motorcycle stopped behind a vehicle when the bike falls to the ground, the airbag triggers immediately.*
BMW R 1200 GS	Helite Wired	90	90		Luxation of the shoulder, cracked ribs and right forearm dermabrasion	*The rear wheel of my motorcycle slipped on gravel due to the work, it took grip and the bike started to bounce and ejected me over it. I fell on the back, roll and slide.*
Honda VFR800X	Helite Wired	?	40		uninjured	*A truck turned around while I was overtaking it. I tried an emergency braking but could not avoid the impact. I had the reflex to give an impulse with the right foot not to pass under the bike and I hit the truck with my back at the right shoulder level.*
?	Helite Wired	?	?		right foot and right hip pains	*I lost the front of the bike. I tried to catch the bike by kick the right foot on the ground but I slide straight on at least 50m. I fell on the right side and then on the back.*

BMW GS 1150	Helite Wired	?	?		Fracture of 5 right ribs	*I was face to face with a car in a sharp curve. Fortunately, I was able to maneuver and avoid the impact with the car. The result was that I was ejected from my bike and thrown hard against the ground. I hit the ground on the right side of my chest.*
Goldwing 1800 GL	Helite Wired	80	?		Fracture of the right foot	*I was cut off by a car coming on my right. I flew about 20m and fell on my back.*
Kawasaki ER6F	Helite Wired	?	?		Uninjured	*I go up the traffic at a rather slow speed (without being able to quantify it) when a driver cut me off the road, probably performing a maneuver (turn or change of lane). I brake but fall. I was ejected and the airbag triggered.*
BMW 1200 RT	Helite Wired	?	?		foot strain and body aches	*I not see a plate of ice of 3m in the middle of a curve. I still lose the front wheel and I cannot do anything. I slide about 5 to 10m, the vest inflates and once again prevents my head from touching the ground.*
Honda PAN EUROPEAN 1300	Helite Wired	?	?		fracture of the hand and leg dermabrasion	*Due to slippery carpet, the front wheel flew away ejecting me from the front while making a beautiful "sun." I fell heavily on the back.*
?	Helite Wired	40	40		Fracture of the patella, sprained of the thumb	*A car who had not seen me, suddenly came out of a parking depriving me of my priority. I made an avoided maneuver but the bike hit the sidewalk and another obstacle. I was thrown forward violently.*
?	Helite Wired	?	?		sprained on the left wrist, knee hematoma, shoulder pain	*After having violently hit the side of a camping-car, I did a sun over the handlebars and fell back a few meters on the back.*