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VERIFICATION OF AIRBAG ACTIVATION DURING COLLISION OF VEHICLES WITH THE USE OF SDC METHOD

P. Aleksandrowicz*

Abstract: *One of the negative effects of motorization development are road collisions which involve the need to carry out post-accident repairs. Costs of post-accident repairs, especially of airbag systems and safety belt tensioners, are high and are not covered by insurance policies. Therefore, it happens that vehicle users arrange collisions to file fraudulent insurance claims to extort money from insurance companies for the vehicle repair. Methods for money extortion are getting more and more sophisticated and involve installation of previously blown airbags as having been activated in a collision reported to the insurer. The study presents a research method SDC providing the possibility of efficient verification of the crash and activation of the vehicle airbags. A statistical analysis (S) dynamic analysis(D) and analysis of characteristic damage (C) are used for verification of a road event in SDC convention. An analysis of a crash with the use of the proposed method is supported by a developed computer tool to be used in order to provide automatization of the verification decision process. The research covered as many as 90 claims which were under court proceedings. The results of investigations show that insurance companies do not use effective methods to verify crashes of vehicles. Use of SDC method allows to detect damage caused by a collision. Thus, the results have a practical and cognitive advantage. The article provides information how to use the SDC method in practice which can be useful for experts, researchers and program designers.*

Keywords: SDC method, crash verification, fraud, damage claim verification

1. Introduction

Traffic road poses a risk of vehicle failure, crash and collision occurrence. The risk of failure is discussed in, eg. the work of Knopik et al. (2017) which deals with the influence of prevention maintenance on risk reduction. However, removal of the effects of vehicle collisions may also provoke insurance fraud. It does not apply only to Poland but also to other countries, e.g. Czech and Germany which is described in the work of Rábek (2013). In Poland, in 2015 alone, fraudulant insurance claims for vehicle post collision repairs in the sum of 20 million Euro were rendered impossible. However, the actual sum of extorted damages is not known (https://piu.org.pl). In order to prevent this phenomenon, the SDC method was developed. Verification of an event by this method requires application of three research methods. The first one is a statistical analysis (S) involving a comparison of the vehicle damage localization and verification, which is described e.g. in works of Aleksandrowicz (2017a,b). Programs used in reconstruction of road accidents are applied for dynamic verification of event (D). However, selection of a simulation program should be adequate to the verified event, (Aleksandrowicz, 2017c) discusses contact models in V-SIM4 program with indication which events they should be applied to. The results of simulation based of conjectural parameters offered by a given program should not be accepted uncritically. The simulations which were carried out allowed to find out that, e.g. V-SIM4 program use the characteristics of contact force F_C in the function of a vehicle deformation Δl which is close to a linear and this is a simplification. The impact of contact parameters on the crash of a vehicle with a round pillar is presented in the work of Kostek et al. (2017a), and a crash of a vehicle with a nondeformable obstacle for 40% overlap is presented in works (Kostek et. al, 2017b,c). In turn, a perpendicular collision of passenger cars is studied by Gidlewski (2012), Kostek et al. (2017d). These works show sensitivity of the collision pattern on the input data and prove that, application of conjectural parameters can lead to wrong

* Piotr Aleksandrowicz, PhD.: Machine Maintenance Department, Institute of Machinery Operation and Transport, University of Science and Technology, Al. prof. S. Kaliskiego 7; 85 796, Bydgoszcz; Poland, p.aleksandrowicz@utp.edu.pl

results. However, an analysis of characteristic damage (C) includes verification of the damage pattern in the contact site of crashing vehicles elements. Occurrence of this type of sites is discussed eg. in works of Gilsdorf et al. (2007) and Treter (2016). In this study, application of the complex SDC method for verification of vehicle collisions and a computer tool to support the decision process has been proposed. A video (https://youtu.be/bIwZ7xvYCQ0) has been recorded in order to depict a practical implementation of the SDC method.

2. Case study

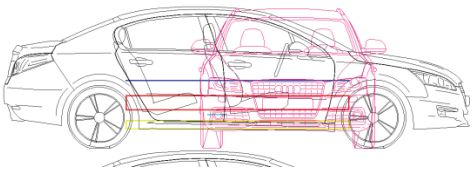
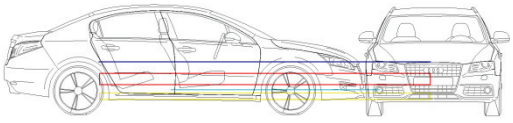
The research object was a car Audi A4 after deployment of airbags (Fig.1a), with disassembled airbags and controllers during repair (Fig. 1b), which rendered impossible to investigate the memory of control devices in order to establish whether the airbags blew up due to a reported crash or they were placed in the car to file a fraudulent insurance claim.

Fig. 1: Audi with blown up airbags (a) and disassembled (b).

2.1. Static analysis (S) results

Analysis has shown geometric coverage of damage zones of vehicles involved in a crash in a declared collision, illustrated in Table 1.

Tab. 1: Static research methods.

Comparison on the basis of calibrated images of vehicles	Comparison of vertical stylings – crash position
	
Comparison of vertical stylings – damage zones	**Transparent superposition of a vehicle damage sites**
	

2.2. Dynamic analysis (D) results

A simulation of a collision of vehicles shows that acceleration reached value a = 10.13 g, in time t = 0.252 s of the simulation, that is higher than the threshold one needed for activation of airbags which is 8 g (Diupero et al., 2006). Fig. 2 presents a crash verification analysis exemplary result and in Fig. 3 there are courses of speed and acceleration change of Audi during the crash.

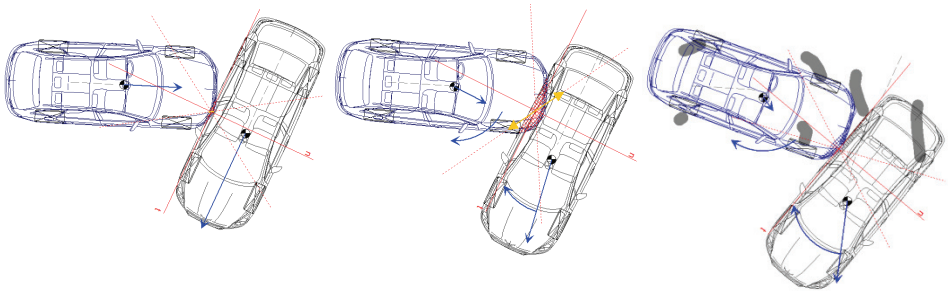


Fig. 2: Dynamic analysis result recorded.

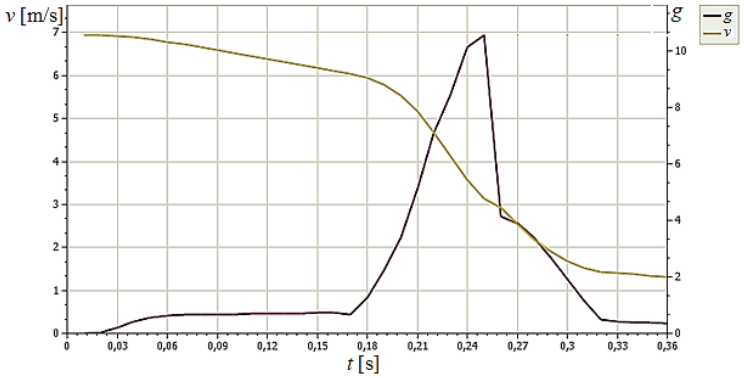


Fig. 3: Speed and acceleration changes during collision.

2.3. Characteristic damage analysis (C) results

Fig. 4 shows a mark of the right headlight case of Audi A4, left on the door of the vehicle indicated as the perpetrator of the damage - Peugeot 508.

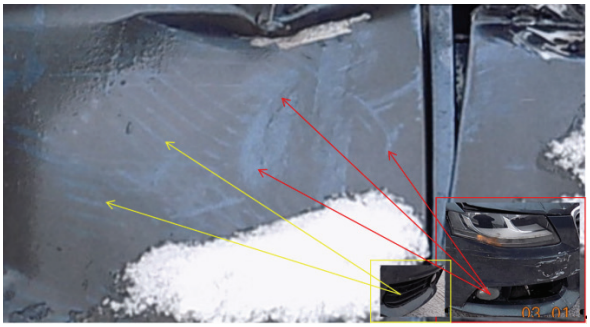


Fig. 4: Characteristic damage identified.

3. Results of the research

As many as 90 vehicle damage claims were verified with the use of the SDC method included whose application results are shown in Fig. 5. The analysis was carried out with the use of a computer tool developed to support the decision process (http://wim.utp.edu.pl/dok/wyklady/analiza_sdc.xlsm).

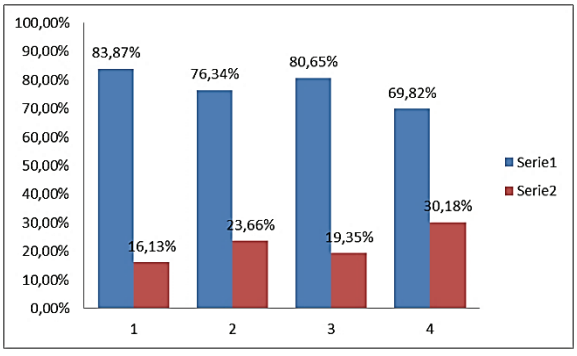


Fig. 5: Results of the research performed with the SDC method.

4. Conclusions

The results of the research show that there is a possibility of a practical application of the SDC method for verification of gas airbags activation during collision of vehicles when there is no possibility of reading data from control devices. However, when comparing threshold values for airbag activation, the condition and quality of the airbag system components and elements of the electric control system cannot be neglected. It particularly applies to vehicles after previous repairs. For of example, the work of Knopik et al. (2016) includes an analysis of time periods between failures of the electric subsystem affecting the transport means safety. Without verification of the technical condition of the above discussed system there is no certainty as to their correct behavior during a collision. Results of analyses of a group of 90 failures carried out by the SDC method show that insurance companies need to cope with the problem of not-applying verification of vehicle collisions. The studies reveal that the static analysis has been incorrectly performed for 83.87 % of damage claims, whereas errors were found for 76.34 % of cases of the dynamic analysis and for 80.65 % of characteristic damage analysis. In general, only 30.18 % of vehicle collisions were classified in the right way. It was also established that the procedure of dynamic verification provides the best results when the influence of input data is taken into consideration which is also described in work (Wach, 2015). Implementation of the SDC research method along with the computer tool supporting the decision process into insurance companies could largely contribute to elimination of insurance frauds and arranged vehicle collisions.

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