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Extended Abstract

METHOD FOR CLASSIFICATION OF FRONTAL COLLISION EVENTS IN PASSENGER CARS BASED ON MEASUREMENT OF LOCAL COMPONENT-SPECIFIC DECELERATIONS

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Abstract

The detection of accident scenarios is essential for a timely deployment of restraint devices and therefore for optimum protection of the vehicle occupants. Based on an innovative concept for crash detection, which involves measuring component-related local decelerations, this paper presents an entirely new method for the simulation and evaluation and estimates this with of a comprehensive set of crash load cases. With this approach, decelerations are detected directly at numerous individual components in the vehicle front end and are integrated in a velocity reduction using small time intervals. An evaluation based on multivariate statistical methods shows that the information content which results from exceedance of one defined velocity reduction threshold per measuring point is sufficient to safely distinguish between and classify all relevant load cases with a high level of independence. The concept has therefore proven to be functional and will be transferred to initial test series. During an accident, the main task of airbag algorithms is to ensure timely deployment of restraint devices. Based on these requirements, an algorithm is first developed and subsequently adapted to the specific vehicle. Its performance is then verified by crash tests of specific load cases stipulated by law and consumer test organizations under reproducible conditions. Table 1 illustrates such a typical set of tests. All these Fire load cases must be distinguished between, and timely deployment of the necessary restraint devices must be ensured. Conventional frontal collision algorithms that are state of the art today, use the measurement of the overall vehicle deceleration during a crash for distinction. By contrast, there are NoFire load cases as described in Table 1 which also result in significant short-term strain on or deceleration of the vehicle but which do not present any danger to the vehicle occupants. In these cases, it is imperative that unnecessary deployment of the restraint devices be avoided.

The approach described in this paper uses a completely different measurement method. In addition to the vehicle deceleration, the temporal sequence of an accident and the resulting vehicle destruction in space and time are unambiguous indicators of crash severity. Figure 1 illustrates the destruction of a vehicle front end for one crash type at increasing crash speeds. The load conditons are simulated by PAM-Crash, a state-of-the-art tool for crash simulation based on real car FEM-Models. The destruction of the vehicle front end increases with the crash front end data, the vehicle is subdivided into geometric zones using the x, y and z-axes of the vehicle coordinate system. The front-end design of mid-range passenger vehicles results in a subdivision into 11 planes on the xaxis, 13 planes on the y-axis and 3 planes on the z-axis. The number of planes for each axis results from the dimensions of the cars front end, because there should be a sensor position every 100 mm. The use of a narrower network does not provide better information, since the size of the components and the geometric constraints of the motion behaviour do not permit and necessitate further resolution of the acceleration signals. In a real model, the sensors have to be placed on a part next to their planned position. As Figure 2 shows, however, overall it is possible to remain within a continuous, virtually symmetric grid. The integrated deceleration signals are used to evaluate the load behavior. A velocity reduction value is then available for each integration interval (t = 0.5 ms). Starting from the point of impact of the crash opponent, the measured decelerations spread through the vehicle and create a local velocity reduction pattern (when being integrated) which is characteristic for the crash, a so called heat map. Using a color scale from green to red, the measuring points indicate where defined velocity reduction thresholds (VRT) have been exceeded.

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