ANALYSIS OF EVENT DATA RECORDER DELTA-V REPORTING IN THE IIHS SMALL OVERLAP CRASH TEST

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Abstract

A review of small overlap crash test data was conducted during which a seemingly anomalous condition associated with crash severity on the "minor axis" (see note 1) for the vehicles involved in those tests was observed as a function of comparing Event Data Recorder (EDR) and test instrumentation data sets. Where the reconstructionist or researcher might assume that longitudinal and lateral acceleration and/or delta-V would accurately represent the effect on the test vehicle based on past literature in the area, the data reviewed revealed a significant discrepancy between EDR data and the test instrumentation based data. Once the basis for the discrepancy was more fully identified, a corresponding or parallel discrepancy between the EDR data and corresponding values which might be calculated or estimated in a crash analysis or reconstruction was identified.

Over the years, there have been numerous studies (see appendix) on the accuracy and performance of Event Data Recorders (EDRs) in instrumented crash tests. However, most have been focused on full frontal impacts and perpendicular side impacts. This study will shift the focus from full frontal barrier crash tests to small overlap crash tests performed by the Insurance Institute for Highway Safety (IIHS) and the resulting effect this type of collision may have on some of the crash severity data recorded in the EDR component of late model vehicles.

Introduction

In 2009, IIHS published a "Status Report"[1] in which the possibility of creating a new crash test procedure was discussed to analyze vehicle responses to a small overlap crash configuration. Previous similar studies conducted by IIHS focused on moderate (40%) overlap crash tests. The Institute performed a statistical study of real world crashes to evaluate the applicability of the smaller overlap crash test configuration. Researchers used the 2000-2006 National Automotive Sampling System (NASS) Crashworthiness Data System (CDS) to study frontal crashes on US roads. As a result of the study, IIHS Sr. Vice President of Vehicle Research David Zuby said that "[IIHS] found that a lot of frontal crashes are happening in configurations that aren't represented in the crash tests being conducted right now, either by us or the National Highway Traffic Safety Administration."[1]

Twenty four percent of the crashes that IIHS analyzed in the study[1] were small overlap crashes where only about twenty five percent of the vehicle is engaged with the impacted object. Mr. Zuby concluded that "based on results of this study, we think small overlap tests have good potential to improve the crashworthiness of new vehicles." The report, along with other technical papers on small overlap crashes provided sufficient justification to further analyze this crash configuration in a laboratory setting. In 2012, IIHS announced that they began testing new vehicles in the small overlap configuration.[2] By early 2013, IIHS completed testing on eleven mid-sized luxury/near luxury vehicles and eighteen midsized moderately priced vehicles.[3] By August of 2013, IIHS completed testing on six small cars in the small overlap crash configuration.[4]

Small Overlap Test Procedure

A brief summary of the IIHS small overlap test will identify data relevant to this study. All the details of the small overlap crash test procedure[5] is available at the IIHS website (iihs.org). The vehicle is aligned such that 25% of the vehicle width

overlaps with a flat faced rigid barrier with 150 mm radius edge, as shown in Figure 1. The test vehicle is accelerated by a propulsion system to 40 mph (64 km/h) upon impact with the barrier. A fully instrumented 50th percentile Hybrid III Dummy is placed in the driver seat and two pressure-sensitive tape switches placed on the front of the vehicle are used to determine the moment of impact. This time (a "time zero") is synced with the data acquisition and camera systems.

IIHS also records vehicle acceleration at a location along the longitudinal axis of the vehicle in the rear floorpan. One set of accelerometers, measuring longitudinal, lateral and vertical accelerations are used in each crash test. To ensure the accelerometers stay on axis during the crash, they are mounted to a metal block which is welded to a strong part of the floorpan. Vehicle accelerometers are oriented according to SAE J211[6]. Figure 2 shows the typical location of the accelerometer array relative to the center of gravity of the vehicle and a target is positioned on the roof of the vehicle over the location of the accelerometer array which can then be seen in later overhead video.

IIHS also captures valuable crash related data from high speed camera footage. Onboard cameras focus on dummy interaction with the vehicle interior while off-board cameras capture vehicle motion and dynamic deformation. All cameras capture 500 frames per second. For this study, the most relevant camera view is the off-board wide overhead angle. Figure 3 shows series of frames captured from a typical small overlap crash test from this "overhead wide" perspective.

Test Results

A group of vehicles from the IIHS small overlap crash testing program were chosen for analysis (see Table I). These vehicles were selected for this study to include many of the available manufacturers supported

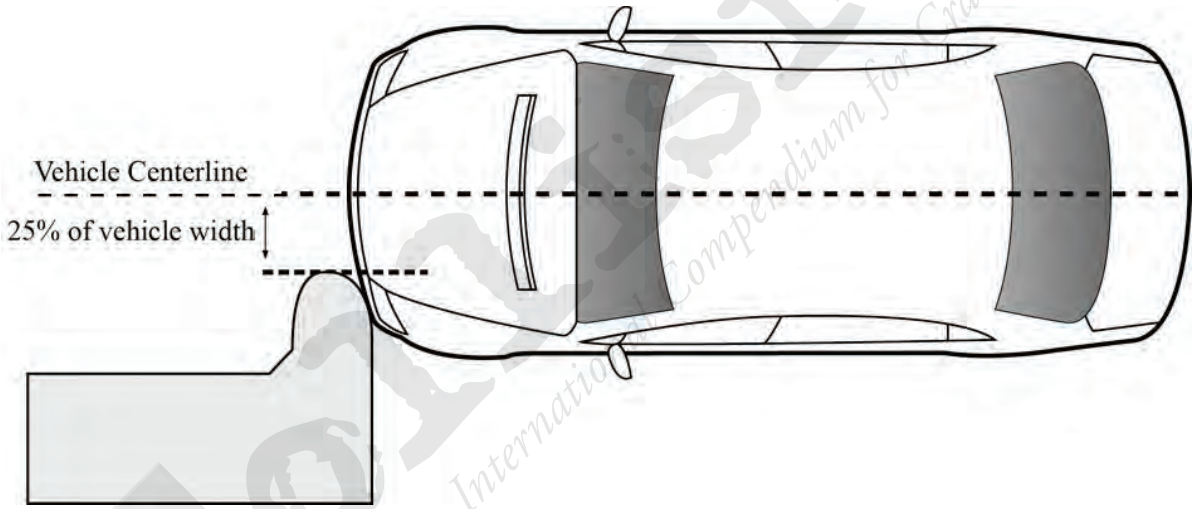

Figure 1: Vehicle alignment for IIHS small overlap crash test.[5]

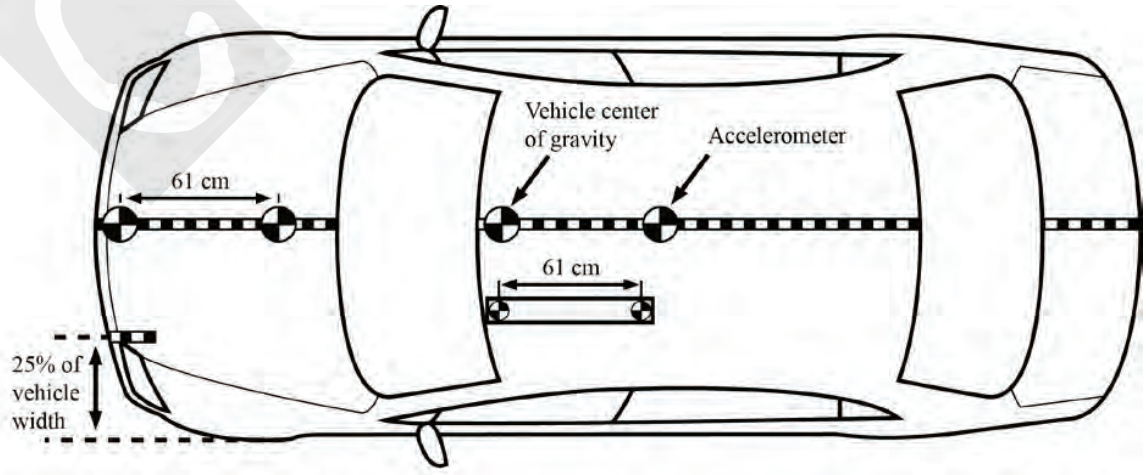

Figure 2: Accelerometer location for IIHS small overlap crash test.[5]