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Development of Advanced HIII Abaqus dummies

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Abstract: *Hybrid III dummies are among the most frequently used dummies in both industry and academia for vehicle crash safety. Abaqus is one of most widely applied finite element codes in the world. To meet the needs of crash safety analysis and to exploit the potential of the Abaqus/Explicit code, a family of HIII dummies, including HII 50th male, 5th female and 95th male dummies, were developed at FTSS in collaboration with Simulia and BMW. This paper describes in detail the development of the HIII dummies with specific reference to the HIII 50th dummy. Firstly correct material models based on material test data are verified. Secondly variety of FTSS standard (certification-based) and non-standard finite element validation tests at component level, i.e. head drop, neck pendulum, lumbar spine, knee slider, knee impact and single rib tests, and at full dummy level, such as thorax pendulum, sled seatbelt and sled airbag tests, were accomplished. In addition, a suite of extra test, developed by the Partnership for Dummy Technology and Biomechanics (PDB), was integrated into the dummy development to enhance the fidelity and robustness of the dummy performances. Those tests include head impact (forehead and cheek), thorax impacts, tibia tests and foot and shoe tests. Based on these series of stringent validation tests, a family of HIII dummies have been successfully developed, which greatly facilitates virtual vehicle development and design process of the occupant safety in the automotive industry.*

Keywords: *Dummy, Anthropomorphic Test Devices (ATD), Occupant protection, vehicle crash safety, Finite element Analysis*

1. Introduction

Since 2001, fatalities due to traffic accidents have been identified as the leading cause of death for people age 2 through 34 years old in the United States [R. Subramanian, 2003, 2005, 2006, and 2007]. Among all traffic fatalities, nearly 40% resulted from front impact accidents. The front impact therefore becomes one of the key crash safety areas targeted by both automobile manufacturers (OEMs) and academic researchers. Front impact dummies have been playing very important roles in front impact analysis for over two decades. Advances in processing power and explicit solver code capability in the last decade has created the possibility for detailed finite element dummy models to deliver timely high quality injury predictions for safety engineers, expanding what had previously been the realm of the fast running multi-body approach. In the past, safety-related CAE relied heavily on a multi-body approximation of dummy mechanics and injury prediction. With the progress in biomechanics and the onset of much more stringent front impact safety regulations, the demands for better performance predictions in front impact safety analysis/development are constantly increasing. Finite element (FE) dummies like the Abaqus HIII series are the right tools to meet these demands. Advances in computer technologies make the

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