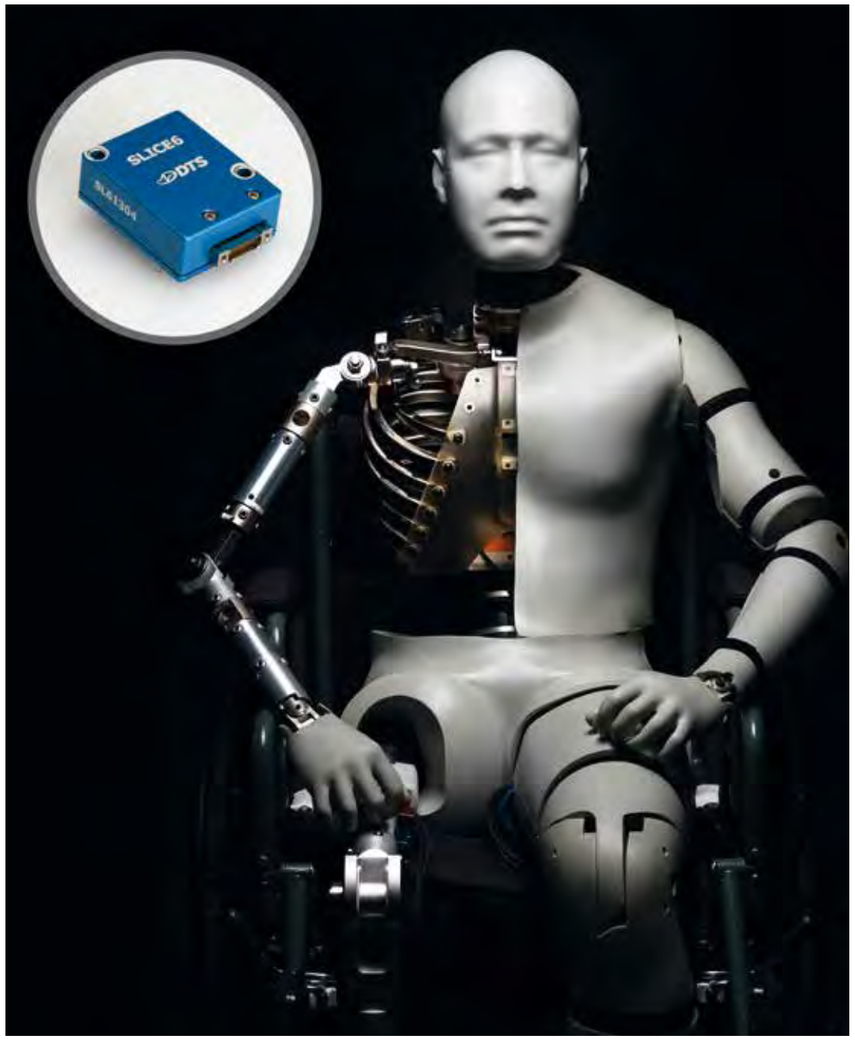
Diversified Technical Systems
To learn more about this advertiser,
please visit: **www.ukimediaevents.com/info/ctt**

MEASURING INJURIES FROM ALL ANGLES

The crash test community is familiar with frontal, side and rear impacts, but what about the fourth direction – vertical?



Frontal, side and rear impacts are assessed as standard in automotive crash testing, but vertical loads are also a factor, particularly when it comes to testing military or armored vehicles for diplomatic and high-asset personnel. Data shows that secondary blast injuries are more common than primary ones. As long as the hull has not been breached, many critical injuries are caused by that secondary impact when the vehicle lands or by debris that is displaced by the blast wind of the explosion.

In a traditional crash, occupants often walk away with just cuts or bruises. However, in a blast test it's more a case of analyzing fatalities, not injuries. Therefore, the test and development work to best protect occupants is vital and something that is subject to stringent regulations. While most people will be familiar with regulations from NCAP and federal bodies for traditional vehicle testing, for underbody blast testing there are Nato's STANAG 4569 standards to adhere to. In addition, every national military has its own specific standards they are working toward.

The setup involved in underbody blast tests differs hugely from preparing for a traditional automotive impact. A conventional crash test is far more standardized because there is a regulation track or barriers, the vehicle is prepared in the exact same manner every time, and it typically has between one and four crash test dummies on board. But a blast test is more complicated. Although there is a standard, it takes a lot of work to ensure the tests can be repeated under the same conditions, in order to meet the STANAG 4569 regulations. The load of the vehicle is just one of the factors because a blast test vehicle could have as many as 10 dummies inside, representing a squadron of warfighters. Military personnel who ride in the vehicles that are the subject of blast tests will also likely have 23kg of safety gear on their bodies, which also changes the dynamics when it comes to setting up the vehicle. Furthermore, given the costs involved, there is the added importance of getting the crash right the first time. A standard vehicle might cost US$100,000 whereas a military vehicle – or something capable of withstanding a blast – would be closer to US$500,000 or more.

Overall there are fewer blast tests run in total, based on several factors. First, vertical load blast tests are always outside, which means waiting for the right weather. Environmental and climatic considerations such as wind and rain could affect test schedules and potentially result in less consistency in the data. The general setup requirements involved in the process are also far greater. For instance, if it takes three to five days for a typical crash test to be prepared, it's weeks to months for a blast test. A blast test also takes a lot more coordination, as well as a bespoke test team assigned to the operation, including a pyrotechnics expert. All dynamic tests demand precision to ensure accuracy and adherence to the standards, but a 'blast master' is required to set the charge and ensure the safety of everyone involved. One way to ensure more consistency is to do static blast tests, which replicate encountering a land mine or IED. These damage patterns can then be compared more easily. Location-wise, automotive test facilities or proving grounds are not typically used for blast testing. Instead, tests are often conducted on military bases or even on a remote ranch in Texas.

Blast tests are also typically run at higher sampling rates, meaning there's a lot more data – up to 60 times as much, compared with a traditional frontal or side crash test. Much of this data is generated via the WIAMan blast test manikin, which was developed by DTS in collaboration with the US Army, specifically for blast tests. A blast test setup with multiple WIAMans may involve as many as 1,500 sensor channels, compared with 200-250 in a standard crash test.

WIAMan also features a completely different spine and pelvis structure, as well as different mass characteristics from the likes of the Hybrid III 50th. The pelvis is molded with some different structures inside of it so that the compression of certain areas better simulates real life. Plus, there's a curve to the spine at the bottom so that when load is put onto the WIAMan, the neck doesn't come forward (as it would do in a frontal impact). It actually goes backward, to replicate the scenario of an impact from underneath.

Much of the extra data is generated because of the complexity of the overall crash test process. In a traditional crash test, there is a single high-energy event and then the vehicle comes to a complete stop. But in a blast test, it's more typical that multiple events will happen. There's the initial event (the blast itself), which prevents items from flying into the vehicle, but once the vehicle has lost its suspension, there's a secondary event when the vehicle actually comes back down to hard earth. The biggest challenges here are the speed and duration of the event. The first 10ms are critical, but so is the period approximately two seconds later when the vehicle finally lands for the secondary impact. That subsequent impact is just as important as the initial blast, if not more so, because this is often when many injuries happen.

Gathering all that data in a blast test is Slice6, a miniature, high shock-rated data acquisition solution that was developed as part of the WIAMan ATD project and is now integrated into the full family of ATDs for NCAP testing around the world. DTS has developed a variation of Slice6 that can sample data up to four times more quickly than the modules typically used in crash testing. These events last only milliseconds, which means that higher data sampling rates are required for blast injury evaluation and pressure wave data, which also causes injuries.

From blast to crash testing, Slice6 DAS can do so much. Slice6 is also the leading in-dummy DAS solution for US and Euro NCAP testing worldwide. With the combined benefits of speed, breadth of operation and ability to process vast amounts of data, Slice6 presents itself as the ideal test partner. Some might even call it the 'blast' line of defense. ❮


US DoD

FAR LEFT: The distributed Slice6 in-dummy DAS solution was designed as part of the WIAMan project

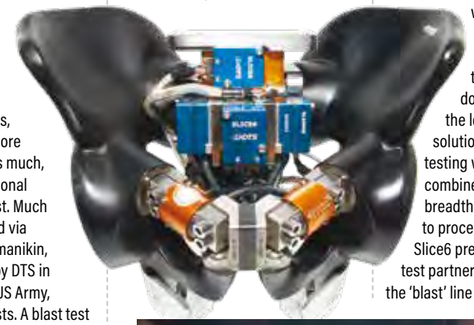
LEFT: The improved biofidelity of the WIAMan blast manikin (left) versus the frontal-impact Hybrid III 50th (right) is clear in a side-by-side blast test

BELOW INSET: Slice6 integrated in the WIAMan high-tech pelvis

BOTTOM: Traditional crash test dummies are not designed to measure vertical loads from an underbody blast

Need to know

- Slice6 DAS is integrated into the full family of ATDs for NCAP testing worldwide
- Its design has been truly put to the test in blast applications



ONLINE READER INQUIRY NUMBER 503