Collecting In-theatre Vehicle Blast Data using Stand-alone On-board Data Acquisition Technology

Allen Vanguard's Blackbird: A Vehicle Mounted Blast Data Acquisition System

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INTRODUCTION

There were more than 7,000 IED incidents in 2009 -- including explosions, the discovery and defusing of the bombs or civilians turning them in -- compared to just 81 in 2003, according to U.S. intelligence figures

According to the Department of Defense, IEDs have caused nearly half of all casualties in Iraq and nearly 30 percent of those in Afghanistan since the start of combat operations. IEDs in Afghanistan became an increasingly large percentage of attacks against coalition forces. In January 2008, the enemy began to shift toward the use of IEDs. By August 2008, 350 IED incidents represented about 75 percent of all enemy initiated action. An Associated Press count, based on daily reports from NATO's International Security Assistance Force, found that 129 of the U.S. fatalities in 2009 -- or more than 40 percent -- were caused by IEDs. About three-quarters of all American deaths and injuries in Afghanistan are believed to have been a result of improvised explosives.

The proliferation of IEDs on the battlefield in both Iraq and Afghanistan has posed the most pervasive threat facing coalition forces in those theaters. The persistent effectiveness of this threat has influenced unit operations, U.S. policy, and public perception. IEDs are a weapon of choice and are likely to remain a major component of the Global War on Terrorism for the foreseeable future.

BLAST DATA ACQUISITION

Military vehicles used in theatre are now more than ever subject to Improvised Explosive Devices (IEDs) and other blast events. In the effort to reduce injury to occupants, most IED incidents are assessed by blast experts in the military who have the ability to determine to a large degree the event history using their blast experience and extrapolation of empirical data found at the scene or through intelligence.

Program managers and vehicle manufacturers incur great costs throughout their development and fielding process by testing their equipment in standards based laboratory blast simulation scenarios. The intent of this costly blast testing is to gather data and evidence from the event to assist in analyzing vehicle and occupant survivability with hopes of validating and improving upon design elements.

Blast test experts generally can wire up laboratory test vehicles with a full suite of sensors and instrumentation (acceleration, overpressure, High-speed film, etc) to aid in understanding blast effects and to further develop their knowledge base. Though useful, these laboratory blast test scenarios are costly and due to their nature somewhat sanitized from real-world events.

A post blast incident is among the most complex of forensic investigations. Currently, no means exists which would allow these experts to capture, store and analyze the actual velocities, accelerations and overpressure levels that military and civilian vehicles and crew are exposed to during real-world, in-theatre blast events.

ALLEN VANGUARD BLACKBIRD TECHNOLOGY

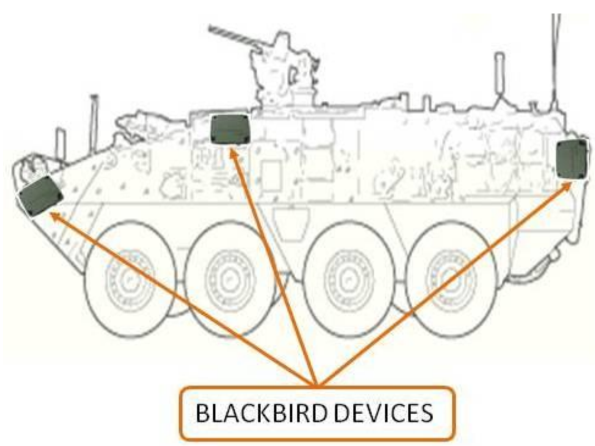
The Allen Vanguard ***BLACKBIRD*** is a field deployable, self-contained Vehicle Blast data Acquisition System and is designed to mount wirelessly anywhere in the vehicle in single or multiple configurations.

ACTUAL SIZE

The ***BLACKBIRD*** system, when deployed prior to the blast event can assist those responsible for defining system requirements and design by providing quantifiable information on blast acceleration and overpressure measurements. This data can then be used in the same manner as test data to modify and test new designs to ensure safety and effectiveness and could aid in understanding more about future events, SOP's and design for survivability.

BLACKBIRD, when used in conjunction with other protective elements and sensors can begin to provide a true picture of the entire vehicle system in terms of its survivability. For example, a vehicle outfitted with blast attenuation seats and BLACKBIRDS, combined with a crew wearing Helmet Mounted sensors, can provide blast induced acceleration and pressure data at the following levels;

- Vehicle level (global and local response)
- Blast attenuation seat output level
- Soldier level



With data at each of these levels, the system design and survivability experts can begin to understand events at each level and deduce how the entire vehicle system is performing from a survivability point of view.

The unit contains a tri-axial cluster of accelerometers which measures explosively-induced linear accelerations in the front-back (x-axis), left-right (y-axis), and up-down (zaxis) directions.

Data recorded from blast events can then be quickly and easily downloaded to build a database of blast- induced accelerations for correlation with effects on the vehicle and more importantly injuries suffered by the vehicle passengers.

The Blackbird also has an integrated pressure sensor to track overpressure within the vehicle.

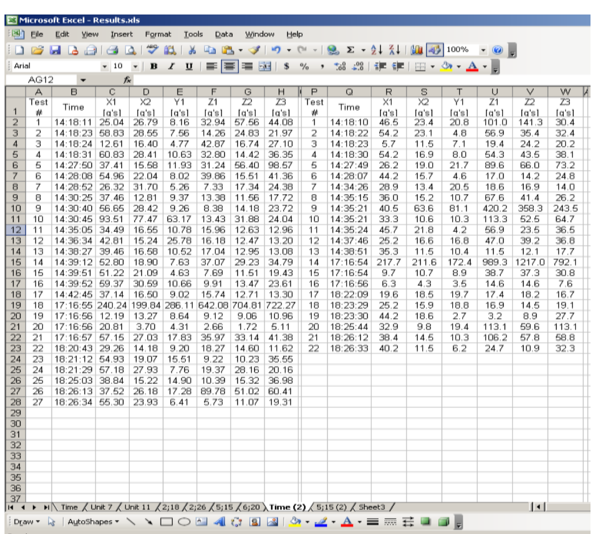
Additional Features & Event Data:

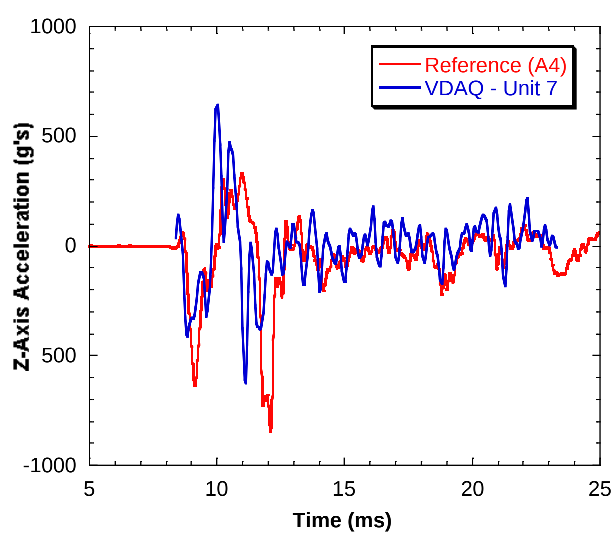
- (2) Li-Ion rechargeable battery
- Battery voltage logging
- Low battery indicator (bicolor LED)
- Temperature logging

The Blackbird is sealed in a robust aluminum package for EMI Shielding. The unit can be turned on and off and has power for greater than 180 day storage/use period, after which data is downloaded and the battery is recharged, all via a USB connector. No wires are needed during deployment. Blackbird can also be quickly and cost-effectively introduced into the laboratory environment and can reduce wiring requirements and set-up times.

SOFTWARE APPLICATION

The Blackbird system includes utility software to download data from Blackbird units via USB. The data may be plotted versus time or stored in Excel compatible files for further analysis.





BLACKBIRD SPECIFICATIONS

Parameter	Gen II *(Available in limited quantities June 2010)*	Gen III *(Generally Available October 2010)*
Batteries:	Lithium Polymer, Rechargeable	Lithium Polymer, Rechargeable
Power Budget:	7.4 volts nominal	4.2 volts nominal
Battery Life:	> 180 Days	> 180 Days
Weight:	6 oz (170 g), approx.	9 oz (255g), approx.
Accelerometer Sampling Rate:	10K Samples/sec	10K Samples/sec
Event Recording Duration:	90 ms / event	4 Seconds / event
Minimum Time Between Event Recordings:	170ms to~300ms	2-event real time buffer 2.25 s flash transfer time
Data Filtration:	5 Hz – 2500 Hz	5 Hz – 2500 Hz
Processor Interrupt Threshold:	+/- 50 g's (on any axis)	+/- 20 g's (on any axis)
Dynamic Sensor Capture Range:	50 - 1000 g	20 - 6000 g
Dynamic Angular Velocity Capture Range:	NA	+/- 300°/sec
Overpressure Capture Range:	0.2 - 6 Bar	0.2 - 6 Bar
Data Storage:	150 events	150 events
Data Retrieval Connector:	5 Pin Mini USB (400 Kbaud)	5 Pin Mini USB (920 Kbaud)
Wireless Data Retrieval	NA	120 Kbaud
Operating Temperature:	-20°C to +55°C	-20°C to +55°C
Dimensions	Roughly 4" X 3" x1"	Roughly 4" X 3" x1"
Weight	170 Grams	170 Grams
Price	~$1,200	TBD

SUMMARY

By integrating an on-board, stand-alone data acquisition system to collect blast event data from actual in-theatre events, survivability engineers and program managers can reduce the development cycle time and realize survivability improvements in their vehicles and systems more rapidly than in the past. Every in-theatre event now becomes a test bed for analysis and can facilitate rapid improvements in design , SOPs and policy.

FURTHER INFORMATION

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