Photo courtesy of Pailton Engineering

Data-driven defence for maximum survivability

Connected and autonomous vehicles are hot topics today, as consumers the world over envisage self-driving cars to make their lives easier. However, connected vehicle technology goes much further than self-driving; design, maintenance and safety are all of vital importance. Emma Cygan, Design and Development Engineer at Pailton Engineering, addresses the need for data-driven design in the manufacture of military vehicles.

Connected military vehicles are generating gigabytes of data from sensor-packed functions including on-board systems that monitor a vehicle's oil, temperature and fuel consumption, as well as more general performance data, such as speed, distance travelled and location. This data can be used to track vehicles and personnel, and importantly, make intelligent decisions that inform the design of future vehicles.

Data is a critical asset for military organisations, but this data is only valuable if it's meaningful, and used effectively. This may explain why the military vehicle industry is proactively responding to evolving security threats and upgraded technologies.

Today, much of Britain's Ministry of Defence (MoD) and the US Department of Defence (DoD) procurement activity now uses cloud services, software and technology products related to generating and analysing colossal datasets. However, when it comes to making full use of the reams of data available to it, the sector still has some way to go.

Data isn't just benefiting connected or autonomous military vehicles, it's benefitting their conception. Designing with data means that military vehicles can handle the extreme terrain and unpredictable road conditions out in service, aiding all military technology's overarching aim of maximising survivability. But, where does this meaningful design data come from?

Real life military vehicles

It starts with real life military vehicles. Strain gauging equipment is added to test vehicles in order to calculate forces and collect meaningful design data for steering and suspension systems. By using this data generated from real-life vehicles, design engineers can make more informed decisions on how to best manufacture a military vehicle.

This process means design engineers have specified load and frequency data to accurately inform the design of a robust and heavy-duty steering system. If the load data is unknown, theoretical calculations and simulation software can also outline loads.

At this point, it's important to note the distinction between static loads and dynamic loads. Military vehicles don't endure the same repetitive force, but instead a multitude of different forces in varying frequencies. If you are to validate a military

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Steering column. Photo courtesy of Pailton

vehicle against its end application, you need to design and test against the dynamic nature of service. The varying loads, the changeable frequencies and irregular abusive loads that occur during the vehicles life should always be a fundamental consideration.

This use of real-life data takes this dynamism from the qualitative realm, to the quantitative realm, so engineers can use representative data when developing a vehicle's design.

Data-driven testing

Data-driven design enables data-driven testing. One of the most important parameters to test for a military vehicle and its parts is the maximum load. With this information you can observe how much force a part can endure, in both tensile and compression, before a failure occurs. Using different rigs to test a range of force applications, forces up to ±400kN can be applied both statically or dynamically.

Moreover, with enough data, you can compile a multitude of loads at their respective frequencies and cycles as part of a dynamic block testing program. This program effectively mirrors the real-life data that is gathered from the vehicle to accurately assess the true fatigue life of the part.

With a variety of loads and frequencies in place, engineers can measure the number of cycles that the parts can endure over time, performing 1,000,000 load cycles in only one week. That's enough to replicate infinite life for a part on a vehicle, meaning lifecycle management decisions can be made in advance.

As connected military vehicles are generating more data than ever before, it makes sense that these vehicles be produced with meaningful design data at conception, to maximise safety, performance and efficiency.

As governments in the US and UK make important decisions to leverage technology for military vehicles, what will always remain at the forefront of this process is designing for survivability.

New technology and use of data could improve the survival rates of personnel — whether it is a result of increased agility, autonomous resupply or high-performance steering, and it's this notion that makes the implementation of such technology, incredibly important.

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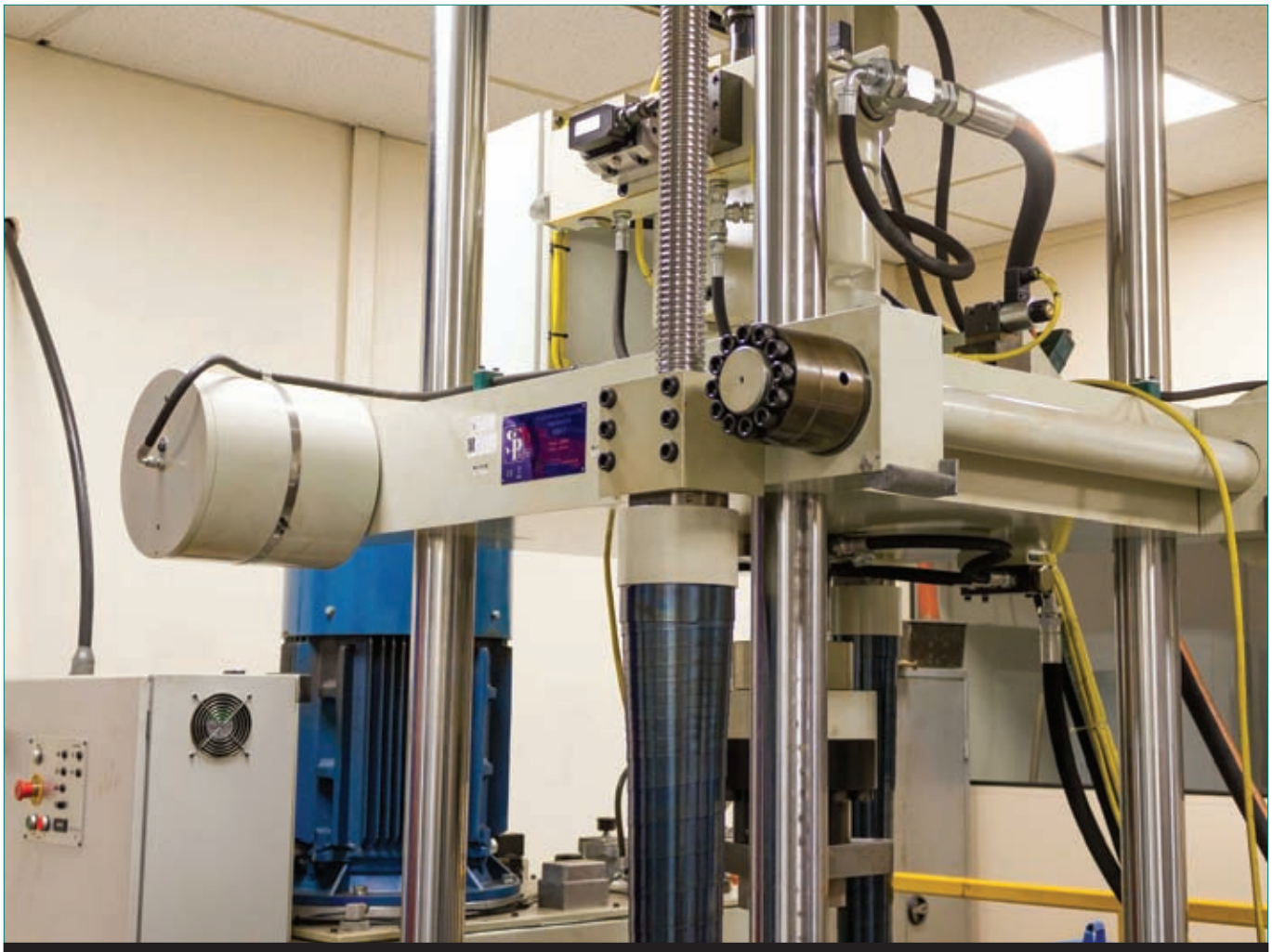

Test rig. Photo courtesy of Pailton Engineering