**AMRC**
Design and Prototyping Group

The University Of Sheffield.

Advanced Manufacturing Research Centre

BOEING

## Case Study
Modular Explosion Resistant Vehicle (MERV)

# AMRC design and build new generation of blast-proof vehicle

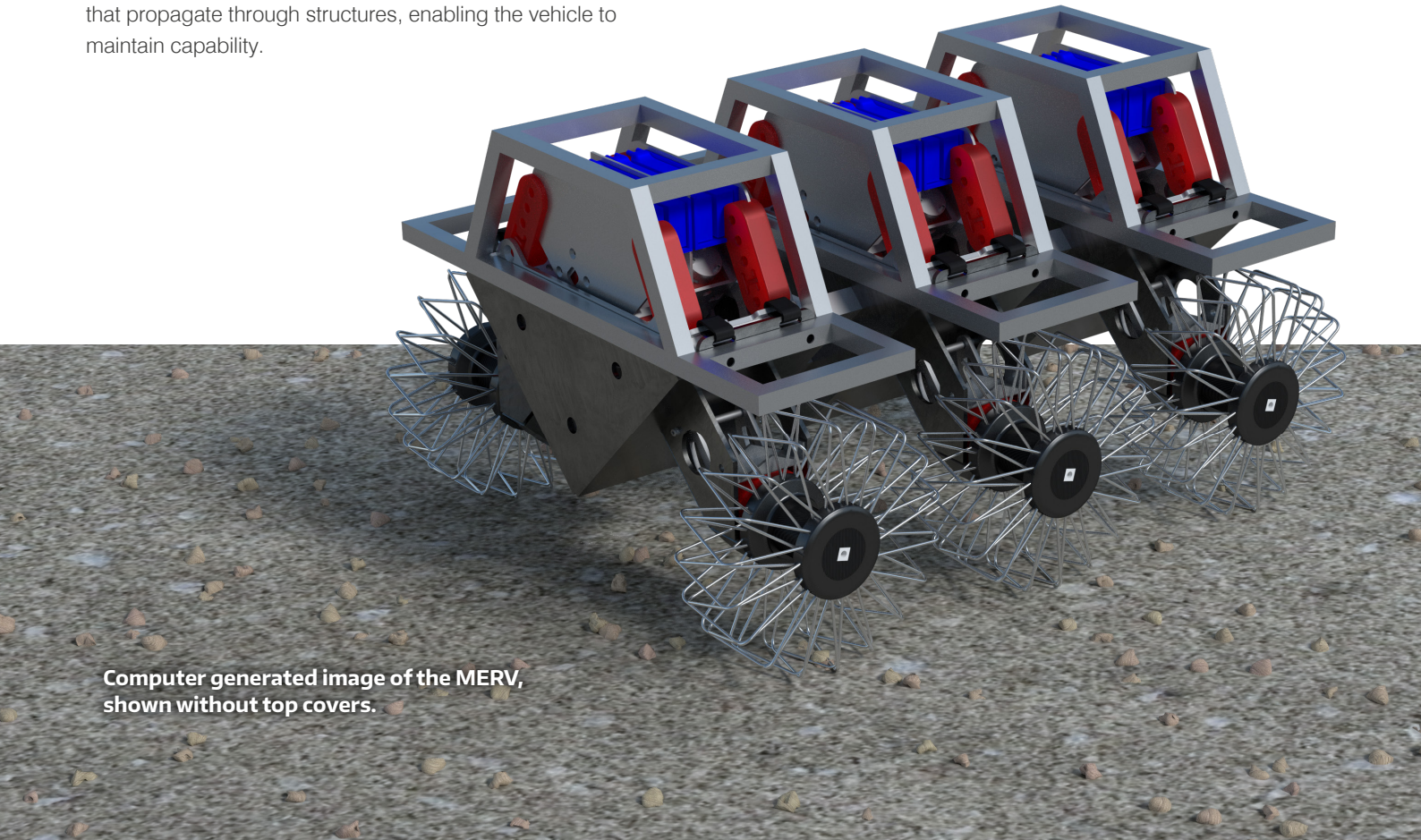
The Design and Prototyping Group (DPG) at the AMRC has designed and built a prototype unmanned ground vehicle (UGV) designed to withstand the blast impact from a buried explosive charge.

The DPG was awarded funding as a result of its proposal in response to the Centre for Defence Enterprise's (CDE) competition to design a highly robust ground platform.

The CDE is part of the Defence Science and Technology Laboratory, which ensures that innovative science and technology can benefit UK security.

The aim of the competition was to identify design features which enhance survivability, by exploiting mechanisms and technology that limit the effects of high-intensity stress waves that propagate through structures, enabling the vehicle to maintain capability.

Senior Project Manager, John Spencer said: "The purpose of an unmanned vehicle such as this is typically to venture into areas where it would be too dangerous or difficult for a vehicle with an on-board crew. Our proposal was to develop a UGV that with further development could be capable of conducting search and rescue, reconnaissance and path finding operations".



**Computer generated image of the MERV, shown without top covers.**

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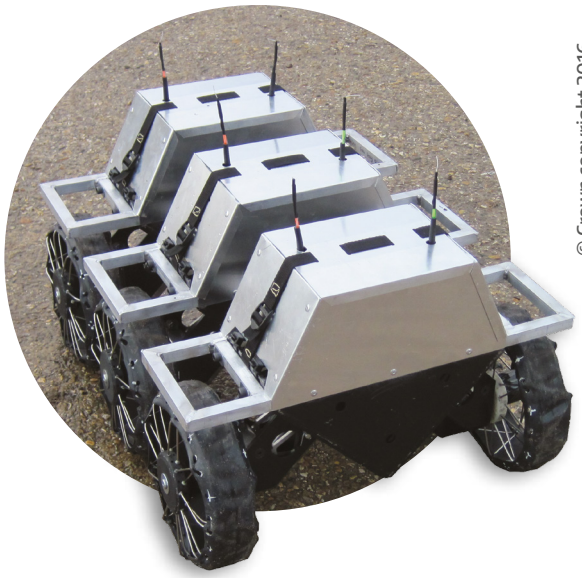
John Spencer, Senior Project Manager.





The DPG designed and manufactured a prototype modular explosion resistant vehicle (MERV) and sensor platform. The vehicle's key features include replaceable modules with an armour steel 'v' shaped outer hull designed to direct a blast away from the drive and control systems, secondary armour comprising 3D printed lattice structures and suspended systems trays within the hull assembly, designed to reduce transferred shock loadings from an explosive charge.

Where possible, the design team tried to reduce exposure to the blast, rather than trying to absorb or deflect direct impacts; using innovative features details such as non-pneumatic wire wheels.

Tom Wood, design engineer on the project, said: "The wire wheels present a small area to the explosive charge to allow much of the blast to pass through.

"A conventional pneumatic tyre can deflate if the tyre or rim suffers localised damage, but the individual elements of the wire wheel are not dependent on each other, so localised damage does not cause complete failure of the wheel. This helps ensure that the vehicle remains mobile after a blast so that it can return itself to base."

Another key area of the DPG's design was the modular segmented body. This enables the vehicle to be easily reconfigured from the six-wheel format to either a four or eight wheel vehicle, depending on its application, and the modules to be replaced quickly in the field.

The completed vehicle prototype was sent for live blast trials, where a series of buried explosive charges of varying weights were detonated beneath the vehicle in positions that were considered to be most vulnerable.

Throughout testing the vehicle exhibited no structural or internal failures and the electronics and drivetrains remained functional. Damage from the lowest charge weights was minimal and even though some damage was sustained to components during exposure to the highest charge weights, these were able to be replaced easily to restore full functionality with minimal repair time.

"The success of the live blast trials confirmed how robust the prototype is, but more importantly it has highlighted the areas that could be developed and improved further," added John Spencer.

"The potential uses of our UGV include driving ahead of a unit to investigate a suspicious object without putting personnel at risk. If some of the design features developed by the team can be scaled up and applied to a manned vehicle, the project has the potential to lead to protection systems that could ultimately save lives in high risk situations. We are now exploring the opportunities for follow-on projects".

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