ENABLING TECHNOLOGIES
Overview

A strong and consistent focus of DMTC's work has been to advance platform-independent technologies that have broad applications across different Defence domains.

DMTC's Enabling Technologies Program uses a range of evolving technologies from leading Australian research to derive industrial outcomes, seeking to deliver both reductions in manufacturing time and cost and maintain or enhance quality and performance.

A major theme in the Program is work on advanced composites and functional materials, to characterise and assess the performance of a range of hybrid composite candidates with regard to their potential adoption in the defence sector.

Composite materials are already widely used in the aerospace industry and in other sectors including automotive and infrastructure, however the rate of adoption in the defence sector to date has been far slower.

In August 2020, Defence released an Industry Plan for the sovereign industrial capability priority related to land combat and protected vehicle production and technology upgrades. The plan highlighted the design, development and industrialisation of survivability and signature reduction material technologies and processes as one of four critical industrial capabilities for Australia, to contribute to the availability and operational effectiveness of land combat and protected vehicle platforms.

The plan also identified future trends and technology evolutions, such as the development and study of new materials intended to reduce system and platform weight, and to enhance survivability and composite armour solutions for evolving ballistic and blast threats. DMTC is well-positioned to contribute to Defence's priorities in this area through the work of partners in the Enabling Technologies Program.

ENABLING TECHNOLOGIES
Highlights

Advancing antenna design

In our special 2018 feature report on DMTC's first decade of achieving breakthroughs for Defence through collaboration, we highlighted a long-running DMTC collaboration with industry and research partners on the integration of communications system capabilities into load-bearing structures. This work was able to be progressed in 2019-20 under DMTC's services contract with the Defence Innovation Hub in a project involving DSTG, Thales Australia, Penguin Composites and UQ.

Initially designed for application to military aircraft and surface ships, this work on integration of systems is now also focused on protected mobility vehicle platforms. Conformal antennas remove or reduce the need for structures to protrude from a vehicle with benefits including lighter weight, reduced likelihood of component damage and vehicle signature.

Advances under the most recent extension of this project have included finalising a design for a cavity-backed spiral antenna structure containing both structural and functional (antenna) elements. Materials utilised include ferrite and ultra-high-molecular-weight polyethylene (UHMW-PE) selected for their electromagnetic properties, and stainless steel and glass-fibre reinforced epoxy which serve both structural and electromagnetic purposes. The radiating antenna element is made of copper foil.

Working around COVID-19 challenges including delays in access to research laboratories and manufacturing facilities, the project partners are undertaking a mix of both experimental and numerical investigations to characterise materials under representative service loads to compare and validate the hybrid antenna structures against conventional materials used in land platforms.

The team has successfully fabricated a first prototype that represents a physical scaling-up of technology previously demonstrated for aerospace applications, to a size and operational frequency required for land-based Defence applications. Because it is surface-conformal, the antenna laminate structure can be bonded to any metallic or composite component. The benefits to Defence of conformal antenna technology are more durable, serviceable communications systems, and fabricating this prototype is the first step in validating the developed antenna design.

Pictured opposite: Dr Azadeh Mirabedini from SUT, Dr Dennis Antiohos of Imagine Intelligent Materials and Dr Nishar Hameed from SUT at SUT's Factory of the Future. Novel solutions being progressed by DMTC to achieve improved functional capability for the next generations of vehicle components include both laminate structures and compounds with embedded nanoparticles. A team from SUT and industry partner, Imagine Intelligent Materials is leading research in the development of graphene nanoparticle (GnP) structures that can deliver significant advances in vehicle signature controls. The project has allowed industry partners Thales Australia and Penguin Composites to extend their knowledge of the performance characteristics of GnP materials, and the routes to achieve efficient and effective manufacturing.