High Speed Systems & Responsive Space Access:

Propulsion Technologies for Next-Generation Missions

When discussing disruptive capabilities and technology, there are few examples more relevant than hypersonics and responsive space access (the ability to launch small payloads into orbit rapidly, at reduced cost, and on-demand). In both instances, propulsion technologies are a key underpinning element enabling the relevant missions: high speed strike weapons as well as a new breed of responsive space access vehicles.

Previous high speed flight experiments, such as the US-conducted NASA X-43 and Boeing X-51, have focused on air-launched insertion of a payload to high altitude at very high speeds. Both flight experiments relied upon solid propellant rocket motors to provide the necessary acceleration and energy to meet the mission requirements. In both instances, the solid rocket booster represented approximately two thirds of the total stack mass, constraining the size of the payloads and limiting the total system performance—requiring launches from large B-52 platforms. In contemporary tactical motor designs, a reduction in the motor mass and an increase in energy density enables and enhances future capabilities, including those that are launched from a tactical platform.

Since 2012, and culminating in 2019, DST Group has undertaken a bilateral collaboration with the United States Air Force Research Laboratory. Titled the Advanced Tactical Booster Technologies program, its main aim is to advance state-of-the-art propulsion system design tools and technologies that are critical to a future air-launched high performance system. Advances in materials and associated processing and manufacturing techniques (such as resonant acoustic mixing and additive manufacturing) also stand to unlock performance gains while reducing the cost of entry for Australian industry and Defence to capitalise on such benefits.

In addition to enabling missile missions in volume-constrained weapon applications, sub-sets of the aforementioned propulsion technologies, design tools and manufacturing techniques have equal utility in the area of responsive space access. Responsive space access is the ability to launch small payloads into orbit rapidly, at reduced cost, and on demand – anywhere from within 24 hours to a few months. Traditional methods of space access may cost billions of dollars and require years to carry out a launch of a single, large, high-capability satellite. A sovereign space access capability would provide the ADF access to new technologies and improved systems integration that will significantly change the military user experience and enhance resilience so that Defence can become a fully space-enabled force. The same technologies applied to high speed systems deliver payoff for small, responsive access to space systems, which has led to the rapid emergence of start-up and R&D programs across Australia.

In addition to evolutionary enhancements in more 'traditional' propulsion systems—such as solid, liquid, hybrid and air-breathing propulsion systems—rotating detonation engines (RDE's) have recently emerged as an exotic form of propulsion that stands to deliver significant advantages over traditional systems. RDEs provide propulsion by harnessing the improved efficiency of a continually rotating detonation wave and can be utilised as an air-breathing engine replacement for high speed vehicles or potentially as a rocket alternative for responsive space access.

This seminar will provide detail on the aforementioned propulsion systems, material and manufacturing technologies and how their utility will deliver: greater lethality; enhanced survivability and extended engagement range for future RAAF-deployed weapons and; positioning Australia to capitalise on the responsive space access market.