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THE AUSTRAL LAUNCH VEHICLE: REDUCING SPACE TRANSPORTATION COST THROUGH REUSABILITY, MODULARITY AND SIMPLICITY

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ABSTRACT

The main driver behind the current high cost of space missions is launch cost. In addition to the large direct cost contribution, launches are seen "once-off" opportunities that require expensive multi-purpose spacecraft with long mission durations. Re-usable launch vehicles (RLV's) have long promised significant cost reductions, increased responsiveness and increased reliability, but unfortunately experience has proven otherwise. This leads to the current situation where all operational launch vehicles are expendable, and the majority of LV's under commercial development are also expendable systems.

The Austral Launch Vehicle (ALV) project is an international effort to develop a cost-optimized partially RLV. Now in its fourth year, the ALV project originated as an investigation into the additional requirements that will ensure that re-usability can provide real launch cost reduction. Through market studies and program cost estimates these requirements were identified as modularity, flexibility and simplicity. Modularity is required to increase the vehicle flight rate (through larger payload range and more module flights per launch) and to reduce development cost (through reduction of the number and size of newly developed elements). Flexibility is required to ensure a wide market can be captured, while simplicity leads to critical reductions in development and operational costs as well as increased reliability.

The ALV family of RLV's are being developed based on these principles. In the ALV architecture only the first stage modular boosters are re-used, since they represent the bulk of the launch vehicle size and cost, while being the simplest to recover. By using well established aircraft design methods, components and operations, the ALV flyback boosters avoid many of the complexities of RLV design including offshore landing and recovery, complex and highly controllable rocket engines, return transport, etc. The ALV incorporates innovative features that address problems commonly experienced with fly-back boosters, e.g. controllability, propellant selection, flight within a wide speed range and re-usability of hardware.

The ALV project is organized in four phases: Phase 1 studies have been completed, and phases 2 and 3 consist of the development of flight vehicles of increasing complexity as precursors to the full-scale development in phase 4. The phase 2 vehicle currently being designed, named the ALV-1, is a small scale, low cost test vehicle to prove key concepts of ALV architecture. The ALV project is also closely integrated with the University of Queensland's SPARTAN-1 scramjet project, which uses ALV boosters as a first stage.

The ALV project is spread over three continents, gathering students and professionals' knowledge from several companies, associations and universities in Australia, France and South Africa. In addition to the commercial value of the ALV project, it also aims to educate and motivate the coming generation. The project is making steady progress, with the ALV-1 Critical Design Review foreseen in the last trimester of 2014 and flight tests scheduled begin during the second semester of 2015.