SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS (D2)
Upper Stages, Space Transfer, Entry and Landing Systems (3)

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ADVANCED TECHNOLOGY UPPER STAGES FOR FUTURE LAUNCHERS

Abstract

The payload performance and flexibility of a launch vehicle is strongly dependent on the design of its upper stage. Therefore, significant research effort is spent in Germany on the improvement of all such future types. A research cooperation of German launcher industry, university academia, and DLR has been initiated to work jointly on various identified needs of advanced cryogenic upper-stage technologies. Different studies are also ongoing in the pre-definition of configurations with storable propellants.

The paper describes two different preliminary system designs for stages employing advanced technologies: 1. An experimental micro-stage with a very small storable propellant engine for LEO applications. This vehicle is part of the multinational (France, Spain, Germany) cooperation Aldébaran investigating future options of micro-launchers [1]. 2. An advanced small TSTO rocket with a payload capability in the range of 2000+ kg in SSO and more than 1200 kg in higher energy orbits like MTO. The first stage consists of a high pressure solid motor with a fibre casing while the upper stage is using cryogenic propellants. Synergies with other ongoing European development programs are to be exploited. Previous work had been published in [2].

The studies of the advanced upper stages include different engineering disciplines: • Preliminary stage architecture and sizing, • Propellant storage, pressurisation, and feed system definition, • Structural pre-sizing, • Avionics and subsystem definition • Trajectory optimisations

The relatively detailed design level allows for a viable stage mass and hence payload performance estimation.

Finally, the paper identifies major development needs for successful realisation of such stages within the next 10 years.

1. Louaas, E; Talbot, Ch.; Berenbach, J.; Gonzalez Gotor, P.; Ruiz Merino, A.; Longo, J.; Sippel, M.; Fröbel, L.: Aldebaran: A "System" Demonstrator Project for New Generations of Space Transportation, Now Entering in the Phase A, IAC-09-D2.6.7, 60th International Astronautical Congress, Daejeon, October 2009 2. Sippel, M.; van Foreest, A.; Klevanski, J.; Gerstmann, J.; Dutheil, J.-P.; Jäger, M.; Philip, P.: Future European Expendable Launcher Options and Technology Preparation, IAC-08-D2.4.6, September 2008