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IAF SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)
Interactive Presentations - IAF SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (IPB)

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TRADE-OFF STUDIES ON MISSION ARCHITECTURE AND CONFIGURATION OF A SMALL PARTIALLY REUSABLE STRATOLAUNCHER FOR SMALLSAT LEO DELIVERY

Abstract

The current state of the art regarding space launch is the traditional vertical launched rocket. To solve the drawbacks and the bottlenecks of this mode, a new technology must be developed and improved: stratolaunch. This concept would allow for more frequent, more distributed, and more efficient launches, as it does not require strictly equatorial takeoff locations and no particular infrastructure, besides a normally equipped airport. FAST, a group of students from Politecnico di Milano, is taking the challenge of developing an automated spacecraft for the delivery of up to 200 kg of payload into LEO using the stratolaunch method. To accomplish such an ambitious mission, the team has conducted in-depth trade-off studies on the current state of the art, analyzing the pros and cons of past and current similar concepts. The studies investigate first the architecture of the mission. Then, once the best fit is selected, technical studies choose between technologies and how they must be integrated together to carry out the mission. Fuel type, engine architecture, material selection, body and wing design are discussed and analyzed. The output is a mission profile and a spacecraft concept inspired by the past, that merges all the strengths of the technologies now available while creating something totally new. Where the solution cannot be implemented with standard methods, a development roadmap is presented to fill the gap and make the project possible. The resulting spacecraft, named HyperDart, falls in the Two Stage To Orbit (TSTO) category. It would be a fully automated drone composed of two stages, with dimensions comparable to Boeing's Ghost Bat or Baykar Tech's Kizilelma. HyperDart would have an airbreathing first stage, with a combined cycle powerplant, and would house the second stage in a piggyback configuration. The

second stage would be rocket-powered and would carry the payload to be delivered. The first stage is designed to be fully reusable, while the second stage has the double feature of expendability or reusability, according to how much mass is required to be inserted into orbit. Other applications of this system are the low gravitational acceleration payload testing and the hypersonic transport of cargo between two Earth locations.