Paper ID: 70293
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IAF HUMAN SPACEFLIGHT SYMPOSIUM (B3)
Interactive Presentations - IAF HUMAN SPACEFLIGHT SYMPOSIUM (IPB)

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A COMMERCIAL SPACEFLIGHT MISSION DESIGN INCLUDING A MID-ATMOSPHERE DOCKING SYSTEM FOR A TOURIST CAPSULE AND LANDING VEHICLE

Abstract

The infamous Space Race has seen many phases since its origin in the mid-1950s. What started as ballistic missiles branched off into satellites and space stations. One such subdivision of this industry is space tourism, which dawns back to the late 90s when Dennis Tito became the first space tourist. With a total of 15 space tourists and more than 400 crew members having crossed the Kármán line, along with SpaceX, Blue Origin, and Virgin Galactic's recent endeavors, this domain has achieved what was previously thought of as 'unattainable' milestones.

This ambitious student-driven project discusses the mission design of a space tourism expedition around the Earth for a particular time span. It is set along lines of- horizontal launch, a responsive and flexible landing, basic structural design of tourist capsule, economic viability, and significantly, the novel docking mechanism which provides the tourist capsule with the ability to integrate with landing vehicle inside the Earth's atmosphere, ensuring the safety using Guidance, Navigation, and Control (GNC) algorithms. Further focusing on speed control during re-entry and its tumbling-free integration in the presence of hindrance and anomalies that the atmosphere offers during docking procedures. The inspiration for this research comes from a report of the NASA-DARPA Horizontal Launch Study (A Versatile Concept for Assured Space Access). After an in-depth study of past trends and current developments in space shuttle launches, the subject of a space vehicle employed with the combination of horizontal take-off and landing is a territory rarely explored due to its low success rates. This venture is feasible with an integration of the space vehicle mounted on a primary launch vehicle and docked into the landing vehicle during its re-entry. This study gives an overview of the aerodynamic and astrodynamic behavior of these vehicles along with other structural aspects. The research methodology employed here entails quantitative data analysis and accumulation and use of software like- GMAT, Project Cost Estimating Capability (PCEC), and STK to design the complete mission pitch. The tourist capsule Vibration and acoustic testing are also done for the launching and landing segments of the mission keeping in mind the comfort of the passengers.

Our proposed mission explores a new approach as well as optimizes the existing advancements of this domain, amidst the growing demand for space travel, and intends to show the feasibility of space tourism, beyond doubt, with the help of steady evaluation and estimation.