IAF SPACE EXPLORATION SYMPOSIUM (A3)
Solar System Exploration including Ocean Worlds (5)

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BUOYANCY PROPELLED AIRCRAFT FOR VENUS EXPLORATION

Abstract

By using a buoyancy propelled solar powered aircraft, it is now feasible to explore the upper atmosphere of Venus and determine the properties, composition, and conditions in a valuable region in a controlled, sustained fashion. Multiple space agencies have placed orbiters around Venus that use remote sensing techniques to map the surface and largescale meteorological properties. The atmosphere has been only been directly explored with uncontrolled probes, most of which are designed to explore the surface. Remote sensing and uncontrolled short-lived probes limit the scope and resolution of data, leaving gaps in our understanding of the most valuable region of the atmosphere, due to similarities to Earth and the potential for life. Ideas have been suggested to use a solar powered aircraft for in-situ, controlled, atmosphere exploration. Instead of using a propeller to sustain this flight, buoyancy has yet to be considered as a potential solution as the primary propulsion system. A buoyant aircraft can propel itself forward by using the system that keeps it buoyant, improving survivability and redundancy. By inflating and deflating lungs inside of a rigid aerodynamic shell, the aircraft will cycle through falling and rising stages, thereby continuously gliding and creating forward velocity while simultaneously spanning multiple layers in the atmosphere. This shell design must contain enough volume for the lifting gas to keep the aircraft neutrally buoyant while also prioritizing aerodynamic performance during flight in the dense Venusian atmosphere. Solar panels on the aircraft will take advantage of the sunlight near Venus, and the buoyant system will inherently keep the aircraft operational during low power phases. This proposed buoyancy propelled aircraft allows for controlled and sustained exploration of the harsh upper atmosphere of Venus, a valuable tool for interplanetary science as Venus and the Earth are similar in size, mass, and composition. Venus, with its dense carbon dioxide atmosphere, is used as modeling the late stages of the greenhouse effect. In-situ data collected by this buoyancy propelled probe at multiple locations in both latitude and depth will deliver a deeper understanding of the Venusian atmosphere. This data will allow climatologists and scientists to improve weather models and provide deeper insight into climate change here on Earth. This proposed buoyancy propelled Venus aircraft will benefit space agencies as

well by providing a sustainable interplanetary exploration tool with low complexity, high survivability, and a greater capability of exploring multiple layers of the Venusian Atmosphere in controlled flight.