ADVANCED, EXTREME ENDURANCE, MULTI-MISSION, POWERED VENUS GLIDER [PVG] WITH VTOL CAPABILITY

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Introduction

✈NEW RONTIER TECHNOLOGY GROUP✈ proposes a highly efficient, maximally versatile, large payload capable, powered ultra-light glider to explore the entire surface and atmospheric regions of Venus, or other bodies having a gaseous envelope, at all altitudes, for continuous, extended missions in the range of 30 years without landing. Several landing and take-off [VTOL] embodiments, enabled by our proprietary propulsion, are considered. Low cost multi-craft networked constellations can be deployed in a single mission or over many years for absolute 4D coverage. Low cost sample return missions are enabled in short time.

Viability: The advanced glider architecture is similar to ones implemented in several terrestrial platforms, including NASA Pathfinder/Helios [1], Sunglider [2] and the ApusDuo [3] which fall into a new category of craft called High Altitude Pseudo Satellites (HAPS). As such, the platform is a proven long endurance solution. The endurance, performance and versatility of the PVG will be significantly greater.

Relevance and Alignment: NASA, ESA and others are developing concepts for controlled variable-altitude balloons in order to study Venusian atmosphere at altitudes ranging from 52 to 62 km. Not only is the PVG drone able to study at high altitudes but is capable of descending below the cloud deck to directly image the points of interest close up.

In addition to carrying a large suite of scientific equipment, the high capacity 'mother ship' will be capable of deploying various long endurance attritionable micro-vehicle networks comprised of mission specific vehicles such as free balloons, gliders, or subterranean probes and/or vehicles. These vehicles further extend the effective operating range and scientific research capability of the PVG in 4D space as required by a range of missions.

Several landing and take-off [VTOL] embodiments, that can explore ANY areas of interest in great detail in 4D space, are considered which is extremely novel. Using any one of the VTOL embodiments, imaging and research is possible at any altitude, on surface and even below surface using recoverable, reusable probes and vehicles. This level of audacious technology and exploration is not possible using balloons or any other platform under consideration by anyone.

Besides being costly and short lived, the balloons and airships being proposed by NASA, ESA and others have poor motivity control which then provides limited value for scientific endeavors and can potentially leave craft at the mercy of the hazardous elements. Moreover, since the Sun rises and sets every 117 Earth days on Venus, there is a distinct possibility that a balloon would be stranded on the night side of Venus for long periods of time and may possibly never recover operationally. PVG's dynamic control will prevent such a fate.

Basic Operation of Core Embodiment: [Note: re-entry dynamics have not been closely examined yet] To lower mission costs, the PVG will deploy in space, slowing down in the upper atmosphere by shedding the transit velocity from Earth in a dynamically controlled low angle descent. This long flight path will allow highly maneuverable circumnavigation and exploration at high altitude over an extended time period without energy input. After the slow down phase, the propulsion system or maneuvers will sustain flight for as long as the craft materials allow which will be impacted by the mission profiles but will be on the order of decades. Note that mission energy supply is not a concern or a temporal limiting factor.

Moreover, operating virtually as a gliding parachute from time of deployment, the craft can be made significantly larger or lighter than ones that take-off from and land on the ground on Earth, further improving its performance in critical metrics.

Overall, such a design is highly scalable in size and load capacity as missions require, making it highly versatile.

Technical Concept / Design: The current HAPS utilize very efficient wing profiles to operate between 50,000 and 80,000 feet but these designs may be too bulky and unsuitable for transportation to other planets. In initial missions, the wing design may take the form of highly stowable fabric/foil wings as found in paragliders or hang gliders. Other architectures are enabled by our designs. An optimal wing and craft design will have to be developed for each mission type.

The core PVG embodiment combines two sets of light wings: one set of rotary wings called "proprotors", mounted in our unique thrust vectoring architecture for maximal power, maneuverability and simplicity, and two pairs of fixed, high aspect ratio wings for large glide ratio with minimal drag [CL/CD >>70] and low stall speeds that allows detailed research. The design minimizes interference with the proprotor thrust for maximally efficient flight at any regime which is important for our VTOL operations.

Several aircraft iteration allow Vertical Taking Off and Landing (VTOL) and Short Take-off and Landing (STOL) capabilities. Such landings would be brief to prevent damage from the Venusian environment. Another iteration would use a hybrid aerodynamic airship design that produces dynamic and static lift to carry most or all of the system weight. This design could lift-off from the surface with little or no input in energy yet have full control authority over the entire flight envelope. Designs by others are unable to execute any of these capabilities and missions.

Venus orbits the Sun at an average distance of about 0.72 AU (108 million km; 67 million mi), and completes an orbit every 224.7 days. Venus rotates clockwise on it's axis in retrograde rotation [solar / universal reference coordinates] once every 243 Earth days—the slowest rotation of any planet. Because of the retrograde rotation, the length of a solar day on Venus is significantly shorter than the sidereal day, at 116.75 Earth days. Venusian equator rotates at 6.52 km/h (4.05 mph). [Earth's rotates at 1,674.4 km/h (1,040.4 mph)]. PVG 's speed is significantly higher, allowing constant exploration in stationary loitering during constant maximal daylight or darkness, if required.

However, the hot, acidic atmosphere of Venus moves westward (prograde) in some places up to 60 times faster [~240 mph] than its retrograde surface, whirling around the planet once every 96 hours, an effect known as super-rotation, creating wind shear conditions that enables an energy input-free and even propulsion-less proven method, called dynamic soaring, to extract propulsive and system energy from atmospheric wind. to power the mission potentially indefinitely, if the mission allows for this highly characteristic motivity. ;) As such, propulsion system batteries might not be necessary, allowing greater design and mission flexibility at significantly lower costs.

Compared to current HAPS architectures, the advanced, efficient, light weight propulsion system allows much smaller and lighter vehicle, for higher altitude operation or greater area coverage or increased payload capacity.

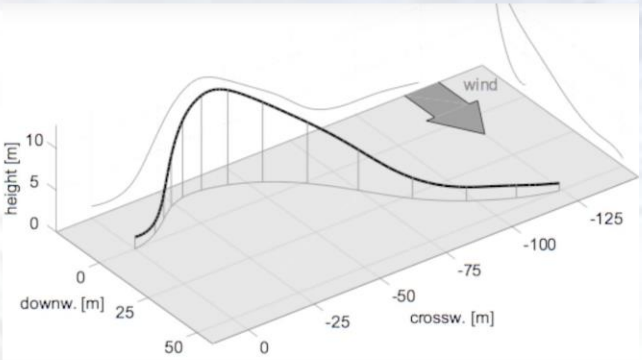

Fig.1 energy-free dynamic soaring using wind energy

Hurdles: We are not aware of any significant parameters and constraints on the primary or ancillary architectures and equipment.

Conclusion: The system designs, modularity, scalability, versatility and economics clearly demonstrate superior solutions which will enable sustained exploration presence on the Venus, Mars and beyond for years to come. Terrestrial applications abound.

Opportunities; NFTG and its associates are open to collaboration with qualified strategic partners/team for all concepts and technologies discussed here and a broad suite of innovations discussed elsewhere[4, 5, 6]

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