Paper ID: 71874
student

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

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# EXPLORATION OF VENUS USING BIOINSPIRED FLIER, BREEZE

**Abstract**

Exploration of celestial bodies with atmospheres has piqued the interest of scientists over recent years. With the success of the Mars helicopter, ingenuity, flying craft have shown potential to revolutionize the speed and scale at which other planets and moons can be explored. One such mission developed by the CRASHLAB team from the University at Buffalo-The State University of New York is BREEZE. Or the Bioinspired Ray for Extreme Environments and Zonal Exploration. This revolutionary concept combines an inflatable structure with bioinspired propulsion to create a buoyant flyer that could efficiently scan the surface of Venus, map the magnetic field, and analyze the atmospheric composition for signs of life. Applications of BREEZE may also extend well beyond the Venusian atmosphere conducting science on Earth or other celestial bodies with atmospheres.

On Venus, there are numerous advantages of an inflatable craft like BREEZE over balloons and fixed-wing aircraft as it is an ideal balance between the two. With a high packaging factor, long mission lifespan, and the ability to survive without the Sun's power on the dark side of planets, BREEZE could prove a powerful tool for a future mission to Venus. Balloons without a propulsion system are at the mercy of the low-velocity meridional winds that would ultimately trap them in Venus' polar vortices. BREEZE can flap to overcome these winds and traverse a range of altitudes by actively controlling its volume as well. Fixed-wing aircraft would have a great deal of control but staying aloft on the dark side of Venus would prove a challenge if solar energy were required to power the craft. Coupled with this, traditional propulsion methods such as propellers would need to be able to withstand the harsh Venusian atmosphere. By increasing in altitude for solar charging while on the bright side of Venus, enough energy would be captured to power BREEZE as it rides the zonal winds around the dark side of the planet. With this concept, the benefits of both lift and buoyancy-based aircraft are combined into a single, elegant form factor.

The BREEZE team has recently demonstrated thrust production capabilities through the bioinspired motion, advanced structural analysis techniques of the flexible structure, and proof of concept actuation methods with string actuators. Through the creation of prototype models, structural and fluid analyses will be verified, control and tracking strategies will be tested, and the TRL of this technology will be increased.