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ASTRAEUS: A NEW PERSPECTIVE ON TITAN'S LAKES

Abstract

Titan, Saturn's largest moon, supports a dense atmosphere, numerous bodies of liquid on its surface, and as a richly organic world is a primary focus for understanding the processes that support the development of life.

In-situ exploration of the body's equatorial regions, something begun by the Huygens lander in the early 2000s, is soon set to continue with the upcoming Dragonfly quadcopter. This commitment of NASA to flying on the body marks a bold step towards more adventurous mission architectures, and following the mission's completion, numerous other opportunities will be available where mission designers can go further and leverage hundreds of years of human experience traversing surface, atmosphere and liquid on Earth to begin the first in-situ exploration of Titan's polar lakes.

Some work on this project has been presented previously; specifically on numerical studies of lake dynamics in the context of an example bioinspired spacecraft, analogous to a robotic diving gannet seabird. Now, however, a larger mission design team are involved in revisiting the conclusions of the previous study and considering a wider range of mission profiles that can access Titan's numerous and unique northern polar lakes. The mission design team, Conex Research, have used a group of astrodynamacists to find an appropriate transfer to the body, informing a top-down systems approach and allowing the detailed design of a spacecraft capable of in-situ lake measurement. As a body of extreme interest, both due to its similarity to the early-Earth and to the astrobiology community, the lakes present a unique mechanism for complex molecules in the upper atmosphere to access the incubatory environment of the interior. In-situ measurements of the multiple distinct surface lakes are therefore of high interest to test this theory.

Conex Research, a portmanteau of Conceptual and Exploration, was founded during the first COVID-19 lockdown as a platform for early-career professionals - mainly current undergraduate and recently graduated students - to develop skills in research and space mission proposal writing.