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# ASTRAEUS: AERIAL-AQUATIC TITAN MISSION PROFILE

**Abstract**

Titan. Key questions about the composition of the surface liquid and abundance of methane in Titan's atmosphere have not been answerable using the limited spatial coverage of Huygens or the obscured observations of Cassini. These questions, when considered alongside the discovery of Titan to be supportive of prebiotic chemistry in one of the most chemically complex environments in the solar system, become among the most important in better understanding solar system evolution. In-situ measurements. Previously proposed missions offering in-situ observation of Titan have included a high-altitude balloon (Reh, 2009), surface lake submarine (Oleson, Lorenz and Paul, 2015), and heavier-than-air aircraft (Barnes et al., 2011). However, the ASTrAEUS (Aerial Surveyor for Titan with Aquatic Operation for Extended Usability) spacecraft is not designed for operation in a single environment, but for both aerial and aquatic conditions, allowing access to both mediums can be addressed. ASTrAEUS: Heavier-than-air flight on Titan proves easier on Titan than on Earth due to the decreased gravitational acceleration and increased atmospheric density. Incorporating water sampling mechanisms into such a vehicle however, proves unfamiliar. The operation of the ASTrAEUS aerobot can be seen in Figure 1 and has heritage in robotic work inspired by observations of the natural world. A 'plunge diving' manoeuvre involves the wings of the aircraft sweeping back, causing a loss of lift and the vehicle to 'plunge' into the surface liquid. Work: Modelling using a combination of classical mechanics and hydrodynamic models has been done to predict forces required to exit the surface liquid, while further technical results using multiphysics simulation software LS-DYNA has shown the stability of various entry attitudes and velocities, with flight mechanics analysis predicting fluid entry conditions from operational flight. Fluid-structure interaction simulation has also been completed, to better inform the design of the vehicle. This concept was published as part of the European Space Agency's Voyage 2050 Science Programme planning session in Madrid, with further technical results published at the British Planetary Science Conference, University of Oxford. The work will further be presented at the British Conference of Undergraduate Research at the University of Leeds in April.