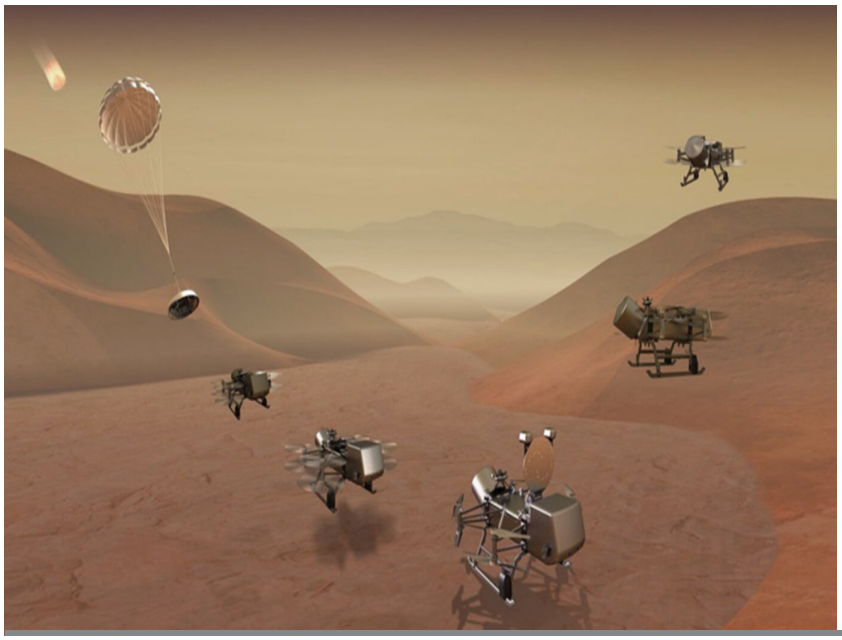


National Aeronautics and Space Administration

NASA

TECHNOLOGY SOLUTION

Aerospace

3D Lidar for Autonomous Landing Site Selection

Ocellus 3D lidar, a compact altimetry and hazard avoidance system

Next generation autonomous planetary exploration missions require advanced sensing capabilities for choosing proper landing areas for the vehicles. Current tools do not have the capability to allow vehicles outside the range of terrestrial control to autonomously perform safe landing operations.

The Ocellus 3D lidar developed by the NASA Goddard Space Flight Center is a lightweight, small-footprint 3D lidar system for planetary and lunar exploration. The new 3D lidar can perform both altimetry (or range-finding) measurements from high altitudes and, at lower altitudes, terrain mapping and imaging. These measurements provide the necessary data for autonomous systems to select safe landing areas for planetary exploration vehicles.

Developed to aid in the safe landing and navigation of the rotocopter for the Dragonfly mission to explore Titan, the Ocellus 3D lidar may be used for a wide variety of altimetry and terrain mapping purposes both in space and terrestrially.

BENEFITS

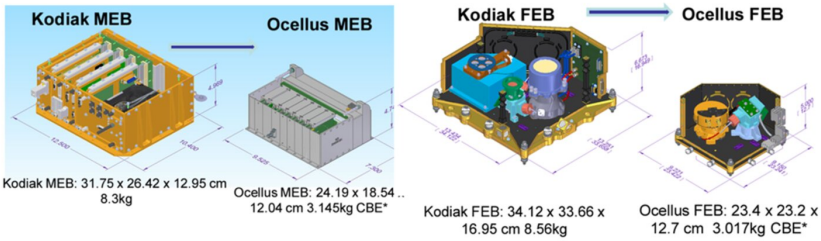
- Dual mode operation: high altitude (~2 km) altimetry and lower altitude (20 to 200 m) imaging and hazard detection.
- Space qualified components: the MEMS-based mirror assembly is space qualified.
- Meets low SWaP requirements: the 3D lidar system will be 6 kg and require 70W of power.
- Robust against temperature variation: the tool can survive the significant temperature variations that will be encountered during planetary exploration missions.
- High radiation tolerance: Ocellus is resistant to radiation damage.

THE TECHNOLOGY

Aerial planetary exploration spacecraft require lightweight, compact, and low power sensing systems to enable successful landing operations. The Ocellus 3D lidar meets those criteria as well as being able to withstand harsh planetary environments. Further, the new tool is based on space-qualified components and lidar technology previously developed at NASA Goddard (i.e., the Kodiak 3D lidar) as shown in the figure below.

The Ocellus 3D lidar quickly scans a near infrared laser across a planetary surface, receives that signal, and translates it into a 3D point cloud. Using a laser source, fast scanning MEMS (micro-electromechanical system)-based mirrors, and NASA-developed processing electronics, the 3D point clouds are created and converted into elevations and images onboard the craft. At ~2 km altitudes, Ocellus acts as an altimeter and at altitudes below 200 m the tool produces images and terrain maps. The produced high resolution (centimeter-scale) elevations are used by the spacecraft to assess safe landing sites.

The Ocellus 3D lidar is applicable to planetary and lunar exploration by unmanned or crewed aerial vehicles and may be adapted for assisting in-space servicing, assembly, and manufacturing operations. Beyond exploratory space missions, the new compact 3D lidar may be used for aerial navigation in the defense or commercial space sectors. The Ocellus 3D lidar is available for patent licensing.



Images showing the design and development of the Ocellus that is based on the previous Kodiak 3D lidar system (MEB = main electronics box, FEB = front-end box).

APPLICATIONS

The technology has several potential applications:

- Aerospace: enhanced navigation and imaging for planetary and lunar exploration as well as for in-space servicing, assembly, and manufacturing.
- Defense: improved autonomous aerial vehicular sensing and navigation.
- Terrain mapping: the 3D lidar may be used in space and terrestrially for mapping terrain features at altitudes below 2 km.

PUBLICATIONS

Patent Pending

technology.nasa.gov

NASA's Technology Transfer Program pursues the widest possible applications of agency technology to benefit US citizens. Through partnerships and licensing agreements with industry, the program ensures that NASA's investments in pioneering research find secondary uses that benefit the economy, create jobs, and improve quality of life.

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More Information

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