NASAfacts

Morpheus Lander

NASA's prototype Morpheus lander, amid the kind of boulder-strewn terrain in which it is designed to land.

NASA's Morpheus Project has developed and tested a prototype planetary lander capable of vertical takeoff and landing. Designed to serve as a vertical testbed (VTB) for advanced spacecraft technologies, the vehicle provides a platform for bringing technologies from the laboratory into an integrated flight system at relatively low cost. This allows individual technologies to mature into capabilities that can be incorporated into human exploration missions.

NASA's strategic goal of extending human presence across the solar system requires an integrated architecture. Such architecture would include advanced, robust space vehicles for a variety of lunar, asteroid, and planetary missions; automated hazard detection and avoidance technologies to reduce risks to crews, landers, and precursor robotic payloads; and in situ resource utilization (ISRU) to support crews during extended stays on extraterrestrial surfaces and to provide for their safe return to Earth. NASA's Advanced Exploration Systems (AES) portfolio includes several fast-paced projects that are developing these necessary capabilities. Specifically, the Morpheus project and the Autonomous Landing and Hazard Avoidance Technology (ALHAT) project provide

The ALHAT system will autonomously determine the safe landing areas in the field and navigate Morpheus to a controlled safe landing.

technological foundations for key components of the greater exploration architecture necessary to move humans beyond low Earth orbit (LEO).

The Morpheus project provides an autonomous, reusable, rocket-powered, terrestrial vertical take-off/vertical landing vehicle for testing integrated spacecraft and planetary lander technologies. The integrated VTB offers a platform to develop,

Morpheus executes one of many successful tether tests; crucial steps in preparations for free flights.

mature, refine, and demonstrate advanced technologies that increase autonomy, reliability, safety, and reusability, and improve navigation and landing capabilities. Morpheus provides a way to help develop these technologies into systems that can be demonstrated and tested. Successfully implementing these capabilities will enable access to landing sites that were previously considered too hazardous to risk a robotic lander mission, much less a human mission.

The Morpheus vehicle is propelled by a liquid oxygen (LOX)/liquid methane propulsion system that can provide a specific impulse of up to 321 seconds during space flight, and these cryogenic propellants burn cleanly, are nontoxic, and can be stored easily in space. For future space missions, it may be possible to produce oxygen or methane in situ. Oxygen is already a necessary and compatible commodity for life support systems in spacecraft, and oxygen/methane systems are being studied for power generation. LOX and methane are also readily available and relatively safe and easy to handle, permitting frequent, low-cost ground testing. These attributes and potential capabilities make propulsion with LOX/methane an attractive technology.

ALHAT, the primary Morpheus payload, provides autonomous precision landing and hazard avoidance. When a vehicle lands autonomously, it must identify a safe landing site: one that is relatively flat and free of large boulders, rocks, and craters.

National Aeronautics and Space Administration

Lyndon B. Johnson Space Center
Houston, Texas 77058

www.nasa.gov

FS-2013-05-010-JSC

The Morpheus Control Room watches closely during a tethered test flight of the vehicle at the NASA Johnson Space Center Vertical Testbed Flight Complex.

Although Morpheus was designed and developed primarily at Johnson Space Center (JSC), other NASA centers, commercial entities, and academic institutions have supported its development and testing. For Morpheus and ALHAT, JSC has partnerships with Kennedy Space Center (KSC) for flight-testing; Stennis Space Center (SSC) for engine testing; Marshall Space Flight Center (MSFC) for engine development and lander expertise; Goddard Space Flight Center (GSFC) for core flight software development; and Langley Research Center (LaRC) and the Jet Propulsion Laboratory (JPL) for ALHAT development. Commercial partnerships with enterprises such as Jacobs Engineering, Armadillo Aerospace, Draper Labs, and others have augmented the development and operation of many aspects of the project.

NASA will use Morpheus and its smaller counterpart, the Mighty Eagle lander at the MSFC, to mature technologies needed to develop a new generation of scalable, smart, versatile robotic landers capable of achieving scientific and exploration goals on the surface of planetary bodies. The specific technologies also have potential application to future human missions.

Morpheus Facts	
Propellants:	Methane and Liquid Oxygen
Cargo Capability:	Scalable; reference mission 500kg to lunar surface
Test Locations:	NASA Johnson Space Center, Houston and NASA Kennedy Space Center, Florida
Potential Missions:	Carry humanoid robot, rover or propellant lab to lunar/ planetary landing; rendezvous and propellant transfer demonstrations in Earth orbit; potential asteroid rendezvous.

For more information visit us at:

http://www.nasa.gov/centers/johnson/exploration/morpheus/
http://morpheuslander.jsc.nasa.gov
http://www.twitter.com/morpheuslander
http://www.facebook.com/morpheuslander