NASA Engineer Works to Develop New Airplane to Seek Water on Mars

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You might think it is impossible to fly an airplane over Mars, but it is possible.

Actually, glider-like airplanes that, in theory, could ride the wispy air of the red planet have been on drawing boards for the last 30 years.

One of the latest proposals is to fly a rocket-powered Mars airplane and land on the edge of a cliff in search of water, a fluid that is essential to life, as we know it.

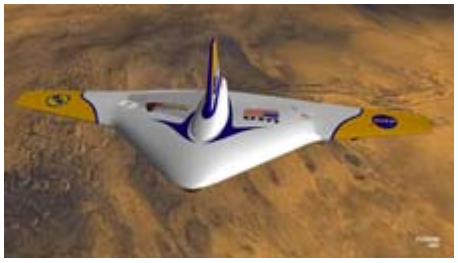

Image Above: Computer-aided-design (CAD) image of the Matador Mars airplane concept.
Image credit: NASA Ames Research Center/Andy Gonzalez

"For the last three years, I've been developing a Mars airplane concept that is specifically designed to accomplish a soft landing," said Larry Lemke, an engineer at NASA Ames Research Center, Moffett Field, Calif., who recently submitted his proposal to space agency officials. "You use small rocket motors to land like a Harrier vertical-takeoff-and-landing (VTOL) airplane lands. The idea would be to conduct a precision landing near Mars gullies to look for subsurface water," he explained.

NASA Associate Administrator for Science, Alan Stern, issued a request for information for small landers that could be secondary payloads on future missions to Mars. The first opportunity for a secondary payload Mars mission might be in 2013 on the Mars Science Orbiter (MSO), according to Lemke.

Lemke's plan calls for the airplane to have ground-penetrating radar to search for water near a gully on Mars after the plane lands. Scientists have found Mars gullies from about 330 feet (100 meters) to 660 feet (200 meters) down steep walls, according to Lemke.

"The gullies always appear on steep walls like a crater or a cliff, and the gullies all appear partway down a wall," Lemke said. "The theory is there is an underground water layer, and every so often the water pops out on the surface." According to Lemke, if the airplane could land on the lip of a crater or edge of a cliff, then the craft could use radar to look for signs of water below the ground's surface.

Radar will go through very dry surface material with very little change, but a water layer would be a hundred times more reflective, Lemke observed. Carbon dioxide would echo radar with yet a different reflectivity, he added.

"You should be able to tell the difference between water ice and liquid water, again by how reflective it is," Lemke noted. The airplane would probably also have a camera, he said.

Previous Mars airplane missions were judged to be extremely exciting scientifically, but very risky technically, so they were not selected, according to Lemke. Mars airplane missions are technically challenging because "the planetary exploration community has no experience with flying airplanes on other planets," Lemke said.

"One of the main technical challenges was to build an airplane that could be folded to fit inside an entry capsule," Lemke observed. "It's a capsule – usually conical in shape. It's got a heat shield on it. It enters the martian atmosphere from space and protects the payload inside," he explained.

A second challenge is that the airplane must unfold itself in mid air, according to Lemke. Once it unfolds, the airplane would fly to a gully using a computer pilot. A pilot on Earth could not remotely control the airplane, because even at the speed of light, radio signals can take longer to reach Earth than the entire flight.

According to Lemke, the airplane would have a mass of about 143 pounds (65 kilograms). The engines would be small rockets powered by hydrazine. In a hydrazine thruster, two chemicals, called bi-propellants, mix to cause a reaction and produce thrust.

"In this kind of a mission you just want to get down to the place and land," Lemke said. "The endurance may be no more than 15 minutes. You'll have to have autonomous software called seeing-recognition software. It means the computer in the airplane has to be able to take images of what it sees and compare that to a stored image of where it wants to be, and then figure out how to get to the desired spot. This is similar to how cruise missiles work," Lemke explained.

Lemke said there several advantages to using an airplane to conduct martian science missions. "It can fly much closer to the surface than a satellite . . . a kilometer above the surface," he observed. Comparing an airplane to a balloon, he said, "An airplane can go where you command it to go. A balloon goes wherever the wind blows it."

Lemke said there are other potential missions for Mars airplanes. "An airplane mission could last anywhere from 15 minutes to probably five hours," he said. Longer missions might use propeller airplanes.

"The most efficient technique would be a propeller," Lemke explained. "The power would come from a storable liquid fuel or an electrical power source, a battery or fuel cells."

The goals of a Mars airplane mission have changed over the years, according to Lemke.

"In the beginning, high-resolution photos would be a main choice, but, today, we have a high-resolution Mars orbiter satellite." He said today's Mars airplane missions would most likely study atmospheric science, such as wind speed, pressure, dust and minor constituents like methane.

Another objective of a Mars airplane mission might be to land a payload, Lemke added. "The idea would be to use it as a precision lander," he said.

"I think when humans arrive, there are two scenarios that make sense," Lemke predicted. "One is that you could use small robotic aircraft for scouting and for a short range communication relay. The second is for transporting people and small amounts of cargo for regional exploration," he continued.

Lemke developed his Mars airplane proposal for the NASA Science Mission Directorate's Mars Technology Program.

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