Why flying a helicopter on Mars is a big deal

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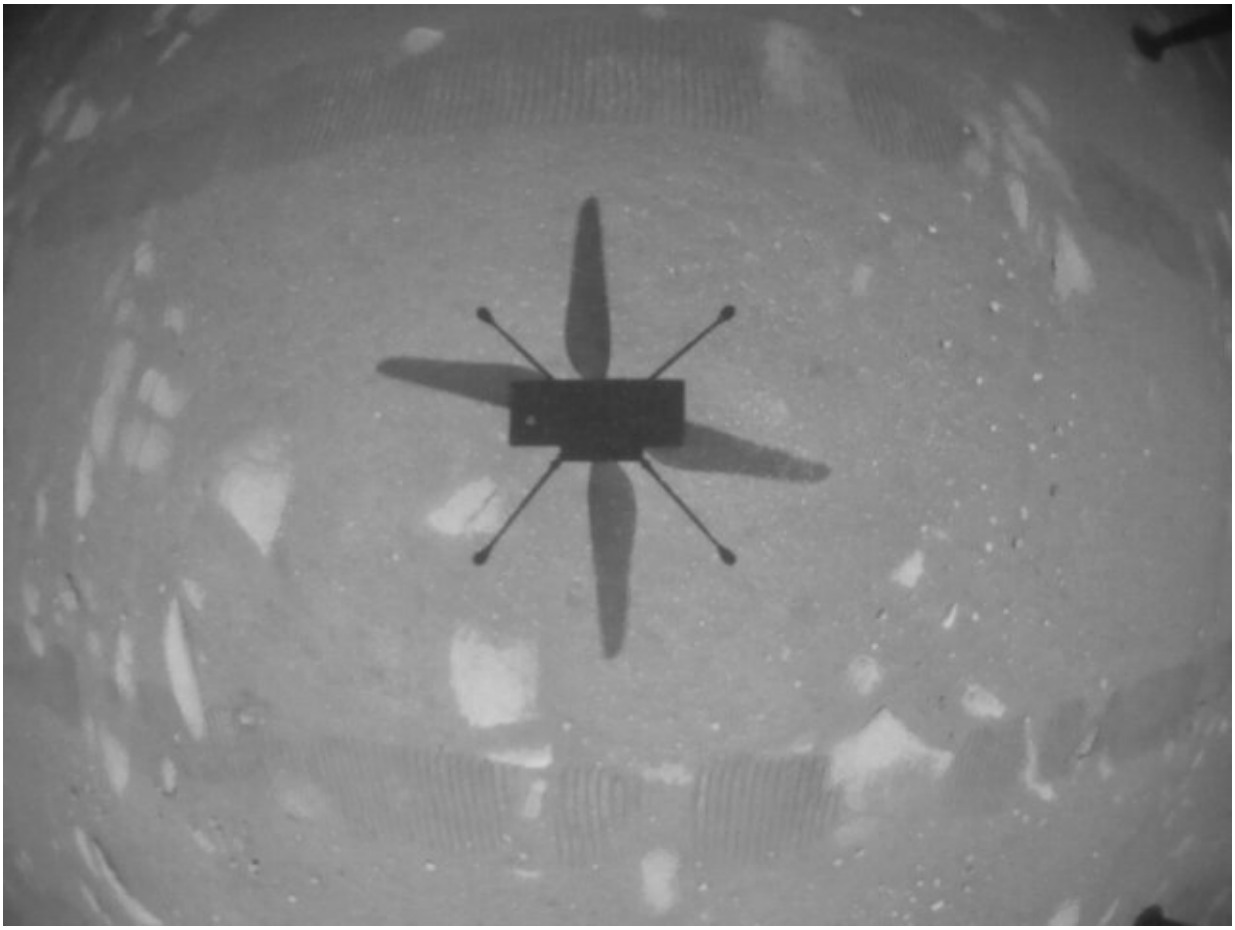

NASA's Ingenuity Mars Helicopter captured this shot as it hovered over the Martian surface on April 19, 2021, during the first instance of powered, controlled flight on another planet. It used its navigation camera, which autonomously tracks the ground during flight. Credit: NASA/JPL-Caltech

NASA conducted its first flight on another planet early Monday morning , a short hop for a small chopper named Ingenuity which demonstrated technology that could prove critical to the future of space exploration.

The four-pound vehicle ascended to about 10 feet above the surface of the red planet for about 40 seconds, before descending back to the ground.

The helicopter arrived on Mars along with the Perseverance rover on Feb. 18 in a dramatic, high-definition landing. As the U.S. and other nations prepare to return humans to the moon, and eventually land on Mars, using drones to closely assess the surrounding landscape will become ever-more important.

"We now have our Wright brothers moment," MiMi Aung, project manager for Ingenuity, said early Monday morning from a control room at NASA's Jet Propulsion Laboratory in Pasadena, California. "This is just the first great flight."

Researchers at JPL have planned four more Ingenuity flights during the mission to demonstrate the technology's viability in the thin Martian atmosphere, a hostile environment to craft that require air for lift (the Martian atmosphere is 100 times thinner than that of Earth).

Indeed, flying close to the surface of Mars is the equivalent of flying at more than 87,000 feet on Earth, essentially three times the height of Mount Everest, NASA engineers said. The altitude record for a helicopter flight on earth is 41,000 feet.

Made up mostly of carbon dioxide, the less-dense atmosphere requires blade rotation speeds of 2,400 rpm for the chopper to remain aloft—five times what's needed on Earth. Researchers also had only an estimate of what kind of wind speeds to expect, which was around 13 mph.

Each subsequent test will be "higher risk" and up to 15 feet above the surface because "we want to stretch and understand the capability of this little vehicle," Aung said. The longest flight will last no more than 90 seconds.

JPL program managers warned that Ingenuity's later flights come with a fair chance of ending the mission entirely, given the increased probability of a crash landing. The small craft has no way to right itself if it lands askew and not on its four legs.

Since the Apollo missions introduced rovers to the Moon's surface, surface exploration has remained at ground-level. Over time, drone flights could allow exploration of inaccessible, rocky terrain or to scan cliffs and other geological futures too treacherous for rovers—or humans.

NASA began concept testing its off-world aviation experiment back in 2014, and has conducted extensive vacuum chamber-testing to understand the complexity of flight on Mars, where it's very cold by terrestrial standards, dipping to -130F (-90C) at night. But Ingenuity is only the beginning.

The agency's Dragonfly mission to Saturn's moon Titan is scheduled for a 2027 launch, with arrival to occur about eight years later. The larger rotorcraft will fly more than 100 miles on the icy moon, collecting samples at multiple locations.

While Titan's nitrogen-heavy, complex atmosphere will be an easier place to fly than Mars when it comes to aerodynamics, methane rain and super extreme cold of -290F (-179C) will present their own challenges.

Ingenuity and its progeny must be largely autonomous given the lag in communications from Earth, which is 180 million miles away. NASA

eventually found itself purchasing two $750 commercial chipsets for the drone flights that were developed by Qualcomm Inc., since the platform offered the helicopter more robust computing with low power usage than NASA's existing technology.

Ingenuity has two cameras, one for navigation, the other for terrain photography, and must connect wirelessly with Perseverance to relay its imagery to an overhead Mars orbiter and back to Earth. The chips also must accept flight profiles sent from JPL pilots.

"This is a historic moment—first flight off planet earth," said Dev Singh, a Qualcomm general manager who oversees drones and robotics. "This is just a beginning."

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