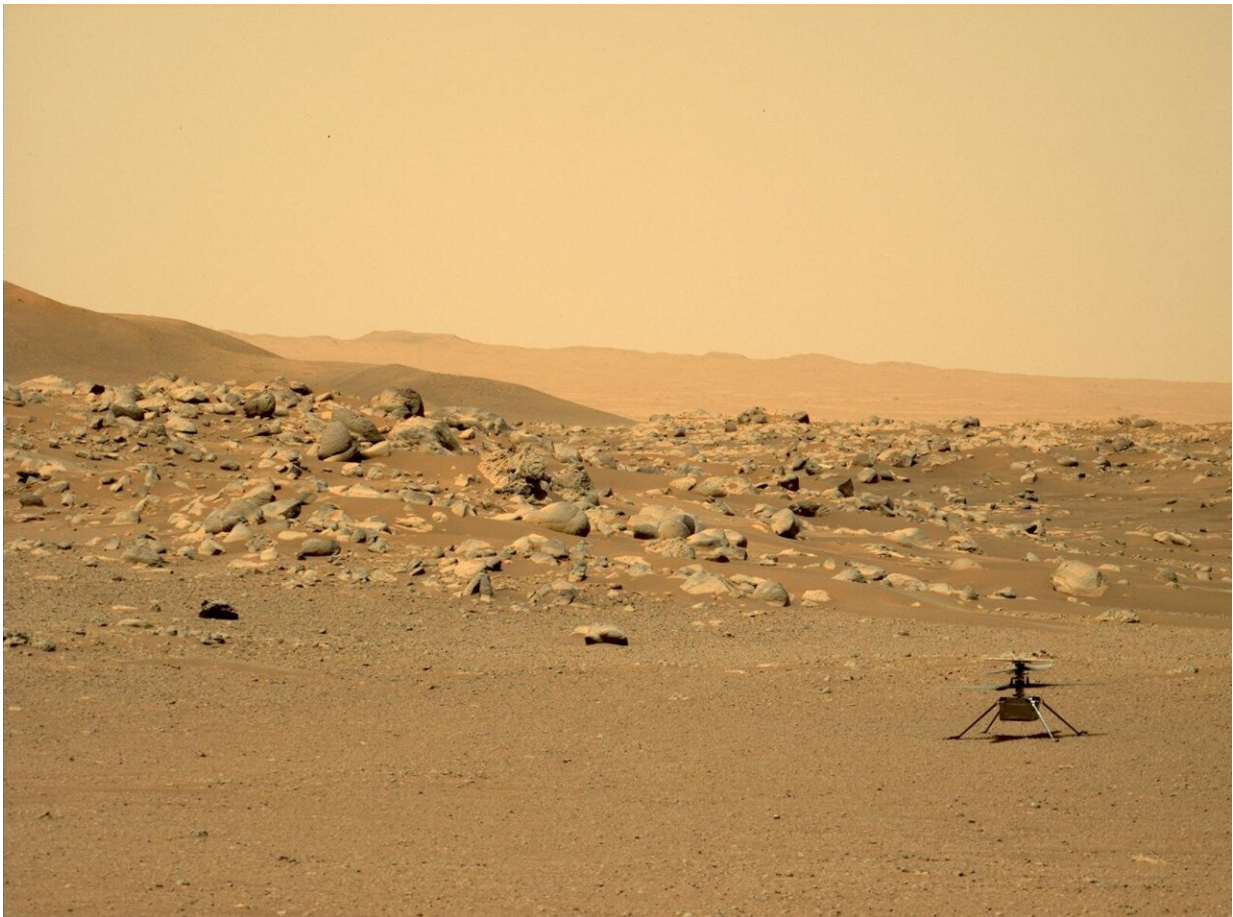# NASA's Ingenuity Mars helicopter completes 50th flight

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This image of NASA's Ingenuity Mars Helicopter was taken at "Airfield D" by the Mastcam-Z instrument on the Perseverance rover on June 15, 2021, the 114th Martian day, or sol, of the mission. The rotorcraft completed its 50th flight on April 13, 2023. Credit: NASA/JPL-Caltech/ASU/MSSS

The history-making rotorcraft has recently been negotiating some of the most hazardous terrain it's encountered on the Red Planet.

NASA's Ingenuity Mars Helicopter has completed its 50th flight on Mars. The first aircraft on another world reached the half-century mark on April 13, traveling over 1,057.09 feet (322.2 meters) in 145.7 seconds. The helicopter also achieved a new altitude record of 59 feet (18 meters) before alighting near the half-mile-wide (800-meter-wide) "Belva Crater."

With Flight 50 in the mission logbook, the helicopter team plans to perform another repositioning flight before exploring the "Fall River Pass" region of Jezero Crater.

"Just as the Wright brothers continued their experiments well after that momentous day at Kitty Hawk in 1903, the Ingenuity team continues to pursue and learn from the flight operations of the first aircraft on another world," said Lori Glaze, director of the Planetary Science Division at NASA Headquarters in Washington.

Ingenuity landed on the Red Planet in February 2021 attached to the belly of NASA's Mars Perseverance rover and will soon mark the two-year anniversary of its first flight, which took place on April 19, 2021. Designed as a technology demonstration that would fly no more than five times, the helicopter was intended to prove powered, controlled flight on another planet was possible. But Ingenuity exceeded expectations and transitioned into being an operations demonstration.

Every time Ingenuity goes airborne, it covers new ground and offers a perspective no previous planetary mission could achieve. Imagery from the helicopter has not only demonstrated how aircraft could serve as forward scouts for future planetary expeditions, but it has even come in handy for the Perseverance team.

By testing the helicopter's limits, engineers are gathering flight data that can be used by engineers working on designs for possible future Mars helicopters. That includes the people designing the Mars Sample Return campaign's proposed Sample Recovery Helicopters.

## Riskier terrain

Since leaving the relatively flat confines of Jezero Crater's floor on Jan. 19, Ingenuity has flown 11 times, setting new speed and altitude records of 14.5 mph (6.5 meters per second) and 59 feet (18 meters) along the way.

Although the deep chill of winter and regional dust events (which can block the Sun's rays from reaching the helicopter's solar panel) have abated, Ingenuity continues to brown out at night. As a result, the Helicopter Base Station on the rover needs to search for the rotorcraft's signal each morning at the time Ingenuity is predicted to wake up. And when the helicopter does fly, it now must navigate rugged and relatively uncharted terrain, landing in spots that can be surrounded by hazards.

"We are not in Martian Kansas anymore," said Josh Anderson, Ingenuity operations lead at NASA's Jet Propulsion Laboratory in Southern California. "We're flying over the dried-up remnants of an ancient river that is filled with sand dunes, boulders, and rocks, and surrounded by hills that could have us for lunch. And while we recently upgraded the navigation software onboard to help determine safe airfields, every flight is still a white-knuckler."

### Frequent flyer

Beyond facing more challenging terrain, Ingenuity will also fly at a greater frequency in the coming days because the helicopter needs to remain within electronic earshot of the rover. With its AutoNav

capability, Perseverance can travel hundreds of meters each day.

"Ingenuity relies on Perseverance to act as a communications relay between it and mission controllers here at JPL," said Anderson. "If the rover gets too far ahead or disappears behind a hill, we could lose communications. The rover team has a job to do and a schedule to keep. So it's imperative Ingenuity keeps up and is in the lead whenever possible."

Perseverance recently completed exploring "Foel Drygarn," a scientific target that may contain hydrated silica (which is of strong astrobiological interest). It is currently headed to "Mount Julian," which will provide a panoramic view into nearby Belva Crater.

**Feats of Ingenuity**

Built with many off-the-shelf components, such as smartphone processors and cameras, Ingenuity is now 23 Earth months and 45 flights beyond its expected lifetime. The rotorcraft has flown for over 89 minutes and more than 7.1 miles (11.6 kilometers).

"When we first flew, we thought we would be incredibly lucky to eke out five flights," said Teddy Tzanetos, Ingenuity team lead at JPL. "We have exceeded our expected cumulative flight time since our technology demonstration wrapped by 1,250% and expected distance flown by 2,214%."

Surpassing expectations like this comes at a cost, however. With some helicopter components showing signs of wear and the terrain becoming more challenging, the Ingenuity team recognizes that every great mission must eventually come to an end. "We have come so far, and we want to go farther," said Tzanetos. "But we have known since the very beginning our time at Mars was limited, and every operational day is a blessing.

Whether Ingenuity's mission ends tomorrow, next week, or months from now is something no one can predict at present. What I can predict is that when it does, we'll have one heck of a party."

Provided by Jet Propulsion Laboratory

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