How NASA keeps Ingenuity going after more than 50 flights

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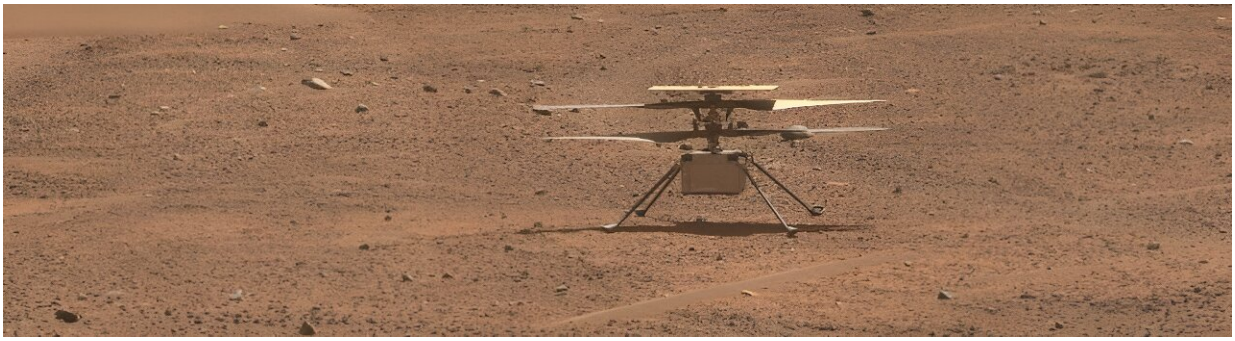

Ingenuity after the emergency landing of Flight #53. Credit: NASA/JPL-Caltech/ASU/MSSS

More information is always better when it comes to publicly funded space exploration projects. So it's welcome when a NASA engineer takes time out of the assuredly busy work lives to provide an update on everyone's favorite helicopter on Mars. Ingenuity has been having a rough few months, and a new article entitled "The Long Wait," posted by Travis Brown, Chief Engineer on the Ingenuity project, on NASA's website, provides a good amount of detail as to why.

The problems started when Ingenuity took off for flight #52 on April 26th. When the helicopter landed, it was out of range Perseverance, its rover companion, and the helicopter's radio link back to its controllers on Earth. This was intentional, but it meant that Ingenuity's minders

didn't know whether the flight had been completed successfully.

Dr. Brown explains why the team would intentionally choose to land the helicopter out of range of Perseverance and details the four main mission priorities for the helicopter's secondary mission. Unsurprisingly, the number one priority is: don't mess up Perseverance. The rover is currently collecting interesting samples for the now-endangered Mars Sample Return mission, which, assuming it still goes ahead, will see those samples eventually return to Earth.

If Ingenuity accidentally interferes with that process, needless to say, the NASA brass would be upset. The helicopter's handlers have decided that the best way for it is to stay well ahead of the rover and let it catch up to them, which is what it was trying to do with Flight #52.

Unfortunately, part of Perseverance's mission is flexibility, and its own project team can make the call as to where they want the rover to go next. After Ingenuity's flight, the rover team decided not to stick to the planned path that would take it near the helicopter in a few days but instead take a long way around to do some exciting science elsewhere. When Perseverance did move back into range, 61 days had passed where the helicopter had been patiently waiting for it.

When Ingenuity could finally transmit its images back, the science team was excited as it had landed on a group of pebbles that had never before been seen on the Martian surface. Another flight was planned immediately, with this one intended to scout the immediate area for any other interesting geological features for Perseverance to look at.

That's where the second problem came up. During Ingenuity's flight #53, a never-before-seen error forced the helicopter to land unexpectedly, what Dr. Brown describes as a time desynchronization between a camera that keeps track of ground features and other sensors tied to its inertial

guidance system. Any engineer who has worked with multiple systems can tell you how difficult timing synchronization timing can be, so the guidance system was right to shut the system down for machine safety. Still, it means that Ingenuity was once again grounded without being able to fulfill a potentially interesting mission objective.

While Ingenuity was recovering from its unexpected landing, Perseverance caught up to the helicopter, making it redundant to provide scientific data since the superior instruments on the rover were now on station. Luckily, that freed the helicopter up for a brief flight #54, where it tested its systems out again and then returned to its scouting duties with flight #55 shortly afterward, with no attendant synchronization problems.

Remember that the original mission plan for Ingenuity lasted for 30 days and three flights. It is now on day 979 and has completed 66 flights in total. That is astounding for such a tiny machine on such a remote planet, and congratulations to Dr. Brown and his team. May they be able to overcome many more obstacles and complete many more flights.

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