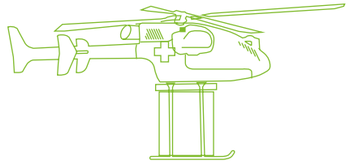
A ‘DROP’ OF FAITH



Unmanned helicopter superARTIS in test flights for humanitarian aid

Field report by Johann C. Dauer

We have been in the Caribbean for a week now, but it is a far cry from the picture-perfect beaches and all-inclusive hotels. This is real life: heat, bad weather, parched landscapes, areas marked by poverty, and, last but not least, friendly people. Our mission: the simulation of a humanitarian relief operation to deliver supplies to hard-to-reach areas in a crisis situation.

We are standing on the road that is to serve as the helipad for superARTIS. I say road, but strictly speaking it is a rugged track that is partly submerged in the growing hypersaline Lake Enriquillo. It is Saturday morning, and way too early. But instead of the sky getting lighter, it is darkening. “A storm is coming. Will we make it on time?” asks Jörg Rößner, our safety pilot. This is our last chance, as we are already running behind schedule. Longer-than-expected waiting times at customs and difficulties in getting Jet A-1 fuel cost us almost two entire days of our two-week stay in the Dominican Republic. As a result, today is all we have to conduct the first of several missions. So we have to try. In the scenario, our unmanned helicopter superARTIS, a Dragon SDO 50 manufactured by the company SwissDrones Operating AG, has to deliver relief supplies to a village isolated by flooding.

It is still dawn as we put everything together. The ground station is set up and the rotor blades fitted to the autonomously flying helicopter. We carry out the pre-flight tests and fill the special transport boxes with food supplies.

Less than an hour has gone by since we left our hotel. A record set-up time! But Jan Binger, our ground station operator, has his doubts as to whether we are working fast enough. The dark clouds amassing in the sky are beginning to worry us. But everything is ready, and we do not want to pass up this chance. Giving up early is not an option. There is no time for chitchat as we go through the checklist for the final launch preparations. The team has perfectly primed for this moment over the last few days. A call from us triggers the roadblock; a hand gesture activates the safety area. From this point onwards, no one will be able to come near our helicopter and us. Leonor, our contact from the local civil aviation authority, confirms that the airspace has been cleared for us. I give clearance for take-off.

The turbine is started, the rotors turn at their nominal speed, and our superARTIS takes off. Its destination lies far out of sight – all the way across the lake. There, it will drop the boxes containing the relief goods. The helicopter is on its way now. Flying at an altitude of 100 metres, it speeds away, and soon all that remains is a small point on the horizon. As always, a strange feeling besets us when the helicopter finally disappears from view. And we suddenly become aware of just how remarkable this test in the Dominican Republic still is.

The ground station is like a camp, but has everything the crew needs to track the autonomous flying helicopter.

superARTIS' mission is to quickly, cost-effectively and safely transport vital goods to locations in need of assistance.

The aircraft and technology are carefully transported to different test areas of the Dominican Republic

The hypersaline Lake Enriquillo grows quickly in the rain – a good test area for rapid humanitarian aid.

The boxes adapted for aid operations with drones unfold automatically when dropped

The missions

Together with the UN World Food Programme (WFP) and the Dutch organisation Wings for Aid, the DLR team investigated the use of drones for delivering supplies in simulated emergency situations. The helicopter automatically dropped relief supplies on hard-to-reach targets. The supplies cannot be damaged in the process. At the same time, the outer packaging had to be as inexpensive as possible, as it would remain in the remote target areas and could thus not be re-used. Elaborate and expensive parachutes were therefore not an option.

Wings for Aid has designed special cardboard boxes for this purpose. Flaps that unfold automatically when dropped have a braking and stabilising effect as the boxes fall, while a crumple zone also protects the contents on impact. The boxes are folded during transport and quickly assembled in the field. Moreover, the cardboard itself is biodegradable. In regular emergency operations, various targets can gradually be supplied with around 20 kilograms of aid items per drop. Even technical devices, such as radio units, can be delivered to the affected region using this method.

During the planning phase, it became clear that dropping goods from drones was feasible. The task of the DLR researchers was to determine the extent to which this delivery method really benefits local humanitarian aid. The WFP selected the Dominican Republic for this investigation, as drones have already been used on test runs for different purposes here. The country has been struck by a number of natural disasters in recent years. Floods, in particular, often assume critical dimensions here. Such scenarios were therefore chosen as the area of application for this study. Affected residents and official local bodies follow the test run and will help to evaluate it. The goal is to determine whether the technical solution would prove effective under the actual conditions with which emergency relief workers are confronted.

The area around the 375-square-kilometre hypersaline Lake Enriquillo has been subject to flooding many times and was the site of the tests carried out in the first week of the scientists' stay. The helicopter was to take off from a point from where it is no longer possible to get through and drop supplies at the small village Nuevo Boca de Cachón. It flew automatically, passing over about six kilometres of water and a road, before hovering above its destination for a specified amount of time. Our payload operator was waiting there to monitor the target area and trigger the drop. The helicopter then returned via the same route.

Another area, where the test took place during the second week is located in the northern part of the island close to the Bajo Yuna River. Rice is the predominant crop here. Floods are very common here, as the land surface is lower than the riverbed itself. The WFP and other aid organisations on the ground report that people are cut off from the surrounding areas by flooding here almost every hurricane season. The permanent stationing of a drone, like superARTIS, would even be conceivable for this region, supplementing the use of boats and manned helicopters.

Several missions that tackle different challenges were devised for this second region. For these, the helicopter covered distances between 800 metres and 3.5 kilometres. The take-off and landing sites were dirt roads that were closed to traffic during the flight. The targets for the cargo drops were near settlements that would require supplies in the event of an emergency.

A new approach to safety assessment

Pioneering work was performed not just from a technical and logistical perspective; the researchers also employed a new procedure for approving on-site flights. The approval of drone operations in general airspace is currently a hot topic in the field of unmanned aviation. Working with the country's civil aviation authority, the scientists decided to apply a new safety-assessment procedure – one of the first times this had ever been done. The Specific Operations Risk Assessment (SORA) looks not only at the drone as a product in its own right, but takes account of the mission for which it is intended. This should provide a level of safety that corresponds to that of manned aviation. Depending on the specific circumstances of the mission, obtaining complete certification for the drone is not always necessary. If, for instance, the mission entails only minor risks to people and the surrounding area of operation, the level of required verification can be reduced.

This procedure has hitherto been missing in civilian unmanned aviation when it comes to performing a safety assessment and formally approving more complex operations, such as flight beyond visual line of sight. As such, the European Aviation Safety Agency (EASA) is endeavouring to enshrine this process in binding regulations in the near term. In this case, an unmanned helicopter with a comparable take-off weight was used, with operations restricted to sparsely populated areas and altitudes below 500 feet. The aviation authority ensured that no other flight operations took place during this time.

The delivery reaches its destination

The expected downpour has held off so far. Our helicopter has disappeared from view. Jan Binger is monitoring the flight parameters from the ground station. In preliminary tests, we determined the kind of gusts that we could expect over the lake. Now, however, the wind is really picking up and the helicopter is struggling. The artificial horizon is no longer horizontal and the turbine temperature is threatening to tip into the red due to the gusts of wind. We have clearly defined criteria for aborting the mission… but in the end our hopes come true. The wind conditions prove challenging but not critical. The helicopter reaches the other shore safely and flies over the closed-off road.

Our payload operator later describes how the helicopter turned in an impressive performance. "From the noise alone, we could tell that a proper aircraft, rather than a little drone, was on the approach," says Barry Koperberg, Founder and General Manager of Wings for Aid, who was responsible for the cargo drop on this test run.

As the helicopter hovers reliably over the drop point, we gaze spellbound at the control instruments in the ground station. Since the aircraft's total capacity is geared towards transportation, there are no additional cameras on board, so we are reliant on following the engine data. When the fuel consumption suddenly drops, we know that the helicopter must have just become lighter. Just seconds later, our payload operator phones to confirm that the drop has been triggered and that the cargo has landed safely and according to plan.

After the allotted waiting time, our superARTIS sets off on the return journey. We scan the horizon, and, indeed, just minutes later we can make it out: a growing black dot in the sky. The helicopter approaches, flies to its landing site and touches down safely. But there is no time to cheer and pat each other on the back, as we are keen to repeat the mission before the dark clouds break. Shortly after, the helicopter sets off again and delivers another box.

Having been behind schedule for a couple of days, we have now successfully completed the first part of our mission. The whole team is proud of this success, and we are naturally delighted at the positive feedback received in interviews with the region's residents and the representatives of local aid organisations. A great load seems to have been lifted from the shoulders of the flight test team, and as we pack up our things, the mood is almost euphoric. On to the second test area for next week!

As we leave, the weather chart shows us a Dominican Republic completely covered in red and purple. Rain beats down on the roof of the car and visibility is restricted to a few metres. What a stroke of luck!

The following week is all about establishing routine flight operations through variations of the missions. The derived figures help us to assess the efficiency of our transport operations. We complete several flights in Bajo Yuna and repeat the procedure. Thankfully, the weather improves and we are able to bring back ample experiences and data to evaluate at home. What we have learned will greatly advance our research into unmanned aviation technology. And at the very end, before returning to Germany, we manage to sneak in a little trip to one of those picture-perfect beaches.

Author Johann Dauer is relieved that the researchers have an advantage over the rain clouds

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