CHIRP

Confidential Human-Factors
Incident Reporting Programme

Aviation FEEDBACK

Edition 4 | May 2022

DRONES

CHIRP GENERAL AVIATION FEEDBACK
Confidential Human-Factors Incident Reporting Programme

This is why we do what we do

Lightning never strikes twice in the same place — or does it?

CHIRP Drone/UAS Programme Manager: RUPERT DENT

Welcome to Drone FEEDBACK Edition 4.

Firstly, I'd like to thank those who have taken time to send in a report. Without you, others would have missed out on learning something, and we would not have any content. We are very grateful to those that have altruistically shared the benefit of their experience.

For those who are new to Drone FEEDBACK, a reminder of what FEEDBACK is all about. CHIRP has developed and is promulgating the use of a confidential, independent reporting programme for Human Factors "HF" and Just Culture occurrences, or near occurrences, arising from the operation of Drones or Remotely Piloted Aircraft Systems.

The aim is that Drone pilots, who are in many cases relatively new members to the world of aviation, will be able to benefit from lessons learnt and existing practices that have developed within the aviation sector over many years for crewed aircraft.

Many of the same theories that apply to crewed aircraft apply to aircraft with remote pilots. If all of us can learn from an event that happened to one individual and might happen to another, it is to everyone's advantage to be able to do so. CHIRP is the conduit for individuals to share their experience of HF occurrences safely and confidentially in a way that enables many others to learn from them.

FEEDBACK is CHIRP's regular publication that seeks to communicate the occurrences we are informed about,

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For those with smaller devices, you can view this report in a single-column format. Open the newsletter in Adobe Acrobat Reader and select the 'Liquid Mode' icon in the toolbar.

Click here for a printer-friendly version

draw some lessons, and pass them on to flyers who might benefit. We hope you find them useful.

FEEDBACK Edition 3 was published in January 2022 and was sent to 16,746 "Skywise subscribers". Since then, CHIRP has received further HF reports, some of which we review here in FEEDBACK 4. We have also been scanning AAIB reports for valuable case studies and are grateful that the British Model Flying Association "BMFA" have shared their occurrence reports with us as well. We have taken a look and there are undoubtedly some useful lessons to be learnt from both of these additional sources for reports.

Of the four reports we set out below, it is interesting to note there is one particular occurrence with an HF element to it that has now happened on at least two separate occasions, each time on the same make and model of aircraft. If any of our readers have experienced something similar, please do get in touch with us. It will help us build a more complete picture of the root cause. The more we can learn about what leads to the over- or under-tightening of the rotor arm locking collar on the DJI M 300, the better. Read on for more details!

Finally, CHIRP understands that the next piece of legislation anticipated from the CAA is no longer an update to CAP 722, but rather a new set of Acceptable Means of Compliance "AMC" and Guidance Material "GM". So, keep an eye on Skywise notices as they are issued over the next few weeks and here's hoping there will be lots of good flying weather as we head towards the summer!

Rupert Dent
CHIRP Drone/
UAS Programme Manager

'This resulted in failure of the rotor'

Reports

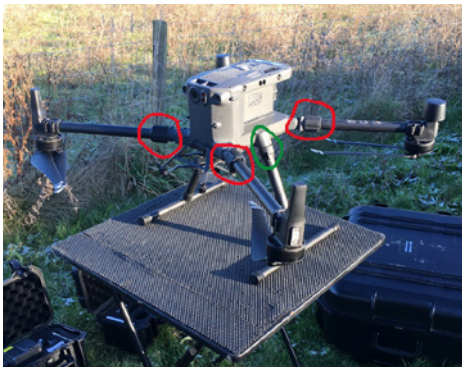
Report No.1 – M 300

Taken from AAIB report number 27564, 3rd August 2021. The DJI Matrice 300 RTK was being operated at night in support of RFFS operations to locate a missing person. After approximately nine minutes and 28 seconds of flight, when at a height of 63 metres, the pilot and observer heard an audible "bang or pop." The UA initiated a three-rotor emergency landing sequence, flying in a rapidly descending arc until it struck the ground. The aircraft was destroyed.

Examination of the UA and review of the log file by the UAS manufacturer identified that the left rear frame-arm folded back during the flight and struck the motor. This resulted in failure of the rotor, triggering the emergency landing mode. The UAS manufacturer considered there was a high likelihood that the locking collar at the junction of the frame arm had not been fully tightened, causing the rotor arm to fold back in flight.

"CHIRP *Comment*"
In the photograph top right, we have highlighted in red three of the four collars that need to be tightened before flight. This is achieved by straightening the arm from its folded position, pushing the collar towards the arm root with the airframe and then twisting the collar so that two red markers align.

If it is not tightened enough, it is possible that vibration would result in the collar becoming loose allowing it to rotate freely and perhaps work its way down towards the motor end of the arm. Although the arm would initially be unlikely to break away from where it is attached to the airframe, the arm would be very likely to swing back towards its folded position. See the diagram that is below Report No 2 for how the rotor arms swing for the purpose of storage.



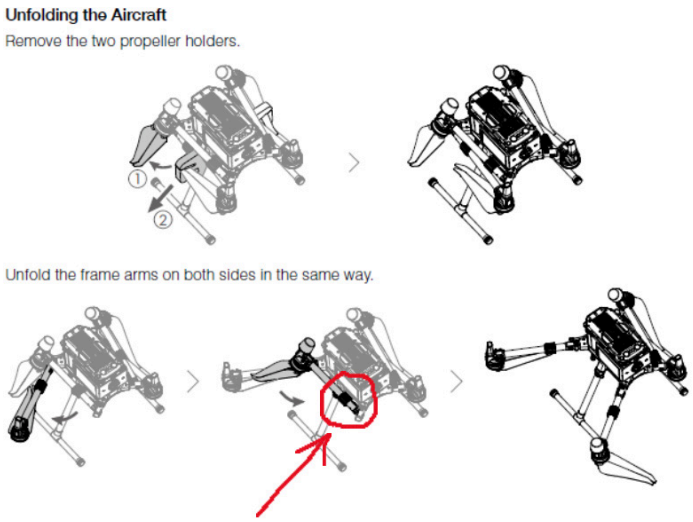
Report No.2 – M 300

We received a report on 30th September from a supplier to a major UK infrastructure owner of an accident that had taken place on the 10th September 2021 at 12:52 during a routine operation near the A358.

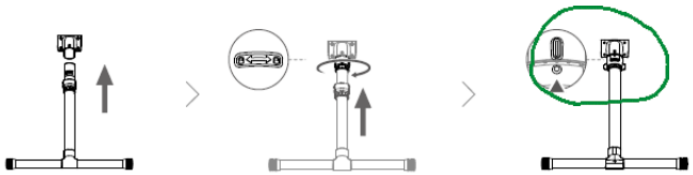
A survey drone encountered a sudden and unexplained mid-air problem. The DJI Matric (sic) M300 RTK drone had completed several flights previously that day using a P1 camera payload. The drone was set up out of the box following the contractor's standard pre-flight procedure and had a short mission with a 9-minute flight. The occurrence happened on the final turn of the flight, roughly 8 minutes and 40 seconds into the mission. The logs recorded a vertical descent of 22.3 m/s or 49.9 mph.

The warnings presented by the drone at the time of this freefall (observed retrospectively through the logs function) indicated a loss/ malfunction to the propeller/motor. No damage to people or property was recorded. The drone fell into an open field from which the pilot had permission to operate in.

"CHIRP *Comment*"
Whilst it is not clear from the report above what the potential cause of the accident was, it sounds similar to Report No 1. The diagrams below originate from the DJI M 300 User Manual and represent how the aircraft is unfolded from its stored position, when "hangered" in its case ready for transport. It is easy to see how a loose collar might allow the whole rotor arm to swing back into the folded position.



Interestingly, in late December 2021 we also received a verbal report of an undercarriage leg of the same aircraft type falling off in mid-flight. The diagram below from the user manual shows how the leg is attached for flight. It again uses a collar that requires tightening, but this one looks like a wing nut. It also employs the use of a red dot and a red dash on the airframe.



Because of the design, the process of tightening a hard plastic collar against a hard plastic screw-thread needs careful attention. Each leg needs to be fully inserted into the airframe body so that the red dashes are aligned, whilst the wing nut collar needs to be positioned as shown in figures A & B to the right.

The wing nut collar can only slide into place when aligned as shown above. Slide the wing nut collar into position so that it fully covers the screw thread and red dashes on the leg and airframe. The wing nut can only be tightened in a clockwise direction, and will only rotate 90º degrees to align with the red dash on the airframe (figures C & D to the right). Note that the wing nut and the airframe have the red alignment markings on both the inside and outside positions.

Either way, from our use of the equipment, it seems that with the material being hard plastic, there is the potential for the material or fitting to become stressed if over-tightened and perhaps lose some mechanical integrity. This clearly means it should be on the list of items to regularly check during standard maintenance and the security of all 4 rotor arms and two undercarriage wing nut collars, should absolutely be checked each time as part of the pre-flight checks.

A

B

C

D

Report No.3 – BMFA Reports

The British Model Flying Association "BMFA" have their own safety reporting system that is well accepted by their community of flyers and is actively used. During the period July to October 2021, there were 24 MORs and, following a review of the reports, it can be seen that at least 6 had clear Human Factors as a contributory element. One repeat occurrence was unintentionally flying Beyond Visual Line of Sight (a total of 14), with the result that the aircraft was lost. Here are three separate reports for example:

A. I think I must have started "flying another member's model" when I was momentarily distracted after about 15 seconds before I realised that what I thought was my model wasn't. By then my model had disappeared from view.

   The unmanned aircraft flew beyond visual line of sight and was not found

B. Whilst flying my trainer aircraft at the same time as another member was flying a very similar model I got confused and followed the wrong aircraft. By the time I realised what had happened I was unable to locate my model in the sky. A search was made of the area, which was fruitless, but the model was returned by the owner of [the local garage] after it landed in his car park. No damage was caused to any vehicles, the only damage was to my model which had a damaged engine mount .

   The unmanned aircraft flew beyond visual line of sight and was recovered

C. Flying a EFX racer. flew through the sun and lost sight of plane. Did not regain site of plane and plane was not found.

   The unmanned aircraft flew beyond visual line of sight and was not found

❝ CHIRP *Comment* ❞

On our first review of the reports submitted to the BMFA by its members, we noted that a few of them mentioned that following an initial event the aircraft ended up flying beyond visual line of sight and then becoming lost. Some were found again some were never recovered.

Our analysis of these occurrences is straightforward. In an environment where multiple aircraft are all flying within the same area, some of which will look very similar, a moment's distraction and mistaking one aircraft for another is an easy trap to fall into. Using new radio equipment with a Failsafe mode to cut power, can make recovery of the aircraft much more likely when unintentional BVLOS flight occurs.

In a few of the instances cited, loss of situational awareness resulted in the wrong aircraft being mistakenly followed and flown. Situational awareness can be improved by operating at a distance relative to the size of the UA, the weather conditions (visibility) and within the visual limitations of the remote pilot's eyesight.

It is also important to maintain a clear background behind the UA to ensure it is easy to see at all times. If the UA were to be flown low in front of a tree line, it is easy to lose sight of it, and if another UA were to then appear above it, it is quite conceivable that the remote pilot assumed that UA was the one they were flying and got confused.

Report No.4 – Indoor roof inspection

We received a report of an indoors inspection flight on April 25th 2021. The operator was undertaking an inspection of the inside of a large warehouse roof that was partly made of sections of clear perspex corrugated panels, allowing natural light to enter the building, and partly with opaque corrugated panels of an unknown material.

Using a DJI Mavic Enterprise 2 with propeller guards and lights fitted, the operator was able to take video and stills of the condition of the underside of the roof. On the third flight of the day, having flown in ATTI mode (GPS and vision protection systems switched off), the decision was taken to switch the vision system back on in order to fly in an area where there were cross beams, lights and cable trays near the base of the roof.

Tripod mode was selected, which configures the onboard systems to slow speed (1 m/s), vision systems on and GPS positioning on. The decision was taken to fly in this mode after some on site analysis of the number of satellites received during earlier flights. The data indicated that although satellites had dipped to 10 for a short period of time, the average was around 12, even though the flights were indoors.

Before commencing the flight, all systems indicated that they were functioning correctly. Once the aircraft was in flight and positioned to video a long transversal beam, it was put into the hover with the vision system preventing it from climbing any higher. After a few seconds in the hover the aircraft suddenly moved sideways by 2 to 3 metres before stabilising again. The pilot reacted by countering the sideways movement with right stick input, but the shift in position had already happened. An immediate switch into ATTI followed, with a return to the home point. Fortunately the aircraft did not come into contact with anything. Subsequent analysis of the log files showed that the aircraft repositioned itself of its own accord at the moment the satellite reception dropped to 5 from 10 before returning to 10.

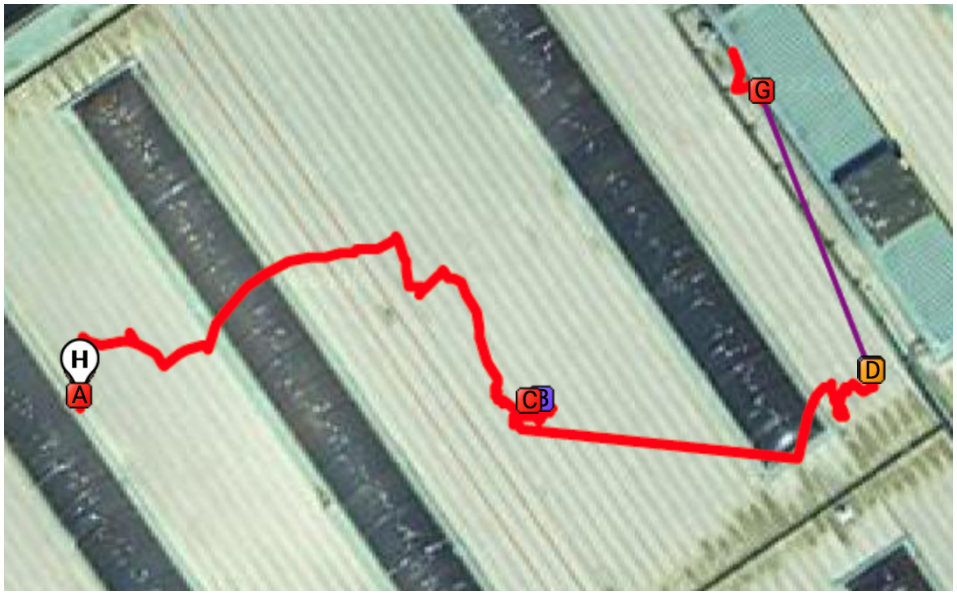
❝ CHIRP *Comment* ❞

The GPS satellite reception map of the flight is attached below. The first straight line was the positioning section of the flight. The second in purple was the sudden displacement of the aircraft.

The HF component of this report is simple. Don't be lulled into a sense of certainty that GPS reception is good enough inside a building. Whilst in the last four or five years the quality of GPS reception has improved enormously, it is still not viable to fly with GPS positioning switched on in an

environment where satellite reception can degrade very quickly and unexpectedly.

Even with vision sensors switched on, the aircraft will change its position very rapidly to correspond to where it thinks it should be, and stick-control inputs will not change its flight path. If ambient lighting is below 100 lux, the vision sensors become very intermittent, which in CHIRP's experience has also resulted in the aircraft changing its position without any control inputs. So do beware of the potential for sudden and unexpected shifts in the position of the aircraft if you are flying in low light or limited GPS.



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SAFE DRONE FLYING

UK Civil Aviation Authority

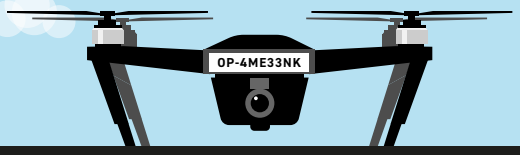
The UK has a set of drone rules to keep everyone safe.

To legally fly most drones, other than toys, you will need to have a Flyer ID and be a registered operator with the CAA.

The rules include how high you can fly and how far away you need to keep from airfields, people and property.

You can check the rules, register as an operator and get a Flyer ID at register-drones.caa.co.uk.

You need to renew your operator registration every year and your Flyer ID every five years.



For more safety information, visit **caa.co.uk/drones**

AIRSPACE SAFETY

When you fly a drone you are sharing the airspace with thousands of others from private pilots to medical emergency helicopters to the military. Some of these may be flying below the maximum height for a drone so please stay alert when flying. Mobile apps and websites are available that show the airspace where you are flying and alert you to the rules for where you are.

STAY UP TO DATE

Once you're flying it's important to stay up to date. Rules do change and short-term airspace restrictions are frequently put in place.

You can get updates by subscribing to the drone and airspace alerts categories in our Skywise system at skywise.caa.co.uk.

INCIDENTS

If you lose your drone, or find a lost drone, then you can report it at dronesreunited.uk.

If you have a serious safety incident with your drone then you should report it to the UK Air Accidents Investigation Branch at aaib.gov.uk.

If you are concerned about a drone being used from either a safety or privacy perspective, then contact your local police on 101.