SOUTH AFRICAN CIVIL AVIATION AUTHORITY

Section/division **Accident and Incident Investigations Division** Form Number: CA 12-58

UAS LIMITED OCCURRENCE INVESTIGATION REPORT – FINAL

Reference Number	CA18/2/3/10292					
Classification	Accident	**Date**	24 April 2023	**Time**	2045Z	
Type of Operation	Remotely Piloted Aircraft Systems – Surveillance (Part 101)					
Location						
Place of Departure	Syferfontein Mine, Mpumalanga Province		Place of Intended Landing		Syferfontein Mine, Mpumalanga Province	
Place of Occurrence	Syferfontein Mine in Mpumalanga Province					
GPS Co-ordinates	Latitude	26º 24’ 36.86” S	Longitude	29º 12’ 13.35” E	Elevation	5253 ft
Aircraft Information						
Registration	ZT-UZY		Class		3A	
Make; Model; S/N	Da-Jiang Innovations (DJI); Mavic 2 Enterprise (Serial Number: MAV0014)					
Damage to Aircraft	Substantial		Total UAS Hours		3743.1	
Pilot-in-command						
Licence Type	Remote Pilot Licence (RPL)		Gender	Male	Age	28
Licence Valid	Yes	Total Hours	332.4	Total Hours on Type		332.4
Total Hours Past 90 Days	153.5		Total Flying Past 90 Days on Type	153.5		
Injuries	0	**Injuries (On Ground)**	0	**Fatalities (On Ground)**	0	
People Controlling	1					

What Happened

On 24 April 2023, an Unmanned Aircraft System (UAS) with registration ZT-UZY was engaged in a surveillance flight at Syferfontein Mine in Secunda, Mpumalanga province. The flight was conducted under visual line of sight (VLOS) rules by night and under the provisions of Part 101 of the Civil Aviation Regulations (CAR) 2011 as amended.

The pilot stated that he launched the UAS and, shortly after, an error message of the left gimbal reflected on the remote pilot station before it failed. As the UAS was in the pilot’s line of sight, he noticed that the gimbal had tilted to the left which also skewed the camera view on the remote pilot station. The UAS impacted a perimeter fence at a height of 2 metres (m). The GPS tracking device separated from the UAS upon impact and the pilot could not track it as it was night time. At approximately 0830Z the following day, the UAS was located next to the perimeter fence, it had sustained scratches on some of the propeller blades.

The UAS was substantially damaged. There was no injury to persons or damage to property that was reported.

Figure 1: A picture of the UAS after recovery from the accident site. (Source: Operator)

- The weather information below was obtained from the Meteorological Aerodrome Report (METAR) that was issued by the South African Weather Service (SAWS) on 24 April 2023 at 2040Z, recorded in Secunda, Mpumalanga province, which is 7 nautical miles (nm) south of the accident site.
  Temperature: 10.4°C; Relative Humidity: 64%; Wind: 110° at 2 kts; Pressure (QNH): 1022hPa; Clouds: CAVOK

Wind Direction	110°	Wind Speed	2kts	Visibility	9999m
Temperature	10.4°C	Cloud Cover	CAVOK	Cloud Base	CAVOK
Dew Point	Unknown	QNH	1022hPa		

- Point of Interest (POI) Flight Mode (Source: Manufacturer)
  Point of Interest is a new intelligent flight mode that will allow one to quickly orbit a point of interest and collect comprehensive data with a 360-degree view of the target. This has been one of the most requested features by first responders and public safety agencies who want to easily add an orbit to their accident reconstruction data capture or orbit a scene. Vertical structures or areas can also be captured utilising this tool.
  Fly directly over the target and drop a Pin at the drone's location. Now, fly back a bit, so you can look at the Pin, and activate POI mode. You will see the option to adjust the altitude/gimbal pitch/speed. You can also lock your current flight speed by pressing the C1 on the back of the

remote controller. The drone will now automatically maintain a consistent radius as it orbits the target. If you want to collect data, turn on the timed photo capture.

- Gimbal (Source: Mavic 2 Enterprise Series User Manual)

  The Mavic 2 Enterprise series 3-axis (tilt, roll, pan) gimbal provides stabilisation for the camera, allowing you to capture clear and stable images and video. The gimbal has a tilt range of -90° to +30° and a pan range of -75° to + 75°. Press the remote control screen until a blue circle appears and drag the circle up and down to control camera tilt. Dragging the circle left and right controls the aircraft's orientation.

  Warnings:

  1. When the aircraft is powered on, do not tap or knock the gimbal. To protect the gimbal during take-off, always take-off from open and flat ground.
  2. Precision elements in the gimbal may be damaged in a collision or impact, which may cause the gimbal to function abnormally.
  3. Avoid getting dust or sand on the gimbal, especially in the gimbal motors.
  4. A gimbal motor error may occur in the following situations:
  a) The aircraft is on uneven ground or the gimbal's motion is obstructed.
  b) The gimbal experiences excessive external force, such as during a collision.
  5. DO NOT apply external force to the gimbal after the gimbal is powered on. DO NOT add any extra payload to the gimbal as this may cause the gimbal to function abnormally or even lead to permanent motor damage.
  6. Make sure to remove the gimbal cover before powering on the aircraft. Also, make sure to mount the gimbal cover when the aircraft is not in use.
  7. Flying in heavy fog or clouds may make the gimbal wet, leading to temporary failure. The gimbal recovers full functionality once it dries.

Figure 2: Mavic 2 Enterprise gimbal. (Source: Manufacturer)

Findings

1. The pilot was issued a Remote Pilot Licence (RPL) with a visual line of sight (VLOS) rating on 14 October 2022 with an expiry date of 31 October 2024. His Class 3 medical certificate was issued on 20 February 2023 with an expiry date of 28 February 2027 with no medical restrictions.

2. The operator had a Remotely Operated Aircraft Systems Operating Certificate (ROC) that was issued on 31 October 2022 with an expiry date of 31 October 2023. The operator's approved operation specifications includes aerial patrol and survey (G3) and was approved for night operations.

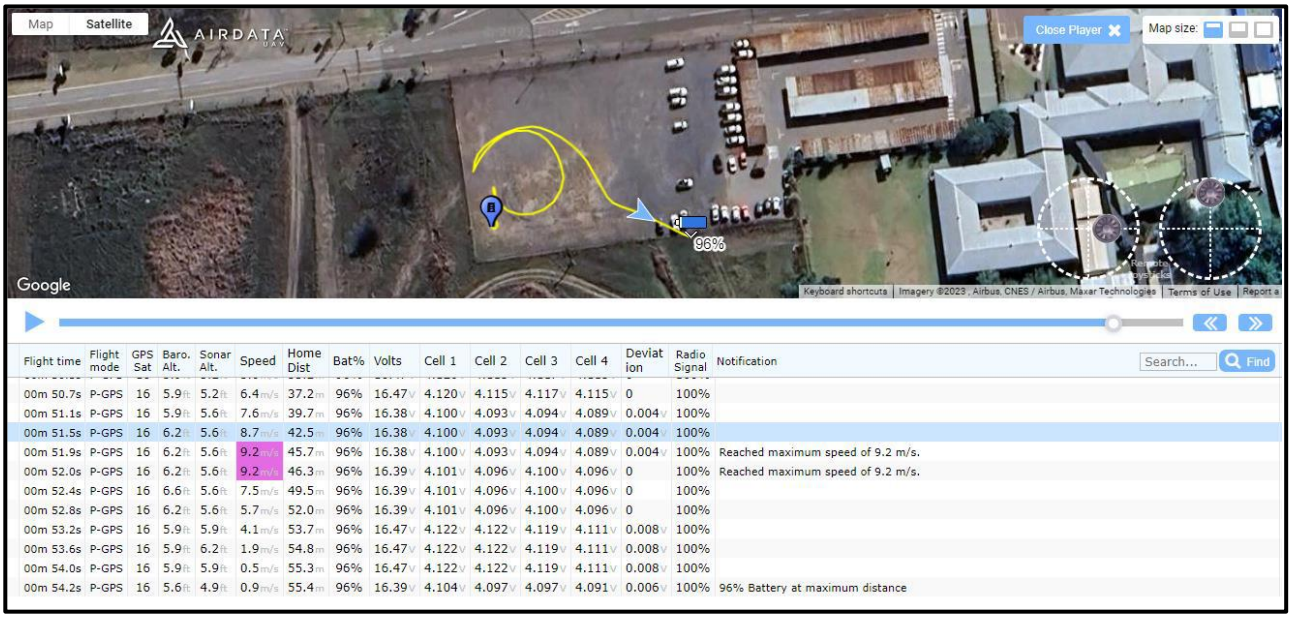
3. The UAS was issued a Remotely Piloted Aircraft Systems Letter of Approval (RLA) on 24 October 2022 with an expiry date of 31 October 2023.

4. The mandatory periodic inspection (MPI) on the UAS was conducted prior to the accident flight on 18 April 2023 and was certified at 3722.5 airframe hours. The UAS was operated a further 20.6 airframe hours since the last MPI.

5. The Remote Maintenance Technician (RMT) who performed the last MPI was issued a RMT Licence on 12 April 2023 with an expiry date on 30 April 2025.

6. The pilot launched the UAS from an open gravel parking lot at the mine. The elevation profile is relatively flat with a maximum elevation gain/loss of 0.03 ft. The launch area could not have caused the gimbal error.

7. Post-accident Log Analysis Report (Source: Manufacturer)
   20:45 UTC: The pilot armed the aircraft and ascended to 6 ft AGL.
   20:45 UTC: The pilot tried to engage a point of interest and lost orientation of the aircraft.
   20:45 UTC: The pilot gave full pitch inputs and flew into a fence 20 metres from the home location.



Flight time	Flight mode	GPS Sat	Baro. Alt.	Sonar Alt.	Speed	Home Dist	Bat%	Volts	Cell 1	Cell 2	Cell 3	Cell 4	Deviation	Radio Signal	Notification
00m 50.7s	P-GPS	16	5.9ft	5.2ft	6.4m/s	37.2m	96%	16.47V	4.120V	4.115V	4.117V	4.115V	0	100%	
00m 51.1s	P-GPS	16	5.9ft	5.6ft	7.6m/s	39.7m	96%	16.38V	4.100V	4.093V	4.094V	4.089V	0.004V	100%	
00m 51.5s	P-GPS	16	6.2ft	5.6ft	8.7m/s	42.5m	96%	16.38V	4.100V	4.093V	4.094V	4.089V	0.004V	100%	
00m 51.9s	P-GPS	16	6.2ft	5.6ft	9.2m/s	45.7m	96%	16.38V	4.100V	4.093V	4.094V	4.089V	0.004V	100%	Reached maximum speed of 9.2 m/s.
00m 52.0s	P-GPS	16	6.2ft	5.6ft	9.2m/s	46.3m	96%	16.39V	4.101V	4.096V	4.100V	4.096V	0	100%	Reached maximum speed of 9.2 m/s.
00m 52.4s	P-GPS	16	6.6ft	5.6ft	7.5m/s	49.5m	96%	16.39V	4.101V	4.096V	4.100V	4.096V	0	100%	
00m 52.8s	P-GPS	16	6.2ft	5.6ft	5.7m/s	52.0m	96%	16.39V	4.101V	4.096V	4.100V	4.096V	0	100%	
00m 53.2s	P-GPS	16	5.9ft	5.9ft	4.1m/s	53.7m	96%	16.47V	4.122V	4.122V	4.119V	4.111V	0.008V	100%	
00m 53.6s	P-GPS	16	5.9ft	6.2ft	1.9m/s	54.8m	96%	16.47V	4.122V	4.122V	4.119V	4.111V	0.008V	100%	
00m 54.0s	P-GPS	16	5.9ft	5.9ft	0.5m/s	55.3m	96%	16.47V	4.122V	4.122V	4.119V	4.111V	0.008V	100%	
00m 54.2s	P-GPS	16	5.6ft	4.9ft	0.9m/s	55.4m	96%	16.39V	4.104V	4.097V	4.097V	4.091V	0.006V	100%	96% Battery at maximum distance

Figure 3: Flight path of the UAS. (Source: Manufacturer)

Probable Cause

The pilot lost control of the UAS whilst attempting to engage a point of interest manoeuvre.

Contributing Factor
Disorientation.
Safety Action(s)
None.
Safety Message and/or Safety Recommendation/s
None.
About this Report
The decision to conduct a limited investigation is based on factors including whether the cause is known and the evidence supporting the cause is clear, the level of safety benefit likely to be obtained from an investigation and that will determine the scope of an investigation. For this occurrence, a limited investigation has been conducted, and the Accident and Incident Investigations Division (AIID) has relied on the information submitted by the affected person/s and organisation/s to compile this limited report. The report has been compiled using information supplied in the initial notification, as well as from follow-up desk top enquiries to bring awareness of potential safety issues to the industry in respect of this occurrence, as well as possible safety action/s that the industry might want to consider in preventing a recurrence of a similar occurrence. *All times given in this report are Co-ordinated Universal Time (UTC) and will be denoted by (Z). South African Standard Time is UTC plus 2 hours.*
Purpose
In terms of Regulation 12.03.1 of the Civil Aviation Regulations (CAR) 2011 and ICAO Annex 13, this report was compiled in the interest of the promotion of aviation safety and the reduction of the risk of aviation accidents or incidents and not to apportion blame or liability.
Disclaimer
This report is produced without prejudice to the rights of the AIID, which are reserved.

This report is issued by:
Accident and Incident Investigations Division
South African Civil Aviation Authority
Republic of South Africa