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FPInnovations
Wildfire Operations Research
1176 Switzer Drive
Hinton, AB T7V 1V3

Exploring the capabilities of helicopter bucket and helitank tracking systems

Ray Ault
Jim Thomasson
Colleen Mooney

Introduction

Helicopter bucket and helitank tracking systems have the potential to change how fire suppression agencies measure and manage their helicopter fleets. The data provided by these systems could help agencies identify inefficiencies and reduce operating costs. We explored the current capabilities of two tracking systems and compared their data outputs to our measured data. To collect the information, we conducted drop tests over a grid at speeds and heights typically used by helicopters operationally. The timing of these tests coincided with the British Columbia's Helicopter Coordinator (HLCO) spring training and we were fortunate to have four high-level HLCOs participate in our tests.

Methods

Aircraft and Tracking Systems

We used two systems in our test:

- Latitude Technologies Corporation — product: IONode100-004
- Absolute Tracking Solutions Inc. — product: FASTTrac

A Bell 205++ from Blackcomb Aviation was equipped with the IONode100-004 from Latitude and a Bell 212 from Wildcat Helicopters was equipped with the FASTTrac product from Absolute. The helicopters dropped water over a grid at the Salmon Arm airport in British Columbia. All bucket drops were with an SEI Bambi-Max™ bucket and the helitank drops were with Wildcat's Bell 212.

Grid Set-Up

We constructed a 150 x 50 foot grid on flat ground at the Salmon Arm airport (Figure 1) and surveyed the grid corner locations with a survey-grade differential GPS unit (Thomasson 2012). We placed two video cameras at the grid edges: a hand-held camera at the end and a tripod-mounted camera to the side.

Data Collection

Tracking Systems

Both tracking systems use a load cell attached to the belly hook to collect data for the following variables:

- bucket or tank volume
- drop start (release) location
- drop end location (Latitude system only)

To determine volume, the software reads the load cell when the bucket it is empty. When the bucket is full and the pilot pushes the release button the software reads the load cell again, before release and after. The software uses these values to calculate **DROP VOLUME**. The software is calibrated for the specific product used; in this case, water.

To acquire the location data, both tracking systems use a commercially available GPS. The software records the latitude and longitude of the helicopter when the pilot pushes the release button. Because the Latitude system records the drop end location as well as the drop start location, we were able to calculate drop length from their data set.

Ground Measurements

We collected data for the same variables as the tracking systems. We measured bucket and tank volume by attaching a flow meter to the filling hose. Our grid team marked the drop start and end locations on the ground which we then recorded with the differential GPS. We used these values to calculate drop length.

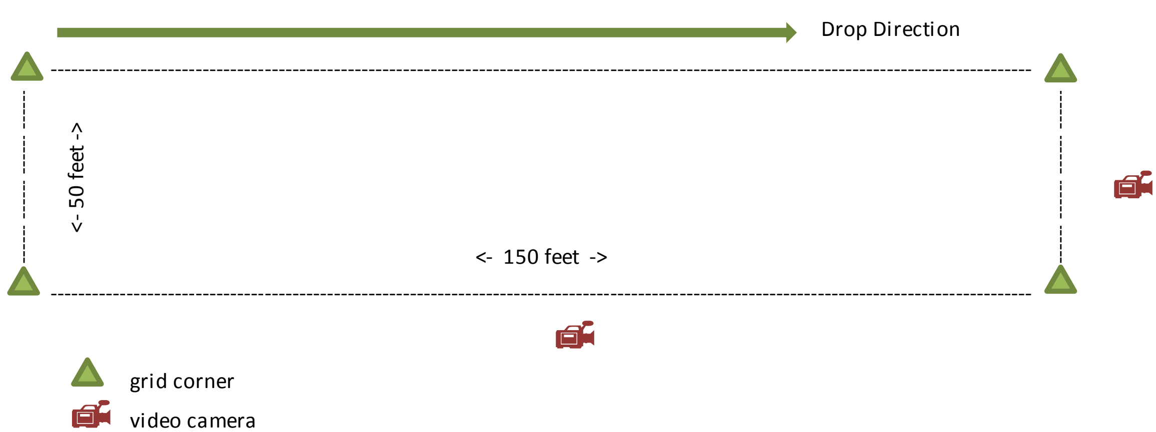


Figure 1. Grid layout for helicopter drop tests at Salmon Arm, BC.

Results

We conducted eighteen drops on June 12–13, 2012: 10 drops with the bucket (5 with Blackcomb and 5 with Wildcat) and 8 drops with the helitanker. We conducted a practice drop on Jun 11 to train the grid crew, the filling team and tracking system representatives on the test process; no data was collected.

During our analysis of the tracking system data, we found that the Absolute system did not provide data for the helitank drops (Drop 11-18). Subsequent discussions with the software developers revealed that the software uses the helitank's pump as a trigger—when the tank pump turns on, the software expects a tank load and begins recording data. When the tank pump does not turn on, the software disregards incoming data, deeming it the result of a door check. Because the helitank was loaded externally (with a hose), the tank pump did not engage and the software ignored all incoming data.

The Latitude system did not record any data for Drop 3 because the load cell was accidentally powered off.

Volume Accuracy (Bucket Only)

Table 1 summarizes the variances between the bucket volume we measured using a flow meter and the bucket drop volume recorded by the tracking systems.[1]

Table 1. Measured bucket volume and system recorded bucket drop volume variances.

Drop No.	Volume Measured by Flow Meter (USG)	Drop Volume Recorded by Tracking System (USG)	Variance (USG)	Variance (%)
Latitude System				
1	257	311	54	21%
2	257	245	-12	-5%
3	257	-	-	-
4	257	216	-41	-16%
5	257	237	-20	-8%
Absolute System				
6	201	170	-31	-16%
7	201	175	-26	-13%
8	251	190	-61	-24%
9	252	168	-84	-33%
10	251	240	-11	-4%

The tracking systems typically under-reported the bucket drop volume. The average was -26 USG; approximately -11%.

Drop Location (Bucket Only)

The differences between the measured drop start and end locations and those recorded by the tracking system are summarized in Table 2 along with calculated drop lengths. Because the Absolute system does not record a drop end location, we did not calculate drop lengths for Drops 6-10.

Drop 8 was placed well off the grid so we did not collect ground data.

[1] Software engineers with Absolute Tracking Solutions dispute the measured volume for Drop 8 (251 USG). According to their data, they feel strongly the actual volume was, in fact, closer to 200 USG.

The drop locations recorded by the tracking system software were offset from the actual locations between 5 - 56m; or an average of 21m. Except for Drop 5, the calculated drop lengths from the tracking system data were within 10m of the measured length.

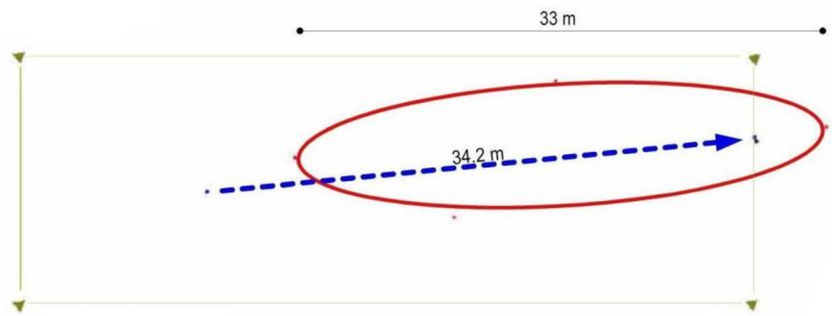
Table 2. Measured drop location and system recorded drop location variances and calculated drop lengths.

Drop No.	Drop Start Variance (m)	Drop End Variance (m)	Measured Drop Length (m)	System Drop Length (m)	Drop Length Variance (m)
Latitude System					
1	5.9	4.5	33.1	34.2	1.2
2	11.5	9.7	27.3	27.8	0.5
3[a]	-	-	-	-	-
4	20.4	11.8	64.4	73.5	9.1
5	22.8	44.7	85.4	63.5	-21.9
Absolute System					
6	29.2	-	61.4	-	-
7	16.5	-	61.6	-	-
8[b]	-	-	-	-	-
9	56.3	-	90.5	-	-
10	13.7	-	71.1	-	-

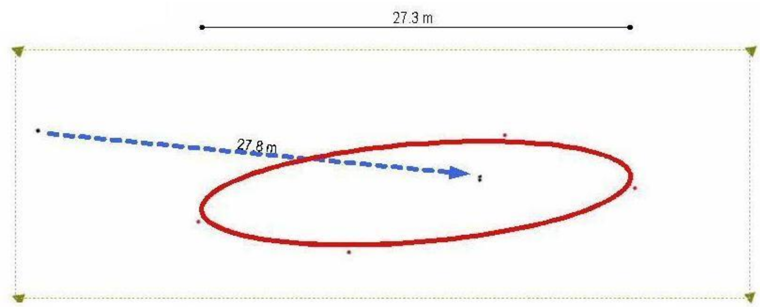
[a] *Drop not recorded by tracking system.*
[b] *Drop not recorded by researchers.*

Figure 2 shows graphical representations of the measured drop start and end locations and those recorded by the Latitude system for Drops 1-5 (excluding Drop 3). Figure 3 shows the graphical representations of the measured drop start location and that recorded by the Absolute system for Drops 6-10 (excluding Drop 8).

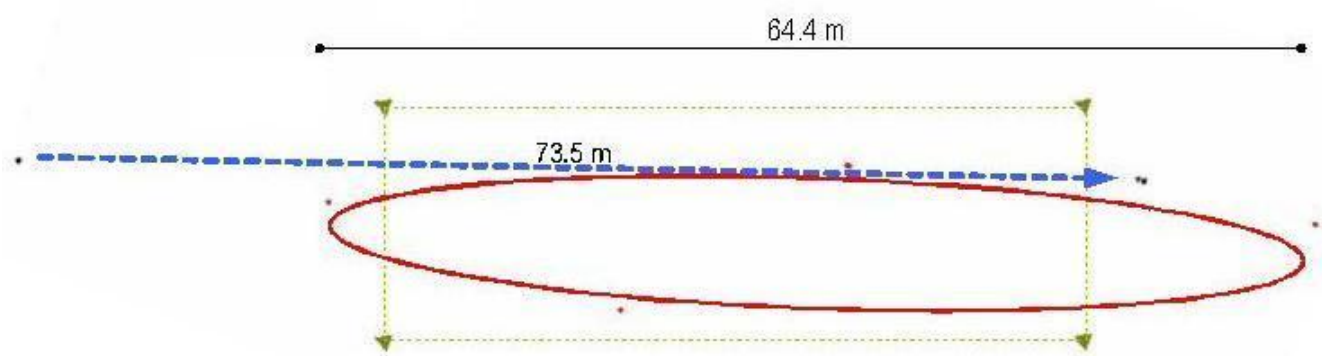
DROP 1



DROP 2



DROP 4



DROP 5

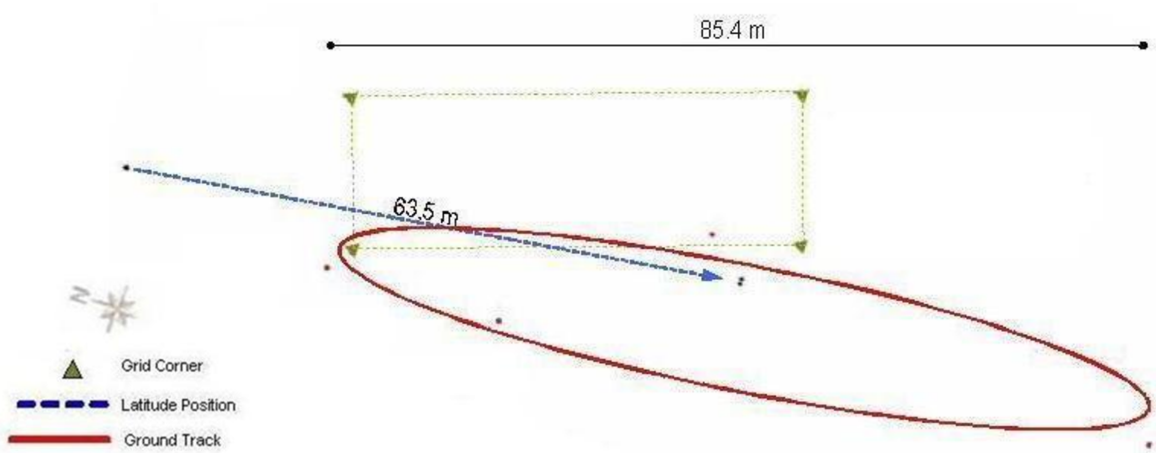
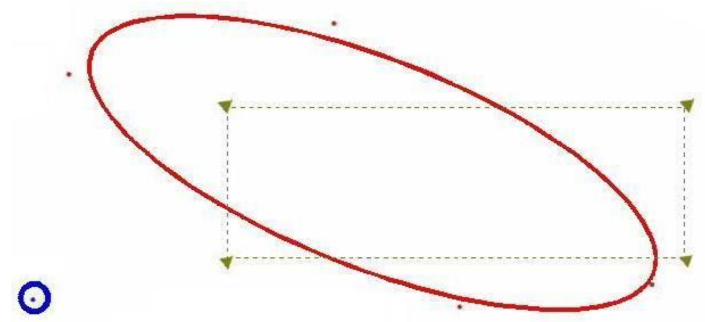
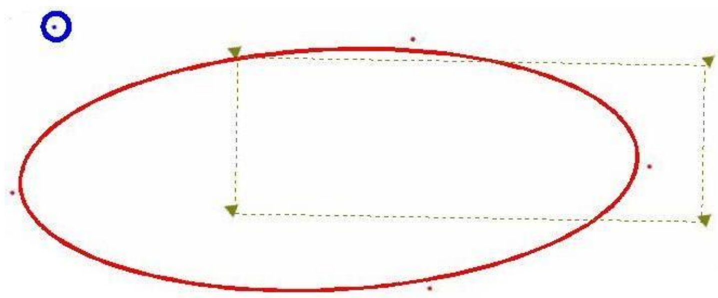


Figure 2. Measured drop locations (red) and Latitude system recorded locations (blue).

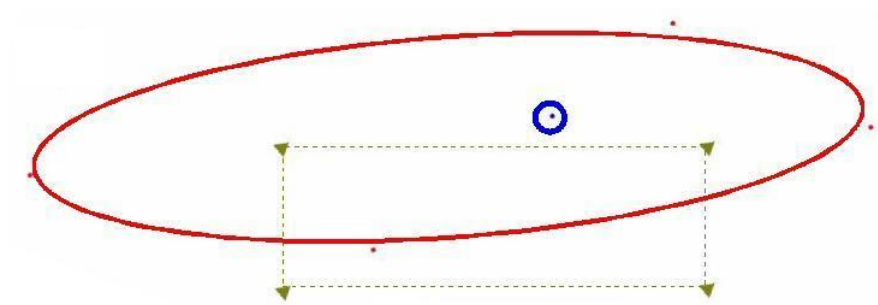
DROP 6



DROP 7



DROP 9



DROP 10

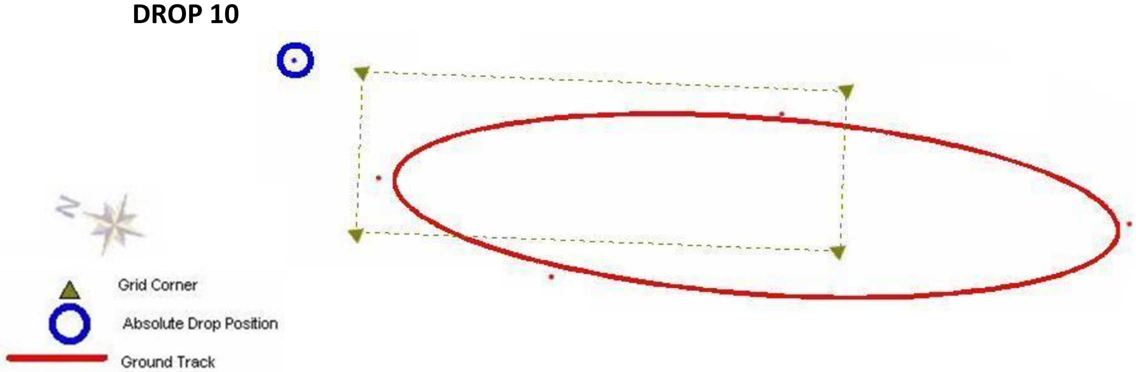


Figure 3. Measured drop locations (red) and Absolute system recorded location (blue).

Discussion

Our primary objective of these drop tests was to determine the capabilities and accuracy of helicopter bucket and helitank tracking systems. Not only were we able to compare the tracking system data to our measured data, but system developers were able to see their product in action and to better understand the needs of the end-user.

Currently, the outputs provided by the tracking systems include:

- DROP VOLUME
- DROP START LOCATION
- DROP END LOCATION (Latitude system only)

From these outputs, two useful metrics can be calculated by the end-user:

- drop length (Latitude system only)
- total volume delivered over time

Apart from a few technical issues that can be addressed by the developers, the data recorded by the tracking systems did not differ substantially from the data we collected. The tracking systems reported bucket and tank volume data that was, on average, 11% less than the measured volume; and reported drop location data that was, on average, within 21m of measured ground locations.

This project was just the first step in testing helicopter tracking systems: what can they do and how well do they do it. The second step now is to involve the agencies to determine how these outputs can be used for the management of helicopters on wildfires and to test their ideas. For example, the HLCOs who participated in our tests felt that tracking system data might be better suited for overall agency fleet management and for post-fire analysis of helicopter efficiency rather than for real-time operational decisions of individual helicopters. Agency users also need to determine whether the level of accuracy is sufficient; and whether more, or different, outputs are needed.

Video

All video footage is available upon request from Rex Hsieh (rex.hsieh@fpinnovations.ca).

Participating Members and Collaborators

- British Columbia Ministry of Forests, Lands, Mines and Natural Resources
- Absolute Tracking Solutions Inc.
- Latitude Technologies Corporation
- Wildcat Helicopters
- Blackcomb Helicopters

References

Thomasson, Jim. 2012. Use of precision GPS for airtanker drop testing. FPInnovations Wildfire Operations Research. Project Note January 2012.