

# Applications of sUAV's (Drones) for Marine Surveying

John (Jack) N. Allinson, II AMS  
Level III Certified Infrared Thermographer

Charles Hazouri, CMS  
Level III Certified Infrared Thermographer

Allinson Infrared Inspection Services, Inc.  
222 University Blvd. North #2  
Jacksonville, FL 32211

AND

Offshore Marine Inspections  
500 Mandeville Street, Unit 10  
New Orleans, LA 70117

Ph: 904-721-2177

Ph: 504-450-8044

www.allinson.com  
email: jna2@allinson.com

www.offshorenola.com  
email: charles@offshorenola.com

## Abstract

Jack is an Accredited Marine Surveyor (SAMS-AMS) and Charlie is a Certified Marine Surveyor (NAMS-CMS). Both of them recognize the value of images both infrared and visual to document the conditions of the vessels and their systems. While they both routinely use visual and infrared thermal imaging from a ground based vantage point, they recognize the importance of gaining an aerial prospective. To this end they use videography from sUAV's. Join Jack and Charlie as they review the equipment they use and show the results of various applications.

## Introduction

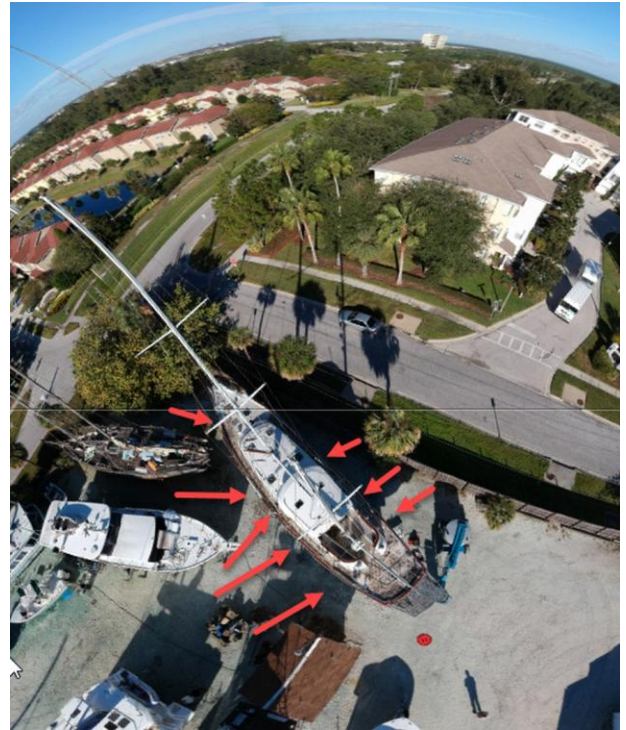
More often than not our clients retain us to “observe and report” on the “condition” of marine vessels. This condition may in turn be used to provide an “opinion” of the vessel’s “estimated market value” or in the case of a “Damage Claim” the cause, nature and extent of damage. The “observation process” requires exact and accurate documentation which we believe is best recorded through photographs and video.

## Study



**Figure 1. Damage claim**

During a named storm event this sailboat rolled off its supporting stands onto its PORT (left) side. The hull sides were composed of a composite laminate sandwich consisting of an outer skin of fiberglass laminate, a low-density foam core and an inner skin of fiberglass laminate. J.N. Allinson Associates, Inc. was retained to do an Infrared Thermal imaging study to determine whether there was evidence of possible “core shear” between the outer skin and low-density foam core.



**Figure 2. Aerial view**

Taken with DJI SPARK drone using its panoramic feature that automatically orients the drone and camera to take forty-six (46) photos which are stitched together to create a 360-degree panoramic view. This stitched image was created from photos that were taken while the drone was approximately two hundred (200) feet above the ground. Red arrows have been added to the image to illustrate where the infrared thermal imager was positioned when taking images.

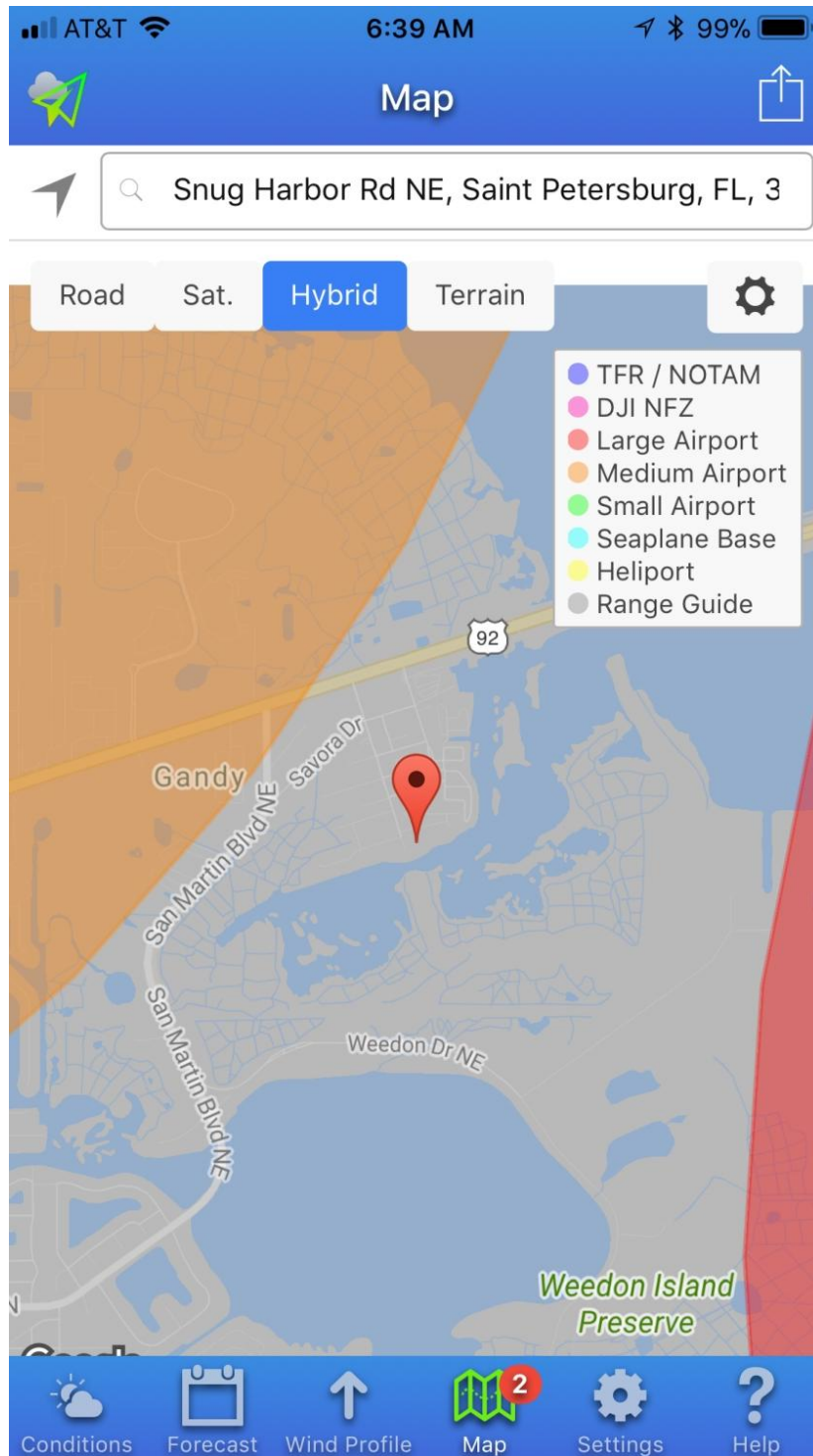
## Flight Preparation

Jack uses UAV Forecast™ when planning flights. They have a website at <https://www.uavforecast.com> and they offer both IOS and ANDROID apps that can be used in the field. The free version shows metrics for a 24-hour period while the paid version will forecast up to seven (7) days. Since Jack uses Apple products (IPAD mini and IPHONE 6S+) during flights he uses the IOS app when in the field.



**Figure 3.** Study location

## Checking for Restricted Areas



**Figure 4.** Here is screen capture of the UAV Forecast™ IOS app which verifies that Jack will not need special approval from regulatory agencies to fly at Viking Boat Works Company Inc. Note as a courtesy you should always meet with the facility manager and request permission to fly.



**Figure 5.** Aeronautical chart from SkyVector shows details of restricted areas that surround the study location. The red arrow in this image marks study location which falls outside of restricted areas.

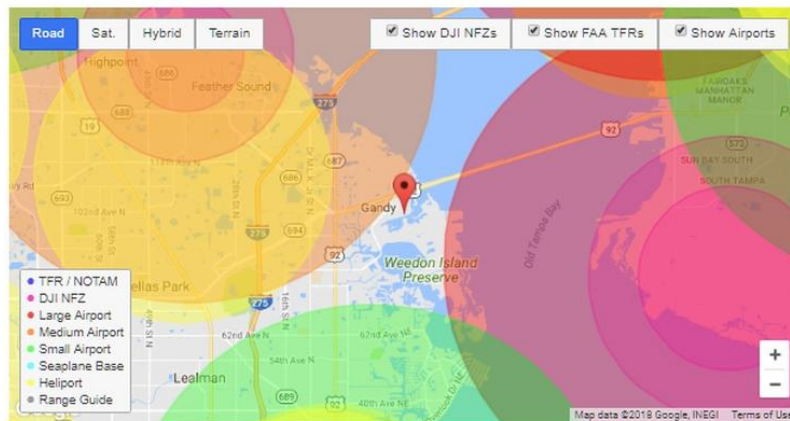
<https://skyvector.com/?ll=27.8637131,-82.61577669999997&chart=301&zoom=1>

10121 Snug Harbor Rd NE, St. Petersburg, FL 33702, USA  Search

Max Wind (mph):  Wind Altitude (feet):   Include Gusts  
 Min Temperature (°F):   Max Temperature (°F):   Adjust For Wind Chill  
 Max Precip Prob (%):   Max Cloud Cover (%):   Min Visibility (miles):   
 Min GPS Sats Visible:  GPS Elevation Mask (\*):   Include GLONASS Sats  
 Min Est. GPS Sats Locked:   Max Kp:   
 Show Daylight Hours Only  Show Cloud Base (subscribers only)  Show Max Wind Altitude (subscribers only)

Wind  Altitude  Temperature  Visibility

Location: 10121 Snug Harbor Rd NE, St. Petersburg, FL 33702, USA [map](#)



See also: [Airspace Sectionals \(SkyVector.com\)](#)

Current Conditions as of Wednesday 2018-01-03 17:43 EST									
Time	Gusts at 328ft	Temp	Precip	Cloud Cover	Visibility	Visible Sats	Kp	Est. Sats Locked	Good To Fly?
17:43 ✱	28 mph ↓	49°F	0%	9%	10 miles	13	0	13.6	no
Wednesday 2018-01-03: sunrise 07:21, sunset 17:48									
Time	Gusts at 328ft	Temp	Precip	Cloud Cover	Visibility	Visible Sats	Kp	Est. Sats Locked	Good To Fly?
18:00 ☉	30 mph ↓	48°F	0%	10%	10 miles	16	0	16.1	no
19:00 ☉	38 mph ↓	47°F	0%	24%	10 miles	13	0	13.1	no
20:00 ☉	44 mph ↓	47°F	1%	46%	10 miles	16	0	14.8	no
21:00 ☉	44 mph ↓	46°F	2%	61%	10 miles	14	0	12.9	no
22:00 ☉	40 mph ↓	45°F	3%	62%	10 miles	12	0	11.4	no
23:00 ☉	38 mph ↓	44°F	2%	50%	10 miles	13	1	12.3	no
Thursday 2018-01-04: sunrise 07:22, sunset 17:49									
Time	Gusts at 328ft	Temp	Precip	Cloud Cover	Visibility	Visible Sats	Kp	Est. Sats Locked	Good To Fly?
00:00 ☾	35 mph ↓	43°F	1%	31%	10 miles	13	1	12.7	no
01:00 ☾	33 mph ↓	42°F	0%	17%	10 miles	13	1	11.9	no
02:00 ☾	31 mph ↓	41°F	0%	10%	10 miles	14	1	12.2	no
03:00 ☾	30 mph ↓	41°F	0%	7%	10 miles	13	1	11.6	no
04:00 ☾	30 mph ↓	41°F	2%	8%	10 miles	14	1	12.4	no
05:00 ☾	29 mph ↓	41°F	1%	17%	10 miles	13	1	12.0	no
06:00 ☾	30 mph ↓	41°F	2%	31%	10 miles	14	1	14.0	no
07:00 ☾	30 mph ↓	41°F	2%	43%	10 miles	14	1	14.6	no
08:00 ☾	29 mph ↓	42°F	2%	53%	10 miles	14	1	14.6	no
09:00 ☾	29 mph ↓	43°F	2%	62%	10 miles	13	1	13.6	no
10:00 ☾	29 mph ↓	45°F	2%	66%	10 miles	15	1	15.1	no
11:00 ☾	31 mph ↓	47°F	1%	60%	10 miles	13	1	13.4	no
12:00 ☾	33 mph ↓	50°F	0%	48%	10 miles	14	1	14.1	no
13:00 ☾	35 mph ↓	52°F	0%	36%	10 miles	16	2	15.8	no
14:00 ☾	36 mph ↓	52°F	0%	25%	10 miles	12	2	12.6	no
15:00 ☾	36 mph ↓	52°F	1%	14%	10 miles	14	2	14.4	no
16:00 ☾	35 mph ↓	52°F	1%	6%	10 miles	12	2	12.6	no
17:00 ✱	34 mph ↓	51°F	1%	6%	10 miles	14	2	14.3	no

Figure 6. The UAV Forecast™ graphic representation of restricted areas is a bit easier to visualize than the SkyVector aviation chart.

10121 Snug Harbor Rd NE, St. Petersburg, FL 33702, USA  Search

Max Wind (mph):  Wind Altitude (feet):   Include Gusts  
 Min Temperature (°F):   Max Temperature (°F):   Adjust For Wind Chill  
 Max Precip Prob (%):   Max Cloud Cover (%):   Min Visibility (miles):   
 Min GPS Sats Visible:  GPS Elevation Mask (°):   Include GLONASS Sats  
 Min Est. GPS Sats Locked:   Max Kp:   
 Show Daylight Hours Only  Show Cloud Base (subscribers only)  Show Max Wind Altitude (subscribers only)

Wind  Altitude  Temperature  Visibility

Location: 10121 Snug Harbor Rd NE, St. Petersburg, FL 33702, USA [map](#)



See also: [Airspace Sectionals \(SkyVector.com\)](#)

Current Conditions as of Wednesday 2018-01-03 17:43 EST									
Time	Gusts at 200ft	Wind Chill	Precip	Cloud Cover	Visibility	Visible Sats	Kp	Est. Sats Locked	Good To Fly?
17:43	25 mph	45°F	0%	9%	10 miles	13	0	13.6	no
Thursday 2018-01-04: sunrise 07:22, sunset 17:49									
Time	Gusts at 200ft	Wind Chill	Precip	Cloud Cover	Visibility	Visible Sats	Kp	Est. Sats Locked	Good To Fly?
08:00	26 mph	36°F	2%	53%	10 miles	14	1	14.6	no
09:00	26 mph	38°F	2%	62%	10 miles	13	1	13.6	no
10:00	26 mph	40°F	2%	66%	10 miles	15	1	15.1	no
11:00	28 mph	42°F	1%	60%	10 miles	13	1	13.4	no
12:00	30 mph	45°F	0%	48%	10 miles	14	1	14.1	no
13:00	31 mph	52°F	0%	36%	10 miles	16	2	15.8	no
14:00	32 mph	52°F	0%	25%	10 miles	12	2	12.6	no
15:00	32 mph	52°F	1%	14%	10 miles	14	2	14.4	no
16:00	31 mph	52°F	1%	6%	10 miles	12	2	12.6	no
17:00	31 mph	51°F	1%	6%	10 miles	14	2	14.3	no

Thanks for using UAV Forecast™! The free edition shows 24 hours. Upgrade now to see 7 days of hourly forecast.

**Figure 7.** This is an example of setting the criteria for a flight and using UAV Forecast™ application to verify that environmental conditions are acceptable. In this scenario maximum wind speeds were set to 20 mph at a height of 200 feet during daylight hours. The UAV Forecast™ model shows it would not be “Good to Fly” on Thursday January 4, 2018 from sunrise to sunset.

## Convenience Factor

Depending upon what needs to be done during the flight and the anticipated environmental conditions we pick the best suited drone from the following DJI models:

**DJI Phantom 3 Advanced**



**DJI MAVIC PRO**



**DJI SPARK**





For this study the DJI SPARK was the drone of choice. Of the three drones, this one had the smallest footprint 143 x 143 x 55 mm and is less disruptive to yard workers. It has a 1/2.3" CMOS sensor that captures a 12 MP effective pixel image in a 3968 x 2976 image size. Video records a Full High Definition (FHD) at 1920 x 1080 image size at 30 frames per second which will capture the surrounding "normal paced movements" quite well and in a natural way.



**Figure 8.** Drone size 143 x 143 x 55 mm (6" x 6" x 2") or slightly larger than Jack's hand (top photo). This SPARK was colored bright sunrise yellow for visibility and equipped with black propeller guards as a safety precaution.



**Figure 9.** DJI SPARK flight video

<https://youtu.be/pZpBQcDk2KQ>



**Figure 10.** Example of a result of the Infrared Thermal imaging study. Here a thermal anomaly was discovered and “core shear” is being proven by percussion sounding with a phenolic hammer. The next step will be destructive testing to examine the bond between the outer skin and the low-density foam core. This area of the hull came in contact with the ground when the vessel rolled onto its PORT side (see Figure 1.)

## Omnidirectional Cameras

A camera normally has a field of view (FOV) that ranges from a few degrees to, at most, 180°. This means that the camera captures, at most, light falling onto the camera focal point through a hemisphere. In contrast, an ideal omnidirectional camera captures light from all directions falling onto the focal point, covering a full sphere. Jack uses cameras that have two (2) one hundred eighty 180° FOV images. These images are stitched together to create a Three Hundred Sixty 360° FOV image.



**Xiaomi Mijia Mi Sphere 360**

<http://360rumors.com/2017/11/review-comparison-xiaomi-mijia-mi-sphere-highest-photo-video-quality-among-consumer-360-cameras.html>



**Insta360 One**

<http://360rumors.com/2018/01/insta360-one-in-depth-hands-on-review-best-360-camera-consumers.html>



**Figure 11.** An unstitched view of the confined space for the engine compartment shows two (2) one hundred eighty 180° FOV images before stitching.



**Figure 12.** Engine compartment after stitching ready to be loaded into a 360° viewer.



**Figure 13.** One of the possible views of the engine compartment from a 360° viewer. See <https://www.facebook.com/photo.php?fbid=1886875961340856&set=a.477315122296954.116071.100000554101945&type=3&theater>

## Summary

Images from sUAS positioned above ground level photography and videography offer a valuable perspective for observing and reporting information about marine vessels. Omnidirectional cameras are excellent when working in confined spaces and in other environments where large visual field coverage is needed to provide orientation.

## References

1. American Boat & Yacht Council Composite Boat Builder Certification (CBBC).
2. Drones by DJI  
**Dà-Jiāng Innovations** Science and Technology Co., Ltd (Chinese: 大疆创新科技有限公司; doing business as DJI) is a Chinese technology company headquartered in Shenzhen, Guangdong.
3. Flight Preparation: <https://skyvector.com>