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UAS OPERATIONS: NIGHT VISION & OTHER USEFUL TOOLS



By Alan Frazier, Deputy Sheriff, Grand Forks (ND) County Sheriff's Office, Associate Professor, University of North Dakota's John D. Odegard School of Aerospace Sciences

Over the past five years, I have had the privilege of leading the Northeast Region Unmanned Aircraft Systems Unit, a collaboration of five different law enforcement agencies providing UAS services to public safety departments in 18 Eastern North Dakota and Western Minnesota counties.

During the course of working with this group of innovative deputies and officers, we have tested a variety of devices with the intention of making our UAS operations safer and more efficient.

In addition to night vision, we have utilized infrared cameras, laser range finders, Apple Mini iPads running "ForeFlight" software, Appareo Stratus ADS-B receivers, Merlin "falcon finder" radio tracking devices, chemical light sticks, portable generators, portable spotlights, anemometers and, of course, handheld radios. All of the devices have proven useful, some more than others. We covered the ForeFlight, Stratus and Merlin tracking devices in the November-December 2015 issue of *Air Beat*, so here we will focus on the other tools.

Night Vision

Federal Aviation Administration certificates of authorization (COAs) permitting UAS operations specifically prohibit the use of vision enhancing devices (binocu-

lars, night vision, etc.) as the primary method of maintaining visual contact with a UAS. These devices may only be used as supplements to unassisted vision.

Our visual observers have used the ITT F6015 (PVS-14) Monocular Night Vision Device (NVD) to supplement their viewing of night operations. The NVD proved to be of little value in maintaining eyes on the UAS, as the aircraft's navigation lights are readily visible. However, the NVD was useful in conducting a pre-takeoff check of the area for obstacles. This method of clearing the operations area is particularly useful in a covert operation when use of a portable spotlight to survey the area would be discernible to suspects and compromise the location of the UAS operators.

Another potential use of NVDs is maintaining visual contact with the UAS during a nighttime "lights off" tactical operation. Two of our UAS are equipped with visual and infrared position lights. The infrared lights are only visible by viewing with an NVD. In order to conduct lights off opera-

tions, the agency would be required to request a special provision permitting such operations be included in its COA. The PVS-14 NVD is a Generation 3 device that retails at \$4,300. Slightly less capable are Generation 2 devices that retail in the \$1,800-2,000 range. At those prices, can a UAS unit live without night vision? Yes, but NVDs are a nice accessory for night operations.

Infrared Cameras

The ability to carry a dual payload of electro-optical (visual) and infrared cameras is a must have for nighttime UAS operations and nice to have for day operations. No small UAS has the payload capacity to carry any type of useful spotlight system. Therefore, there is no way to artificially illuminate a scene from the UAS. While routinely adding \$6,000-\$10,000 to the payload cost, infrared is worth every penny.

During night operations, our unit depends solely on infrared cameras. Electro-optical cameras have proven to be almost useless in poor lighting conditions. Even during day operations, infrared has proven its worth by permitting closer scrutiny of dimly lit areas, such as shadows cast by structures and large trees. If you plan to perform night operations, ensure you include the ability to carry a dual EO/IR payload in your planning.



PVS-14 night vision device



Laser Range Finders

For the last five years, our UAS pilots and observers have made visual estimates of the height of obstructions within our UAS operations areas. On rare occasions, we reference a sectional aeronautical chart for obstacle heights and routinely utilize Google Earth to do an initial survey of an area.

We recently purchased and tested a Nikon Forestry Pro Laser Rangefinder at the suggestion of one of our pilots. The rangefinder has proven to be an excellent tool for gaining additional situational awareness. In seconds, we are able to accurately gauge the height and distance of obstacles. Merely turn the device on, look through the viewfinder, select the correct mode, place the viewfinder's targeting cross on your object and press a button. The range or height (depending on mode selected) instantly appears on the viewfinder screen.

The rangefinder has taken the guesswork out of UAS altitude selection and made our operations much safer. All rangefinders are not created equal. In choosing a unit, ensure it is capable of making both horizontal and vertical measurements. The Nikon Forestry Pro, as the name implies, is specifically made for forestry applications (measuring tree heights) and is simple and intuitive to use. The unit retails for \$380. Be forewarned: a recent Amazon.com search revealed many

laser rangefinders in the \$120-250 price range but most (if not all) were incapable of calculating obstacle height.

Other Useful Tools

Many of the other tools we have tested and adopted are mundane but valuable:

- "Cyalume" brand chemical light sticks have proven useful in marking night takeoff/landing zones and nearby obstacles. The light sticks come in various colors, intensities and durations (30 minutes to 12 hours). Bought in packs of 12, they are approximately \$1.00 per stick.
- Portable generators provide 120V of power to charge UAS batteries, operate a VHF radio base station and plug in laptop computers, all essential for extended UAS operations. We use a Honda EU2000i generator/inverter, which is very quiet (59 dB), capable of 2,000 watts/16.7 amps and can run for eight hours on one gallon of gas. The EU 2000i retails for \$1,000.
- Portable handheld spotlights are essential for night operations. Providing a wider field of illumination than traditional flashlights, handheld spotlights can be used to check an operating area for obstructions and illuminate the takeoff/landing area.

We utilize two Sirius 500 lumen rechargeable handheld units with LEDs that we keep plugged into a 120V outlet when our UAS vehicle is parked in the garage. The Sirius units retail for \$47. Many other similar units are available for \$31-\$55.

- The Achilles heel of many UAS is the maximum wind limitation, making wind velocity measurement devices known as anemometers useful. Although you can easily get a METAR wind velocity from a nearby airport, the only way to know the exact wind velocity at your takeoff location is by making a local measurement. We have an Ambient Weather WM-2 handheld anemometer in each of our UAS cases. The device is held up while the operator turns in a slow circle searching for the highest wind velocity reading. It also includes a thermometer and wind chill calculator (important in North Dakota). My only criticism of the Ambient unit is the fact that the LCD stops working around 15 degrees F. We have a lot of cold days in North Dakota, and unfortunately, every portable anemometer currently available uses an LCD display that is susceptible to cold. We have had some luck in keeping the device inside our outer clothing to keep it warm and then

UAS CORNER

Nikon Forestry Pro Laser Rangefinder



taking a quick measurement to limit exposure. The Ambient Weather Anemometer retails for \$27. Similar units from numerous manufacturers are available for \$16-100.


- Portable radios are essential. As a law enforcement community, we tend to take radio technology for granted. Don't. We have five different agencies in our UAS unit and serve agencies in 18 counties that utilize a wide-variety of frequencies, many of them dependent on repeaters. Trying to rely on such a disparate variety of frequencies and systems is a recipe for communications failure. To avoid

Anemometer



the complexity posed by this situation, our unit has a bank of eight Motorola CP185 UHF handheld transceivers in our UAS vehicle. The CP-185 is a simple 4-watt, 5-channel radio with 3-5 miles of range. When on-scene, we distribute radios to our team members, as well as representatives of the agency we are assisting. This has proven to be a simple, error free way of establishing and maintaining communications while on-scene. We use code free language, as some agencies in our mutual-aid area use different "10 codes" or no codes at all. We also have an ICOM VHF radio base station

and three Yaesu handheld VHF aviation transceivers for communicating with ATC towers when we operate within Class D airspace. Prior to our unit going operational, we tested the VHF base station at various points within the Class D airspace of Grand Forks Airport and the Grand Forks Air Force Base. We found the radio was capable of receiving and transmitting to both towers from anywhere within the Class D surface areas. The Motorola handhelds retail for \$195, the ICOM base station for \$1,050 and the Yaesu aviation band handhelds for \$200.

Starting a UAS unit is not just about selecting an airframe and getting a COA. It is also about policies and procedures, public perception, training and tools of the trade. 

Author's Note: *If you wish to learn more about establishing a UAS unit, please consider attending ALEA's UAS Operations Course to be held in Savannah, GA, July 18-20. The 24-hour UAS Operations Course is a great way to learn the many ins and outs of establishing and operating a UAS unit.*

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