Using a Drone for Antenna Installation at TI5W

New antenna installation tactics help this Costa Rican station outperform its previous setup.

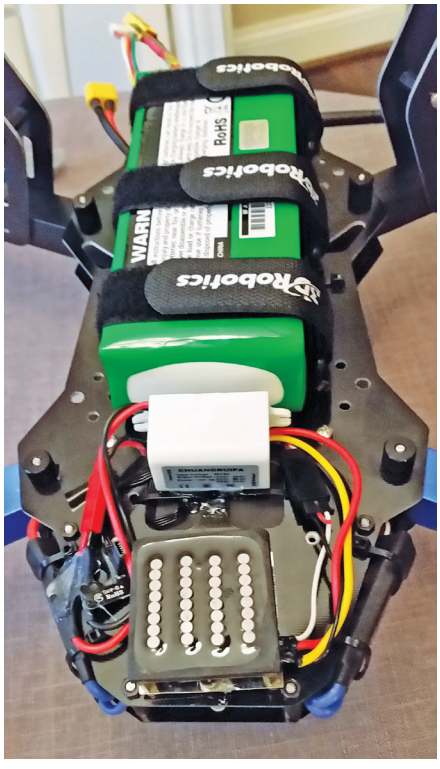
Kam Sirageldin, N3KS

Located at an elevation of 2,000 feet above sea level on the side of a volcano in the northern reaches of the province of Alajuela, the TI5W station is blessed with great terrain characteristics that help out tremendously on the 160 – 40 meter bands. Currently, TI5W holds the world DX records for all Multioperator categories in the ARRL International DX CW contests, and also regional records in CQ World Wide contests. After using a drone to install a full-sized loop antenna, this station had even more success on 160 meters.

Choosing Drones

For the TI5W multi-multi effort in the 2012 ARRL International DX CW Contest, we hung a 10-meter Yagi from a tree branch, roped a two-element 15-meter Yagi to the side of the tower, and relied on a log periodic on top of an 80-foot tower for everything else. Krassy, K1LZ, also designed a full-size loop with a 75 Ω matching section feeding at an upper corner to provide vertical polarization, which he hung 75 feet into the trees with the antenna sloped to the ground. We had no noticeable radio frequency interference (RFI) in the shack, so we kept the Krassy 160-meter loop for several years, once using a crossbow to restring it.

Two years ago, I decided to install an even higher loop antenna for 160 meters based on the success of the low 160-meter loop. For supports for the loop, we used a 170-foot and a 140-foot tree, effectively doubling the height of the 160-meter antenna. However, because of the inaccuracy of a crossbow, the landing of the bolt could not be predicted to be in a safe, cleared area. So, I decided to replicate the drone installation that I had successfully used for antenna drops at my N3KS home station in Maryland.

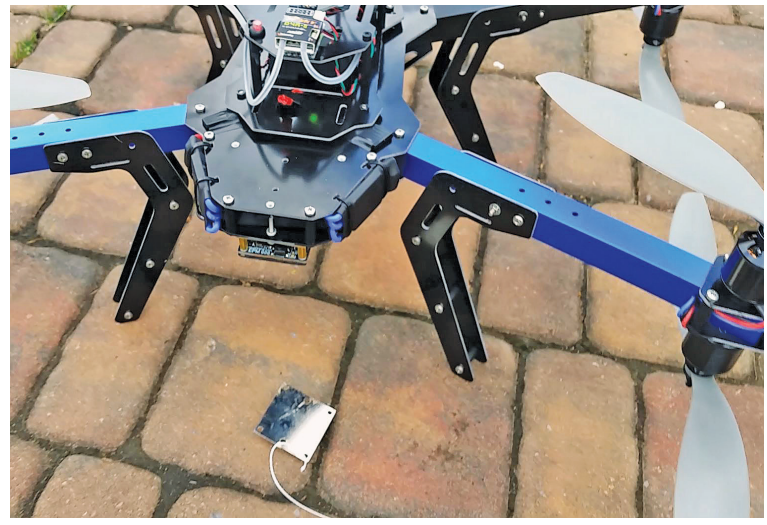


A drone with an EPM installed (the EPM is the square piece at the bottom of the photo).

The Model 3DR X8+ drone was well suited for an amateur lift, carry, and drop application because its open-source operating code is written around the Arduino processor. Even better, the code was written so certain I/O functions could be modified by changing parameters in the setup software — hence no actual new code needs to be written and compiled. The drone is capable of lifting about 1 kilogram of external weight and could stay aloft for about 15 minutes with that load.

We needed a device that could be energized to act as a magnet and then be de-magnetized remotely from the drone controller. Nicadrone in Nicaragua makes an electro-permanent magnet (EPM), which can be directly

A drone controller with a twist knob potentiometer at the upper left that controls the EPM (similar to a camera gimbal control).



A mounting plate for an EPM, which is visible at the very front of the drone.

interfaced to the PWM I/O signals of the X8+ drone. (A technical application note on the details of the interface is available on the *QST* in Depth web page.)

An EPM requires an initial jolt of current to enable it to grab like a very powerful magnet, but then only needs a small trickle current to keep the magnetism energized (i.e. holding onto the other piece of ferrous metal) and then can be commanded with another jolt to de-magnetize. I managed to change the parameters of the X8+ PWM I/O at the drone camera gimbal interface, so that the drone controller could command three different PWM rates using the controller gimbal control: one PWM rate for grabbing the external piece of metal that would be attached to the line, another rate for holding while the drone flew to the appropriate spot, dragging the line under it, and yet another for dropping the weight/line.

This would enable me to fly the drone precisely over the exact tree branches and drop the weight/line exactly where it needed to be.

Lessons Learned

From experience, I found that you should use a line that is light enough not to drag the drone down, but heavy enough not to blow sideways in the wind. The X8+ has eight propellers, four of which are mounted on the bottom of the drone, and it is very easy for the line to tangle in one of the propellers and bring everything crashing down. I also learned the weight that is attached to the EPM needs to be about 0.4 kilograms. It's got to fall through tree branches and leaves, dragging a line behind it. There is more friction than one might suppose.

The planned day of the mission came and I had three people to help me. The wind and rain were not cooperative. After a few hours of waiting, two people decided to call it a day, leaving me and Luis, my 14-year-old neighbor, as the remaining crew members. We were actually hoping for a bit of rain, but no wind, because we were worried about the reaction that the drone buzz would elicit from the killer bees in the area. Once the wind eased up and the rain slowed, Luis and I started the operation, keeping our own voices low and hoping that the drone noise would cause the bees to attack the drone and not us. Fortunately, everything went very smoothly, and the new full-size 160-meter loop was high in the trees.

The antenna has been a joy to use, resulting in great multiplier numbers for us on 160 meters, and in its broadside direction, it outperforms a co-located beverage antenna and is essentially equivalent (in one direction) to an eight-circle RX array.

Kamal Sirageldin, N3KS, has been a ham since 1975, and received an electrical engineering degree from Johns Hopkins University in 1982. He later formed his own company that provided GPS tracking and messaging services to government and commercial clients, and retired after selling the company in 2011. His interests include DXing and contesting, and he now spends most of his time in Costa Rica. Kamal can be reached at **kamal.sirag@gmail.com**.