

UP, UP & AWAY

Multicopters and hot air balloons share the skies!

BY PATRICK SHERMAN

ROTORDRONES HAVE UPENDED THE WORLD of model aviation and show enormous potential in professional fields that are as diverse as film and television production to scientific research – but can they safely share the sky with full-size pilots and aircraft? In many ways, hot air balloons and rotordrones are polar opposites: one being the oldest type of manned aircraft, and the other having just come into their own over the past few years as unmanned aerial platforms.



Opposite page: Before beginning the process of inflating the balloon's envelope, pilots test their burners in the open air to verify that the system is working properly. Here, the Roswell Flight Test Crew's flagship hexacopter – RQCX-3 "Raven" – hovers in the foreground while a tongue of fire juts into the cold morning air.

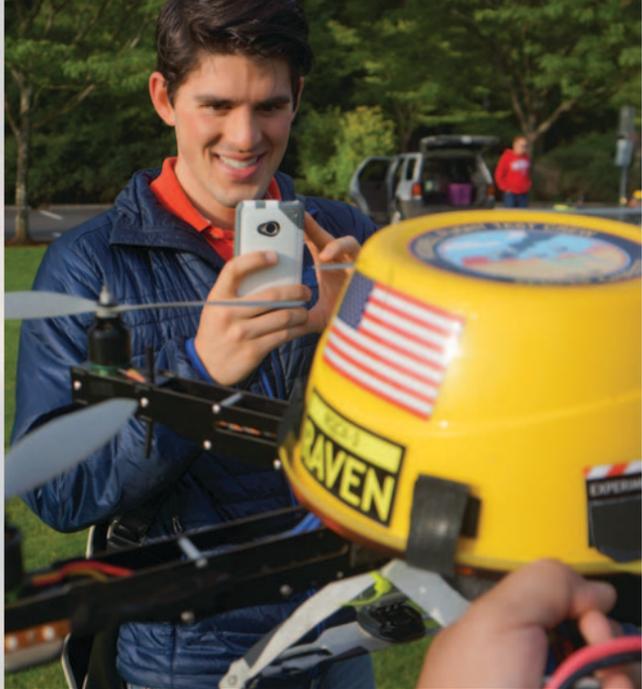
This page: Viewed from the unique aerial perspective that only a rotordrone can provide, two balloons simultaneously ignite their burners during the night glow at the Tigard Festival of Balloons on Saturday evening.



The first manned balloon flight occurred more than two centuries ago, in Annonay, France, on October 15, 1783. Among the first aeronauts, as balloonists are called, was a scientist named Pilatre de Rozier – from whose name our modern word "pilot" is derived.



While capable of controlling the vertical by means of its propane burners and vents, this balloon named *Outer Limits* must rely on the wind to control the horizontal. Cook Park, the site of the annual Tigard Festival of Balloons, is visible below with two additional balloons preparing for takeoff.



Above: Having followed RQCX-3 "Raven" back to the Roswell Flight Test Crew's launch site, Scott Boyce captures a quick photograph of the hexacopter with his cell phone. Still largely unfamiliar to the public, FPV multirotor crews should anticipate a great deal of interest and questions when participating in community events.

Below: Boldly going where no rotordrone has ever gone before, the Roswell Flight Test Crew's RQCX-3 "Raven" hovers inside the envelope of a standing hot air balloon, while its propane burners inject a fiery blast of hot gas from below. To see the drone's point of view, be sure to check out the video on RotorDroneMag.com. The black balloon used for this demonstration is a flying billboard for the Broadway show *Wicked*, a musical prequel to *The Wizard of Oz*.



Watch the video on RotorDroneMag.com

In the beginning

Three years ago, my partner, Brian Zvaigzne and I got our start as "the Roswell Flight Test Crew" flying with hot air balloons. My bird was an overloaded Gaui 330x-s upgraded with a MultiWii flight control system, which used parts scavenged from a Nintendo Wii Nunchuck Plus, to add auto leveling capability to the flight control system. With a first-generation GoPro strapped on board, I overcame the limitations of the primitive technology available at the time with a deep reserve of unwarranted self confidence. I managed to get through that first-ever balloon festival without damaging anything—and it was clear that we had discovered something amazing.

For me, the standout moment while flying using a live FPV (First Person View) downlink, was when I approached the basket of a distant balloon and watched a passenger look toward my quadcopter. His eyes were drawn toward the buzzing sound of the propellers. Startled, he gestured toward my airborne camera and the second guy immediately lifted a binoculars to his eyes as the basket slipped out of my camera's field of view. That image has always stayed with me. Even as I sat in the middle of a soccer field wearing a head-mounted display, I had interacted with people more than a thousand feet away and hundreds of feet in the air. I was, in a very real sense, flying. You can see my video on our YouTube channel. It's the very first video the Roswell Flight Test Crew posted.

This all took place at the 2011 Festival of Balloons in Tigard, OR, where we again returned earlier this summer. But this time we had much improved equipment and a lot of valuable experience. We've flown at many different balloon festivals, which has given me some understanding of the balloonists' world. Though their bright colors and fantastical shapes can make hot air balloons seem like whimsical creations that forever float above the cares of the world, they are indeed lighter-than-air aircraft with tail numbers registered by the FAA (Federal Aviation Administration) requiring certified pilots at the controls.

It's an aeronaut's life for me

If you want to become an aeronaut, or at least fly your rotordrone alongside hot air balloons, the first requirement is that you wake up early — really early! Balloons fly best in the cold, still air just before sunrise. Also, you need to have a high tolerance for uncertainty. Light rain or winds can be a show-stopper for balloonists.

Inflating hot air balloons is a two-step process, which begins by blowing cold air into the envelope with a large fan — a procedure known as cold packing.

Next, it's time to give it some gas. At this point in the process, the propane burners are pointing horizontally into the mouth of the envelope. The pilot uses the burners to blast hot gasses into the envelope until it lifts off the ground and pulls the basket upright. This is referred to as "standing up" the balloon.

To lift off, the pilot just keeps hitting the burners until the buoyancy generated by the hot gas inside the envelope overcomes gravity. Then, you go where the wind takes you. At the end of the flight, you find an open field to safely set down.

At the end of the day, it's tradition at balloon festivals to hold a "night glow." Instead of flying however, everyone uses their burners to illuminate their envelopes creating a beautiful, flickering glow that I've often heard described as looking like giant holiday lights.

The 2014 Tigard Festival of Balloons had all of this and the event fell on the summer solstice — the longest day and, therefore, the shortest night of the year. It was a schedule that tested my ability to cope with sleep deprivation, but as a rotordrone pilot, it provided me



RQCX-3 "Raven" hovers in front of a hot air balloon that has begun the inflation process. Before the propane burners are used to "stand up" the balloon, gas-powered fans are used to blow air into the envelope — a process called "cold packing."

with some amazing opportunities. Today, with more experience, and much better equipment, I am able to safely fly up to the balloons and rock my craft from side to side — always provoking a smile and a wave. Thanks to newer, better cameras, I also capture cleaner still images and video during the night glows.

Pushing the envelope

As we've proven ourselves to the aeronauts with years of safe flight operations, they came up with a few ideas of their own. The crew of the *Wicked* balloon, which travels the country as a "flying billboard" for the hit Broadway musical, suggested that we fly our multirotor inside the envelope of their standing balloon! We've had flown inside the envelope of a balloon once before, but that was after the crew had finished cold packing, while it was still lying on the ground. This would be an entirely different challenge.

I put my radio in the hands of my good friend Brian, who is definitely a better pilot than me —but I still had a critical role to play. I had to climb up on top of the basket

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carrying our rotordrone and then lift it up between the shroud lines. Brian then spun up the motors and lifted it out of my hand.

This experiment was dicey to say the least, especially when the pilot hit the burner and the hot gasses lifted our bird perilously close to the lines and cables that stretch back and forth across the inside of the envelope. However, Brian pulled it off, completing what I'm sure is a worldwide first.

At the end of the internal flight, he brought it back down and put it gently in my hand. A once-in-a-lifetime experience? It definitely was a thrill, and it really showed what amazing opportunities for adventure are possible for the rotordrone pilot.

But, wait! There's more!

As a special treat for *RotorDrone* magazine readers, the Roswell Flight Test Crew has produced a video providing a behind-the-scenes look at their adventures at the 2014 Tigard Festival of Balloons. It includes footage captured by their "RQCX-3 Raven" while flying inside the envelope of the *Wicked* balloon, as well as other exciting footage. Watch for it on RotorDroneMag.com!