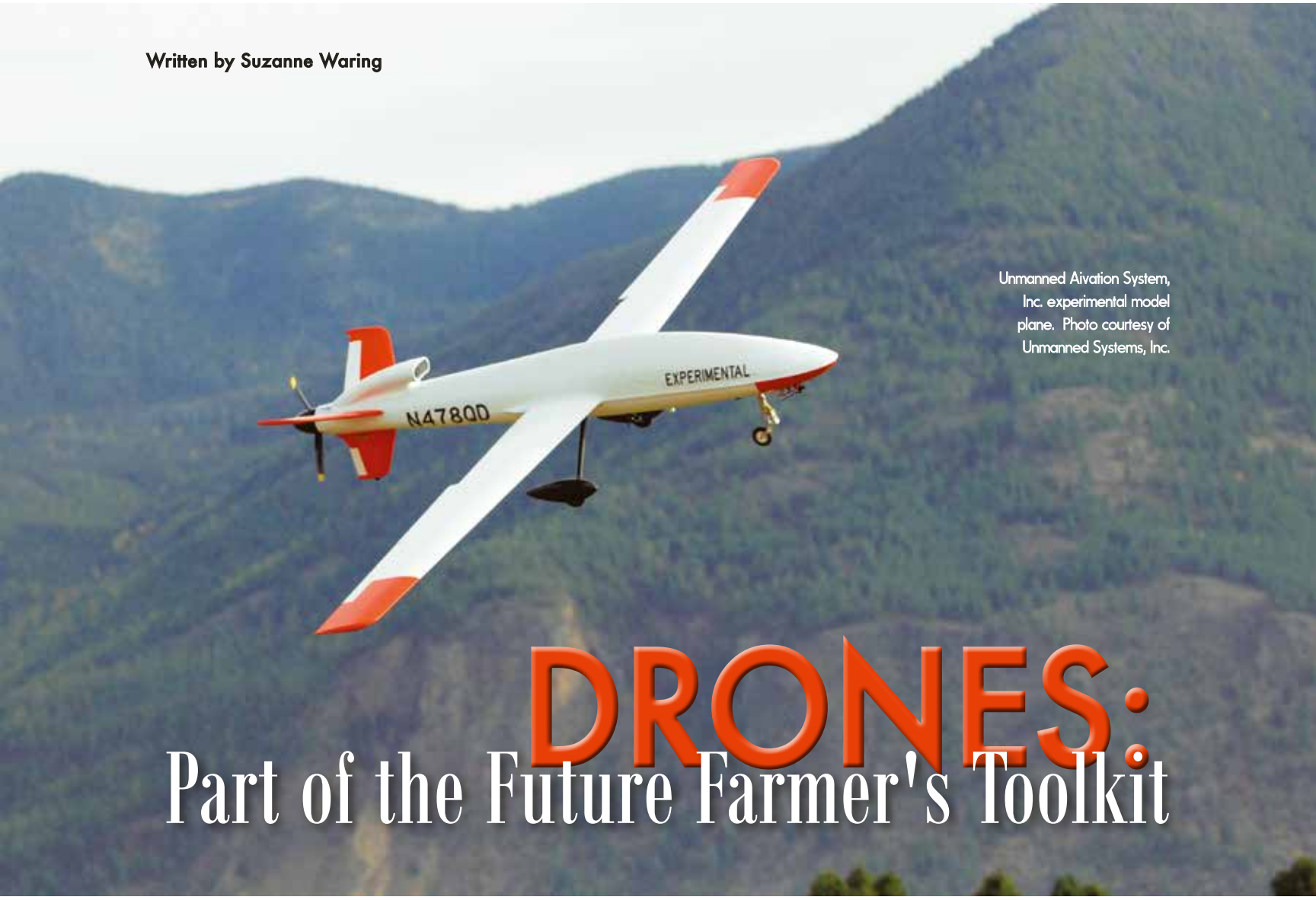
Written by Suzanne Waring



Unmanned Aivation System, Inc. experimental model plane. Photo courtesy of Unmanned Systems, Inc.

DRONES: Part of the Future Farmer's Toolkit

Drones are making headlines in the news. Unmanned Aircraft Systems (UASs)*, with the street name of drones, have been used in airstrikes by the U.S. military in the Middle East; Amazon and United Parcel Service have made news with their statements that packages will be delivered by drones in the future; and movie makers have received Certificates of Exemption from the Federal Aviation Administration (FAA) to film scenes from the air.

Many Americans are wary of drones because they may further decrease personal privacy plus there are safety risks. Should even a small drone collide with a manned aircraft or be sucked into a aircraft engine, the results could be catastrophic. Close to home, three Yellowstone Park visitors were fined for flying drones in a national park last summer. When a drone landed on a New York City street and almost struck a pedestrian, many became aware of the personal dangers of drones.

Even before these drone stories hit the news, progressive farmers and agribusinesses had been experimenting with using drones in agriculture. In a positive light, drones appear to be the next innovative measure beyond auto-steer and other GPS systems in assisting farmers and ranchers to increase yields, cut costs, and save time.

Ed Buttrey, who is working with a

UAS Research at Montana State University

Since 2008 students at Montana State University (MSU) have had the opportunity to enroll in courses making up an aerospace minor that dovetails with other majors, such as mechanical engineering. Projects in the advanced aerospace courses entail analyzing, designing and building UASs (Unmanned Aircraft Systems) that become students' entries into design competitions sponsored by the Society of Automotive Engineers.

The criteria for determining the best drone in the competition is cost, difficulty, dependability, performance, and manufacturability and must comply with the Federal Aeronautics Administration (FAA) regulations. In 2013, one of university's UASs won third in design, and in 2014 students were second place winners also in design. At the present time, students are making three different drones for the 2015 competition to be held in April. The micro model must fit into a 6" tube and fly around a closed circuit. The standard UAS also flies around a closed circuit but will have a maximum payload, and the advanced UAS must be able to transmit data, to drop a payload at a designated target, and to be within the 55 lb. limit.

Through the building of a drone for the competition, "students learn firsthand about airframe and flying components, GPS guidance systems, cameras, wireless communications, and other features of UASs," said Doug Cairns, who is the Lysle Wood Professor in the Mechanical Engineering Department At MSU.

Along with other relevant research, students have done field testing for precision agriculture.

With this history in aeronautical studies, Montana State University has been identified to be a core team member in a Mississippi State University Project for the organization, Alliance for System Safety of UASs through Research Excellence (ASSURE). Under the umbrella of this organization, students at nineteen universities do research to make UASs efficient, quiet, dependable, and safe. ASSURE is also comprised of one hundred industry/government partners. For the university, being a member of ASSURE provides opportunities to do research that will aid with the integration of UASs into the national air space. It provides a connection to private companies and governmental organizations that hire MSU graduates, and opens the gateway to other fascinating projects that the FAA offers to university aerospace programs for research.

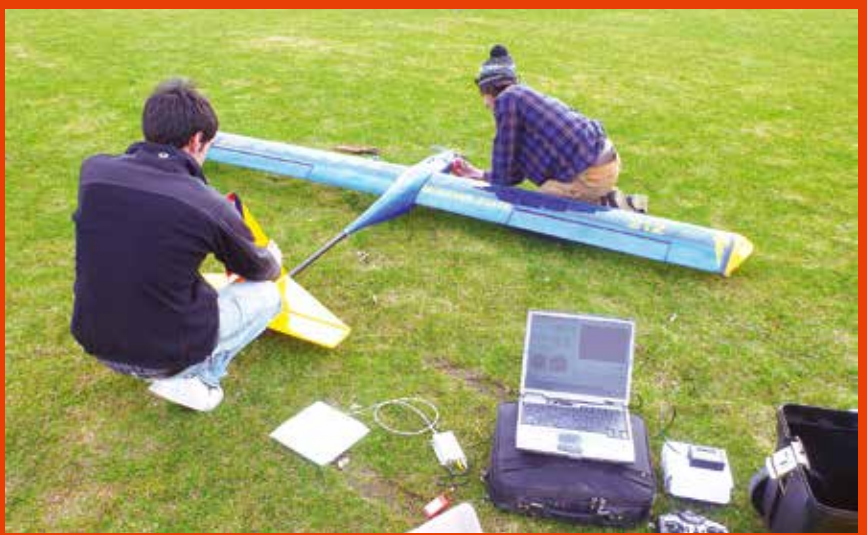


Photo courtesy of Doug Cairns at Montana State University

Nevada-based drone maker, Unmanned Systems, Inc., to bring the manufacture of drones to Montana, said, "Once the FAA allows for the use of drones in business, it is likely that as high as 80 percent of their use will be in agriculture."

That's because the information derived from a drone flight will be highly useful to a farmer and rancher. To benefit the farmer, UAS surveillance components detect plant height, weeds, number of plants, crop coverage, crop health, and season monitoring, leading to knowledge of water issues in fields, fertilizer and pesticide use, and crop yields. Ranchers will know whether distant water tanks have water, fences are secure, and livestock have been injured or are having troublesome births. Can you just imagine how helpful it would be to quickly find the location of livestock preceding a big winter storm.

The imagery coming from drones has to provide specific data to be useful. With stitched together visual, thermal, infrared, or multispectral images, much more can be seen from the air than from the ground with the naked eye, and the information is available immediately.

A simplified sequence of what drone photography does when a crop or piece of land is being scrutinized is the following: Once the parameters of the area needed to be analyzed are determined, the drone will make a series of back and forth patterned flights over the land while taking photographs with on-board cameras. Then the imaging processing software in the wireless ground-station computer identifies repeated patterns in the photographs and stitches them together creating a topographical map called a "orthomosaic," giving a precise and accurate visualization. From that, computer software manages the collected data that, in some cases, are GIS ready.

Whether drones will be purchased by an individual agricultural owner will likely depend on the purpose of owning a drone and the cost. Small surveillance

A radio controlled DJI Phantom quadcopter drone taking off from a grass field. For more information on rules for flying a drone, contact The FAA Safety Hotline website at www.faa.gov/contact/safety.hotline or call 1-866-835-5322.

drones may be part of a rancher's or farmer's tool kit, but future, larger, multi-use drones may be used by commercial businesses. Farmers may form cooperatives to own shared drones.

Presently manufactured drones are built in many shapes and sizes. Mostly they are shaped as copters (with four to six rotors) or fixed-wing aircraft. "Most UASs are powered by rechargeable batteries, but I have read about their being run on nitro methane or diesel," said Doug Cairns, professor with the Mechanical & Industrial Engineering Department at Montana State University.

FAA regulations identify three different categories of UAS use: Civil UAS, Public UAS, and Model Aircraft. Under the civil category, certificates are given to applicants performing UAS research and development, flight and sales demonstrations, and crew training. Public UAS certificates go to law enforcement, firefighting, border patrol, disaster relief, search and rescue, and

An operator launches the senseFly eBee, a professional mapping drone Use this fully autonomous drone to capture high-resolution aerial photos that you can transform into accurate 2D orthomosaics & 3D models.. Photo courtesy of senseFly.

military training. Model aircraft, the third category, is for hobby and recreation. Note that there are no certificates for any type of business use—and that includes agriculture—unless a company has received an exemption. The FAA has given a total of only twenty-eight exemptions, as of February 10, 2015.

Presently, three companies, located in Idaho, Iowa, and Florida, are the only agribusinesses to have received exemptions, but some farmers want to get into the drone game to at least learn how a UAS works. Under the FAA Modernization and Reform Act of 2012, units weighing less than 55 pounds; operated in the line of sight of the operator; flown below 400 feet when over water and sparsely populated areas and not closer than 500 feet to any person, vessel, vehicle or structure; and flown at less than 100 miles per hour can function under Unmanned Aircraft System (UAS) mandates. When it is flown within 5 miles of an airport, the operator of the aircraft provides the airport operator and the airport air traffic control tower with prior notice of operation. No certificate of use is needed for a model aircraft as long as it is flown for purposes of hobby or recreational use. If considering using an UAS on your property well away from any air traffic patterns, you are advised to investigate all of the dos and don'ts of flying these units with the FAA (See https://www.faa.gov/uas) as the guidelines given above are always changing and may also be incomplete.

Students in Dr. Cairns' classes in the engineering department at Montana State University have been building and flying fixed-wing drones since 2008 under the auspices of a Certificate of Waiver or Authorization from FAA that ensures that they fly a UAS for research in a safe manner and away from manned aircraft.

Scott Powell who is an assistant professor in the Department of Land Resources and Environmental Sciences at Montana State University is in the process of purchasing a senseFly eBee fixed wing UAS to do research on the different effective ways drones will be used in agriculture. "Although there are many early adopters, UASs are still in the research stage. I see them becoming a tool that will be widely used in agriculture in the next five years," said Powell. SMT

**When writing of drones, instead of using the FAA terminology, which is UAS, some groups use the acronym, UAV, standing for Unmanned Aircraft Vehicle.*

~A life-long interest in communications made Suzanne Waring first a college instructor and then a writer. She lives in Great Falls and writes about Montana people and their communities.