In today’s precision agriculture, knowledgeable farmers utilize sophisticated tools and technology to reduce costs, increase crop yield and maximize profit margins. Given the advantages, their demand for ag tech is growing, from GPS-guided tractors to computer-controlled variable-rate seeding and fertilizing to apps that track the commodities market.

Textron Systems is on the leading edge of delivering the next smart tool directly into the hands of farmers — aerial multispectral imaging. Multispectral imaging captures light at various wavelengths, including frequencies beyond visible light such as near-infrared and thermal infrared. Using a specialized airborne camera, Textron Systems captures high-resolution images of fields and applies complex algorithms to provide farmers with an informed...
Mounted to the windshield, the pilot console provides guidance to each flight line, and displays airspeed, altitude and details about bank and pitch angles.

Textron’s images combined with historical data allow agronomists and farmers to understand plant growth and create customized crop prescriptions such as adding more fertilizer or reseeding specific areas to enhance yields and product margins.

WORKING ACROSS SPECIALTIES

To deliver meaningful, actionable information for farmers with multispectral imaging, Textron Systems relies on a multi-faceted team of experts in aviation and airborne systems, data processing and analytics, and end-to-end customer support.

“Textron Systems has core sets of technologies that lend themselves to solving these types of problems for customers,” said Ellsworth. “The synergy across our companies — Geospatial Solutions, Support Solutions and Unmanned Systems — as well as with Textron Aviation, gives us a breadth and depth that is our key competitive advantage.”

The teams work fluidly, flexibly and rapidly, sharing data and discussions within minutes, not days. This close alignment offers another distinct advantage.

“When farmers look at the imagery, it has to be recent because of how quickly the crops change. With some crops like corn, a day or two has a big impact on its growth and health. Farmers need that imagery quickly so they can take action,” Ellsworth said.

Textron Systems invested heavily in researching and developing the best practice for delivering the multispectral images, including spending a year and a half working in farmers’ fields. The onboard computer-controlled camera and flight management system work complex tasks behind the scenes, including metering light, collecting geolocation information, and providing current flight data. The sensor operator monitors the images and adjusts the flight lines as needed all while contending with a variety of challenges.

“Spotty clouds cause uneven lighting on the ground. If you process the data and have a small cloud with a little shadow in the middle of the corn field, the algorithms detect a lower reflectance of light. It will look like you got a dead spot in the field, when in fact it is just a shadow from a cloud,” said Eric Jorgensen, Senior Trainer Developer and Support Solutions Branch Manager.

CAPTURING THE IMAGES

On collection day, that disciplined, synergistic approach shines. In South Dakota recently, Textron System’s team flew over the same area for the fifth time in the growing season to capture multispectral images for one of the largest agricultural co-ops in the country.

Using a Textron Aviation Cessna® 172 equipped with a computer-controlled high-resolution multispectral camera, pilot console and sensor operator console, the team flew thousands of acres on the first day of the collection period. On day two, the team flew hundreds of thousands of acres in mere hours. Textron Systems can scale its operations quickly, up to millions of acres annually, to meet the growing needs of its customers.

“We develop the mission plans in concert with our customer. Then the flight lines are preplanned and analytics are input into the system, along with the location of the fields to be flown, when in fact it is just a shadow from a cloud,” said Eric Jorgensen, Senior Trainer Developer and Support Solutions Branch Manager.

Textron Systems can scale its operations quickly, up to millions of acres annually, to meet the growing needs of its customers.

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Capturing accurate multispectral images of crops requires far more than a few passes over the field testing technology and workflows. The result is a combination of proprietary Textron equipment and supplier systems with best-in-breed sensors and best-in-breed software. Together, with efficient processes in place, customers receive the highest quality images with meaningful information at the right moment, and at a very competitive cost.
for Textron Systems Support Solutions. “We had to time where the clouds would be and capture images between the holes in the clouds and their shadows.”

**COMBINING EXPERTISE WITH ADVANCED ALGORITHMS**

Given Textron Systems’ experience with its long-time Aerosonde® small unmanned aircraft system (UAS), aerial surveying analysis at Geospatial Solutions, and field service capabilities through its Support Solutions business, the team was well-prepared to navigate the logistics of processing and analyzing the large amounts of raw data collected from the farmers’ fields.

For every field, every flight flown in South Dakota during growing season, Textron Systems delivered four image types or products, each one offering the agronomists and farmers a different perspective of their crops.

To depict a field, the data analysts and automated processes stitched together many images in a mosaic with roads, buildings, field boundaries and other elements aligning correctly. They then overlaid the geo-located mosaics onto a virtual globe that corresponds to the real world.

“It’s basically a map, not just an image. It’s in the correct place on earth. You can take measurements from it. You can put other layers on top of it,” said Bill Veteto, GIS analyst for Geospatial Solutions.

For one image product, we create an NDVI, a Normalized Difference Vegetation Index. It uses the red and the near-infrared bands to give you an idea of vegetative health. The closer the value is to one the better the crop health or greater the biomass. In another image, healthy crops show up in red. The gray areas show where the plants aren’t growing.”

**DEVELOPING NEXT-GEN SENSORS**

Through the application of targeted research and development, Textron Systems continues to lead the industry in aerial imaging. For agriculture today, most imaging focuses on visible light and near-infrared. The company believes that the next generation of sensors will be able to measure the moisture content in crops by capturing thermal infrared wavelengths.

“That’s really exciting because it’s going to let farmers answer a different set of questions. Not just about crop health but irrigation, too, for example. If they have a clogged nozzle, it might not show up for some time in a Normalized Difference Vegetation Index, or NDVI, at which point it might be too late to fix. If you start looking at moisture content in the plants, you might be able to identify that problem a lot sooner,” said Ellsworth.

By harnessing the expertise across its sister companies, Textron Systems is uniquely positioned to scale for the future. Its relationship to Textron Aviation, which manufactures 80 percent of the general aviation assets in the world, gives Textron Systems access to the best aircraft for each mission. The Support Solutions business developed training to equip more field service representatives like Jorgensen with the aircraft pilot and sensor operator capability. Beyond agriculture, Support Solutions can supply similar expertise tailored to the oil and gas industry, wildfire surveillance, and terrain mapping.

Geospatial Solutions’ analysts are working on even more ways to automate manipulation of the raw data. Streamlining processing and analytics is key to providing images to farmers quickly. Lastly, Unmanned Systems is accustomed to managing and tracking large programs, and delivering valuable data to customers on time and on budget.

“We have a more competitive offering because we’re working together across these business units. Our combined strength really is an advantage,” said Ellsworth.

Textron Systems is on the leading edge of delivering the next smart tool directly into the hands of farmers — multispectral imaging.