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SENSORS & DRONES

WHITE PAPER

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The 6X Sensor Series

Why Capture Rate Matters

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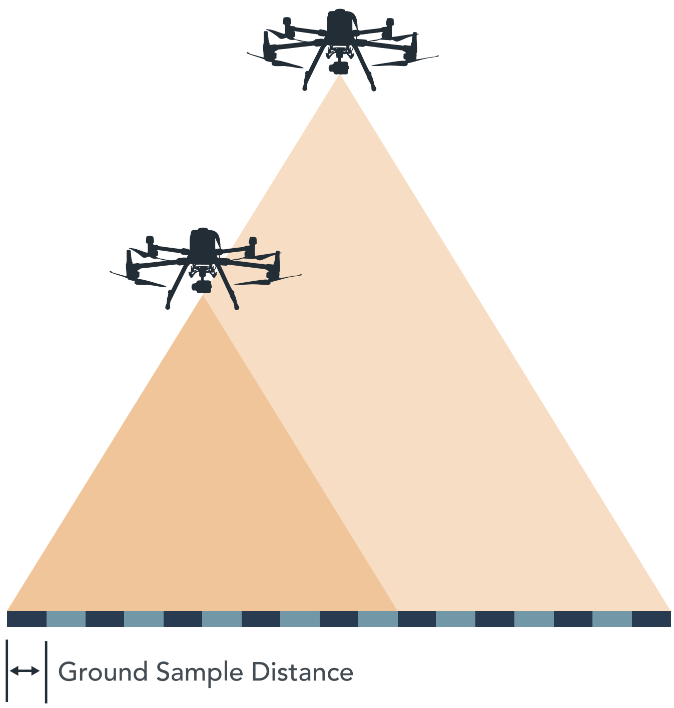
When planning a drone mission, users have grown accustomed to accommodating the maximum capture rate of their camera equipment; that is, how fast the camera can take the next photo after a photo has been taken. This is particularly true of agriculture use cases employing multispectral sensors. Some commercial multispectral sensors available today offer only a 1 frame per second (1 Hz) capture rate or less. Such slow capture rates can limit the allowable flight speed of the drone, and thereby the coverage rate of the drone system, as well as increase the risk of insufficient overlap between photos.

At Sentera Sensors & Drones, our mission is to build the most accurate spectral sensors on the market, ensuring that these sensors are equipped to accommodate the simplicity and productivity needed to support large-scale operations. When we set out designing the 6X Sensor Series, our goal was to completely eliminate capture rate as a limitation to coverage rate and as a consideration in the operator's pre-flight process.

What drives coverage rate?

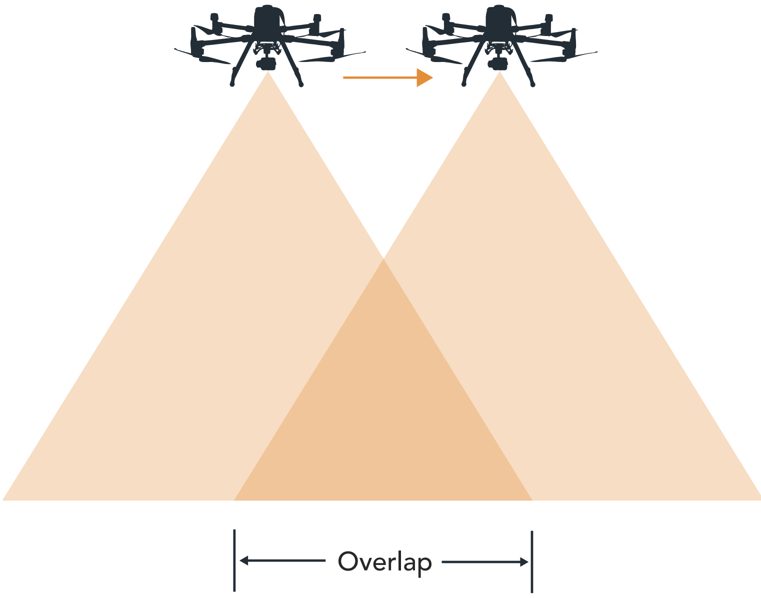
Ground Sample Distance (GSD)

When planning an aerial multispectral survey, there are typically operational parameters that must be achieved. Perhaps the most common parameter is ground sample distance (GSD), which refers to the size of the area of land that each camera pixel will represent. The end application of the imagery will drive what GSD is required; typically, larger GSD is sufficient for basic vegetative index mapping while smaller GSD may be required for advanced analytics such as plant counting, phenotyping, or weed detection. The more pixels the camera is equipped with, the larger area that can be covered while maintaining an equivalent GSD.



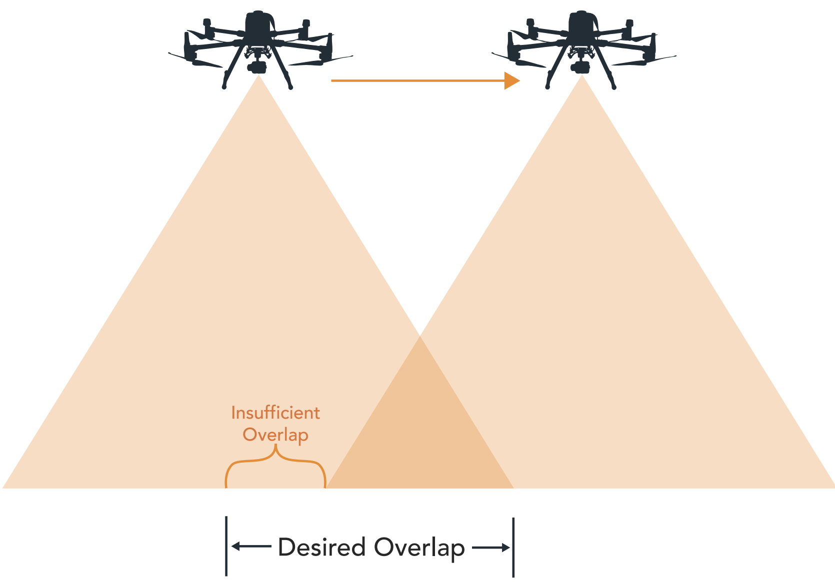
Overlap

Secondly, when planning the mission, the operator must consider overlap, which is the amount of coverage there is between a photo and its adjacent photos. Again, this will be driven by the end application for the imagery, but it is common that drone missions are planned with 75% overlap to accommodate stitching the photos into an orthomosaic using tools such as Pix4D Mapper or Agisoft Metshape.



Allowable Ground Speed

Lastly, the operator must consider the allowable ground speed, the rate at which the drone can pass over the land being surveyed. Allowable ground speed is a function of GSD and overlap, which we described earlier, but it is also a function of the capture rate of the camera, the speed at which the camera can collect images. Exceeding the allowable ground speed would result in insufficient overlap or even gaps between photos, likely requiring the mission to be flown again at reduced speed. Unfortunately, this is an all-too-common experience and allowable ground speed calculations have become a standard, and unfortunate, part of pre-flight mission planning.



Determining Flight Speed

The equation below shows how to determine the allowable flight speed for a mapping mission.

Ground Speed = GSD * Vertical Pixels * (1 – Overlap) * Capture Rate

Let's look at an example application employing a DJI Mavic 3 Multispectral where the sensor operates at 0.5 Hz capture rate and is equipped with 5.0 MP cameras measuring 1944 pixels in the vertical direction. For this mission, the desired GSD is 2.5 cm with 75% overlap.

Ground Speed = 2.5 cm/pixel * 1944 pixels * (1 - .75) * 0.5Hz = 607.5 cm/s = 6.075 m/s (13.59 mph)

As shown, the drone could fly no faster than 6.075 m/s (13.59 mph) to maintain the desired overlap. Given that the DJI Mavic 3 Multispectral is capable of flight speeds of 21 m/s (46.98 mph), this mission would achieve only around one third of the potential coverage simply due to speed limitations caused by slow capture rate. Failing to calculate this limitation prior to flight could drive insufficient overlap and a poor resulting imagery product.

The 6X Series Difference

When designing the 6X Sensor Series it was our utmost priority to simplify the mission planning process, effectively eliminating the need to calculate allowable ground speed, and maximize the potential coverage of an aerial drone system equipped with a 6X sensor. It was clear early on that to meet that objective we needed to dramatically increase the capture rate of the sensor relative to the industry standard. While GSD and overlap are parameters driven by the data analysis needs, the capture rate is simply a matter of what the hardware is capable of. Outfitting your rig with a camera with twice the capture rate means you can double your flight speed and thereby double your coverage rate (within the limitations of your drone system). With this goal in mind, we architected the 6X Series sensors from the ground up to pack them with processing power, streamlined the image pipeline, and maximized storage write speeds. The result is a powerful sensor series that delivers an unmatched sustained rate of up to 5 captures per second. The 6X Multispectral captures five synchronized monochrome 3.2MP images and an additional synchronized 20MP color image, while the thermal variants—6X Thermal and 6X Thermal Pro—offer four 3.2MP global shutter multispectral imagers, a 20MP RGB imager, and a thermal imager (320 radiometric FLIR Boson on the 6X Thermal and 640 radiometric FLIR Boson on the 6X Thermal Pro).

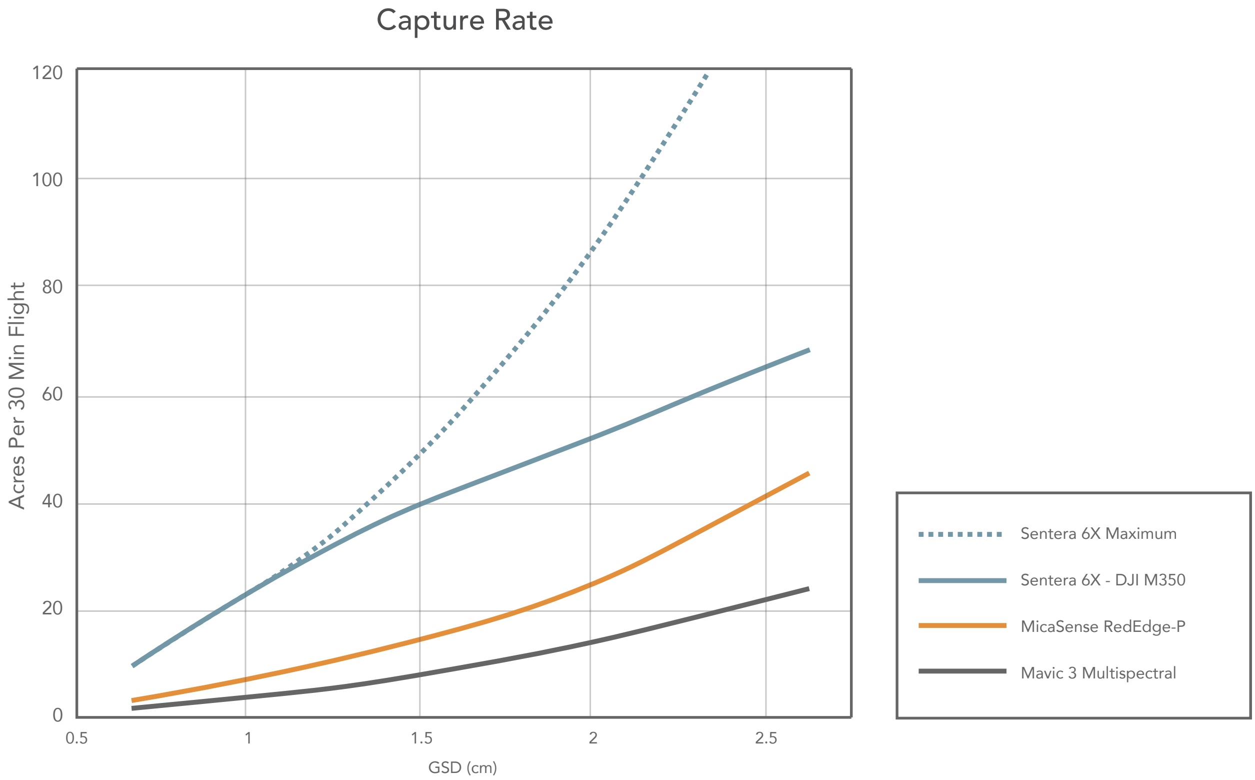
Now let's run our earlier mission parameters through the allowable ground speed calculator using the 6X Sensor:

Ground Speed = 2.5 cm/pixel * 1542 pixels * (1 – 0.75) * 5 Hz = 4819 cm/s = 48.19 m/s (107.80 mph)

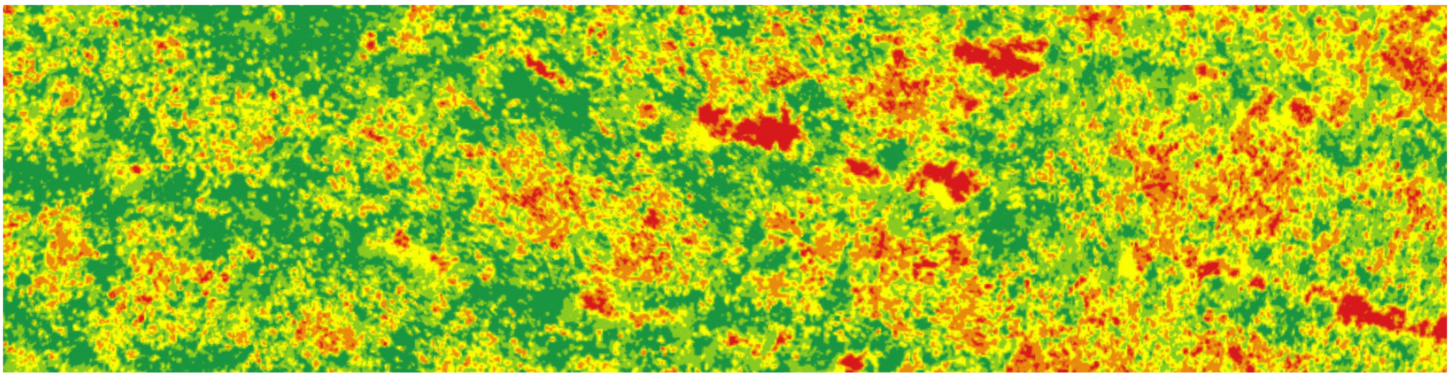
It would be virtually impossible to exceed this ground speed in any realistic drone operation. This is approximately double the speed that the DJI Matrice 350 can achieve (and near the speed of a typical small plane). Regardless of the drone's speed, tailwind, or mission parameters, it is unlikely an operator would ever need to consider capture rate driven limitations as part of their pre-flight planning.

What This Means for Land Coverage

Now, let's look at area coverage for a typical drone mission. We've established that the 6X Sensors enable flying as fast as the drone system will allow, but what does that translate to in terms of land acres? The plot below shows the number of acres that should realistically be mapped in a 30-minute flight at various GSDs. These assume 75% overlap for a stitched orthomosaic end product.



This plot shows how the coverage of the Sentera 6X series sensor installed on a DJI M350 drone (blue curve) clearly outpaces competing multispectral camera systems. For a mission collecting 2cm GSD photos, for example, a 6X sensor can map over two times the acres of a MicaSense RedEdge-P and over three times the acres of a DJI Mavic 3 Multispectral.



Of additional note is the dotted blue line which illustrates how much coverage the 6X system could be capable of were it not limited by the maximum airspeed of the aircraft. Clearly the Sentera 6X Sensor Series system has significant margin to accommodate faster aircraft or significant tailwinds without capture rate ever becoming a concern. Meanwhile, coverage rates for the competitors are limited by the sensor capture rate. These curves allow no margin and would require the proper calculations to be performed to determine allowable ground speed before flight.

Summary

The 6X Sensor Series: Why Increasing Capture Rate Matters demonstrates how the advanced capture rate across the Sentera 6X Series—including the 6X Multispectral, 6X Thermal, and 6X Thermal Pro—transforms mission efficiency by enabling faster flight speeds and expanding area coverage. Traditional sensors, limited by slower capture rates, restrict drone flight speed and reduce operational area per flight. In contrast, the Sentera 6X Series achieves up to 5 captures per second, allowing operators to maximize coverage, minimize time in the field, and eliminate complex ground speed calculations.

Discover more about the Sentera 6X Sensor Series at senterasensors.com/6X.

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6X Multispectral

5 Band Multispectral +
Hi-res RGB

6X Thermal Pro

4 Band Multispectral +
Hi-res RGB +
Hi-res Thermal LWIR

6X Thermal

4 Band Multispectral +
Hi-res RGB +
Thermal LWIR

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ABOUT SENTERA

Sentera is a leading innovator in drone sensor technology, dedicated to providing cutting-edge remote sensing solutions for various industries. Specializing in high-quality sensors, they are prioritizing precision, reliability, and performance in aerial data collection applications. Offering a diverse range of sensors, from advanced multispectral sensors to high-resolution cameras, Sentera delivers unparalleled accuracy and performance. Backed by industry expertise and a commitment to innovation, they empower clients in more than 45 countries to unlock new possibilities in data-driven decision-making. Visit senterasensors.com to learn more about their innovative sensor solutions.

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