Key Considerations for Selecting a Sensor for Aerial Image Capture in Agriculture

In the realm of precision agriculture, aerial image capture plays a vital role in obtaining high-quality data for crop monitoring, analysis, and decision-making. When selecting a sensor, there are several key considerations that need to be evaluated to ensure that the sensor does what it needs to do – whether it's focused on capturing RGB imagery, getting multispectral data, or evaluating performance via key vegetative indices.

Frame Rate

The frame rate of an aerial sensor refers to the number of images it captures per second. Higher frame rates can result in time savings for data capture, meaning you can capture imagery faster and accommodate more flights in the season. enabling the capture of rapid changes in crop conditions.

This is particularly important when monitoring dynamic agricultural processes such as plant growth, disease progression, or irrigation patterns. The frame rate can also impact how fast your drone can fly – the faster the frame rate, the higher speeds your drone can fly while still capturing high-resolution aerial imagery. (This also equates to less battery changes in the field per flight!)

Image Quality

Image quality is a crucial consideration as it directly affects the accuracy and reliability of data analysis. Factors to assess include spatial resolution, spectral range, and radiometric resolution:

- Higher spatial resolution provides finer details of crop health and facilitates the identification of smaller objects such as pests or weeds; in addition, by using higher resolution sensors, capture data with faster flights without impeding ground sampling distance (GSD).
- A wider spectral range enables the capture of more diverse information, allowing for advanced analysis such as vegetation indices. This may vary depending on whether you choose a RGB or multispectral sensor, each of which has their own benefits and drawbacks depending on what your unique use case may be.
- Higher radiometric resolution ensures greater sensitivity to subtle variations in reflectance, enhancing the precision of crop assessment.

Understanding which aspects are most important based on what you are trying to achieve will help to inform your sensor selection.

Co-registered Data

Co-registration refers to the alignment of data acquired from different lenses on the same sensor. If the sensor does not include co-registration, it means that the user will have to align – and crop – the images manually – which can be extremely time-intensive and prone to errors.

Multispectral images, for instance, can be captured by multiple lenses with one band per lens or by one lens with multiple bands.

Monochrome images captured by a one-band lens will need to be co-registered before they can be used in multispectral analytics. When using a sensor like the 6X from Sentera, onboard image alignment can co-register – and crop – the images as they are captured. Onboard image alignment will reduce processing time.

If imagery is captured by one lens with multiple bands, such as the Double 4K NDVI/NDRE, it doesn't need to be co-registered and can be used for multispectral analytics without any processing or cropping.

Shutter Type

The shutter type employed in an aerial sensor can significantly impact image quality.

Electronic shutters, which are also referred to as rolling shutters, capture images line by line, which can result in image distortion when capturing fast-moving objects or during high-speed flight.

Global shutters, which are also known as mechanical shutters, capture the entire image simultaneously, eliminating such distortions. Mechanical shutters provide a global or simultaneous exposure, capturing the entire image at once. This eliminates the rolling shutter effect seen in electronic shutters, resulting in distortion-free images even in fast-moving scenarios. However, because of the mechanism in which it triggers the image capture, mechanical shutters may have a maximum speed that slows down aerial imagery capture.

Sensor Size and Resolution

When evaluating sensors, it's important to note there is a distinction between camera, which includes the casing and all components, and sensor, which is the specific component which receives light data. Large sensor sizes allow for capture of more pixels and/or larger pixels; more pixels result in higher resolution, while larger pixels result in better performance in low-light conditions.

Higher resolution sensors capture finer details and facilitate precise analysis of crop health indicators, enabling more accurate decision-making. However, a trade-off here comes with price. Higher resolution sensors tend to be more expensive, and can be cost-prohibitive to users just starting to capture aerial imagery. Finding a balance on what makes the most sense based on the resulting analytics and use of data is important.

Pixel Size

Pixel size refers to the physical dimensions of each pixel on the sensor, and the size determines how many pixels can fit on a sensor. For instance, if you decrease the size of pixels in a sensor by 50%, there is now room for twice as many pixels – which means the spatial resolution will improve. Physical pixel size on a sensor affects the noise in your image – meaning that the larger the pixel size, the less noise in your image.

Spatial resolution is determined by the number, and ratio, of pixels on your sensor. The smaller the pixel size, the higher spatial resolution. This equates to capturing finer details in the imagery. The balance between pixel size and spatial resolution depends on the size of your sensor, and often equates to how much one is willing to invest in a sensor solution.

Bit Depth (Radiometric Resolution)

The number of bits used to represent the color or grayscale information in each pixel can impact the quality and accuracy of imagery, often referred to as the radiometric resolution. Higher bit depths provide a broader range of colors or grayscale values, enabling more accurate and detailed representation of crop characteristics. This is particularly important when capturing subtle variations in vegetation or differentiating between different crop stress levels.

Selecting the right sensor for capturing aerial imagery in agriculture requires careful evaluation of various factors. Considering these aspects, key use cases, and how the data will be used, will ensure that the imagery captured will be accurate and reliable for crop monitoring and analysis.

Find your ideal sensor by visiting **sentera.com.**