



# Product Guide

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AGRICULTURAL DATA SYSTEMS

SlantRange systems combine powerful analytics tools with accurate and reliable aerial crop sensors to deliver actionable and immediate data for agriculture.

## Accurate, Powerful Spectral Measurement Systems

We introduced and patented the industry's first multispectral sensing systems with onboard sunlight calibration in 2014 - dedicated to delivering reliable data on crop conditions from virtually any drone.

In 2017, we introduced the industry's most powerful onboard processing capability with a new Qualcomm Snapdragon processor for more efficient workflows. A new integration with DJI Matrice 200 Series drones delivers in-flight data updates for even more efficient operations in an enterprise-level package.



## Immediate Analytics. Anywhere.

We've architected a better approach to agricultural analytics - all to make data collection, processing, and delivery more efficient and more scalable.

- 20% image overlap requirement increases your area coverage by up to 4x per flight
- Radically more efficient processing algorithms enable on-site data delivery in minutes, no internet or cloud required
- Innovative new methods to improve measurement accuracy over satellite and manned aircraft systems
- New classes of data types that are only possible from low-altitude drones to address specific agronomic questions across multiple crop types

Altogether, SlantRange sensing and analytics tools deliver an entirely new approach to crop measurement and data delivery.



# Trust

THE FIRST IN DATA ACCURACY



Good agricultural decisions and forecasts depend upon accurate information, so we make reliable measurements the cornerstone of product design and a continuing area of innovation.

## Accuracy in Measurement

Spectral measurement systems determine plant health by quantifying how much sunlight is absorbed by the different pigments present in the leaf.

If the lighting conditions change because of cloud conditions or time of day or season, your measurements will change - leaving you with data you can't trust. Without proper correction, trend analysis and forecasting become highly inaccurate.



Historically, this has been corrected by placing "calibration panels" on the ground with the crop. But this is a cumbersome approach, unscalable for large operations, and only works when the panels are in view.

To address this, we introduced an innovative solution with the first onboard, Ambient Illumination Sensor back in 2014 – so all of your measurements can be trusted. No calibration panels necessary.

SlantRange's patented Ambient Illumination Sensor (AIS) corrects data for changing sunlight conditions.

## Accuracy in Analytics

Accuracy involves more than correcting for sunlight conditions. It also involves carefully isolating crop plants for measurement from other objects in the field.

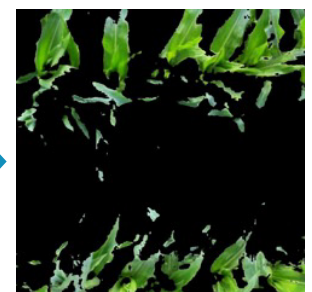
For example, a major problem with satellite and manned aircraft data is that soil and plant measurements get mixed together because their image resolution is insufficient to separate them - and that results in errors.

SlantRange sensors are designed with resolution high enough to separate these signals. Our Smart Filtering™ analytics can spatially and spectrally separate crop vegetation signals from soil, specular reflections, shadows, or other signal types to get the most accurate measurements possible.

RAW IMAGE



SMART-FILTERED IMAGE



SlantRange's Smart Filtering™ & Smart Compression™ algorithms achieve new levels of data accuracy through selective measurement (US patent 10,217,188).

# Efficient

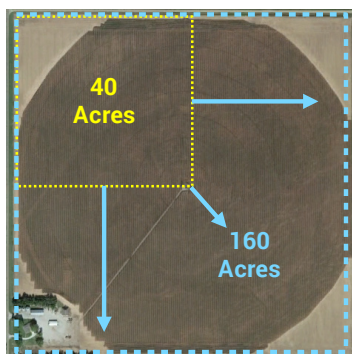
## THE FIRST IN DATA AVAILABILITY

To eliminate data collection and processing bottlenecks we've developed new technologies that dramatically reduce the time spent collecting and processing data so results can be delivered in minutes, anywhere.

### 4x Reduction in Collection Costs

For drone-based agricultural surveys, your costs are driven by your area coverage rate - how many acres can you cover in an hour while still delivering the resolution you need to get the job done.

In 2014 we introduced a radically more efficient approach to image stitching, one that can produce reliable, robust data maps with only 20% overlap between images compared to traditional methods which require up to 80%.



Why does that matter? Reducing your overlap by 4x can **increase your area coverage rate by 4x**. Put another way, that means you can survey a field 4x faster. That means **your data collection costs go down by 4x - all by using a data processing technique designed specifically for agriculture.**

### No Network? No Problem

There's another benefit to low-overlap processing - decreasing your overlap by 4x decreases your redundant raw data volume by 16x. Combined with a more efficient stitching algorithm, that means all your processing can be done within minutes, right in the field.

*Why does that matter?*

- Crop data has the highest value when it can be delivered and acted on quickly
- Not everyone has access to high-powered computing systems, or the high-speed internet connections required to get raw data into the cloud
- You need to be done with your job in one trip to the field.

### SLANTRANGE - 30 MINUTES



### TRADITIONAL METHODS - HOURS OR OVERNIGHT



● Preflight ● Collection ● Processing

**Times shown to collect 5 cm resolution, 6-band multispectral imagery and deliver NDVI results on a 160-acre field @ 120 m AGL, 20 m/s flight speed, in minutes.**

# Efficient

## WORKFLOWS THAT WORK

From collection to action, SlantRange simplifies the information management challenges presented by airborne agronomy.

### Collect

SlantRange sensor systems can be used on virtually any commercial drone aircraft.

Installation kits are available for many common platforms and the sensor includes its own navigation system, so it knows how to manage its own configuration.

Just mount it, apply power, and go.

### Analyze

SlantRange's industry-leading "SlantView" analytics toolset delivers data within minutes, right in the field, with just a few clicks. No need to connect, no need to go back to the office.

### Decide & Act

Your SlantRange data is portable. Whether you want to port your aerial data to your favorite farm data management platform or run your own imagery analytics, the tools are available to you.



# Spectral Measurement Systems

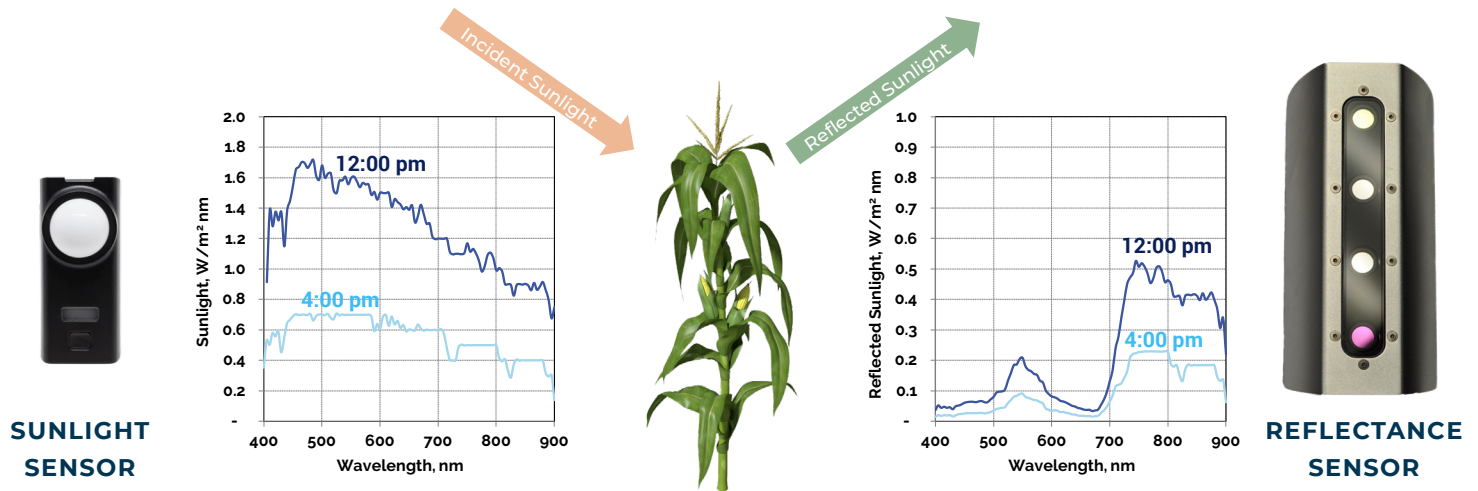
THE STARTING POINT FOR MEANINGFUL DATA ANALYTICS

Your data is only as good as the sensor you use to collect it.

We've engineered SlantRange multispectral sensor systems to ensure image quality while remaining spectrally true, introducing the industry's first onboard sunlight calibration capability in 2014.

US Patents 9,470,579 , 9,791,316 and 10,217,188

Australian Patent 2015315327 B2



## Two Sensor Models for Flexibility & Efficiency

SlantRange sensors are available in two models: the 4P and 4P+.

The 4P sensor delivers industry-leading spectral and spatial resolution with integrated sunlight calibration, RGB color, and modular add-on capability.

The 4P+ is the most advanced multispectral sensor in its class with the 2x the spatial resolution as the 4P and comes with all the features of the 4P.



## Now With Modular Capability

They are both designed with modular capability and can be integrated with our all new Precision Navigation Module. This new module allows you to get more precise measurements for advanced data solutions.

# Spectral Measurement Systems

## SPECIFICATIONS

4P

4P+



Spatial Resolution (GSD @100 m AGL)	4.0 cm	2.2 cm
Spectral Channels	6	6
Processor Type	Snapdragon 801	Snapdragon 801
Processor Speed	Quad-Core 2.26 GHz	Quad-Core 2.26 GHz
On-Board RAM	2 GB	2 GB
Sensor Type	Si CMOS	Si CMOS
Available Spectral Range	410 - 950 nm <sup>1</sup>	410 - 950 nm <sup>1</sup>
Band Positions	470, 520, 620, 670, 720, 850 nm <sup>1</sup>	470, 520, 620, 670, 720, 850 nm <sup>1</sup>
Shutter Type	Global	Global
Positioning & Pointing	GPS / IMU with EKF	GPS / IMU with EKF
Recommended Image Overlap	20% <sup>2</sup>	20% <sup>2</sup>
160 Acre Survey @ 2.0 cm GSD, 12 m/s (rotary)	50 minutes	32 minutes
160 Acre Survey @ 120 m AGL, 20 m/s (fixed)	16 minutes	18 minutes
160 Acre Survey @ 120 m AGL, 12 m/s (rotary)	22 minutes	24 minutes
Available Data Layers	All SlantView	All SlantView
In-Flight Data	Available with DJI SKYPORT Integration	Available with DJI SKYPORT Integration
Precision Navigation Module	Available	Available
Removable SD Card Storage	64 GB (4 hours)	64 GB (2 hours)
Output Formats	KML, SHP, GeoTIFF	KML, SHP, GeoTIFF
Size (Vegetation Sensor)	14.6 x 6.9 x 5.7 cm	14.6 x 6.9 x 5.7 cm
Size (Ambient Illumination Sensor)	8.1 x 3.5 x 1.7 cm	8.1 x 3.5 x 1.7 cm
Weight	350 g	350 g
Power	12 W @ 9.0 - 28.0 VDC	14 W @ 9.0 - 28.0 VDC
Aircraft Capability	Many, call for details	Many, call for details

<sup>1</sup> Band positions are selectable at time of order between 410 - 950 nm. Some conditions apply, please call for details.

<sup>2</sup> 20% image overlap for SlantView analytics only.

# SlantView Analytics

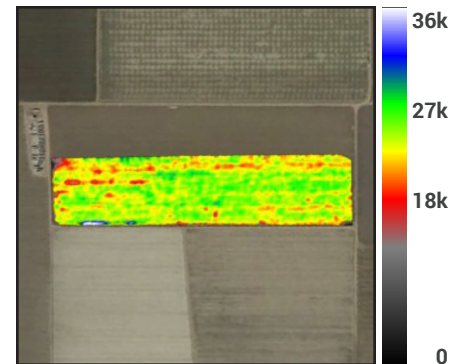
## TOOLS FOR POST-EMERGENCE SURVEYS

SlantView transforms your 4P Series sensor imagery into valuable new classes of data through rapid, in-field analytics.

Our post-emergence surveys include measures of stand count statistics and weed pressure to support critical early season decisions and longer term yield prediction.

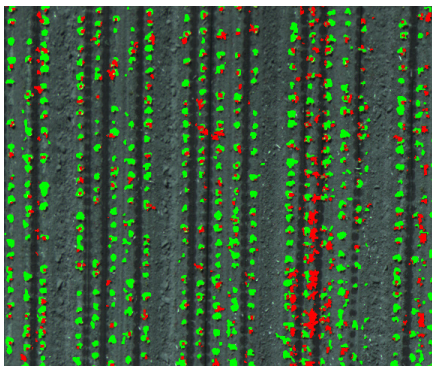
Originally developed for use in corn crops, these algorithms have been adapted and extended for use in new crop applications including soybean, wheat, cotton, and multiple specialty fruit and vegetable crops. Please contact us for details on your application.

Some data products are limited to specific crop types, stage of growth, and flight characteristics.



### Plant Population (Stand)

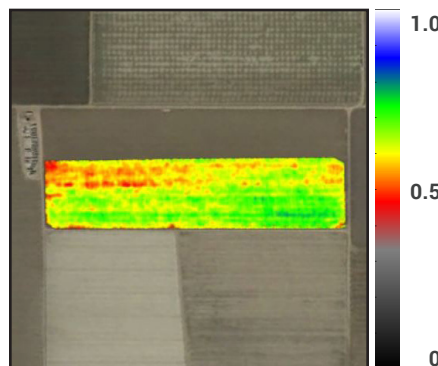
SlantView's algorithms detect each plant in the field and segregate them into crop and weed populations for accurate measurement. Populations are indicated in plants per acre to assist with critical replant decisions or to help assess yield potential.



### Weed Density

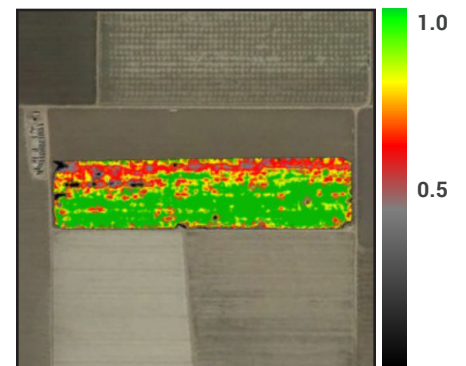
SlantView exploits the spectral and spatial characteristics of differing plant classes to detect weed pressure in early-stage row crops.

Weed densities are indicated according to the fraction of local field area they cover. This data layer is designed for use in specific row crops under pre-defined conditions of measurement. help assess yield potential.



### Plant Size

The Plant Size data layer has multiple uses for different crop applications. For broad-acre row crops like corn and cotton, plant size can be used to assess crop maturity in the early stages of development. In specialty produce applications, this layer is commonly used to help estimate yield.



### Emergence Fraction

For crops with very high planting densities (e.g. soybean, wheat), the Emergence Fraction data layer provides a tool to help assess population. In contrast to the Plant Population layer, Emergence Fraction provides a measure of row gaps.



# SlantView Analytics

MEASURING CROP DEVELOPMENT IN ENTIRELY NEW WAYS

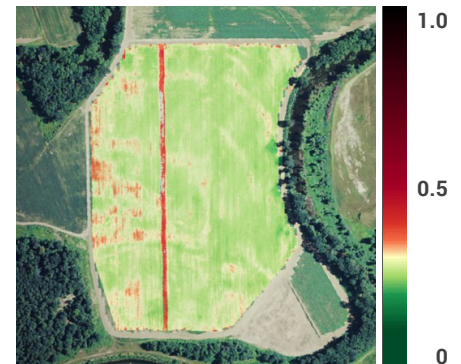
For crops developing past emergence, SlantView includes multiple data layers that each provide a unique measure of status for growers.

Contact us for details on how these data layers may apply to your crop and specific application.



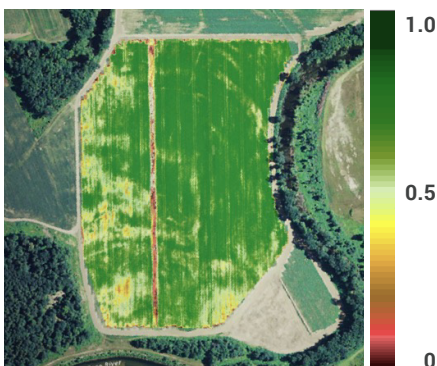
## Vegetation Fraction

The Vegetation Fraction layer segments the crop canopy from bare soil or other field residue to measure canopy closure. This layer is valuable for locating mis-planted or thin coverage areas, or for measuring damage from weather or other events.



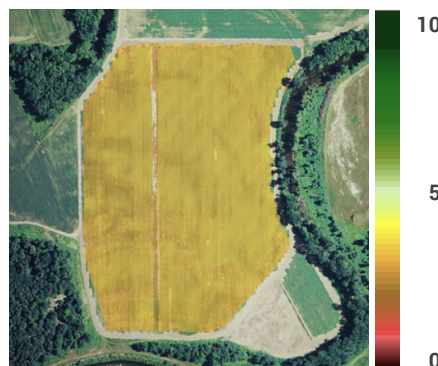
## Quad-Band Vegetation Stress

This data layer combines four spectral bands across the visible and near infrared to provide a more sensitive measure of vegetation stress than simple 2-band NDVI. This enables earlier detection of nutrient or pest problems for more effective treatment.



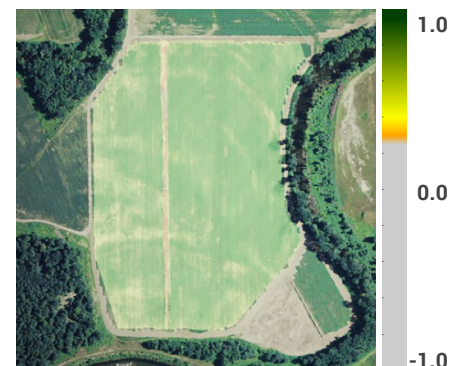
## Yield Potential

Multiple crop metrics are combined to assess future performance in the Yield Potential layer. This is the producer's highest level assessment tool and includes the contributions of numerous independent factors that ultimately contribute to yield.



## Chlorophyll Index

The Chlorophyll Index layer uses algorithms established in academia to estimate the relative chlorophyll content in a crop. This data layer is valuable for tracking chlorophyll content independent of other crop metrics.



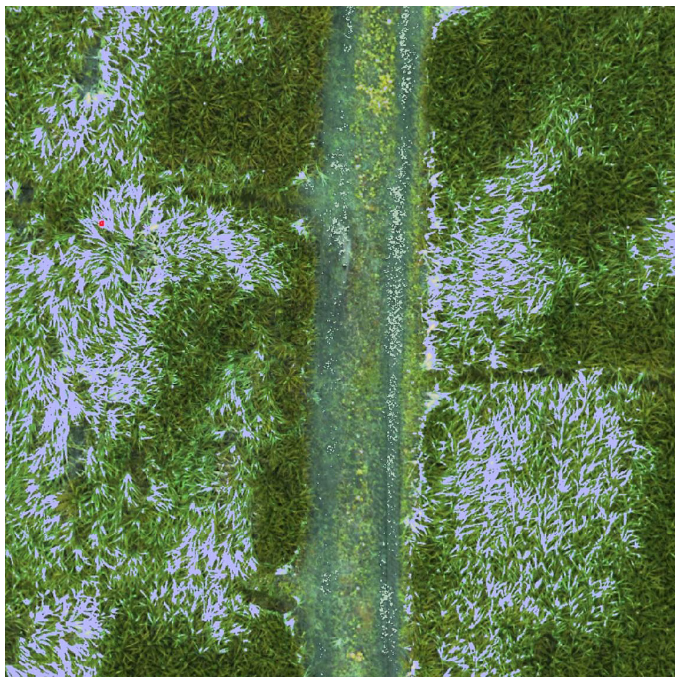
## Multiple NDVI Variants

SlantView also produces traditional vegetation indices including NDVI normalized against red, green, and red edge bands.

# SlantView Analytics

TRAIN YOUR DRONE TO SUPPLY CUSTOMIZED DATA

## LODGED PLANT DETECTION



### The first agricultural analytics you can train yourself with SlantRange Smart Detection™!

We recognize that grower information needs are incredibly diverse, and that generic measures such as NDVI don't always deliver.

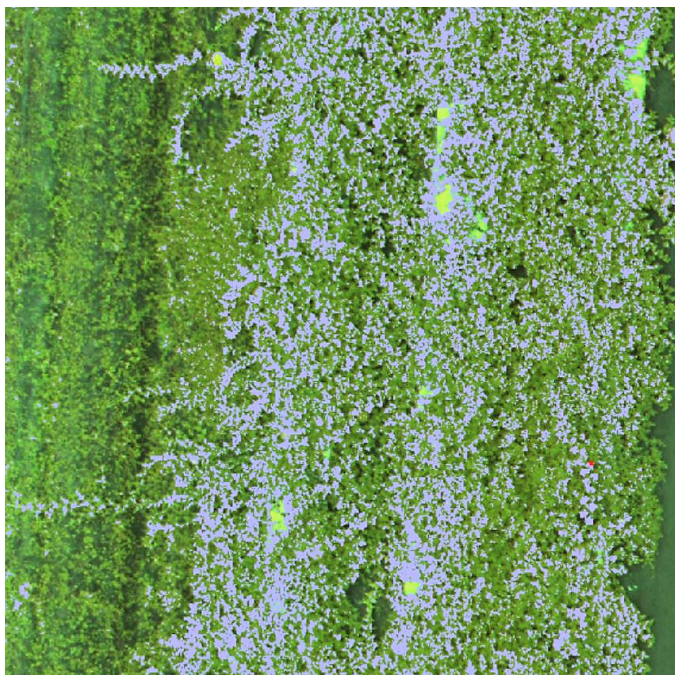
In 2016, we introduced an incredibly powerful new tool for customizable data layers that allows you to teach the software to find what you're looking for. The potential applications are immense.

- *How large is my greensnap/lodging problem?*
- *Which stress areas are due to this infection?*
- *Where is a particular weed emergent?*

These are just a few examples of how SlantView users are training their software to their own needs.

*What is it you're looking for?*

## WEED DETECTION

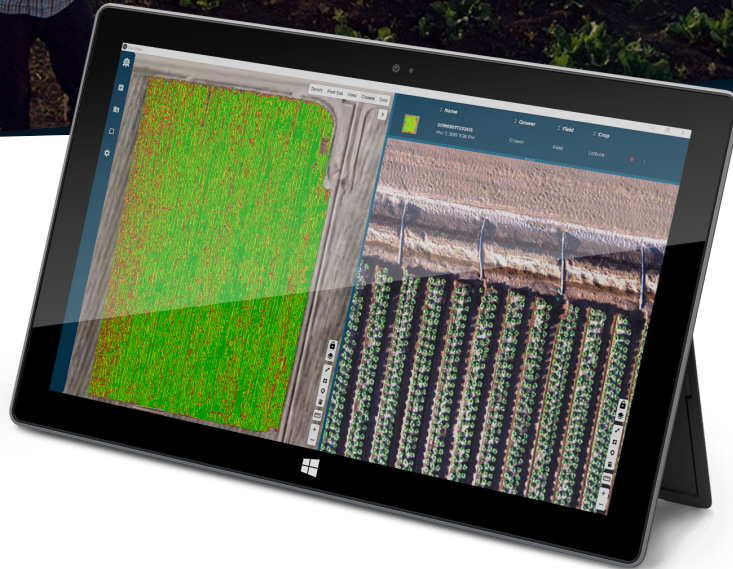


## SOIL MOISTURE VARIABILITY



# SlantView Analytics

ANALYTICS BUILT FOR AGRICULTURE



## SLANTVIEW PRODUCT FEATURES:

- ✓ NDVI (GNDVI, RNDVI, RENDVI)
- ✓ Vegetation Stress
- ✓ Population Density<sup>1</sup>
- ✓ Population Size Distribution<sup>1</sup>
- ✓ Emergence Fraction<sup>1</sup>
- ✓ Weed Coverage<sup>1</sup>
- ✓ Vegetation Fraction
- ✓ Chlorophyll Index
- ✓ Yield Potential
- ✓ User-Defined Smart Detection™
- ✓ Custom Analytics Toolboxes

<sup>1</sup>Subject to crop type and stage of growth. Please call for details.

## EACH PLAN INCLUDES:

- ✓ Unlimited Processing
- ✓ No Per Acre or Map Charges
- ✓ Unlimited Installations
- ✓ Free Software Updates
- ✓ Free Customer Support
- ✓ No Network Connection Required
- ✓ Export Calibrated Reflectance Images
- ✓ Instant Coverage / Quality Check
- ✓ Process Images with 20% Overlap
- ✓ Rapid In-Field Processing
- ✓ Annotations
- ✓ Management Zones
- ✓ Customizable Statistics Reports (PDF)



**For more information contact us at:**

[sales@slanrange.com](mailto:sales@slanrange.com)

+1 858 434 1037

**Or visit us at:**

4901 Morena Blvd., Suite 701

San Diego, CA 92117

[www.slanrange.com](http://www.slanrange.com)