IP-S2

3D Mobile Mapping System

- **Capture Geo-referenced, Time-Stamped Point Clouds and Imagery**

- **3D Scanning of Roadside Features**

- **360° Camera for Spherical Image Capture**

- **Dual Frequency GNSS Tracking**

- **High Accuracy 6-Axis IMU Integration**

- **External Wheel Encoders for Odometry and Tracking**

- **Quick and Easy Setup**

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IP-S2
3D Mobile Mapping System

Topcon's IP-S2 Mobile Mapping System overcomes the challenges of mapping 3D features at a high level of accuracy. Accurate vehicle positions are obtained using three technologies: a dual frequency GNSS receiver establishes a geospatial position; an Inertial Measurement Unit (IMU) provides vehicle attitude; and connection to the vehicle CAN bus or external wheel encoders obtains odometry information. These three technologies work together to sustain a highly accurate 3D position for the vehicle even in locations where satellite signals can be blocked by obstructions such as buildings, bridges, or tree lines.

The IP-S2 is modular and can be configured with multiple sensors. The standard system includes three high-resolution LiDAR scanners oriented to cover the road surface and adjacent buildings up to 30 meters away. A high-resolution digital camera can be added providing 360 degree spherical images at fixed distance intervals. Other sensors can be integrated for total flexibility of system configuration, additional range or scan density, and support for a wide variety of applications. All sensor inputs are recorded and time stamped to a common clock driven by the IP-S2.

Geoclean, Topcon's powerful software, will post-process the geo-referenced LiDAR and/or digital imaging data into a viewable 3D image representation which can then be exported to industry standard formats. GNSS data can be post-processed against a reference station for higher accuracy. Optional desktop software includes a viewer enabling the user to review geo-referenced point cloud and camera information, label features and assets, make measurements and export data into GIS programs.

The IP-S2 quickly provides high accuracy data and dynamic imaging for any mapping project. The vehicle-mounted system can map data at normal travel speeds for roadway surface condition assessments and roadside feature inventories. Safety is increased by removing pedestrians from the travelled lanes. Other applications include pipelines, railways, utility corridors, and waterways. Homeland security and disaster management can benefit from the IP-S2's ability to collect high accuracy GIS information simply and quickly. The IP-S2 is perfect for 3D street-level city mapping and provides essential information for these applications.

IP-S2 Features
- Geo-referenced spherical imagery produced
- Sensor fusion software provides colorized 3D models of the environment
- Viewer software to identify and label assets and features
- Easily export to industry-standard formats
- Accurate vehicle position and attitude
- Flexible, custom sensor integration
- Factory calibrated, integrated system
- Cost effective, turnkey solution

The IP-S2 is a modular system – sensors can be added based on user requirements.

Laser Scanners (optional)
Laser scanners capture high-resolution 3D point clouds of roadside features regardless of lighting conditions. Included PC software projects sensor data into 3D global coordinates with accurate time-stamps. Geo-referenced panoramas can be produced for visual inspection and detailed analysis such as time-dependent changes in profile, geometry and location.

IP-S2 Box
The IP-S2 Box determines precise vehicle position and attitude on a real-time basis using multiple sensors. An integrated dual frequency GNSS receiver tracks both GPS and GLONASS signals expanding the operation area. An inertial measurement unit (IMU) constantly monitors vehicle motion and attitiude, allowing the IP-S2 system to track the vehicle position even when driving near obstructions or through tunnels where satellite signals can be blocked.

Vehicle Wheel Encoders
Vehicle wheel encoders further enhance positioning accuracy and reliability. Retrofitted to rear wheel axles, the encoder detects rotation of each wheel. Vehicle attitude can be computed even more accurately by comparing difference in rotation speeds between two wheels. CAN bus vehicle wheel data can also be used, if available in the vehicle.
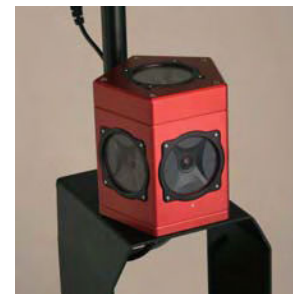
360° Digital Camera (optional)
The 360° digital camera continuously captures spherical video imagery. A combination with point cloud data significantly enhances the quality of the 3D data and the resulting data analysis.
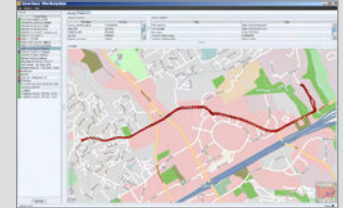
IP-S2
Project Workflow

Drive vehicle through route

Full Color Point Cloud

Vehicle Trajectory

The IP-S2 Software Provides User-friendly Data Collection and Processing Solutions

IP-S2 Dashboard-Data Collection Software

The IP-S2 Dashboard operates on a PC web browser. This software allows the user to easily control and configure the IP-S2 Box with all connected sensors. It also controls field data capture, storage and display.

Geoclean – Post Processing Software

GNSS Post Processing
Geoclean determines the vehicle positions by means of continuous kinematic processing using the vehicle mounted GNSS receiver and fixed base station data.

Hybrid Analysis for Vehicle Attitude and Location
By integrating GNSS data with IMU and wheel encoder data, Geoclean determines a vehicle attitude correlated to accurate geographical locations.

Combining Images and Point Clouds
Geoclean software precisely combines imagery and scanned data to generate insightful full-color point clouds.
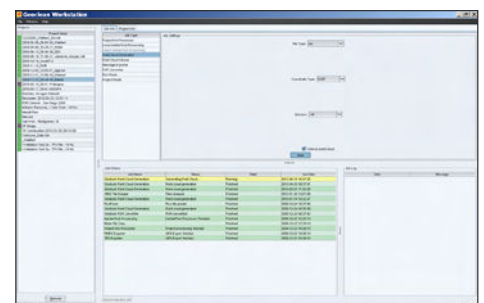
Coordinate Conversion Module
Geoclean software converts WGS84 coordinates into local coordinate systems applicable in GIS and CAD projects.

- Projection and datum conversion
- LiDAR point cloud (.las) support
- ESRI ArcGIS .shp, .e00, .gen support
- AutoCAD .dwg and .dxf support
- .kml and .gml support
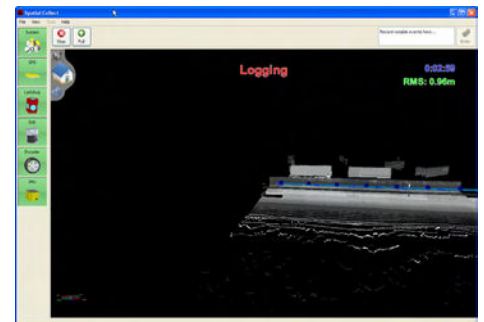
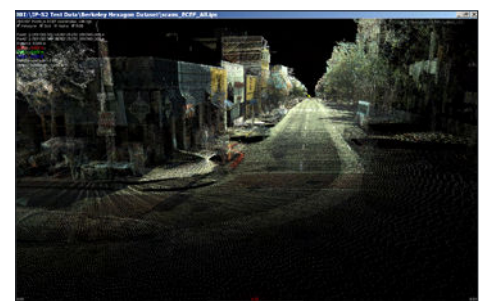*IP-S2 Dashboard*

Geoclean Post-Processing Software

Image and Point Cloud in Geoclean Software

Utilities

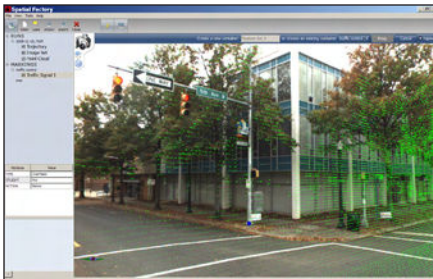GIS Asset Management

Transporation

Full-color, high-resolution Point Clouds Dramatically Increase Efficiencies in the following areas:

Utilities

Topcon's IP-S2 effectively addresses utility infrastructure needs such as mapping electric and telephone grids in both urban and rural areas. In instances where it has been cost prohibitive to collect location and attribute data due to the time consuming, labor intensive nature of traditional data collection techniques, the IP-S2 now provides a fast and affordable means to create accurate map data. The amount of ground that can be covered in a day is greatly increased and the number of personnel required to do the job decreases in magnitude. The opportunity for human input error is also greatly decreased. Having expansive and accurate maps and pictures of these utilities benefit the management agencies in many ways such as making quick maintenance decisions right from the office saving field time and costly mistakes.
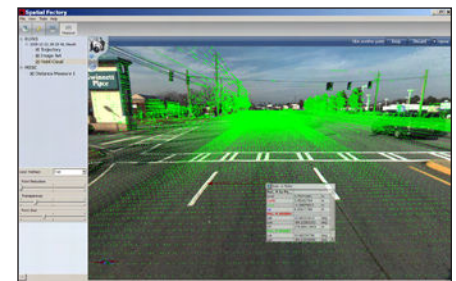

IP-S2 point Cloud with Image Overlay

IP-S2 point Cloud with Image Overlay

GIS Asset Management

Creating a GIS databse of assets can be an overwhelming task as the number of items to map can be immense. Topcon's IP-S2 can simplify the task by obtaining data on all assets in a particular area as the truck drives through at normal highway speeds. In addition to location information, asset managers can view descriptive details of the assets using the colorized point cloud image overlay. It is not necessary to predefine the attribute values needed in the GIS database before fieldwork. All information is in the IP-S2 database and can be extracted at any time after the field work is complete. IP-S2 can even be exported to a handheld device to navigate to selected locations for update and maintenance.

Transporation

Using GPS alone for data collection of transportation facilities such as roads, highways, tunnels and overpasses can often pose problems as GPS signals are blocked by nearby buildings and structures. Topcon's IP-S2 becomes a great solution for transportation mapping as the combination of GPS and IMU sensors allows for continued accurate position updates in GPS outage areas. The IP-S2 truck can also get data under overpasses and in areas where aerial flyover methods produce no data. A combination of the multiple sensors and the speed and accuracy of the IP-S2 make the system a perfect fit for transportation mapping applications such as highways, railways and roads.

IP-S2 point Cloud with Image Overlay

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The plug-and-play flexibility of the IP-S2 system allows for your choice of sensor combination to accurately collect just the information you need in a timely manner from the safety of your vehicle.

IP-S2

GNSS Antenna

360 Degree
Digital Camera

IMU

Laser Scanners

Odometry Data from CAN Bus
or External Wheel Encoders

Web Browser Interface for IP-S2 Data
Logging and Application Software

Universal Car Mount
also available

Integrated, Calibrated Mounting Solution

Turnkey solution delivered fully-calibrated and ready to deploy by end-user. Factory calibration using advanced machine learning algorithms enables system to automatically extract system parameters and tunes the filter for optimal performance.

Supports Multiple Laser Scanners and Other Sensor Integration

With flexible sensor and interface options, powerful automated calibration and high performance filtering the IP-S2 enables applications which demand high precision positioning in diverse and demanding environments. Multiple LiDAR and camera options are supported and additional ports allow for synchronization of custom sensors.

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IP-S2 SPECIFICATIONS

GNSS Component[1]

Channels	40 channels, all-in-view, L1
	L1 GPS, L1/L2 GPS, L1/L2 GLONASS,
	L1/L2 GPS + L1/L2 GLONASS
	WAAS
Low Signal Tracking	Down to 30 dBHz
Cold Start	< 60 sec
Warm Start	< 10 sec
Reacquisition	< 1 sec
Vibration	Up to 30 g's of dynamic
Advanced Firmware Function	Multipath Mitigation, Co-Op Tracking
Real time Position & Raw Data	Up to 20 Hz update rate
RTCM SC104 v2.1 and 2.2	Input/Output
NMEA 0183 v2.1, 2.2, 2.3 & 3.0	Output

High-Accuracy IMU

Type	Honeywell HG1700
Data Rate	100Hz
Gyro Bias/Drift Rate	1°/hr, 3°/hr

Power

Input Supply Voltage	10-18V providing 10 amps max current (at 12V)

Physical

Size	7.87" x 9.06" x 4.33" (IP-S2 Receiver)
	23.04" x 22.84" x 26.50" (IP-S2 System)

Weight	8 lbs (IP-S2 receiver)
	50 lbs (IP-S2 system)

Environmental

Temperature Operating Storage	-30° to +60°C -40° to +70°C

I/O Ports

CAN Bus	OBDII - MOLEX-9 Pin
Encoder	TTL quadrature input
Ethernet	100 Base-T
USB 2.0	Host input/output
RS-232-/422	Up to 2 Mb/s
High-speed Digital I/O (x4)	LVDS 400 Mb/s

Standard Laser Scanner Configuration

Type	Two (2) SICK™ LMS 291-S05,
	One (1) SICK™ LMS 291-S14
Scanning Angle/Angular Resolution	
- LMS 291-S05	180°/1° Angular Resolution
- LMS 291-S14	90°/0.5° Angular Resolution
Typical Measurement Accuracy	±45mm*
Typical Range	30m (Max. 80m with 10% reflectivity)
Date Rate	75 Hz sweep

Vehicle Position Metrics*

Outage Duration	System	Position Error (m)		Attitude Error (Degrees)		
		2D	H	Roll	Pitch	Heading
0 s	IP-S2 (AG58 - 1°/Hr)	0.015	0.025	0.020	0.020	0.040
	IP-S2 (AG60 - 3°/Hr)	0.015	0.025	0.025	0.025	0.050
15 s	IP-S2 (AG58 - 1°/Hr)	0.020	0.025	0.020	0.020	0.045
	IP-S2 (AG60 - 3°/Hr)	0.025	0.025	0.025	0.025	0.060
30 s	IP-S2 (AG58 - 1°/Hr)	0.040	0.030	0.025	0.025	0.050
	IP-S2 (AG60 - 3°/Hr)	0.055	0.030	0.030	0.030	0.075

Outage results are determined by calculating the RMS of the maximum errors for a minimum of 30 outages. Each outage was selected such that at least 100-second high-accuracy GNSS outputs (fixed ambiguities) were available before and after the outage. All results are based on a forward-and-backward smoothed solution with inertial and wheel sensor data input. Metrics were obtained using PPK (Post Processing Kinematic) solution.

* Under optimal conditions

[1] GNSS capable. Currently offered in the GPS only version.

For further information on the IP-S2 product, please email:
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It's time.

topconpositioning.com

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