



VIVAX
METROTECH

Spar 300 & Spar 300 PPS

Survey and Mapping Underground Utilities



Utility Survey for Trimble Access™

www.vxmt.com | www.vivax-metrotech.com



Geospatial Underground Utility Survey



REMOTE POSITION SENSING

In Line Mode, precise magnetic field measurements (regardless of orientation or relative position to the utility) permit model-based estimates of offset, depth, and impressed AC current. Sonde mode detects the offset, depth, and range to a battery-operated point source.

GEOSPATIAL POSITIONING

The Trimble Access-based Utility Survey software integrates seamlessly with Trimble GNSS receivers, merging measured offsets to the utility with the geospatial position of the aboveground spar. Elevation, Easting, and Northing are directly recorded in a Trimble Access "job" file. Each utility position may be logged upon command, or as a semi-automatic stream, and coupled with the estimated accuracy. Aboveground points can be measured and coded as per the normal field data collection process.

WIRELESS INTEGRATION

The system relies on Bluetooth and IEEE 802.15.4 wireless technology to integrate GNSS, the host computer, and dual-spar tracking modes.

SELF-ORIENTATION

The Spar 300 includes on-board orientation sensors including a 3-axis digital compass, 3-axis accelerometer, and (optionally) a dual antenna RTK-based precision heading measurement.



Underground utility asset survey can now use the same trusted methods, and with similar quality metrics as for corresponding aboveground assets. The new Spar 300 is a precise utility surveying system that collects positions in your site coordinates, in a package that easily adapts directly to a range pole, ATV, riverboat, or push cart. With conventional handheld locating equipment, logging underground position information of pipelines, cables, and ducts has required cumbersome integration of GNSS receivers and locating equipment using special brackets and cables. Now, the Spar 300 continuously logs the utility depth and offset, along with statistical confidence and automatic offset calculations. Over a Bluetooth or USB link, the instrument outputs the 3-D positions to a Trimble TSC3 or Tablet for real-time display on the Trimble Access™ map, independent of its own perspective with respect to the utility or the GNSS antenna. When a complex locate scenario is encountered, as can occur when several utilities are co-located within a common right-of-way, the Spar 300 applies

automatic tolerance masks to the position data, flagging these areas on the map.

Casual contact to the underground utility line is maintained during a survey. The system logs geospatial positions and expected error of the utility regardless of the perspective of the spar relative to the line.

Accurate utility infrastructure geopositioning leads to long term cost savings, since an electronic record is available when needed for repair and maintenance of the line. Positions, with both horizontal and vertical precision, are continuously plotted in coordinates, and easily exported to the GIS, CAD, or modeling environment. The Utility Survey module for Trimble Access supports a variety of external Trimble GNSS receivers.



Spar Position

- A 
- B 
- C 
- D 
- E 

Utility Position

- A 
- B 
- C 
- D 
- E 

Decreasing confidence

FieldSens Technology is based on the joint optimization of data from many sensors against a physical model of the magnetic field expected from a utility line. The method minimizes the need to bring the measurement equipment to specific points related to the utility cable or pipe in order to validate position. Using two 3-D magnetic field sensors, a triaxial accelerometer and digital compass, the Spar 300 estimates the 3-D offset and orientation angles to the underground utility regardless of its position in the radiated field.

FieldSens View ↔ Trimble Access™

TRANSMITTERS

The Spar is compatible with many existing locating transmitters, and is offered with an optional Very Low Frequency transmitter for maximum accuracy in direct connect mode. Passive AC can be optionally traced.

FIELDSENS VIEW

Manages the Spar hardware, and performs the coordinate rotations that combine the Spar-centric offset measurements with the geospatial utility position.

MODEL OPTIMIZATION

The Spar includes a numeric processor that performs many iterations per positioning result, wherein each represents the best match of the measured sensor data to a physical model of the magnetic field. A unique model is used for each of the two main targets (Line or Sonde) detected by the Spar 300.

TRIMBLE ACCESS

Designed to fully support everyday field data collection, including topographic surveys, staking, control and more; Trimble Access offers a familiar easy-to-use interface to ensure a short learning-curve. Trimble Access for General Survey supports the full range of Trimble GNSS and optical sensors, plus robotic radio connections. Simply choose the Trimble controller that best meets your surveying needs.

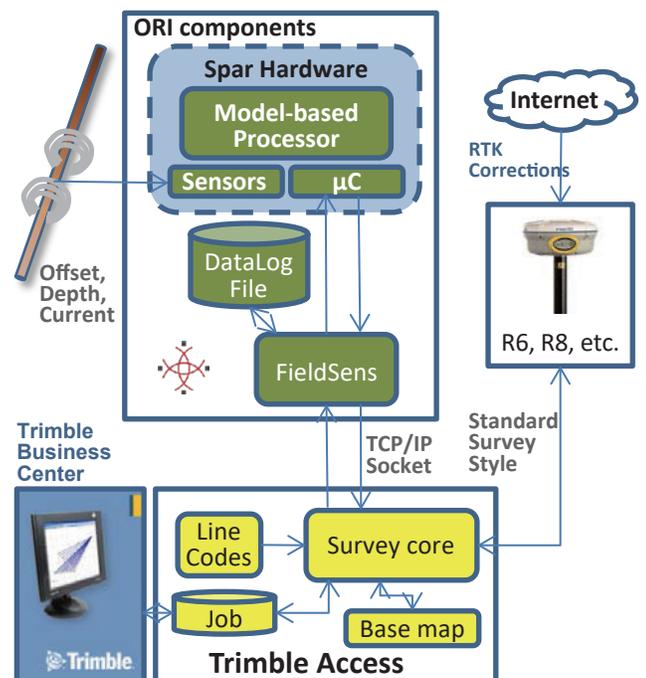
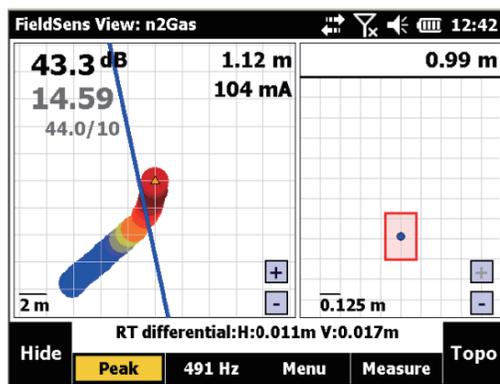
MULTI-ANTENNA HEADING

Again with respect to Dual-Spar measurements, an optional two-GNSS antenna true heading measurement results in improved accuracy of underground static point positions, or dynamic sonde tracking, using ORI-supplied magnetic dipole transmitters.



Spar Hardware and model-based FieldSens software integrate seamlessly with Trimble GNSS receivers and robotic total stations within an Access-based workflow. Any external GNSS receivers supported by existing Survey Styles can be used in a Spar measurement. Trimble S- and VX-series total stations are supported, as are the controller platforms Trimble TSC3, GeoXR, and Tablet.

FieldSens View provides control and monitoring of the locating subsystems of the spar. With both bird's eye and down-line views, it's easy to collect 3-D utility positions simply by "walking the line". With the Spar 300's revolutionary positioning ability from arbitrary offset positions, accurate mapping is possible even when the spar can't be brought over the utility. The user need only be reasonably close, and the system automatically applies all offsets and ensures logged points meet desired tolerances.



Trimble Access™ handles base map display, data collection in a point database, line coding, local coordinate transformation, GNSS receiver control, and data export. In addition, customized utility reports can be developed to adapt the system to your particular company's data collection conventions. Local coordinate systems in use throughout the world are supported, and where unique requirements exist, custom coordinates can be configured using built-in transformations. All existing Survey Styles are supported.

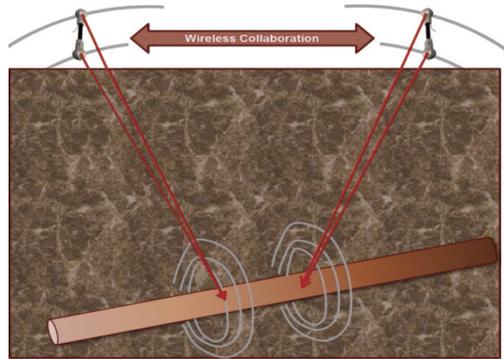
Map Views are particularly valuable during data collection, to validate the position of the incoming points compared to already mapped utilities, or the as-built positions. Continuous Topo points based on time and/or distance intervals, coupled with auto-tolerancing of the merged utility offset and GNSS positions, provide a very efficient mechanism for collecting line data. After the measurement session, Trimble Access supports field editing of the dataset, or alternatively, synchronization of the data with Trimble Business Center and online servers.

Utility Line Positioning

SONDE TRANSMITTERS

Sonde transmitters placed within pipes and ducts can be tracked in 3D geospatial coordinates at ranges up to 24 m using a dual-spar system. This mode is useful when validating directional drilling bores, or mapping plastic pipes, conduits, tunnels and underwater pipelines in rivers, bays, and estuaries without using marine grade equipment. Coordinates of the tracked sonde are presented in real-time, both in profile and map views.

Single Spar measurements are obtained for over ranges up to 3m, but can be reduced in areas of significant distortion. Often distortion can be mitigated by traversing the spar over the top of a facility, verifying that both the depth and expected error provide consistent positioning results. Areas of high distortion will cause the confidence to quickly erode, and choosing a perspective from the side of the distorting influence can lead to improved results.



Dual-Spar measurements effectively extend the vectoring capability of the spar by increasing the baseline distance between magnetic sensors. Rather than a fixed ½ meter separation between measurement points, the baseline can be increased to up to 10 or 15 meters. As long as sufficient signal from the utility target can be detected at each spar, the sensors on each spar are combined to improve detection accuracy and confidence. The spars must include a synchronization option either using a cable or using internal GPS timing hardware, both of which are available at the time of order.

Fixed Mount dual-spar setups work just like a single spar system, but extend the range of the system for deep targets, as long as the signal is strong enough at each spar.

3D CAD Interface

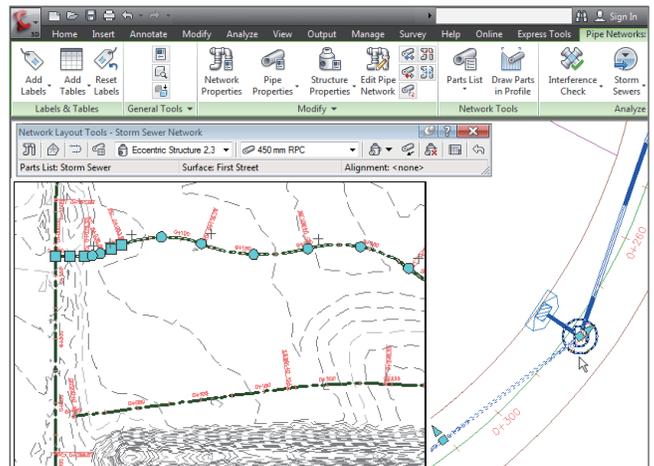
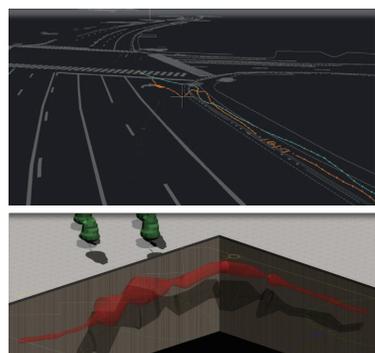
RETURN ON INVESTMENT

FieldSens Utility Survey provides a convenient platform for utility surveying, without the necessity of manually positioning the system over the target line. The volume and quality of position data is far greater than is practically obtained using existing methods. This saves time and effort, reducing the cost of underground utility data collection.

RTK NETWORKS

RTK Networks are available in many urban areas of the world. With a 3G enabled Trimble TSC3 or Tablet, the spar can access these data streams for RTK corrections. All industry standard formats are supported, including RTCM 2.3, 3.0, and CMR+, in either direct IP or NTRIP formatted packets.

Confidence can be represented as a cloud around the target utility. This permits a quick look at segments of the utility survey that suffer from increased error due to magnetic field distortion, poor signal, or excessive distance between the spar and the targeted line. In the top two images, the 3-D spar position is plotted in relationship to a surveyed underground telephone line. Droops and twists in the offset and depth may be real, or can also be caused by field distortion (see ORI application note 100). Without inspection of the confidence attributes, the viewer of the plot does not know. Trimble Access Utility Survey records the horizontal and vertical accuracy for every utility position. A more sophisticated graphical representation of the utility position can make use of this confidence information. The third image above exposes the position confidence for a surveyed underground power cable by varying the diameter of the cable as a function of the measured confidence. Distortion is caused by the direction change of the cable (at the right angle bend). When the spar had to be walked around obstructing vegetation (modeled in the image as green shrubs), reduced confidence also resulted. Thus the spar's ability to annotate the data with confidence can provide designers actionable information regarding the position accuracy.



Sonde Tracking

WALKOVER-FREE TRACKING

Either single or dual spars can be used to track sonde transmitters, with tracking range being the most important reason to use a dual spar system. For all but the smallest and least powerful plumbing sondes, the tracking range of a single spar system is 3 meters. For a dual-spar system, the strength of the sonde is the key determinant. ORI offers a range of sondes at several frequencies that can be tracked at up to 24m (80ft) range. Sondes are rated in terms of tracking range, which also determines the maximum separation of the two spars. Lower frequencies are less susceptible to distortion due to underground eddy currents, while higher frequencies offer greater tracking range. All ORI sondes are level-stabilized and do not require calibration. Check with ORI regarding compatibility of sondes from other manufacturers.

SURVEY ARCHIVAL

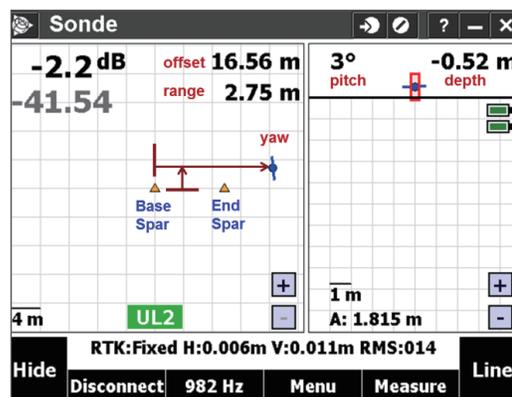
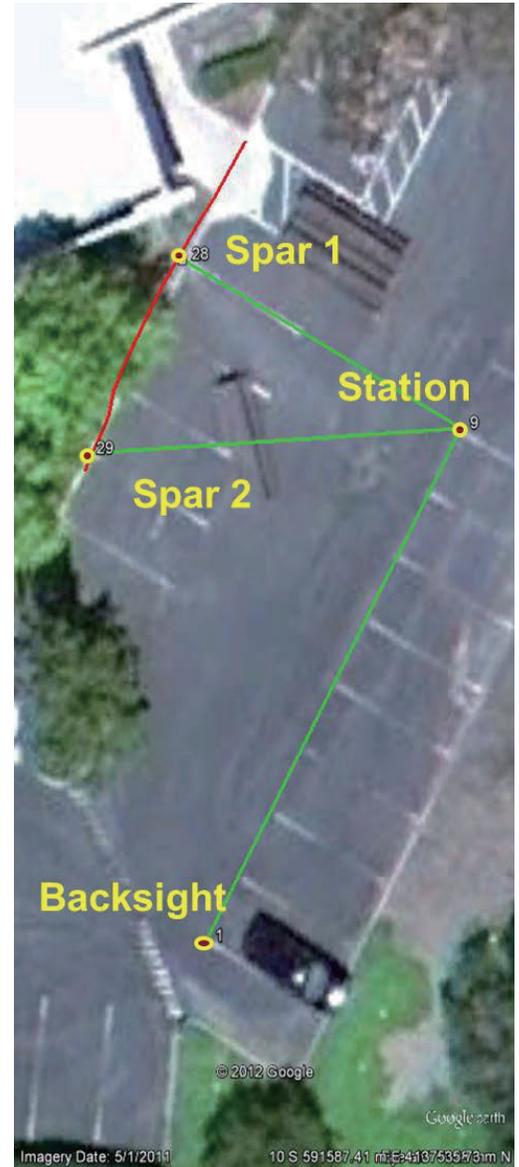
FieldSens collects measured utility positions and attributes in a Trimble .job file, allowing post analysis and review. Export of geospatial position and depth information in AutoCAD .dxf or ASCII .csv formats can occur from the field, or later in the office using Trimble Business Center. A special .csv export is directly compatible with Autodesk's Civil3D software. Industry standard raster and vector map formats are supported for base maps (.dxf, .shp, .jpg, .bmp).

TURNKEY OR OEM

For most users, Utility Survey is deployed as a turnkey application, and is fully integrated with Trimble Access.



Sonde Tracking permits accurate positioning in GPS-Denied locations without having to maintain a position over the peak signal. Depth, offset, and range measurements are automatically converted to Easting, Northing, and Elevation. The position of the spar relative to the underground target is completely arbitrary, and permits positioning in inaccessible areas. Examples include tracing a conduit under a major highway without traffic control, capturing duct positions under a building, a tracking a robot in a tunnel of unknown extent. ORI's model based method offers unparalleled performance and a completely new method of collecting accurate underground positions.



External GNSS or Total Stations are

used to site the spar placements aboveground. The underground survey then can take place over a line section within the tracking radius specified by the sonde in use. A simple rule is that the radius of the tracking range is equal to the spar separation distance, as measured from the midpoint of the spars. This permits using the dual-spar system to track underground sonde transmitter positions under deep foliage cover or near buildings, as long as the spars can be accurately sited. Collecting Spar "control" positions can even be done as a separate operation, and those points imported into the Trimble Access job for use during the tracking operation.

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