georeferenced by
APPLANIX
aided inertial technology

POS LV™

position & orientation system land vehicles

POS LV - Land Vehicles

***The Next Generation* - The new POS LV is a compact, fully integrated, turnkey position and orientation system, utilizing integrated-inertial technology to generate stable, reliable, and repeatable positioning solutions for land-based vehicle applications.**

APPLICATIONS

The POS LV system is designed to operate under the most difficult GPS conditions found in urban and suburban environments. It enables accurate positioning in the following applications:

- **Road Geometry** – Accurate horizontal and vertical measurements generated for highway design and analysis
- **Pavement Inspection** – Road surface inspection and crack detection monitoring, longitudinal profiling and rut depth measurement
- **GIS Database and Asset Management** – GIS database information, roadside inventory and corridor surveys
- **Road Surveying** – Centerline road mapping
- **Vehicle Dynamics** – Safety testing and stability, autonomous vehicle operation

ATTRIBUTES

The system's key attributes include:

- Tightly-coupled integration allows raw GPS data from as few as one satellite to be processed directly within the POS LV. This reduces position drift, reduces RTK re-acquisition time, and strengthens the system's ability to provide continuous, accurate data in areas with intermittent GPS reception
- GPS Azimuth Technology (GAMS) significantly increases accuracy
- For existing POS LV users, various system component upgrade options are available
- Operational in as little as three days (Installation, Calibration, Training)

ACCURACY

Depending on the configuration, Real-time Differential GPS, Inertially Aided RTK, or using Post-processed GPS base data, POS LV can generate accuracy levels to suite particular project requirements. With its high data update rate, the system produces a full 3-axis inertial solution which generates a true representation of vehicle motion, using the most accurate position and orientation data available.

POS LV™ land vehicles

- **POS Computer System (PCS)** - A rugged, compact computer system contains the core POS processor, IMU and DMI interface electronics, plus two GPS receivers and a removable PC-card disk drive.
- **POS Inertial Measurement Unit** - The system's primary sensor allows for the continuous output of position and orientation data when GPS reception is unavailable.
- **Distance Measurement Indicator (DMI)** - A rugged sensor that mounts directly to one of the host vehicle's rear wheels, using wheel rotation measurements to aid positioning.
- **Primary GPS Receiver Antenna** - A dual frequency antenna provides GPS raw observables data, for system timing, positioning and velocity aiding
- **Secondary GPS Receiver Antenna** - Provides GPS raw observables data, for use with the GPS Azimuth Measurement Subsystem (GAMS).

REDEFINING THE WAY YOU SURVEY

GIS Data Capture Applications

GIS Applications Include:

- **Generating accurate position and orientation data for road corridor map features, which cannot be accurately acquired using conventional mapping methodology employing aerial photography, or traditional GPS survey techniques**
- **Producing precisely positioned road centerline map data quickly and accurately**

ACCURATE GEOPOSITIONING

POS LV is a mobile mapping technology which allows custom GIS data capture to be carried out at normal traffic speeds, in areas where GPS reception is severely restricted. Locations in which the POS LV system is particularly advantageous include downtown urban environments where highrise office buildings, multi-level roadways, tunnels and bridges, and dense tree canopies obscure GPS reception.

GIS DATABASE FEATURE LOCATION AND IDENTIFICATION

Geographically positioning and geocoding planimetric map data, beneath a multi-level highway, can be a difficult undertaking using aerial photography alone. Fire hydrants, manholes, and catch basins would be difficult if not impossible to see on the under-pass roads, and costly and time consuming to locate, using traditional GPS survey methodology.

CONTINUOUS SOLUTION

The vehicle-mounted POS LV system, with its ability to provide continuous and accurate position and orientation information, in locations where GPS reception is hampered by multipath effect and complete signal loss, is the ideal system for this type of application.

The system's IARTK (Inertially-Aided Real-time Kinematic) configuration enables precise positioning data to be computed while the mapping vehicle is experiencing intermittent GPS reception and total signal loss.

Curbs, centerlines, and fixed assets are easily georeferenced with the POS LV system.

Survey Vehicles using POS LV Technology:

Roadware, *Canada*

DWW, *Netherlands*

Facet, *USA*

TN, *France*

Moses, *Germany*

Stantec, *Canada*

IMS, *USA*

ViaGeos, *Czech Republic*

Dynatest, *USA*

Geo-3D, *Canada*

ICC, *USA*

Multi-Sensor GIS and Asset Management Applications

Client: PASCO Corporation

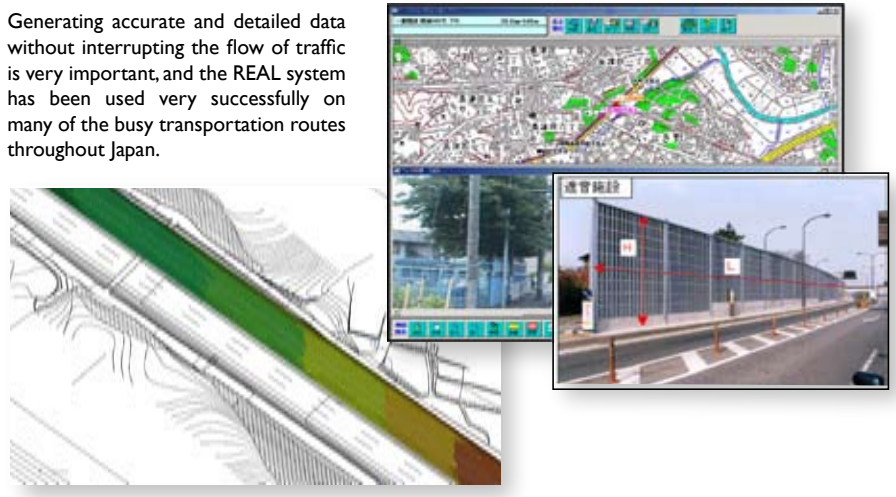
PASCO Corporation is one of the world's largest suppliers of geographic information and one of the leaders in implementing the most advanced surveying and GIS technology in the Far East. Based in Tokyo, PASCO is heavily involved with digital data capture for the airborne, marine and land survey markets for various GIS, engineering and land development programs in Japan, and around the world.

The company utilizes a number of Applanix position and orientation systems (POS LV) installed on land vehicles equipped with thermal sensors, digital cameras, and laser scanning technology. The mobile mapping system, known as REAL (Road Excellent Automatic Logging), is designed for sophisticated monitoring of road surface conditions, infrastructure planning and maintenance, and transportation network design.

The POS LV systems are used as the geopositioning component for the onboard sensors, providing the position and orientation information for the digital video and still cameras, and laser scanning equipment. The POS LV system's ability to operate very effectively in dense urban environments has proven to be a tremendous advantage. When GPS signal reception is blocked by tall buildings, the system will still provide accurate positioning and orientation information.

Japan boasts approximately 1,152,207km of roadway, including 6,114km of expressways. In addition, a high-speed network of limited-access toll roads connects the major cities on the islands of Honshu, Shikoku and Kyushu, all of which need ongoing inspection and monitoring to ensure they remain fully operational.

Generating accurate and detailed data without interrupting the flow of traffic is very important, and the REAL system has been used very successfully on many of the busy transportation routes throughout Japan.



Above - A 3-dimensional survey of a 6 lane national highway.

Multi-Sensor GIS and Asset Management Applications

Client: PASCO Corporation

The system is capable of collecting multiple data sets simultaneously while driving at normal traffic speeds of up to 100kmh. It is able to acquire three sets of georeferenced road image data in a single pass of the vehicle: the condition of the pavement, the location and shape of the road, and the road asset features.

Used in conjunction with airborne digital imagery, the data produced is GIS-compatible and easily utilized by the various transportation engineering and planning departments for their specific requirements.

PASCO's REAL system combines precision sensor data with Applanix fully integrated Inertial/GPS technology to provide the geospatial community with the most accurate data possible.

The PASCO REAL system incorporates a stereo camera, POSLV, line scan camera, laser scanner, distance sensor and generator.

Asset Management Applications

Asset Management Applications Include:

- Road Sign / Traffic Signal Inventory
- Utility Pole maintenance scheduling
- Tree inventory and assessment

QUICK AND EFFICIENT ASSET DATA

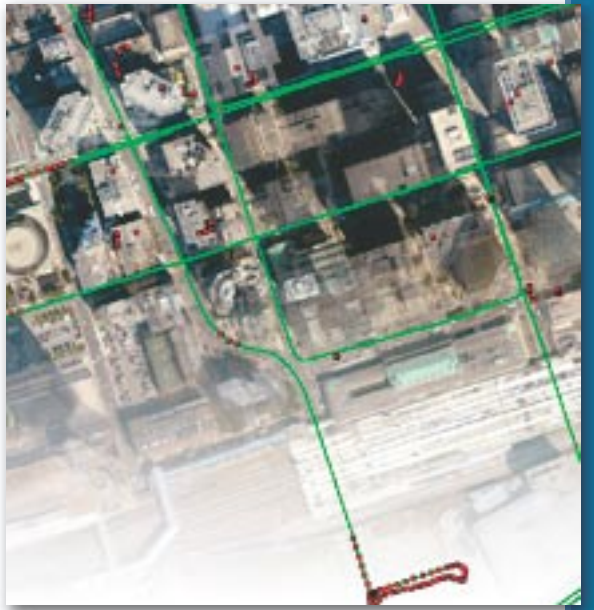
Generating accurately positioned roadside asset data can be a time consuming activity particularly if carried out as a manual operation. To further complicate the task the majority of roadside assets are found in areas where continuous access to GPS is problematic. Using POS LV as part of your field automation technology will enable data capture tasks to be accomplished quickly and efficiently.

TREE INVENTORY DATA CAPTURE

Completing an accurate street tree inventory for a busy metropolitan area, where a large percentage of the trees are old and have a dense canopy, is a major undertaking as tree cover will often interfere with GPS reception.

CONTINUOUS SOLUTION

To complete this type of project using conventional methodology, such as pedestrian GPS survey compiled element by element, would be unmanageable. This technique is also very susceptible to satellite shading and signal loss. Using a mobile mapping vehicle equipped with a POS LV system, and traveling at normal traffic speed, the complete survey can be accomplished in a fraction of the time. Using cab-mounted digital cameras, full-lane width, georeferenced imagery, can be generated in a single pass.



Conventional GPS (red dots) are scattered and inadequate for Asset Management applications. A continuous positioning solution is provided by the POS LV system (green line).

Asset Management Applications

Client: Stantec Inc.

Stantec is a multi-disciplinary organization that has been providing innovative engineering and data gathering services to the planning, surveying, geomatics, and engineering communities, for well over 50 years. With locations throughout North America, Stantec offers knowledge-based solutions to clients in both the public and private sector. Utilizing an extensive array of state-modern equipment and technology, the company is recognized throughout the industry for its ability to deliver sustainable, practical, and cost-effective solutions in response to the diverse needs of its clients.

CHALLENGE

The New Jersey Department of Transportation recently selected the Infrastructure Management and Pavement Engineering group from Stantec to undertake an extensive data-gathering project covering more than 17,000 miles of non-Federal Aid routes. The scale of the project would take the Stantec team across the state, generating pavement condition survey information, together with simultaneously captured high-resolution digital video imaging. Both pavement and imaging data would need to be accurately georeferenced with no GPS outages allowed.

SOLUTION

"Stantec's custom-designed RT3000 mobile mapping/data capture system uses various sensors engineered to generate a variety of information," Rob Huber, Operations Manager, Infrastructure Management and Pavement Engineering at Stantec, explained. "We generally drive a route once and generate multiple georeferenced sets of data, which can then be analyzed by our technicians at the office. This technique works very well, particularly when using a single georeferencing source, such as the POS LV."

RESULT

Capturing the pavement data and digital videolog imagery took less than 18 months to complete. "Known as the Garden State, tree cover is extensive, particularly throughout the south, said Rob Huber. "Being able to utilize the POS LV system's continuous positioning ability is a real plus in areas like this. Even collecting data in urban areas presented the POS LV with little problem, where buildings often have an effect on a GPS solution." With the project complete, Stantec were able to deliver the road roughness, rutting, and pavement distress data together with a set of videolog imagery all georeferenced to the states coordinate system. By using multiple sensors the company is able to provide value added options such as geometrics data for crossfall and radius curvature, and georeferenced asset data should their clients require it. This infrastructure management and pavement engineering methodology, has allowed Stantec to deliver reliable, and repeatable data collection solutions to its customers, every time.

"Being able to utilize the POS LV system's continuous positioning ability is a real plus in areas like this. Even collecting data in urban areas presented the POS LV with little problem, where buildings often have an effect on a GPS solution."

Rob Huber, Operations Manager, Infrastructure Mgt and Pavement Engineering, Stantec

Pavement Analysis Applications

Pavement Analysis Applications Include:

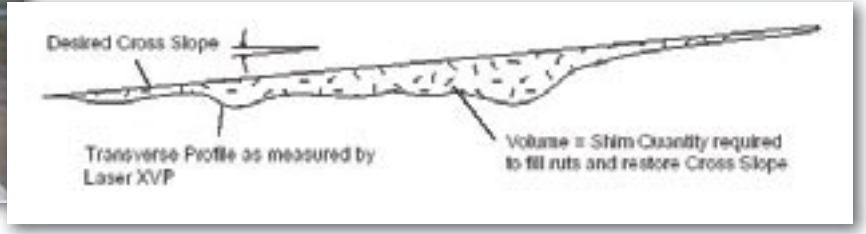
- Pavement inspection
- Crack detection
- Road profiling
- Cross-fall and Gradient
- Rutting

REGULAR MAINTENANCE

Monitoring road surface conditions is one of the most important tasks undertaken by any highway department. It is one operation that must be carried out on a regular basis, to ensure public safety is not compromised as a result of poorly maintained transportation routes.

PAVEMENT INSPECTION

Pavement deterioration is a common problem where climate change and environmental conditions have a severe effect on heavily traveled road surfaces. Knowing where the problems are, and where maintenance is required, is one challenge that requires positional information. Knowing the degree of seriousness of the problems, such as the depth of ruts, crossfall and gradient, is another, and requires orientation information as well. Using a POS LV-equipped vehicle for this type of project will ensure uninterrupted position and orientation data is collected, even when operating in areas where GPS reception is limited and not consistently available.



CONTINUOUS SOLUTION

The information obtained from POS LV can be used to meet risk management, maintenance and operational needs, providing valuable information on a variety of road related issues. When used with various sensors such as, acoustics, point lasers, and scanning lasers, the POS LV data's geometric properties can prove invaluable.

Pavement Analysis Applications

Client: Roadware Group

Roadware Group Inc. is the global industry leader in automated pavement distress data collection. The company manufactures the Automatic Road Analyzer (ARAN) and manages a fleet of vehicles from its headquarters in Paris, Ontario, Canada, as well as being the leading manufacturer and seller of such equipment worldwide. Specializing in the automated analysis of pavement cracking, high accuracy asset inventory projects, georeferenced pavement profiling, and road geometry data collection, Roadware's clients share a common need for accurate georeferenced data. Many DOT's and highway departments in the United States, government agencies in Europe and Asia, and some of the most advanced engineering firms around the world, utilize Roadware Group's services.

CHALLENGE

Since 1996 PennDOT (Pennsylvania Department of Transportation) has relied upon Roadware's expertise to provide accurate and reliable data in support of its highway maintenance plans, asset management tasks, and videolog image update programs. PennDOT regularly requires current information on the condition of its highway network, information which can easily be incorporated into its existing database, and accessed by various engineering and GIS departments.

SOLUTION

In May 2003, Roadware was tasked with generating a revised set of pavement data for 22,000 miles of highway, which included edge drop-off detection information captured using its recently acquired Laser XVP. The data would be supplemented with panoramic videolog imagery provided by forward-facing cameras mounted in the roof of the vehicle.

RESULT

The project began in May and was completed the following year. "Roadware's ARAN vehicles are designed to operate under a variety of conditions, and in locations where GPS signal loss can be a real concern," Eric McCuaig, account manager at Roadware explained. "We quickly realized the benefits of using the POS LV for this type of project. By integrating the POS LV to provide a supplementary georeferencing component to the sensor data, we are able to deliver continuous, accurate positioning information under most conditions. Whether it is the condition of a road sign or a section of cracked pavement, knowing where it is located is as important as knowing whether it exists at all."

Roadware was Applanix' first customer for land-based applications and pioneered the use of the POS LV on a mobile mapping vehicle. "Both companies have benefited from this long term relationship" said Toby Crow, "and our close cooperation has allowed us to continue to lead the industry in this dynamic field". Roadware has installed more than 20 POS LV systems on its vehicles worldwide, and see it quickly becoming a standard feature on its ARAN fleet.

"Over the past decade accurate absolute positioning of data has become the industry standard. We needed to adapt to this demand and provide a reliable solution for our clients. We saw the Applanix POS LV system as the answer."

Toby Crow, VP Sales, Roadware Group

Advanced Applications

Advanced Applications Include:

- Vehicle Testing
- High-performance racing
- Mining Operations
- Vehicle Navigation

POS LV - providing solutions for an expanding and diverse set of applications

VEHICLE TESTING

Monitoring vehicle movement

How will a vehicle react under extreme driving maneuvers? POS LV is being used as an integral component in the research and development stage of vehicle design. Orientation information can be generated and used do determine various suspension, axle, and wheel loading configurations, for vehicles subjected to violent maneuvering.

NON-CONVENTIONAL APPLICATIONS

The POS LV system has been used in a number of non-conventional applications to provide position and orientation information for:

High-performance racing - providing data on how vehicles interact with race track design and layout.

Mining operations - generating position and orientation information to assist large construction vehicles in open pit mines, with earth moving and grading tasks.

Vehicle navigation – supplying navigation data in the development of commercial on-board vehicle navigation systems.

Advanced Applications

AUTONOMOUS VEHICLES

Letting the vehicle drive itself

The DARPA Grand Challenge – Robotic Utility Vehicles – Unmanned Military Vehicles. The POS LV has been successfully tested in all of these transportation areas where human intervention is unnecessary. The DARPA Grand Challenge in 2004 proved the system's ability to provide continuous and accurate positioning and orientation information in a rugged and inhospitable environment, the Mojave Desert.

Applanix integrated-inertial technology was chosen as a key component for Carnegie Mellon University's entry, The Red Team, competing in the Defense Advanced Research Projects Agency Grand Challenge for autonomous unmanned vehicles.

Technology Advantages

Next Generation POS LV

- Smaller and lighter POS Computer System
- Improved real-time performance through enhanced error modeling
- Automatic redundant data logging to embedded flash disk
- Next generation embedded survey grade GPS receiver, for improved positioning performance
- Lower power consumption
- Strengthened exterior casings and connectors

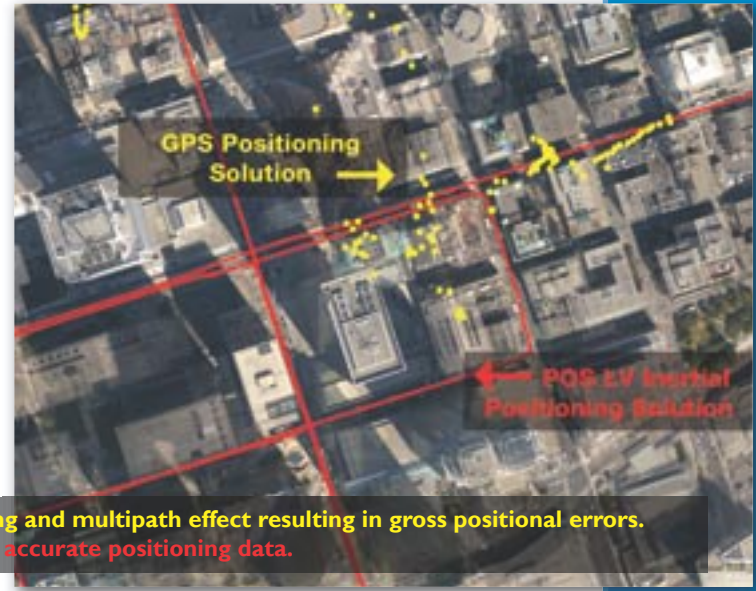
The increased demand for accurate absolute positioning has meant the more traditional georeferencing methodology, of using linear distance traveled to provide relative location data, is now no longer acceptable for many applications.

The POS LV system will generate precise, robust positioning and orientation information for mobile data acquisition systems. The system combines all the advantages of GPS technology, together with those of inertial technology, to provide continuous and accurate data. By utilizing the POS LV system, data capture can be undertaken quickly and efficiently.

A GPS positioning solution is derived from the triangulation of satellite signals, and requires unobstructed line-of-sight, or differential GPS corrections.

An Inertial Navigation solution, the result of incremental velocities and angles measured with accelerometers and gyros, produces changes in position, velocity and orientation.

Applanix POS LV technology combines the advantages of both GPS and Inertial to include a fully integrated turnkey system.



The GPS-only positioning solution suffers from satellite shading and multipath effect resulting in gross positional errors.
The POS LV solution using GPS/Inertial Navigation generates accurate positioning data.

Technology Advantages

SYSTEM COMPONENTS

- Inertial Measurement Unit (IMU) generates a true representation of vehicle motion in all three axes, and allows for continuous output of position and orientation information
- POS Computer System (PCS) enables raw GPS data from as few as one satellite to be processed directly into the system, to compute accurate positional information in areas of intermittent, or no GPS reception
- Distance Measurement Indicator (DMI) computes wheel rotation information to aid vehicle positioning
- Embedded GPS receivers provide heading aiding to supplement the inertial data

CONTINUITY AND ACCURACY

- Under the most difficult GPS conditions found in dense urban environments, mountainous terrain, or heavily treed areas, the POS LV will provide continuous, accurate, position and orientation information
- The POS LV system produces precise, high-rate, low-latency, real-time data. The vehicle-mounted system can be operated at normal highway traffic speeds for cost-effective data capture

A PROVEN TECHNOLOGY

- Applanix position and orientation systems are used successfully for a variety of survey, mapping, and vehicle testing applications
- Installation, calibration and training can be completed in three days allowing for quick operational capability
- Unparalleled customer support is available 24/7 anytime, worldwide

Under difficult GPS conditions, reception is prone to satellite shading and reflected signal position error (multipath effect). The POS LV system will generate precise, robust positioning and orientation information for mobile data acquisition systems.

POS LV 200 - *Combining the best of today's technology*

The POS LV 200 is designed for integration with an existing GPS receiver/antenna-equipped vehicle. It is ideally suited to those organizations currently using GPS-only technology to generate positioning information, but looking for increased data continuity and position and orientation accuracy. The POS LV 200 will provide the solution, with easy integration and optimization of existing GPS equipment.

The advantage over a GPS-only system:

- Provides continual position and orientation data
- Operates effectively in difficult GPS environments by maintaining positioning accuracy through short GPS outages: The POS LV 200 will not only maintain positioning during periods of GPS signal loss (as in tree covered areas), but will also continue to operate effectively when only one or two satellites are in view (such as when obscured by tall buildings).
- Can be used with DGPS and RTK corrections
- Generates data at a rate up to100Hz
- Produces continuous orientation information to enable accurate grade and crossfall measurement
- Compatible with existing distance-pulse/direction and quadrature logic odometers (DMIs) operating at 16,000 ppk (pulse per kilometer) or higher*
- Can be easily moved between vehicles for maximum utilization
- Fully upgradeable to a higher accuracy system, such as the POS LV 220

POS LV 200 components include:**

- Inertial Measurement Unit (IMU) – A compact and lightweight component, using miniature RLG (ring laser gyro) technology
- POS Computer System (PCS) – Powerful processing unit that contains no internal GPS receivers. Incorporates automatic redundant data logging, and operates with either 12v or 24v power supply
- Distance Measurement Indicator (DMI) – Odometer technology facilitates ZUPT (zero velocity updates) functionality to prevent position drift when vehicle is stationary. The DMI may be user supplied
- Cable kit – A versatile set of cables supplied for easy integration with a supported external GPS receiver

Optional:

- Post-Processing Software (POSPac) – Data analysis and QC toolkit designed to generate the most accurate results from your POS LV system

The POS LV 200 is configured for use with the Trimble AG132 GPS receiver and the Trimble MS750. The POS LV 200 will enable high performance, reliability and operational versatility, using beacon/satellite differential receivers, for L1 and DGPS operations with OmniStar. For some existing GPS systems a firmware upgrade may be required.

** Accurate DMI input is essential to maximize the effectiveness of POS LV. If required, Applanix can supply the necessary sensors.*
*** **System Components Not Included:** GPS receiver and antenna are not supplied with the POS LV 200. The system is designed to be integrated with the users existing GPS equipment*

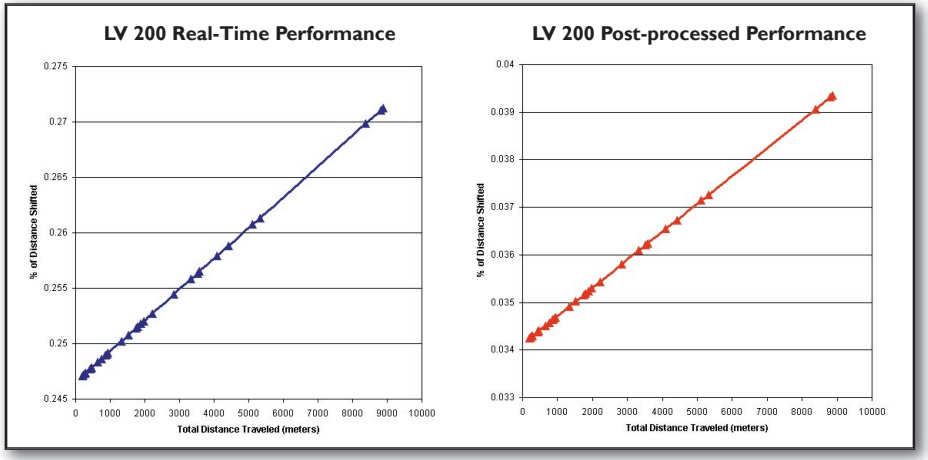
POS LV 200 - *Combining the best of today's technology*

Positional Accuracy:
When no GPS signal is present, the navigation solution will drift with time and distance relative to the last good GPS position. With no GPS fix available, the POS LV 200 real-time peak 3D position drift is better than 0.4% of distance traveled for outages of less than two minutes. After post-processing, the peak 3D position drift is better than 0.04 % of distance traveled. (see performance graphs)

Under real-life conditions, long-duration GPS outages are rare. As a result of the LV 200 tightly-coupled navigator, the overall accuracy can still be controlled when between one and four satellites are in view. In urban areas where there are frequent stops, position drift can be reduced.

Orientation Accuracy:

Roll & Pitch	0.07 deg (0.06 post-processed)
True Heading	0.27 deg (0.25 post-processed)



Positional accuracies are RMS values. The above accuracy specifications assume good GPS mission planning (when GPS is available). IARTK performance values valid at baselines out to 40 kilometers. Corrections data must arrive at regular intervals, at least every 1 second and with a latency of no greater than 5 seconds, to maintain performance. The post-processed performance is achieved using nearby GPS base station data with the Applanix POSPac post-processing package and baselines less than 40 kilometers. DGPS performance assumes that the user is within the network coverage area when wide area corrections are used. DGPS performance assumes that the user is within a 40 kilometer radial distance of any beacon DGPS service used; operating at significantly greater distances will degrade performance. Corrections data must arrive at regular intervals, at least every 10 seconds, to maintain performance. Specifications are subject to change without notice.

ABOVE: A city street area mapped with GPS only (yellow dots) and with POS LV added (red line). The solution using POS LV represents a significant increase in data accuracy.

System Specifications

1. PHYSICAL

Size:	IMU	204 × 204 × 168 mm
	PCS	281 × 165 × 90 mm
	DMI (Applanix)	908 x 115 x 254 mm
	(maximum, not including collets)	
	Antenna (2)	160 × 58 mm
Weight:	IMU	3.5 Kg
	PCS	3.0 Kg
	DMI (Applanix)	2.4 Kg
	Antenna (2)	0.46 Kg
Power:	PCS	12vdc, or 24 vdc, 60
	W (peak)	
Temp:	IMU	-40° to +60° C
	PCS	-20° to +60° C
	DMI (Applanix)	-40° to +105° C
	Antennas	-40° to +70° C
Humidity:	PCS	5 to 95% RH non-condensing
Cables:	IMU	8 m (standard)
	DMI (Applanix)	8 m (standard)
	Antenna (2)	10 m (standard)

2. GENERAL – SENSORS

IMU:	Reliable high performance sensors
DMI:	Rugged construction able to withstand harsh vibration and shock environment, as well as temperature and humidity extremes
GPS:	12 channel dual frequency (L1/L2), low noise, 12 channel single frequency (L1), low noise

3. ETHERNET INPUT/OUTPUT (10/100 BASE-T)

Function:	Operate POS LV & record data
Data:	Position, attitude, heading, velocity, track & speed, acceleration, status & performance, raw data. All data has time & distance tags.
UDP Port:	Display Port – low rate (1 Hz data)
TCP/IP Ports:	Real-Time Data Port – high rate (1 – 200 Hz data) Logging Data Port (buffered for data logging) Control Port – used by LV-POSView™ (controller software)

4. LOGGING OUTPUT TO REMOVABLE PC-CARD DISK DRIVE

Parameters:	Position, attitude, heading, velocity, track & speed, acceleration, status & performance, raw data. All data has time & distance tags

5. RS232 NMEA OUTPUT

Parameters:	Position ($INGGA), Heading ($INHDT), Track & Speed ($INVTG), Statistics ($INGST), Attitude ($PASHR), Time & Date ($INZDA), Events ($EVT1, $EVT2)
Rate:	1 – 50 Hz (user selectable)

6. RS232 HIGH RATE DIGITAL OUTPUT

Parameters:	Roll, pitch, true heading, latitude, longitude and altitude.
Rate:	1 – 200 Hz (user selectable)

7. RS232 INPUT

Parameter:	Auxiliary GPS input Position ($GPGGA), DOP ($GPGSA), Statistics ($GPGST), Satellites in View ($GPGSV)
Rate:	1 Hz

8. RS232 BASE 1 & BASE 2 INPUT

Parameter:	CMR, CMR+, RTCM 3,18 & 19, RTCM 1, RTCM 9

System Specifications

9. OTHER I/O

PPS: 1 pulse-per-second Time Sync output. Normally low, active high pulse where the rising edge is the reference.

Event Input: Two input discretes used to mark external events. Discretes are TTL pulses > 1 msec width where rising or falling edge is time-tagged and logged. (Maximum rate 300 Hz.)

10. FUTURE EXPANSION

- 2 additional Event Inputs & 2 Event Outputs
- 1 TTL Input & 1 TTL Output
- External Primary and Secondary GPS support
- Second DMI sensor support
- 3 Analog Inputs & 3 Analog Outputs via I²C interface

11. USER SUPPLIED EQUIPMENT

- PC or laptop computer for LV-POSView (controller): Pentium 90 processor (minimum), 16 MB RAM, 1 MB free disk space, Ethernet adapter (10/100 base T, RJ45), Windows 95/98/Me/NT/2000/XP
- PC for POSPac™ (post-processing): Pentium 90 processor (minimum), 16MB RAM, 500 MB free disk space, Type II PC-Card reader, Windows 95/98/Me NT/2000/XP
- 12 or 24 vdc power supply, capable of supplying 60 W (peak) power from the host vehicle's electrical system

IARTK: *Inertially-Aided RTK*
PP: *Post-processed*
DGPS: *Real-time DGPS*

	GPS Outage Duration (IARTK/PP/DGPS)														
	0 sec.			15 sec.			30 sec.			60 sec.			120 sec.		
	IARTK	PP	DGPS	IARTK	PP	DGPS	IARTK	PP	DGPS	IARTK	PP	DGPS	IARTK	PP	DGPS
POS LV 220															
X, Y Position (m)	0.035	0.02	1.0	0.20	0.05	1.13	0.35	0.08	1.25	0.70	0.15	1.5	1.0	0.60	1.75
Z Vertical Position (m)	0.05	0.03	1.5	0.20	0.08	1.63	0.30	0.12	1.75	0.50	0.20	2.0	0.90	0.70	2.2
Roll & Pitch (deg)	0.07	0.06	0.07	0.07	0.06	0.07	0.07	0.06	0.07	0.07	0.06	0.07	0.07	0.06	0.07
True Heading (deg)	0.07	0.025	0.07	0.07	0.025	0.07	0.07	0.025	0.07	0.07	0.025	0.07	0.07	0.03	0.08
POS LV 320															
X, Y Position (m)	0.035	0.02	1.0	0.10	0.05	1.13	0.20	0.08	1.25	0.35	0.15	1.5	0.60	0.40	1.63
Z Vertical Position (m)	0.05	0.03	1.5	0.10	0.07	1.63	0.15	0.10	1.75	0.25	0.20	2.0	0.40	0.50	2.2
Roll & Pitch (deg)	0.05	0.02	0.05	0.05	0.02	0.05	0.05	0.02	0.05	0.05	0.02	0.05	0.05	0.02	0.05
True Heading (deg)	0.05	0.025	0.05	0.05	0.025	0.05	0.05	0.025	0.05	0.05	0.025	0.05	0.06	0.03	0.06
POS LV 420															
X, Y Position (m)	0.035	0.02	1.0	0.07	0.05	1.13	0.13	0.07	1.25	0.20	0.12	1.5	0.30	0.27	1.63
Z Vertical Position (m)	0.05	0.03	1.5	0.07	0.06	1.63	0.10	0.09	1.75	0.15	0.15	2.0	0.20	0.35	2.13
Roll & Pitch (deg)	0.02	0.005	0.02	0.02	0.005	0.02	0.02	0.005	0.02	0.02	0.005	0.02	0.02	0.005	0.02
True Heading (deg)	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.02	0.03

Positional accuracy are RMS values. The above accuracy specifications assume good GPS mission planning (when GPS is available.) IARTK performance values valid at baselines out to 40km.